RENR9013-18 (en-us)
April 2020

Systems Operation
Troubleshooting
Testing and Adjusting

120M , 12M , 140 , 140M , 150 , 14M, 160M , 160 , 16M Motor Graders
Implement Electronic Control System

B92 1-UP (Machine)
B54 1-UP (Machine)
B55 1-UP (Machine)
B56 1-UP (Machine)
B57 1-UP (Machine)
B59 1-UP (Machine)
B9H 1-UP (Machine)
R9H 1-UP (Machine)
B9J 1-UP (Machine)
R9J 1-UP (Machine)
B9R 1-UP (Machine)
R9B 1-UP (Machine)
B9F 1-UP (Machine)
B9L 1-UP (Machine)
B9E 1-UP (Machine)
B9M 1-UP (Machine)
B9D 1-UP (Machine)
B9N 1-UP (Machine)
R9A 1-UP (Machine)
B9C 1-UP (Machine)
B9G 1-UP (Machine)
D9G 1-UP (Machine)
B9T 1-UP (Machine)
D9T 1-UP (Machine)
B9W 1-UP (Machine)
R9C 1-UP (Machine)
D9W 1-UP (Machine)

Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards, including human factors that can affect safety. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you verify that you are authorized to perform this work, and have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the “Safety Alert Symbol” and followed by a “Signal Word” such as “DANGER”, “WARNING” or “CAUTION”. The Safety Alert “WARNING” label is shown below.

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

A non-exhaustive list of operations that may cause product damage are identified by “NOTICE” labels on the product and in this publication.

Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. You must not use this product in any manner different from that considered by this manual without first satisfying yourself that you have considered all safety rules and precautions applicable to the operation of the product in the location of use, including site-specific rules and precautions applicable to the worksite. If a tool, procedure, work method or operating technique that is not specifically recommended by Caterpillar is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that you are authorized to perform this work, and that the product will not be damaged or become unsafe by the operation, lubrication, maintenance or repair procedures that you intend to use.

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Cat dealers have the most current information available.

NOTICE

When replacement parts are required for this product Caterpillar recommends using original Caterpillar® replacement parts.

Other parts may not meet certain original equipment specifications.

When replacement parts are installed, the machine owner/user should ensure that the machine remains in compliance with all applicable requirements.

In the United States, the maintenance, replacement, or repair of the emission control devices and systems may be performed by any repair establishment or individual of the owner's choosing.

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Testing and Adjusting Section

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Systems Operation Section

i07244133

General Information

SMCS Code: 1400; 5000; 5700

Illustration 1 g01315518

Series M Series Motor Grader

IMPLEMENT ECM CONTROL SYSTEM COMPONENTS

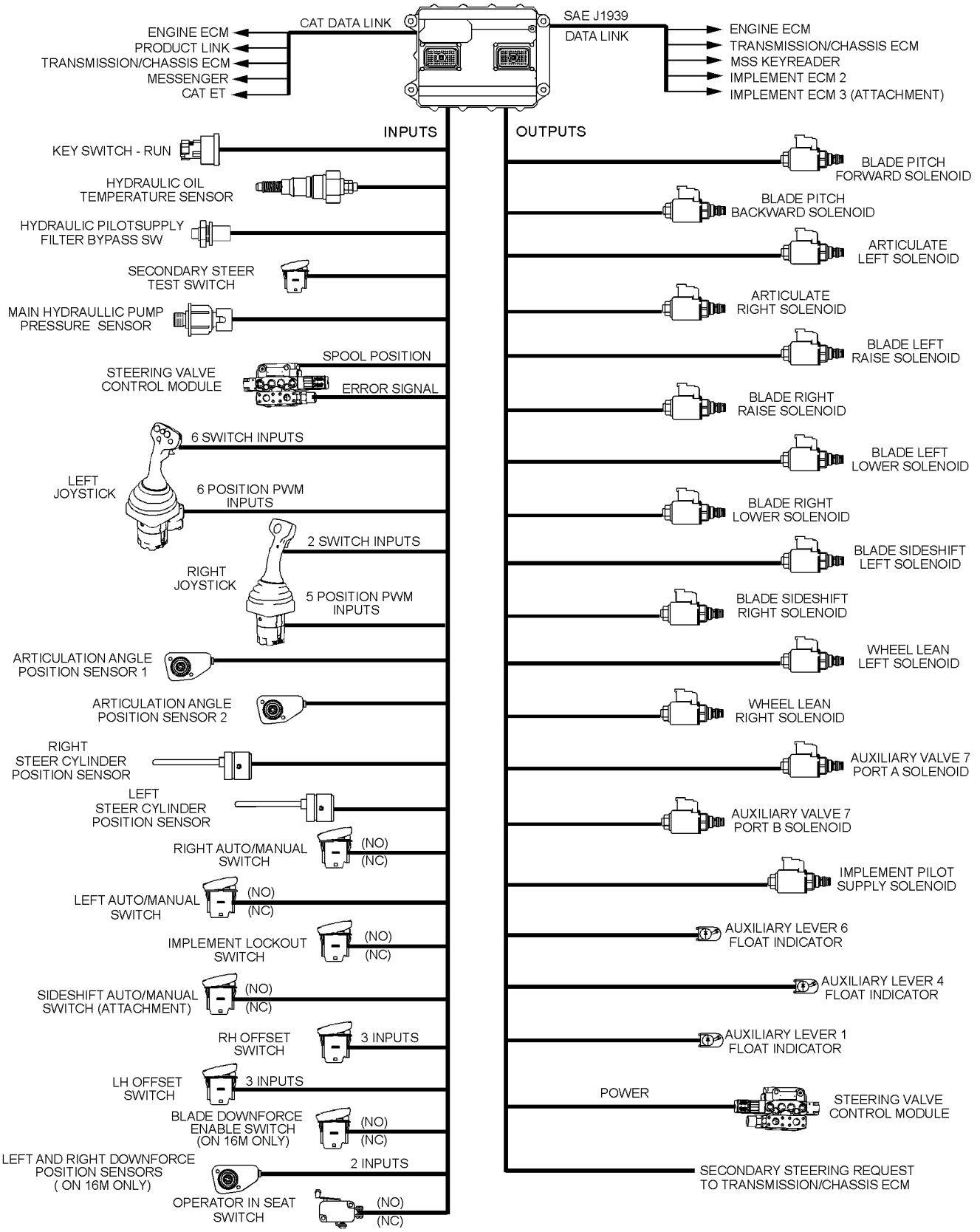


Illustration 2 g01469587

Implement ECM Control System Components

S/N: B921–368; R9A1–UP; R9B1–UP; B9C1–UP; R9C1–UP; B9D1–4762; B9E1–1143; B9F1–UP; B9G1–UP; D9G1–1585; B9H1–UP; R9H1–UP; B9J1–UP; R9J1–UP; B9L1–UP; B9M1–UP; B9N1–UP; B9R1–UP; B9T1–UP; D9T1–1438; B9W1–UP; D9W1–UP

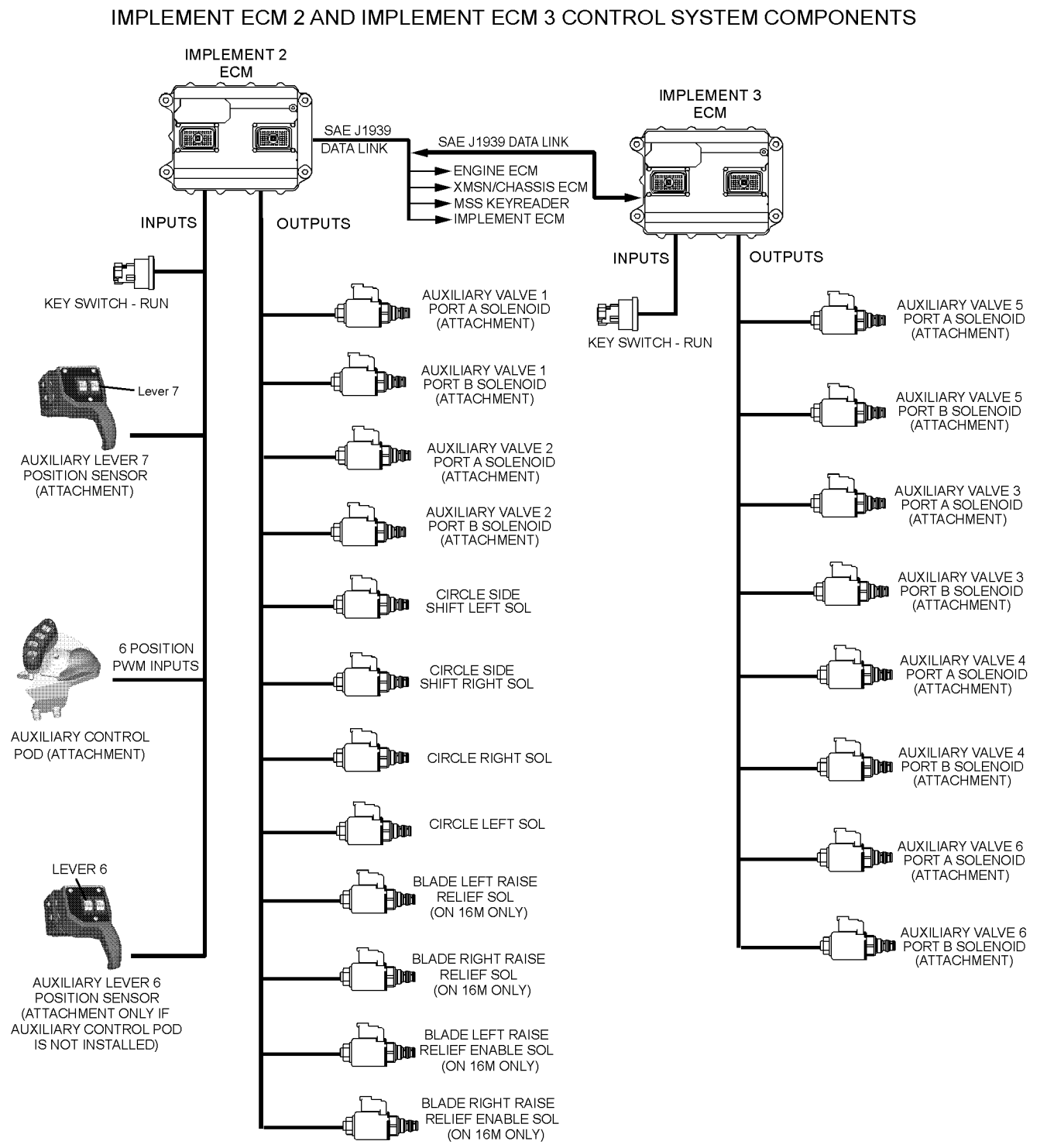


Illustration 3 g01501941

Implement ECM 2 and Implement ECM 3 Control System Components

S/N: B921–368; R9A1–UP; R9B1–UP; B9C1–UP; R9C1–UP; B9D1–4762; B9E1–1143; B9F1–UP; B9G1–UP; D9G1–1585; B9H1–UP; R9H1–UP; B9J1–UP; R9J1–UP; B9L1–UP; B9M1–UP; B9N1–UP; B9R1–UP; B9T1–UP; D9T1–1438; B9W1–UP; D9W1–UP

IMPLEMENT ECM CONTROL SYSTEM COMPONENTS

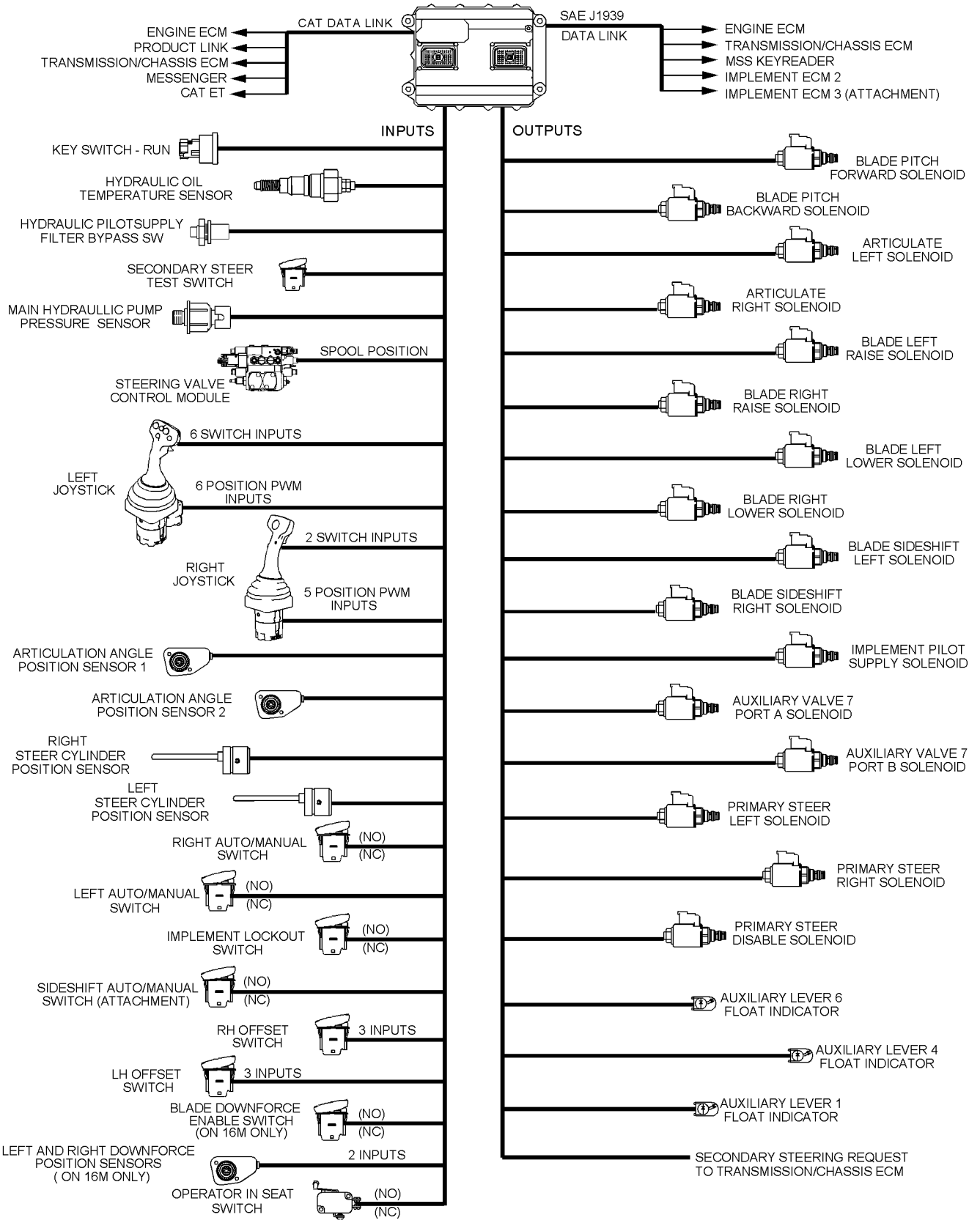


Illustration 4 g06075965

Implement ECM Control System Components

S/N: B92369–UP; B9D4763–UP; B9E1144–UP; D9G1586–UP; D9T1439–UP

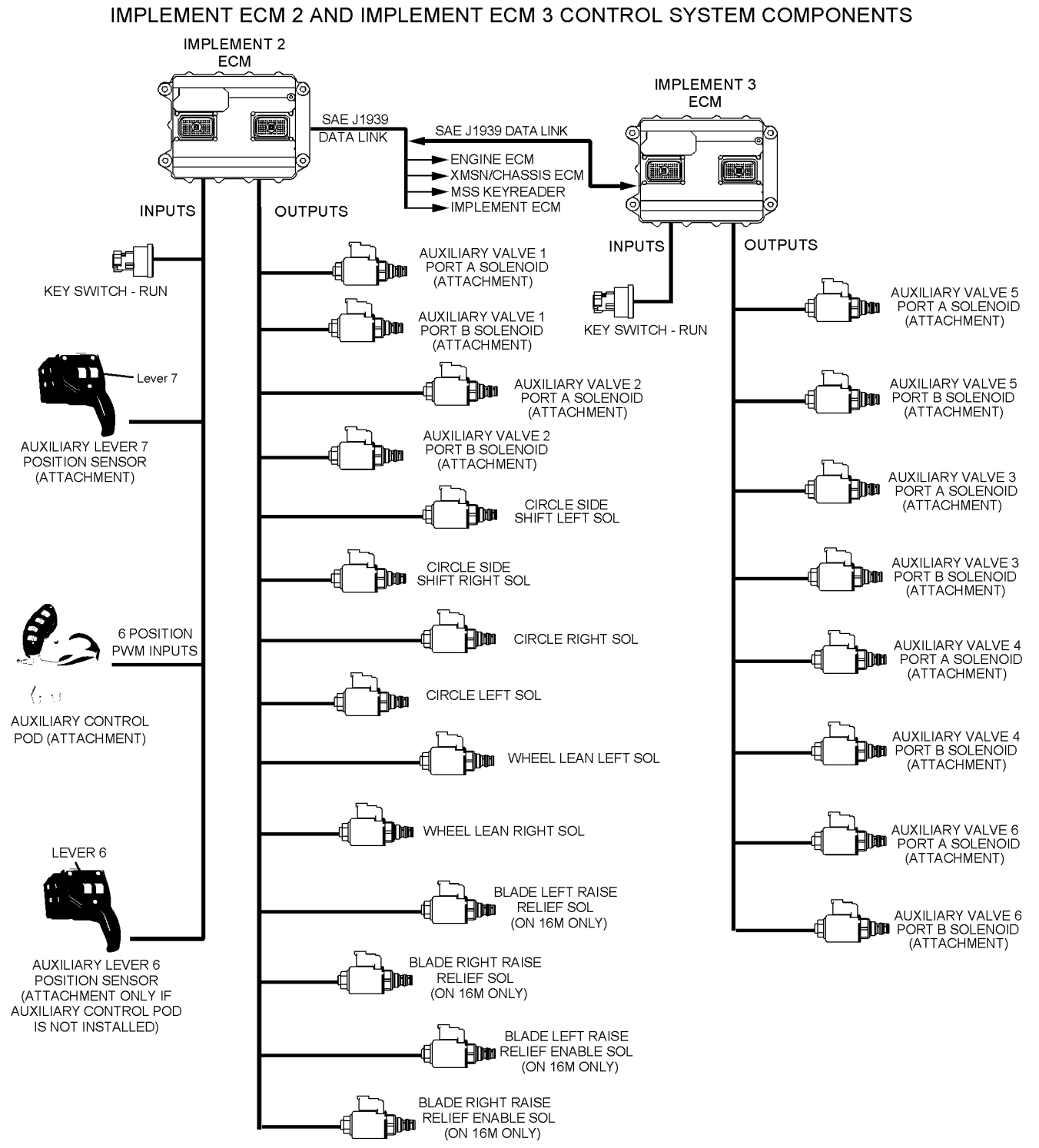


Illustration 5 g06075989

Implement ECM 2 and Implement ECM 3 Control System Components

S/N: B92369–UP; B9D4763–UP; B9E1144–UP; D9G1586–UP; D9T1439–UP

The Series M Series Motor Graders are equipped with an implement system that is electronically controlled and hydraulically actuated. The machine is equipped with fully electronic left and right joysticks. The joysticks enable the operator to send commands to each Implement ECM. An attachment “auxiliary control” pod is installed on machines that are equipped with auxiliary hydraulic valves. The “auxiliary control” pod is used by the operator to provide Implement ECM control of the attachments. The Implement ECM controls the following hydraulic systems:

- The control system of the blade with operator input from the left joystick and the right joystick.
- The blade constant down force system with operator input from the blade constant downforce enable switch. (On 16M only)
- The primary steering system with operator input from the left joystick
- The system for the articulation of the machine with operator input from the left joystick.
- The front wheel lean system with operator input from the left joystick.
- The auxiliary control system attachment with operator input from the auxiliary control pod.

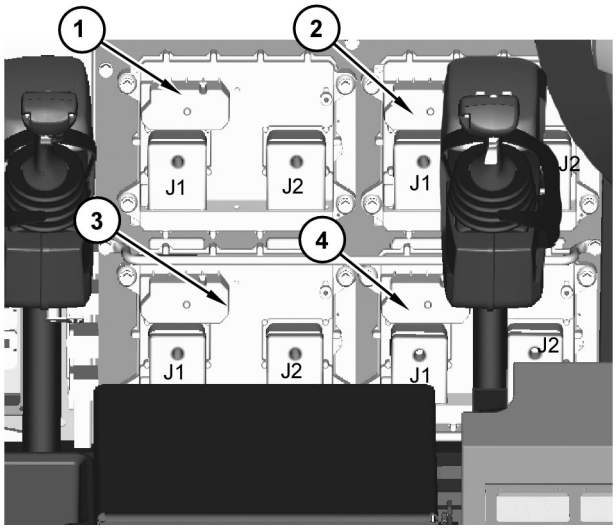


Illustration 6 g01380001

Implement and AWD Control Modules (view: looking to rear of cab with seat removed)

(1) Implement ECM 2
(2) Implement ECM
(3) AWD ECM (models equipped with all wheel drive)
(4) Implement ECM 3 (attachment)

In order to control the systems, all machines are equipped with two Implement Electronic Control Modules (ECM). With the addition of auxiliary attachments, a third Implement ECM can be installed on the machine. The Implement ECM modules are mounted on the inside of the cab and behind the operator's seat.

The three Implement ECM modules are listed below along with a brief description of the functions that each ECM controls.

Implement ECM (MID 082) - The Implement ECM is the main Implement ECM. The Implement ECM is installed on all Series M Series machines. All diagnostic codes are activated by this control module under the module identifier MID 082. The other implement control modules communicate diagnostics over the “SAE J1939” data link to the Implement ECM. The Implement ECM will activate diagnostic codes and activate event codes when necessary. The Implement ECM controls the primary steering functions and most of the blade control functions. The Implement ECM receives operator input from the left joystick and from the right joystick in order to control the steering and blade functions.

Implement ECM 2 (MID 145) - Implement Control #2 (MID 145) is the second implement control. Implement Control #2 is installed on all Series M Series machines. Implement Control # 2 controls some blade functions. The Implement Control # 2 also receives input from the attachment “auxiliary control pod” . The Implement Control #2 controls the attachment auxiliary valves 1 and 2 when equipped on the machines.

Implement ECM 3 (MID 147) - The third implement control is only equipped on machines that have the attachment auxiliary hydraulic valves 3, 4, 5 and 6 installed. The Implement Control # 3 is used to control the solenoid outputs for these valves.

During machine operation, the Implement ECM modules receive input data from a variety of components in the implement system. The ECM makes decisions that are based upon the state of these inputs and the operating parameters that are stored in the ECM memory. Input devices in the implement control system include the following:

- The left and right joysticks
- The attachment “auxiliary control pod”
- The auxiliary lever 6 and/or 7 position sensor (Auxiliary lever 6 only used if auxiliary control pod is not installed)
- Other control modules on the machine via the Cat Data Link and the “SAE J1939” Data Link
- Various switches that include the “Operator Control” switches and the “Machine System Pressure” switches

- Various Machine System sensors that include position sensors, pressure sensors and temperature sensors
- The Cat “Electronic Technician” service tool through the service tool connector

i06688456

Features

SMCS Code: 1400; 5000; 5700

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

The Implement ECM modules activate outputs to the solenoids. The solenoids control the implement system.

Electronic Joystick Control

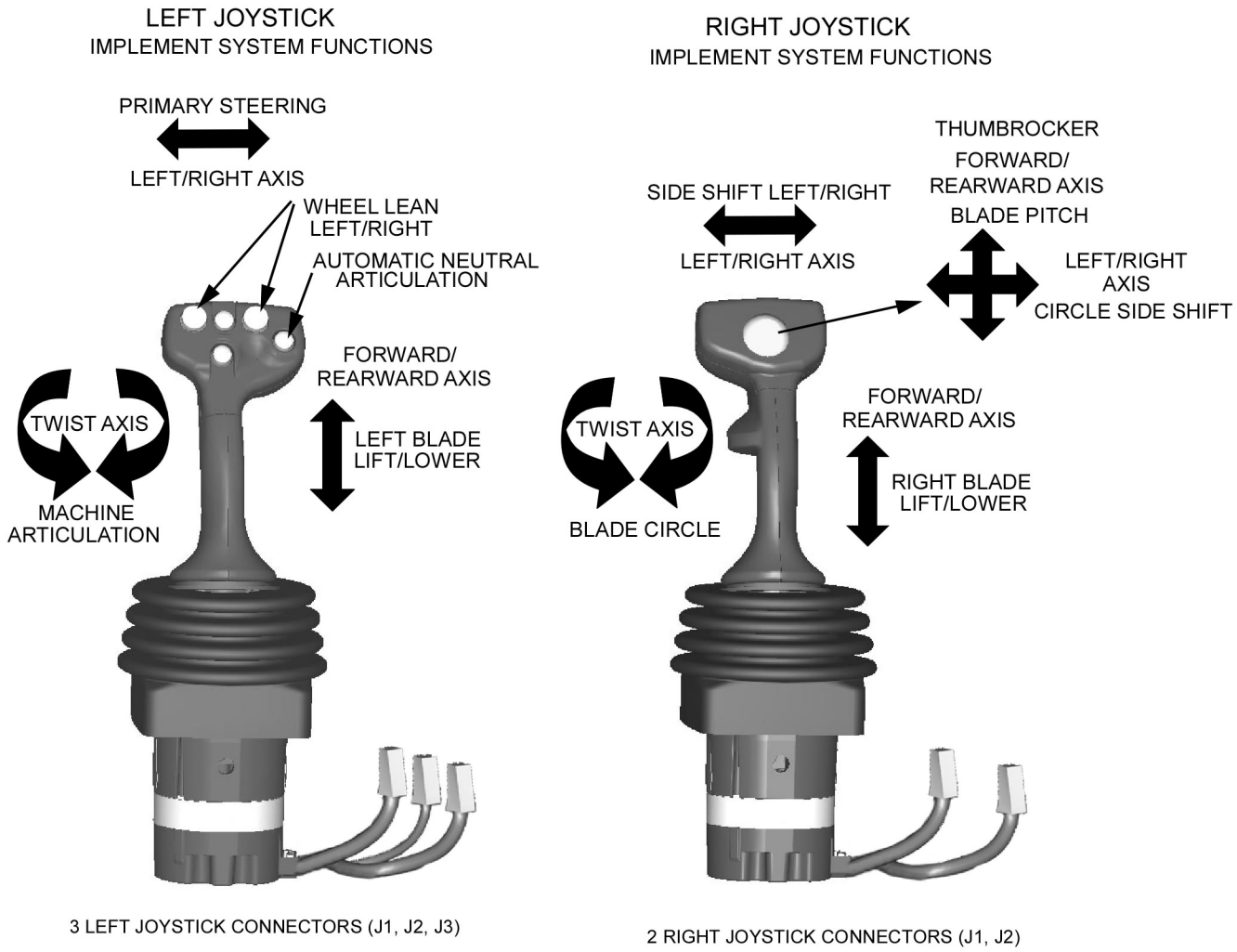


Illustration 7 g01481321

Functions of the LEFT and RIGHT joystick that are controlled by the modules of the Implement ECM

Note: The illustration above shows the functions that are controlled by the Implement ECM. The functions that are controlled by the Transmission/Chassis ECM are not called out in this manual. Refer to the manual for the Transmission/Chassis ECM for the joystick functions that are controlled by the Transmission/Chassis ECM.

Series M Series Motor Graders Implement ECM modules enable the operator to use the LEFT and RIGHT joysticks to control movement of an implement or function. The implement or function are assigned to a specific joystick axis. The joysticks are equipped with position sensors and switch-to-ground type switches that send input signals to the ECM.

Operation of the Position Sensor

Any movement of the joystick handle on a specific axis is detected by an internal position sensor for that axis. When the position sensor is powered up, the sensor will continuously send a Pulse Width Modulated (PWM) square wave signal to the ECM. The duty cycle of the PWM sensor signal changes depending on the direction and the amount of joystick movement on the axis. Duty cycle is the percentage of time the signal is high, compared to the amount of time that the signal is low for one cycle. Typical duty cycle signals recognized by the ECM are 10 ± 5 % to 90 ± 5 % at the extreme ends of axis movement. A joystick that is in the center or the neutral position would result in a duty cycle signal of approximately 50 ± 6 %. For more information on PWM sensor signals, refer to Diagnostic System Procedures, “Pulse Width Modulated Sensor”.

In most cases, the Implement ECM will respond to the duty cycle of the PWM signal by sending a specific level of electrical current output to the appropriate proportional solenoid valve. For the position sensors of the steering axis, the Implement ECM will respond to the duty cycle of the PWM signal by sending a control signal to the steering control module. The ECM relates a specific duty cycle value to a specific position of the joystick.

The amount of current applied to a proportional solenoid determines the amount of pilot oil pressure applied to a control valve. An increase in the amount of electrical current applied to the solenoid will increase the movement of a valve spool. The increased movement of a valve spool results in an increase in the hydraulic flow to a cylinder.

When movement of more than one joystick axis is detected, the ECM responds by outputting current signals to multiple solenoids or controls to cause movement of the implement in several directions at the same time.

Operation of the Left Joystick

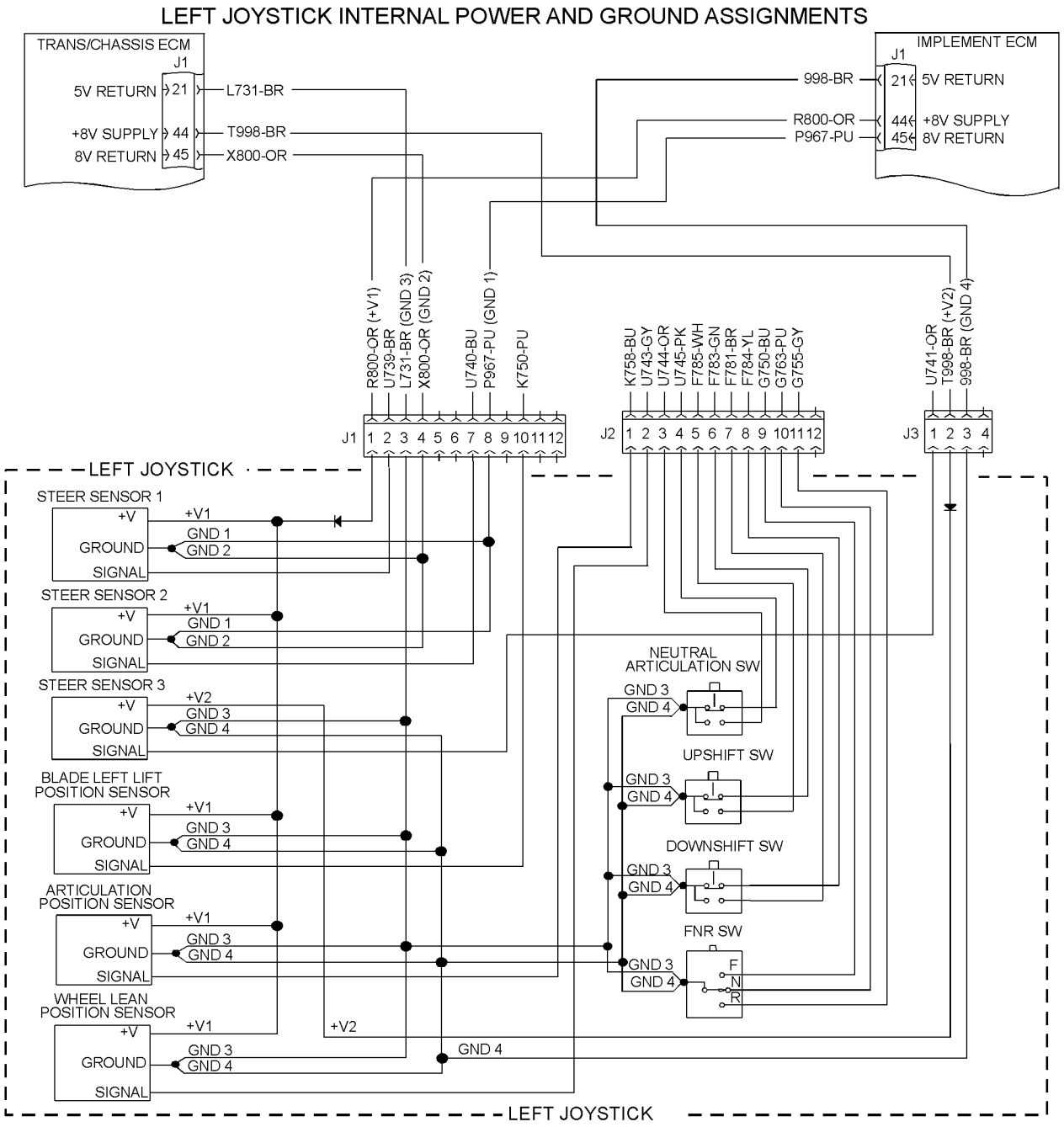


Illustration 8 g01487634

Power supply and ground assignments for internal components of the left joystick

Note: The illustration above shows the various power and ground assignments for the LEFT joystick. The components that are in the LEFT joystick are not serviceable. If a component in the joystick has failed, the complete assembly of the joystick must be replaced. The illustration is displayed in order to aid in the troubleshooting of the component and circuit. For a complete connection diagram for all of the joystick to ECM connections, refer to the System Schematics in the back of this manual.

All of the internal components and the harness circuits have assigned diagnostic codes. The Implement ECM will activate the diagnostic code for a component when an abnormal condition is detected in the involved circuit.

Two ground sources are connected to all of the internal components of the joystick. Both of the ground circuits must fail, internally or externally, for the component not to function due to a loss of the ground connections.

Primary Steer Position Sensors

The LEFT/RIGHT axis of the LEFT joystick is assigned to the primary steering function. The LEFT/RIGHT axis does not have the “return to center” type of axis movement. Since this axis controls the steering function, the joystick will stay in a position until the joystick is moved to another position.

Three sensors for the steer position are connected to this axis in order to provide uninterrupted operation of the primary steering system. The loss of one of the power supply circuits or one of the ground circuits will not cause the primary steering system to fail.

Each sensor of the steer position outputs a PWM signal. The frequency of the sensor signal is approximately 500 ± 100 Hz. The position sensor sends the PWM signal to the Implement ECM and to the Transmission/Chassis ECM. The signal duty cycle varies from approximately 10 ± 5 % at joystick full LEFT to approximately 90 ± 5 % at joystick full RIGHT . When the joystick is in the CENTER position, the duty cycle will be approximately 50 %.

The Implement ECM and the Transmission/Chassis ECM monitor the PWM signals from each of the steer sensors. The Implement ECM will use the signal from the steer sensor in order to determine the correct command signal to send to the steering control module. The signals of the PWM duty cycle from each of the three steer position sensors must match within 5 % of each other or both of the ECM modules will activate a diagnostic code for the sensor that does not match the other two.

The Implement ECM will use the signal from steer sensor 1 to determine the requested steering command. If the signal from steer position 1 does not match the signals from the other two steer sensors that do match, the ECM will use steer sensor 2 as the good signal. If the signals from steer sensors 1 and 2 are both determined to be incorrect, the signal from steer sensor 3 will be used.

Blade Lift, Articulation, Wheel Lean Position Sensors

The blade LEFT lift position , machine articulation position, and the wheel lean position sensors are internal sensors located in the assembly of the LEFT joystick. The axis assignments and details are listed below:

Blade LEFT Lift Position Sensor – Assigned to the FORWARD/REARWARD axis. The position sensor outputs a PWM signal. The signal frequency of the sensor is approximately 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will vary from approximately 10 ± 5 % at the full rearward position of the joystick to approximately 90 ± 5 % at the full forward position of the joystick. When the lever is in the center position, the duty cycle will be approximately 50 ± 6 %. When the joystick is moved to a FULL FORWARD DETENT position, the ECM will enable the float mode of the blade for the LEFT lift hydraulic valve.

Position Sensor for Machine Articulation – Assigned to the twist LEFT/RIGHT axis. The position sensor outputs a PWM signal. The frequency of the sensor signal is approximately 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will vary from approximately 10 ± 5 % at the FULL ROTATE LEFT position of the joystick to approximately 90 ± 5 % at the FULL ROTATE RIGHT position of the joystick. When the joystick is in the CENTER (neutral) position, the duty cycle will be approximately 50 ± 7 %.

Position Sensor for Wheel Lean – Assigned to the LEFT/RIGHT rocker button axis on the joystick handle. The position sensor outputs a PWM signal. The frequency of the sensor signal is approximately 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will be approximately 10 ± 5 % when the joystick LEFT button for the wheel lean is fully depressed. The duty cycle of the signal will be approximately 90 ± 5 % when the joystick RIGHT button for the wheel lean is fully depressed. When neither button is depressed, the duty cycle will be approximately 50 ± 7 %.

Joystick Switches

The neutral articulation switch is the only switch on the LEFT joystick that provides inputs to the Implement ECM. The switch provides 2 switch to ground types of input to the ECM. The switch is connected to two of the four return circuits of the sensor. The switch must lose both of the ground circuits in order to cause a circuit failure.

Due to internal ECM pull-up voltage present at the contacts of the switch input, the switch contact not connected to ground will be pulled high. The ECM expects to detect one switch circuit that is grounded and one switch circuit that is high at all times. If both of the circuits are high or grounded at the same time, the ECM will activate a diagnostic code for the switch.

Operation of the RIGHT Joystick

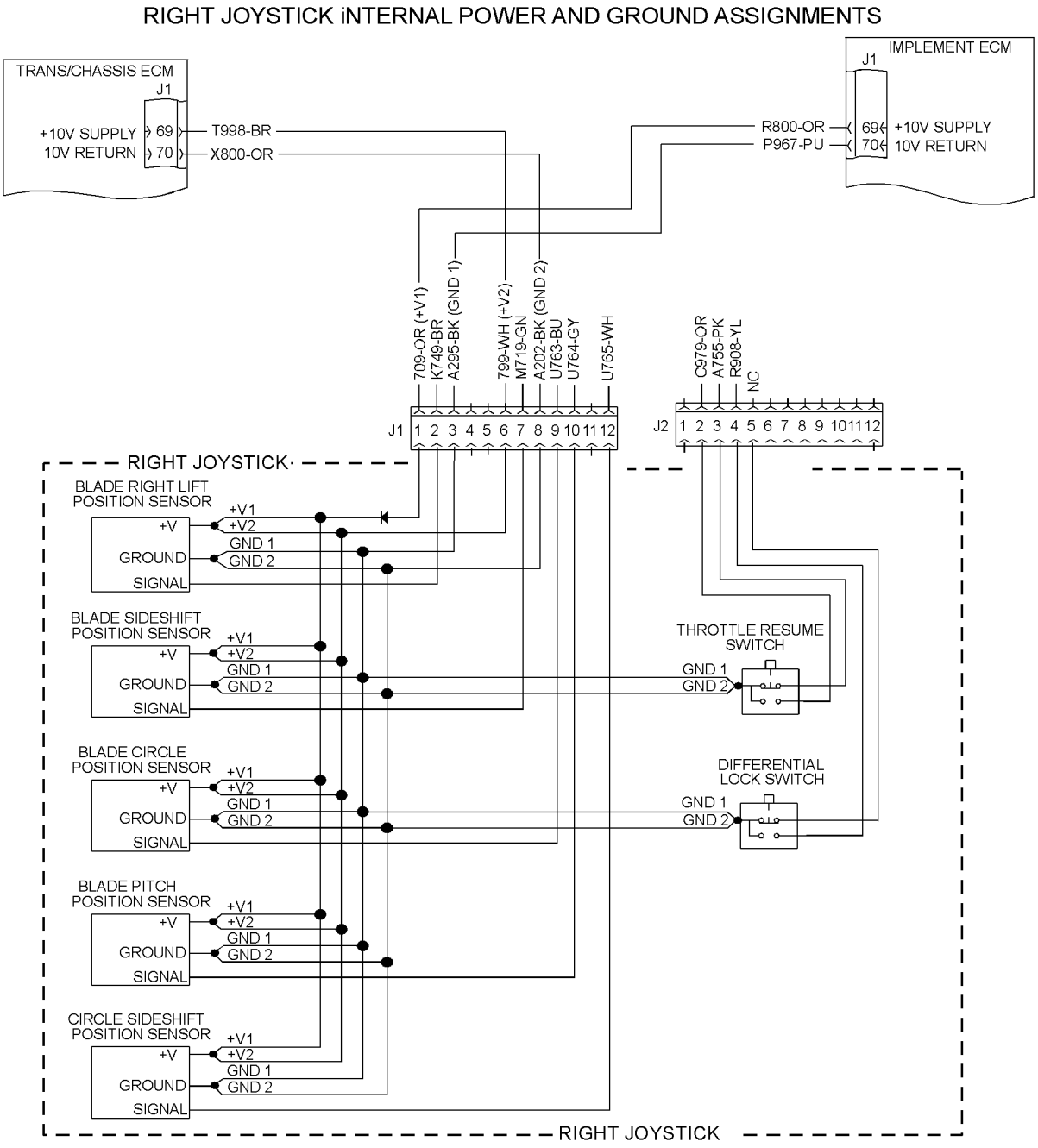


Illustration 9 g01335139

Power supply and ground assignments for internal components of the RIGHT joystick

Note: The illustration above shows the various power and ground assignments for the RIGHT joystick. The components that are in the RIGHT joystick are not serviceable. If a component in the joystick has failed, the complete assembly of the joystick must be replaced. The illustration is displayed in order to aid in the troubleshooting of the component and the circuit. For a complete connection diagram for all of the joystick to ECM connections, refer to the System Schematics in the back of this manual.

The RIGHT joystick receives power connections and ground connections from two separate 10 VDC sensor power supply circuits. One power supply from the Implement ECM and one power supply from the Transmission/Chassis ECM. As shown in the illustration above, each position sensor is internally connected to both of the power supply circuits. The position sensors are inside of the joystick and each switch connects to both of the sensor return circuits inside of the joystick. All of the internal components and the harness circuits that are controlled by the Implement ECM have diagnostic codes that are assigned. The ECM will activate the diagnostic code for a component when an abnormal condition is detected in the involved circuit.

When two power and two ground sources are connected to a particular component, both power or both ground circuits must fail, either internally or externally, for the component to fail to function correctly.

Position Sensors

The position sensors that are located on the inside of the assembly of the RIGHT joystick send a PWM signal to the Implement ECM. Each of the position sensors will output a PWM signal at a frequency of approximately 500 ± 100 Hz to the Implement ECM. The assignments for the axis and the details are listed below:

Blade RIGHT Lift Position Sensor – Assigned to the FORWARD/REARWARD axis. The duty cycle of the sensor signal will vary from approximately 10 ± 5 % at the full rearward position of the lever to approximately 90 ± 5 % at the full forward position of the lever. When the lever is in the CENTER position, the duty cycle will be approximately 50 ± 6 %. When the joystick is moved to a full forward detent position, the ECM will enable the float mode of the blade for the RIGHT lift hydraulic valve.

Blade Side Shift Position Sensor – Assigned to the LEFT/RIGHT axis. The duty cycle of the sensor signal will vary from approximately 10 ± 5 % when the joystick is at the FULL LEFT position to approximately 90 ± 5 % when the joystick is at the FULL RIGHT position. When the joystick is in the CENTER position, the duty cycle will be approximately 50 ± 7 %.

Blade Circle Drive Position Sensor – Assigned to the twist LEFT/RIGHT axis. The duty cycle of the sensor signal will vary from approximately 10 ± 5 % when the joystick is rotated to the FULL LEFT position to approximately 90 ± 5 % when the joystick is rotated to the FULL RIGHT position. When the joystick is in the CENTER position, the duty cycle will be approximately 50 ± 7 %.

Blade Center Shift Position Sensor – Assigned to the LEFT/RIGHT axis on the “thumbrocker” switch on the handle of the joystick. The duty cycle of the sensor signal will vary from approximately 10 ± 5 % when the “thumbrocker” switch is at the FULL LEFT position to approximately 90 ± 5 % when the “thumbrocker” switch is at the FULL RIGHT position. When the “thumbrocker” switch is in the CENTER position, the duty cycle will be approximately 50 ± 7 %.

Blade Pitch Position Sensor – Assigned to the FORWARD/REARWARD axis on the “thumbrocker” switch on the handle of the joystick. The duty cycle of the sensor signal will vary from approximately 10 ± 5 % when the “thumbrocker” switch is at the FULL LOWER position to approximately 90 ± 5 % when the “thumbrocker” switch is at the FULL UPPER position. When the “thumbrocker” switch is in the CENTER position, the duty cycle will be approximately 50 ± 7 %.

Electronic Primary Steering Control

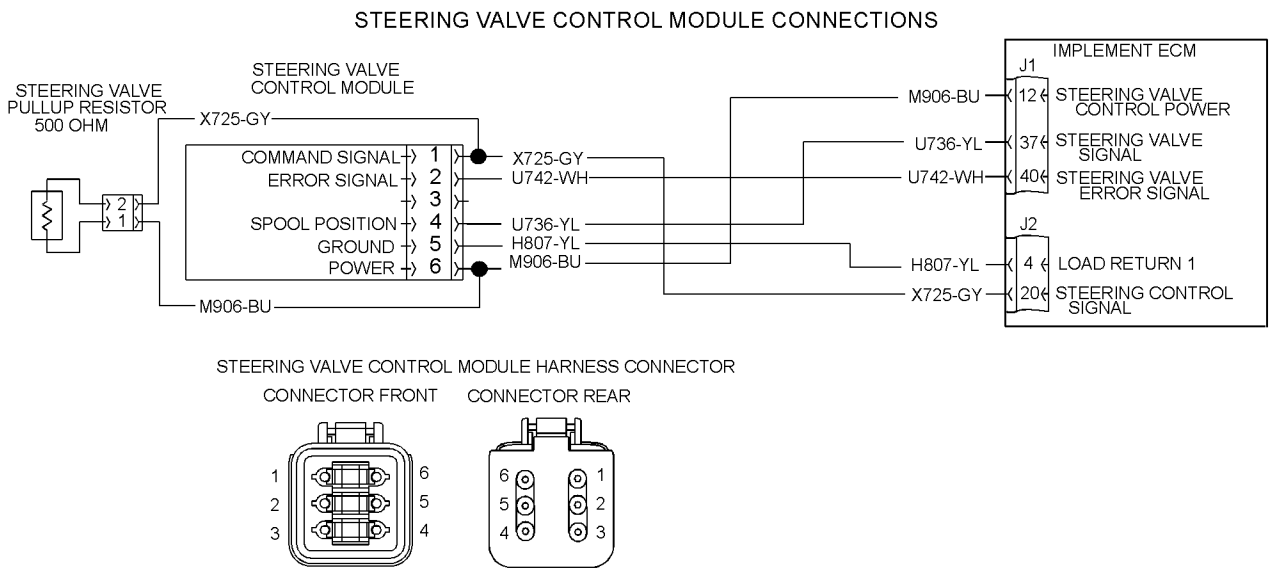


Illustration 10 g01310632

Steering Valve Control Module Connections

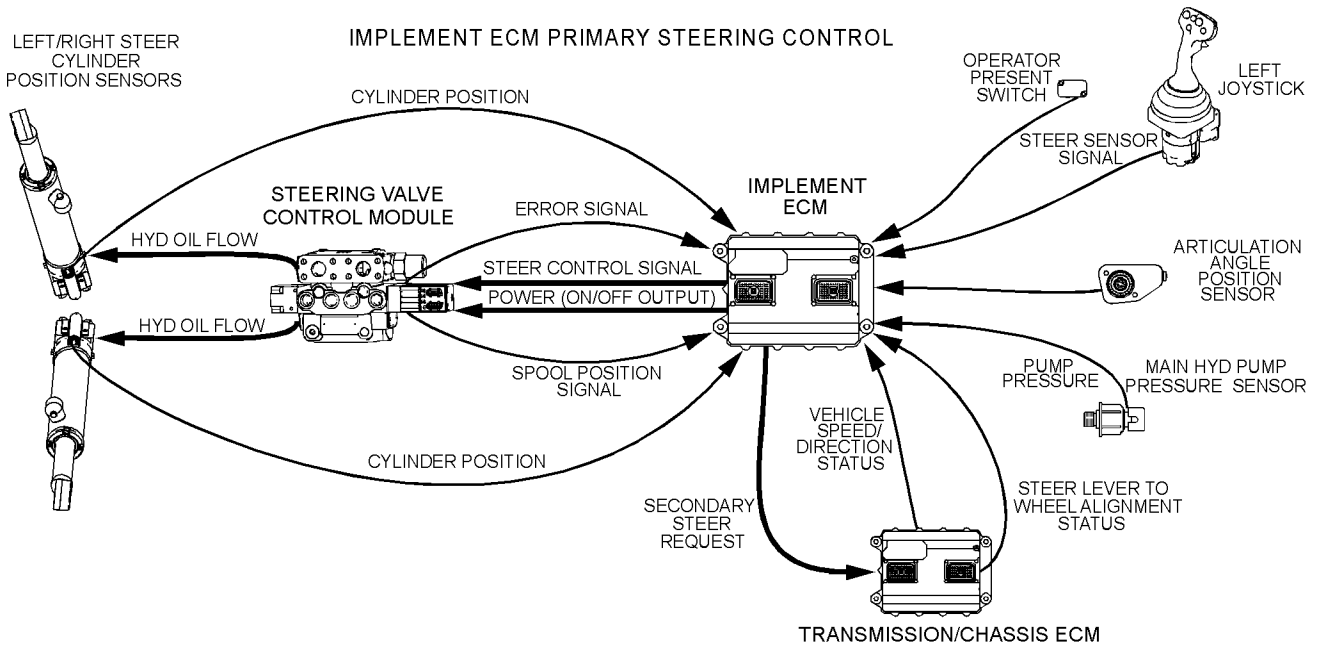


Illustration 11 g03316023

The Implement ECM controls the primary steering system. The Implement ECM uses a “closed loop” system for the position feedback in order to control the position of the front wheels on the motor grader. The ECM sends a control signal to the control module for the steering valve that is based on the LEFT position of the joystick. Then, the ECM monitors the position of the steer cylinders and the position of the steering valve spool in order to adjust the command accordingly. As the steering cylinders approach and reach the commanded position, the ECM will decrease the control signal to the control module for the steering valve until movement of the valve spool and the cylinders is stopped. The cycle repeats as steering input from the joystick changes.

The Implement ECM outputs to the steering valve control module are for operating power and the steering command/control signal. The ECM receives inputs from the control module for the steering valve for the position sensor of the spool and the error signal.

The Implement ECM is used to supply the machine power to the control module of the steering valve through an ON/OFF output driver. The steering module will operate within a power supply range of between 8.5 VDC and 36 VDC, however, the ECM will not allow the system voltage to go below 18.0 VDC without activating a diagnostic code for low system voltage.

When the key start switch is in the ON position, the Implement ECM will turn ON the power output for the control module of the steering valve. The ECM will not enable the operation of the steering system until certain machine conditions are met. The conditions that must be satisfied before the Implement ECM will enable the steering system are listed below:

- **Engine ON** - The engine must be operating.
- **Hydraulic Pressure OK** - The main hydraulic pump pressure sensor must be indicating sufficient pressure.
- **Operator In Seat** - The operator in seat switch must be indicating that an operator is in the seat in order to enable steering. Once the steering system is enabled and the machine is moving, the operator can steer the machine while raised from the seat. The machine will not automatically shut down in this circumstance.
- **Park Brake ON, Transmission in NEUTRAL**
- **Steer Cylinder Position Sensor Signals OK** - The signals from both steer cylinders must not be faulty.

When the above conditions are satisfied, the position of the LEFT joystick must be aligned with the angle of the front wheels before the ECM will allow the steering system to operate. The operator accomplishes this by slowly “sweeping” the joystick through the full range of travel for the LEFT/RIGHT axis. When the Implement ECM detects that the position of the joystick has been aligned with the position of the front wheels, the primary steering system will be enabled. This procedure must be performed every time the engine is started. This procedure must also be performed every time the parking brake is engaged and the operator leaves and returns to the seat.

Providing that the required conditions listed above are correct, other conditions that will prevent the ECM from enabling the steering system are listed below:

- **Sweeping The Joystick Too Fast** - The LEFT joystick must be swept from SIDE TO SIDE in a steady motion. The full SIDE TO SIDE sweeping motion should not be done in less than 4 seconds.
- **Not Sweeping The joystick Through the Full Range Of Motion** - Ensure that the LEFT joystick is being swept from STOP TO STOP in the full range of motion. If the travel of the joystick is inhibited, the joystick may not reach the correct position for alignment.
- **Front Wheel Position Out of Range** - If the front wheels are positioned at an extreme angle either LEFT or RIGHT due to a collision or other factors, the sweep of the joystick may not align. The wheels must be at an extreme angle in order for this to occur. If this condition does occur, the wheels must manually be moved back into an acceptable position before the ECM will align with the joystick. Actuating the wheel lean function to the LEFT and to the RIGHT may help move the wheels into an accepted range.

Steering Control Signal

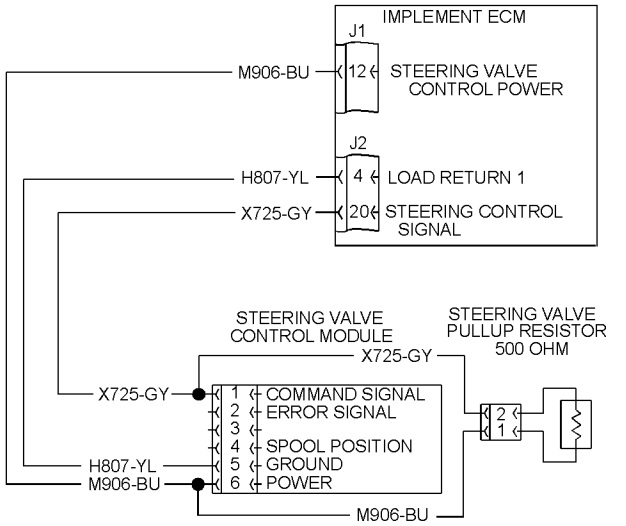


Illustration 12 g01311176

Steering Valve Control Module Control Signal connections

When the control module of the steering valve is powered up, the Implement ECM is outputs a 5000 Hz PWM signal to the module. The duty cycle of the control signal is dependent on the following:

- The signal that the position sensor for the steering is sending from the left joystick.
- The input signal that is received from the position sensors for the steering cylinder.

The steering control module will adjust the position of the valve spool based on the duty cycle of the control signal.

The control signal circuit is connected to a sinking driver output on the ECM. At the steering valve control module harness connector, a pull-up resistor is connected between the control signal circuit and the power circuit. This causes the circuit for the control signal to be held high until the ECM turns ON the sinking driver output. The sinking driver output will ground the control signal and the output will cause the signal to go low. The cycling ON and OFF of the output by the ECM will result in a PWM duty cycle signal. The ECM will adjust the output signal according to the input signal of the LEFT joystick and the input signal that is received from the position sensors of the steering cylinder.

The duty cycle of the control signal will range between 25 ± 5 % and 75 ± 5 %. When the LEFT joystick is stationary in any position and the front wheels are aligned with the position of the joystick, the duty cycle of the control signal will be 50 ± 5 % until the joystick is moved to another position.

When the joystick is moved in the left direction, the duty cycle of the control signal increases from 50 ± 5 % to a maximum of 75 ± 5 %. When the joystick is moved in the RIGHT direction, the duty cycle of the control signal decreases from 50 ± 5 % to a minimum of 25 ± 5 %.

The control signal can be measured as a voltage. However, this is not a simple measurement as the voltage range of the control signal from the ECM will change as the system voltage is changed.

When the control signal is measured as a voltage, the signal must be in the range of 15 % to 85 % of the system voltage that the Implement ECM is supplying to the steering module for operating power.

For example, if the output supply voltage from the ECM is 24.0 VDC, the voltage of the control signal must be between approximately 3.5 VDC and 20.0 VDC during movement of the LEFT joystick.

When the LEFT joystick is not moving, the voltage should be approximately 50 % of the system voltage or approximately 12.0 VDC.

The Implement ECM does not monitor the signal circuit for diagnostics. The steering control module will detect a problem, such as a high or low voltage in the signal circuit, and the module will send an error to the Implement ECM. If this occurs, the Implement ECM which will turn OFF supply power to the steering valve control module and will send a request to activate the secondary steering system to the Transmission/Chassis ECM.

Spool Position Signal

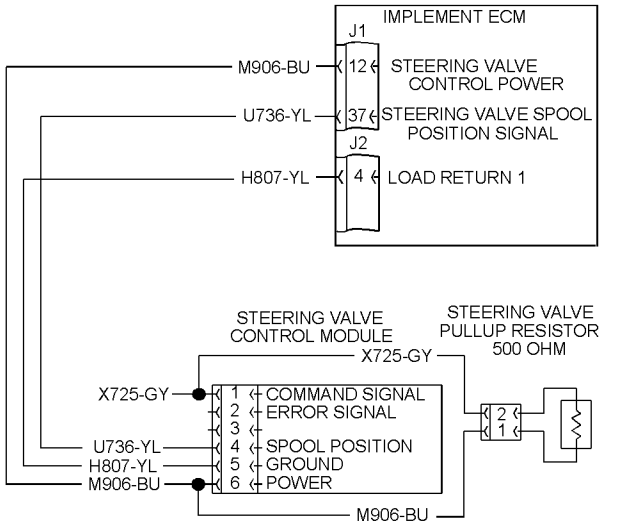


Illustration 13 g01311212

Steering Valve Spool Position Sensor connections

The Implement ECM receives an input from the control module of the steering valve in order to indicate the position of the valve spool. The ECM uses this information to help determine if the control module of the steering valve is responding correctly to the steering control signal.

In order to indicate the position of the valve spool, the position sensor supplies an analog voltage signal to the ECM. The voltage of the signal will range from 1.25 VDC to 3.75 VDC. When the joystick is stationary and is in any position, a signal of between 2.2 VDC and 2.8 VDC will be supplied to the ECM.

The Implement ECM monitors the sensor voltage for the spool position for diagnostics. If the ECM detects that the voltage at the signal is too high or too low, the ECM will activate a diagnostic code.

The steering valve control module also monitors the external and internal circuits and detects an internal failure of the position sensor for the spool.

An active diagnostic code from the position circuit of the spool or an error signal from the steering module will result in the Implement ECM turning OFF the supply power to the control module of the steering valve. When this occurs, the ECM will send a request in order to activate the secondary steering system to the Transmission/Chassis ECM.

Steering Control Module Error Signal

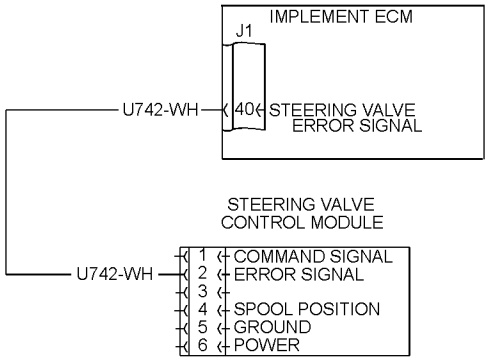


Illustration 14 g01311353

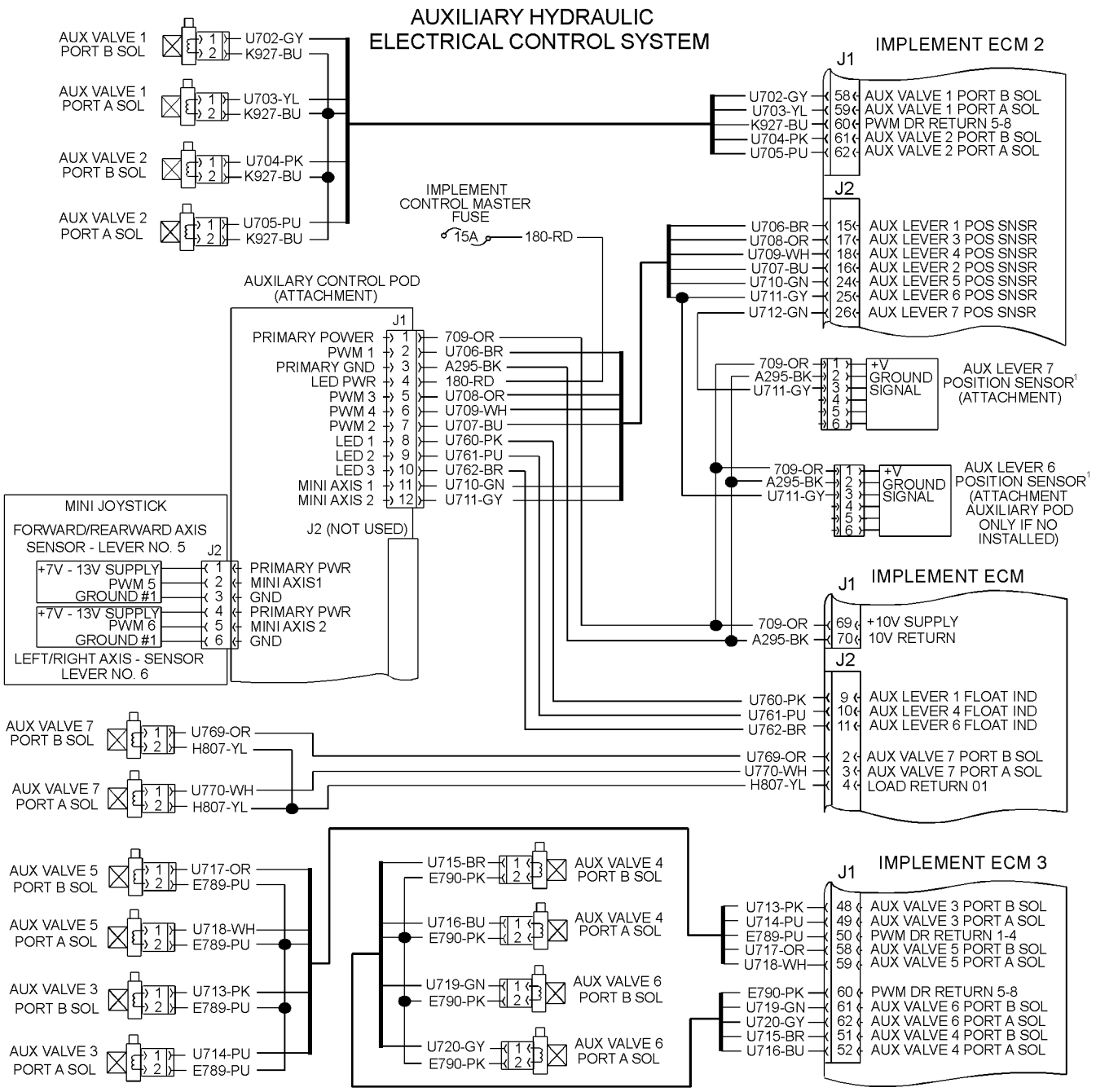
Steering Control Valve Error Signal connections

The control module of the steering valve is a self-diagnostic module. If the control module of the steering valve detects a number of abnormal conditions, the control module will send a signal to the Implement ECM to indicate an error.

The error signal circuit is connected to the Implement ECM at a switch to ground type of input. An internal pull up voltage in the ECM holds this contact high. During normal operation, the control module of the steering valve grounds this circuit to hold the signal low in order to indicate that the system is OK. When a problem is detected, the steering valve control module removes the ground on the error circuit. The signal is pulled high by the ECM pull-up voltage indicating to the ECM that there is a problem. When this occurs, the Implement ECM will turn OFF supply power to the steering valve control module and the Implement ECM will send a secondary steering request signal to the Transmission/Chassis ECM in order to activate the secondary steering system.

If the steering valve control module activates an error signal, follow the troubleshooting procedure identified with code MID 082 - CID 2202 - FMI 12.

Auxiliary Hydraulics



[1] Along with the assembly identified above a machine may also have the following assemblies: Auxiliary Handle with Lever 7 (right roller), Auxiliary Handle with Lever 6 (left roller), Auxiliary Handle with Levers 6 and 7, a Full Auxiliary Pod (with mini joystick) or no control handle.

Illustration 15 g01511274

Auxiliary Hydraulics Electrical Control System Component Connections

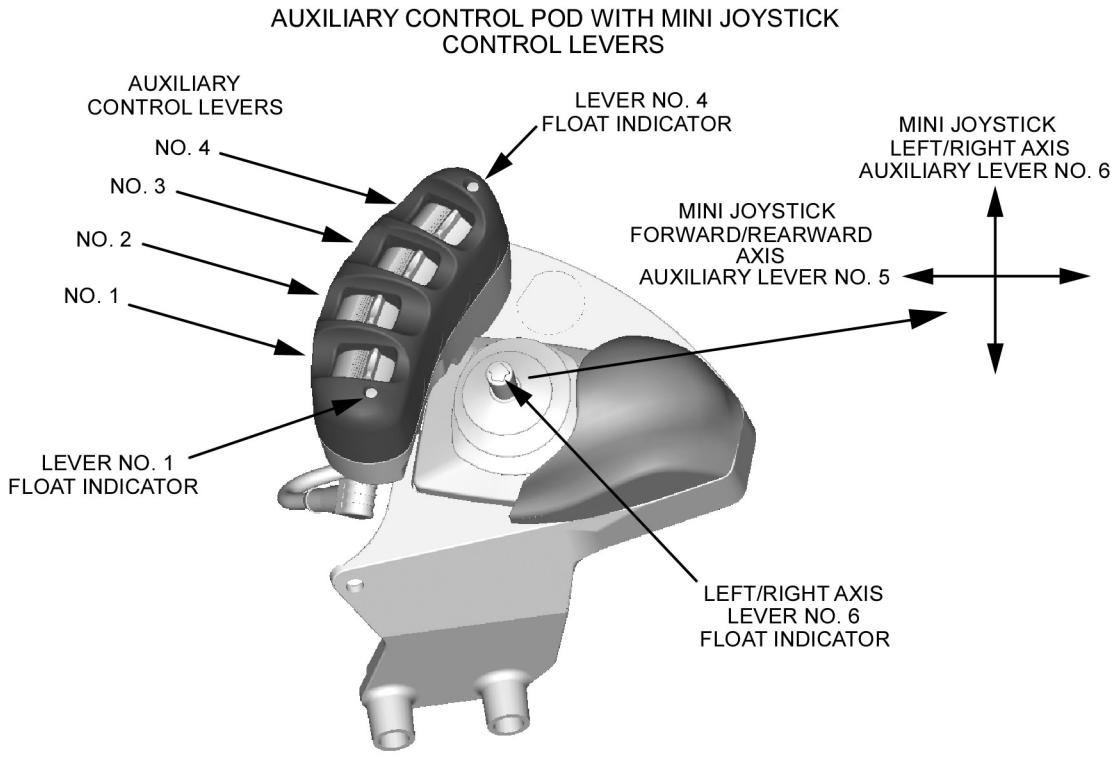


Illustration 16 g01372895

"Auxiliary Control Pod" with Mini Joystick with control levers 1, 2, 3, 4, 5, and 6

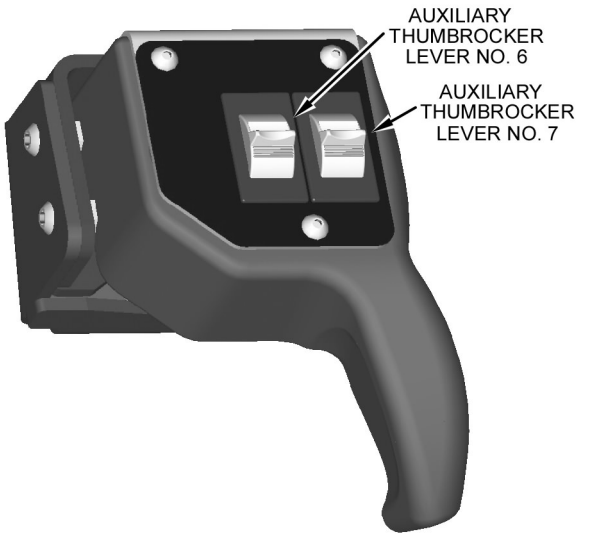


Illustration 17 g01316090

"Auxiliary Levers No. 6 and No. 7"

Note: The illustrations show all possible components that can be installed in the auxiliary hydraulic system. The components that are installed on your machine are dependent on the machine configuration.

The Implement ECM modules control the attachment auxiliary hydraulic system. Different combinations of auxiliary control levers that control the hydraulic valves can be installed on the machine. A full complement of auxiliary control levers and valves will allow seven separate auxiliary hydraulic circuits to be available for the control of implement attachments. The Implement ECM can be configured to allow any one auxiliary control lever to control any one of the auxiliary hydraulic valves that are installed on the machine.

Note: Auxiliary hydraulic valve 7 is controlled by ON/OFF solenoids. All of the other auxiliary hydraulic valves are controlled by proportional solenoids.

The Implement ECM can be configured using Cat ET. The configuring of the auxiliary hydraulic system enables the assignment of any one auxiliary control lever that is installed on the machine to control any one of the hydraulic valves that are installed on the machine. Refer to "Configuring Auxiliary Hydraulic Control" .

The configuration of the auxiliary hydraulic system will determine if the "Implement ECM 3" is installed. The solenoid outputs for two auxiliary hydraulic valves are controlled by the "Implement ECM 2" . "Implement ECM 3" controls the solenoid outputs for the other four possible auxiliary hydraulic valves. If only two auxiliary hydraulic control levers for control of the two valves are installed on the machine, "Implement ECM 3" is not needed.

Depending on the auxiliary hydraulic configuration of your machine, some of the following electrical components could be installed for control of the system:

- The Implement ECM, “Implement ECM 2” , “Implement ECM 3”
- Auxiliary Control Pod (control lever no's. 1, 2, 3 and 4)
- Stand alone auxiliary “thumbrocker” switch control lever no. 7
- Stand-alone auxiliary “thumbrocker” control combination lever no. 7 and lever no. 6 (available only if no auxiliary control pod is installed)
- Mini Joystick (only available with auxiliary control pod - adds lever no's. 5 and 6)
- Two proportional solenoids and a valve for each auxiliary control lever installed

The different combinations of auxiliary hydraulic control levers that can be installed in the system are:

- The stand-alone “thumbrocker” lever no. 7
- The stand-alone “thumbrocker” levers no. 6 and no. 7
- The auxiliary control pod (without the mini joystick)
- The auxiliary control pod (without the mini joystick) and the stand-alone “thumbrocker” lever no. 7

The status of the auxiliary hydraulic valves equipped on the machine, must be “installed” in the Cat ET configuration screen before the ECM will enable operation. Also the “Auxiliary Control Pod” enable status must be set to “enabled”.

Auxiliary Hydraulic Control Operation

Each control lever that is installed on the machine contains an internal position sensor that, when powered up, will send a constant Pulse Width Modulated (PWM) square wave signal to either the Implement ECM or the “Implement ECM 2” . The ECM that the particular signal circuit is connected to depends on the control levers that are installed. Each installed lever position sensor circuit is monitored by the ECM for diagnostics. If the ECM detects a problem in the signal circuit, the ECM will activate a diagnostic code for the circuit.

The duty cycle of the control lever PWM sensor signal changes depending on the direction and the amount of lever movement. The duty cycle is the percentage of time that the signal is high as compared to the amount of time the signal is low for one full cycle. The percentage of duty cycle signal from a typical position sensor that the ECM will recognize as valid is 10 ± 5 % to 90 ± 5 % at the extreme ends of lever travel. A control lever that is in the center or the neutral position would result in a duty cycle signal of approximately 50 ± 5 %. For more information on PWM sensor signals, refer to Diagnostic System Procedures, “Pulse Width Modulated Sensor”.

The ECM uses the PWM duty cycle signal that is received from the control lever to control two proportional solenoids for the assigned auxiliary hydraulic valve. The ECM will use a PWM output signal in order to control the amount of electrical current that is sent to the solenoids. When the PWM duty cycle signal from the lever position sensor changes, the ECM adjusts the amount of current that is sent to the solenoids. The current that is sent to the solenoids will determine the amount of pilot oil pressure that is directed to the hydraulic valve in order to move the valve spool. An increase in the amount of electrical current that is applied to the solenoids will increase the movement of the valve spool. The movement of the valve spool will result in more hydraulic oil flow to the hydraulic cylinder for the implement. When the lever is in the neutral position, the duty cycle is approximately 50 %. At this level, the ECM outputs a very small current that is not enough to cause the valve spool to move. This small current output to the solenoid enables quicker response time when a move is requested.

Hydraulic Float Function

A hydraulic float function is available for the auxiliary hydraulic valves that are assigned to auxiliary control lever 1, auxiliary control lever 4, and auxiliary control lever 6. Auxiliary control levers no. 1 and no. 4 are only available if the auxiliary control pod is installed. If the auxiliary control pod is not installed, a stand-alone control lever 6 can be installed along with a stand-alone control lever 7. The mini joystick control cannot be installed independent of the auxiliary control pod.

To enable the float function for the auxiliary control levers, the status of the float function needs changed to “installed” in the Cat ET configuration screen when the status of the control lever is “installed” .

The control levers no's. 1, 4 and 6 have a “soft detente” position on the lever travel. When the lever is moved through the SOFT DETENT position, the ECM will send a current signal to the assigned proportional solenoids that move the valve spool to the float position. Each control lever has corresponding LED indicators that are located on the control pod. If the stand-alone control lever 6 is installed, an LED indicator is installed in the cab to indicate when the lever is in the float position. The Implement ECM will illuminate the LEDs when the auxiliary valves are in the float mode.

The power for the LED float indicators is supplied directly from the “Implement Control” fuse. The LED circuits are connected to the Implement ECM sinking driver contacts. The ECM turns ON the sinking circuit for a particular LED in order to provide a ground path and illuminate the LED.

Configuring Auxiliary Hydraulic Control

When the machine is shipped from the factory with an attachment implement installed, the implement is assigned to a factory default auxiliary control lever and auxiliary valve. The Implement ECM can be electronically configured to allow any auxiliary control lever that is installed on the machine to control any auxiliary hydraulic valve that is installed on the machine. The electronic assignment of specific control levers to control specific valves can be accomplished using the Caterpillar Electronic Technician (Cat ET) service tool.

For the procedure of assigning specific control levers to specific valves and a table of the factory default assignments, refer to Testing and Adjusting, “Auxiliary Hydraulic System - Configure” in this manual.

Blade Down Force Control Function

Note: The blade down force system is only available on the 16M Motor Grader.

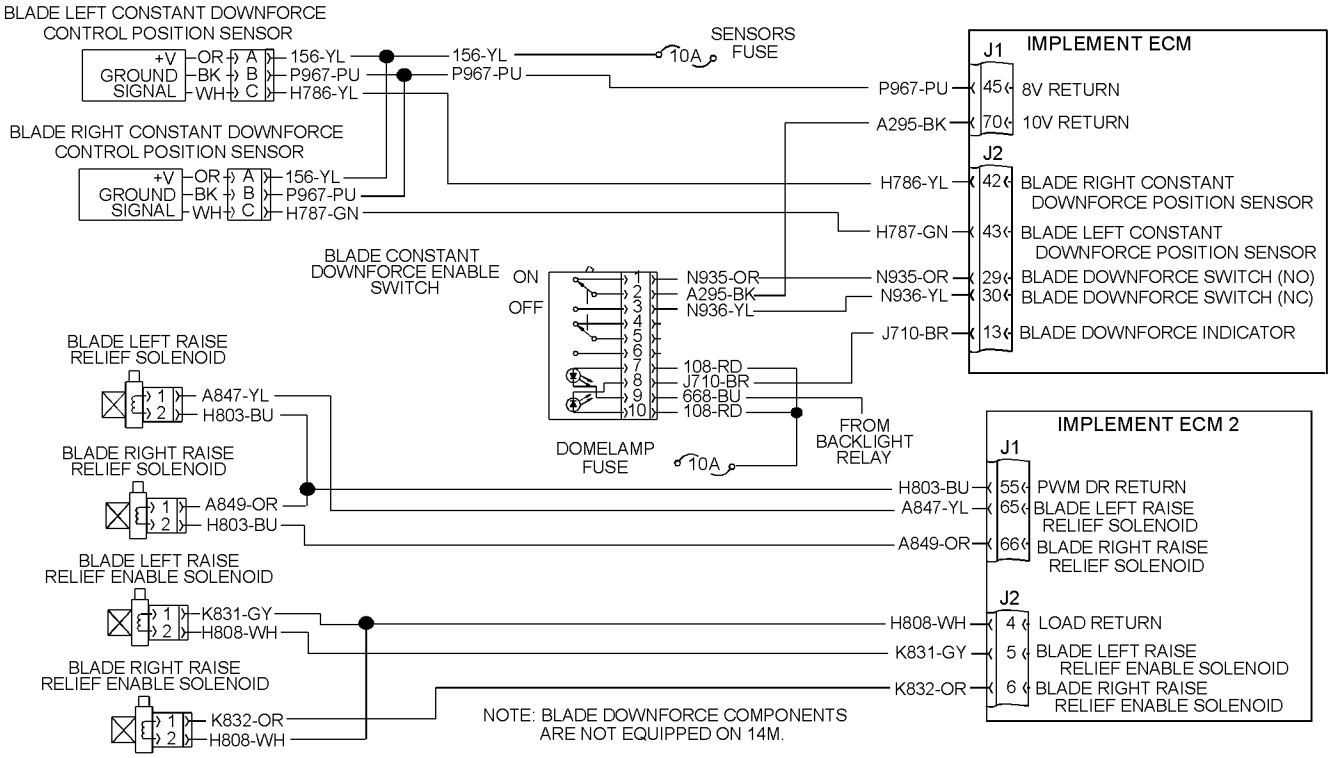


Illustration 18 g01469748

Blade Down Force System Circuit connections

The blade down force system works along with the blade float function to allow the operator to determine how much down force will be applied to the LEFT side of the blade or the RIGHT side of the blade.

The blade down force that is applied to the working surface can be adjusted from a “zero blade float” condition (no down force) to a “full blade float” condition (maximum down force). The maximum down force will allow the full weight of the blade to be applied to the work surface.

The Implement ECM and the “Implement ECM 2” control the blade down force system. The Implement ECM receives the input from the operator controls in the cab. The “Implement ECM 2” provides the outputs for the system solenoids.

The blade constant down force feature must be installed in the Cat ET “Status” screen in order for the system to be activated by the ECM.

The following conditions must be correct before the Implement ECM will activate the blade down force system:

- The engine is running.
- No diagnostic codes are active for any of the blade down force system components

Once the machine conditions are correct and the ECM detects that the blade constant down force enable switch is moved to the ON position, the LEFT joystick blade lift control or the “right” joystick blade lift control must be moved forward past the DETENT FLOAT position. When the ECM detects that the joystick has moved to the DETENT position, the ECM will activate the down force system. Once the down force function is activated, the joystick can be moved to another position and the down force system will remain active.

If the blade float mode is active when the blade constant down force enable switch is moved to the ON position, the ECM will activate the down force system without the joystick having to be moved to the DETENT position.

When the Implement ECM has activated the blade down force system, the ECM will turn ON the sinking output for the blade constant down force enable indicator in order to indicate that the system is enabled. The blade constant down force enable indicator is located in the enable switch. The blade float indicators on the “Instrument Cluster” will illuminate in order to indicate the side of the blade that is in the active mode for blade float.

When the down force system is active, the Implement ECM will disregard any automatic lift or lower commands from an installed Accugrade System.

The ECM will use the following priority for blade commands in order to control the blade:

- Manual blade lift commands from the joysticks
- Blade constant down force commands
- Automatic Accugrade commands

When the down force system is activated, a manual blade control request from the joysticks will cause the ECM to override the down force command. The down force command will remain enabled in an inactive state until the joystick is moved to the DETENT position again. The ECM will then reactivate the down force system at the prior commanded settings.

When a temporary manual blade lift command is requested, the blade float indicator will turn OFF, however, the down force enable indicator will remain illuminated in order to indicate that the blade down force system is still enabled. The blade float indicator will illuminate when the joystick is moved to the detent position again. The Blade Constant Down Force Enable Indicator will only turn OFF when the system is no longer active.

Blade Down Force Operation

Note: The following description of the down force control operation will focus on the operation of the LEFT blade constant down force components. The operation of the RIGHT blade constant down force components are controlled in the same manner.

Once the machine conditions are correct, the blade constant down force enable switch is in the ON position and the LEFT joystick has been moved to the FORWARD DETENT position. The “Implement ECM 2” will energize the blade raise relief enable ON/OFF type solenoids. These solenoids will activate a poppet valve within the blade lift control valves. When the poppet valve is active, hydraulic fluid from the rod end of the blade lift cylinders is allowed to flow to the blade LEFT raise variable relief valve.

After the “Implement ECM 2” has energized the blade raise relief enable solenoids, the Implement ECM will send a small lift command to the proportional blade LEFT lift solenoid. This will allow a small amount of hydraulic oil to be directed into the rod end of the LEFT blade lift cylinder. The result will be that the lift cylinder will provide a small amount of lift to the LEFT side of the blade.

The ECM will use the LEFT blade raise relief proportional solenoid to control the amount of hydraulic oil that is allowed to flow through the blade LEFT raise variable relief valve back to the tank. The amount of hydraulic oil that is directed to the tank from the rod end of the lift cylinder will determine how much of the small lift command is neutralized. When the amount of oil that returns to the tank is increased, the amount of blade down force that is applied to the work surface will increase.

The amount of oil that the ECM will allow to flow back to the tank through the blade left raise variable relief valve is dependent on the position of the LEFT down force dial. The dial is attached to a position sensor that will supply a PWM duty cycle input signal to the Implement ECM. This signal will indicate the position of the dial to the ECM. When the dial is moved to the FULL CLOCKWISE position (no down force), the PWM duty cycle of the signal is approximately 93 %. When the dial is moved through a detent to the FULL LEFT COUNTERCLOCKWISE position (maximum down force), the PWM duty cycle of the signal is approximately 10.6 %.

When the LEFT blade down force dial is moved in the clockwise direction from zero, the “Implement ECM 2” will send a proportional PWM current signal to the blade LEFT raise relief solenoid. The amount of electrical current that is sent by the ECM will range from 0 to 2000 mA. The amount of current that is applied to the solenoid will determine how much hydraulic oil flow is directed from the rod end of the LEFT blade lift cylinder through the blade LEFT raise variable relief valve to the tank.

When the LEFT down force dial is in the FULL LEFT COUNTERCLOCKWISE DETENT position, a minimum output current is applied to the blade LEFT raise relief solenoid by the “Implement ECM 2” . This results in the LEFT raise variable relief valve allowing the most amount of hydraulic oil to flow from the rod end of the LEFT blade lift cylinder back to the tank. This will cancel out the hydraulic oil flow from the constant 35 % lift command and will result in the maximum amount of down force (weight of the blade) applied to the work surface.

When the LEFT down force dial is in the FULL CLOCKWISE position, a maximum output current is applied to the blade LEFT raise relief solenoid by the “Implement ECM 2” . This results in the “left raise variable” relief valve allowing the least amount of hydraulic oil to flow from the rod end of the LEFT blade lift cylinder back to the tank. The hydraulic oil flow from the constant small lift command will provide more lift to the blade resulting in a minimum amount of blade down force applied to the work surface.

The Implement ECM and the “Implement ECM 2” monitor the blade down force component circuits for diagnostics. If an abnormal condition is detected in one of the circuits, the Implement ECM will activate a diagnostic code for the circuit. When this occurs, the ECM will not enable the blade down force system. If a diagnostic code for a blade down force component circuit is activated while the system is active, the ECM will disable the blade down force system.

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Features

SMCS Code: 1400; 5000; 5700

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Electronic Joystick Control

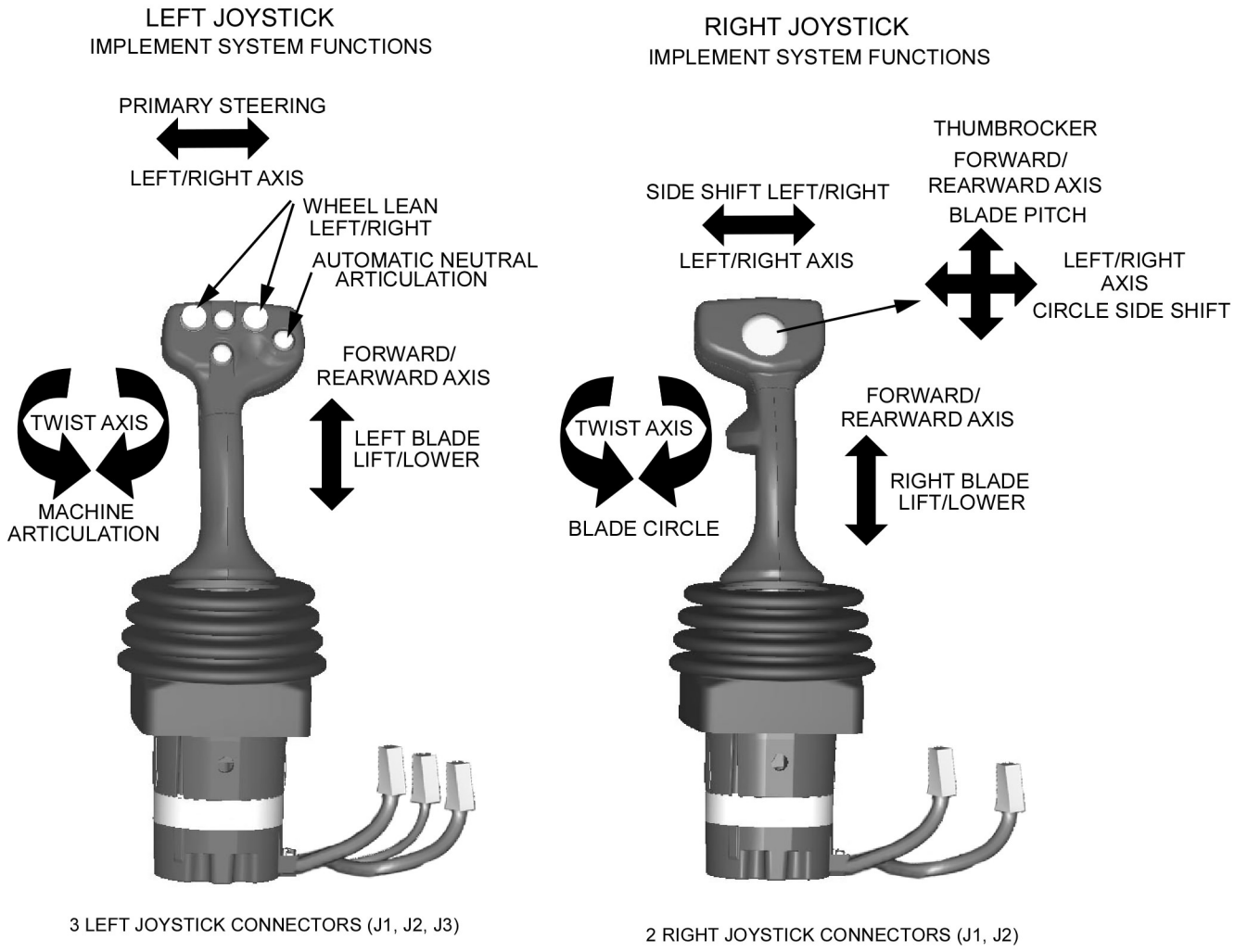


Illustration 19 g01481321

Functions of the LEFT and RIGHT joystick that are controlled by the modules of the Implement ECM

Note: The illustration above shows the functions that are controlled by the Implement ECM. The functions that are controlled by the Transmission/Chassis ECM are not called out in this manual. Refer to the manual for the Transmission/Chassis ECM for the joystick functions that are controlled by the Transmission/Chassis ECM.

Series M Series Motor Graders Implement ECM modules enable the operator to use the LEFT and RIGHT joysticks to control movement of an implement or function. The implement or function are assigned to a specific joystick axis. The joysticks are equipped with position sensors and switch-to-ground type switches that send input signals to the ECM.

Operation of the Position Sensor

Any movement of the joystick handle on a specific axis is detected by an internal position sensor for that axis. When the position sensor is powered up, the sensor will continuously send a Pulse Width Modulated (PWM) square wave signal to the ECM. The duty cycle of the PWM sensor signal changes depending on the direction and the amount of joystick movement on the axis. Duty cycle is the percentage of time the signal is high, compared to the amount of time that the signal is low for one cycle. Typical duty cycle signals recognized by the ECM are 10 ± 5 % to 90 ± 5 % at the extreme ends of axis movement. A joystick that is in the center or the neutral position would result in a duty cycle signal of approximately 50 ± 6 %. For more information on PWM sensor signals, refer to Diagnostic System Procedures, “Pulse Width Modulated Sensor”.

Inmost cases, the Implement ECM will respond to the duty cycle of the PWM signal by sending a specific level of electrical current output to the appropriate proportional solenoid valve. For the position sensors of the steering axis, the Implement ECM will respond to the duty cycle of the PWM signal by sending a control signal to the steering control module. The ECM relates a specific duty cycle value to a specific position of the joystick.

The amount of current applied to a proportional solenoid determines the amount of pilot oil pressure applied to a control valve. An increase in the amount of electrical current applied to the solenoid will increase the movement of a valve spool. The increased movement of a valve spool results in an increase in the hydraulic flow to a cylinder.

When movement of more than one joystick axis is detected, the ECM responds by outputting current signals to multiple solenoids or controls to cause movement of the implement in several directions at the same time.

Operation of the Left Joystick

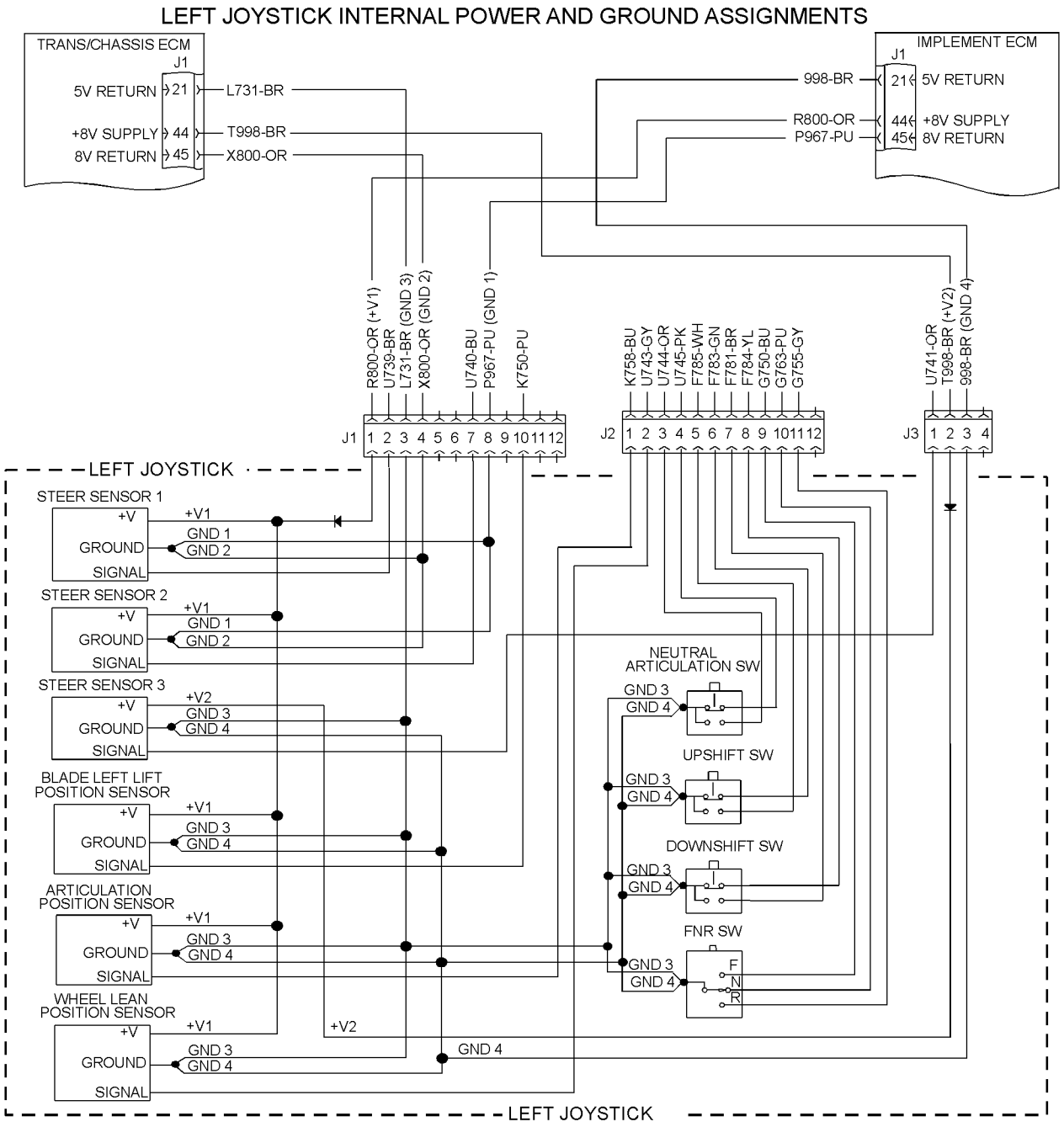


Illustration 20 g01487634

Power supply and ground assignments for internal components of the left joystick

Note: The illustration above shows the various power and ground assignments for the LEFT joystick. The components that are in the LEFT joystick are not serviceable. If a component in the joystick has failed, the complete assembly of the joystick must be replaced. The illustration is displayed in order to aid in the troubleshooting of the component and circuit. For a complete connection diagram for all of the joystick to ECM connections, refer to the System Schematics in the back of this manual.

All of the internal components and the harness circuits have assigned diagnostic codes. The Implement ECM will activate the diagnostic code for a component when an abnormal condition is detected in the involved circuit.

Two ground sources are connected to all of the internal components of the joystick. Both of the ground circuits must fail, internally or externally, for the component not to function due to a loss of the ground connections.

Primary Steer Position Sensors

The LEFT/RIGHT axis of the LEFT joystick is assigned to the primary steering function. The LEFT/RIGHT axis does not have the “return to center” type of axis movement. Since this axis controls the steering function, the joystick will stay in a position until the joystick is moved to another position.

Three sensors for the steer position are connected to this axis in order to provide uninterrupted operation of the primary steering system. The loss of one of the power supply circuits or one of the ground circuits will not cause the primary steering system to fail.

Each sensor of the steer position outputs a PWM signal. The frequency of the sensor signal is approximately 500 ± 100 Hz. The position sensor sends the PWM signal to the Implement ECM and to the Transmission/Chassis ECM. The signal duty cycle varies from approximately 10 ± 5 % at joystick full LEFT to approximately 90 ± 5 % at joystick full RIGHT . When the joystick is in the CENTER position, the duty cycle will be approximately 50 %.

The Implement ECM and the Transmission/Chassis ECM monitor the PWM signals from each of the steer sensors. The Implement ECM will use the signal from the steer sensor in order to determine the correct command signal to send to the steering control module. The signals of the PWM duty cycle from each of the three steer position sensors must match within 5 % of each other or both of the ECM modules will activate a diagnostic code for the sensor that does not match the other two.

The Implement ECM will use the signal from steer sensor 1 to determine the requested steering command. If the signal from steer position 1 does not match the signals from the other two steer sensors that do match, the ECM will use steer sensor 2 as the good signal. If the signals from steer sensors 1 and 2 are both determined to be incorrect, the signal from steer sensor 3 will be used.

Blade Lift, Articulation, Wheel Lean Position Sensors

The blade LEFT lift position , machine articulation position, and the wheel lean position sensors are internal sensors located in the assembly of the LEFT joystick. The axis assignments and details are listed below:

Blade LEFT Lift Position Sensor – Assigned to the FORWARD/REARWARD axis. The position sensor outputs a PWM signal. The signal frequency of the sensor is approximately 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will vary from approximately 10 ± 5 % at the full rearward position of the joystick to approximately 90 ± 5 % at the full forward position of the joystick. When the lever is in the center position, the duty cycle will be approximately 50 ± 6 %. When the joystick is moved to a FULL FORWARD DETENT position, the ECM will enable the float mode of the blade for the LEFT lift hydraulic valve.

Position Sensor for Machine Articulation – Assigned to the twist LEFT/RIGHT axis. The position sensor outputs a PWM signal. The frequency of the sensor signal is approximately 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will vary from approximately 10 ± 5 % at the FULL ROTATE LEFT position of the joystick to approximately 90 ± 5 % at the FULL ROTATE RIGHT position of the joystick. When the joystick is in the CENTER (neutral) position, the duty cycle will be approximately 50 ± 7 %.

Position Sensor for Wheel Lean – Assigned to the LEFT/RIGHT rocker button axis on the joystick handle. The position sensor outputs a PWM signal. The frequency of the sensor signal is approximately 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will be approximately 10 ± 5 % when the joystick LEFT button for the wheel lean is fully depressed. The duty cycle of the signal will be approximately 90 ± 5 % when the joystick RIGHT button for the wheel lean is fully depressed. When neither button is depressed, the duty cycle will be approximately 50 ± 7 %.

Joystick Switches

The neutral articulation switch is the only switch on the LEFT joystick that provides inputs to the Implement ECM. The switch provides 2 switch to ground types of input to the ECM. The switch is connected to two of the four return circuits of the sensor. The switch must lose both of the ground circuits in order to cause a circuit failure.

Due to internal ECM pull-up voltage present at the contacts of the switch input, the switch contact not connected to ground will be pulled high. The ECM expects to detect one switch circuit that is grounded and one switch circuit that is high at all times. If both of the circuits are high or grounded at the same time, the ECM will activate a diagnostic code for the switch.

Operation of the RIGHT Joystick

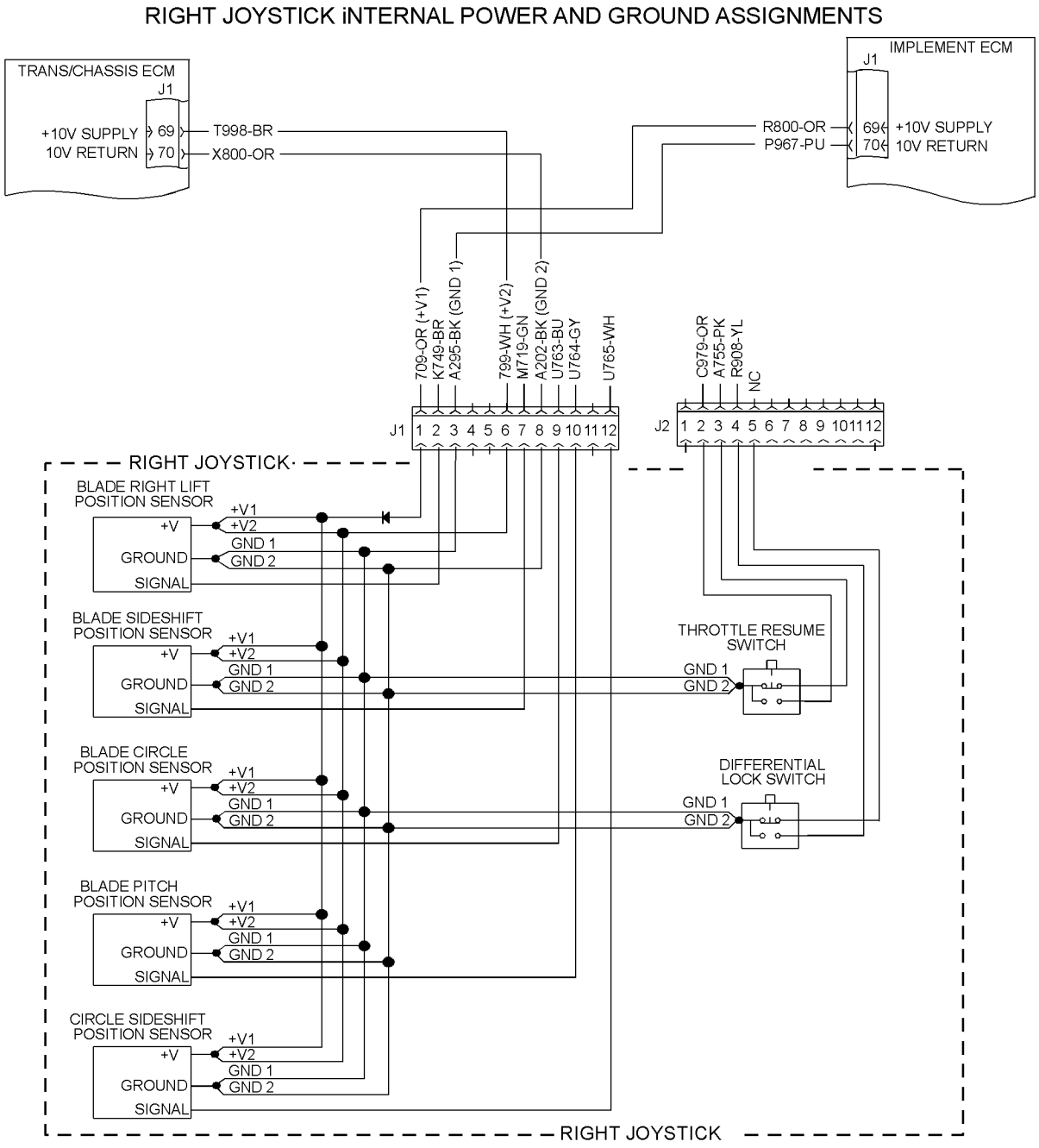


Illustration 21 g01335139

Power supply and ground assignments for internal components of the RIGHT joystick

Note: The illustration above shows the various power and ground assignments for the RIGHT joystick. The components that are in the RIGHT joystick are not serviceable. If a component in the joystick has failed, the complete assembly of the joystick must be replaced. The illustration is displayed in order to aid in the troubleshooting of the component and the circuit. For a complete connection diagram for all of the joystick to ECM connections, refer to the System Schematics in the back of this manual.

The RIGHT joystick receives power connections and ground connections from two separate 10 VDC sensor power supply circuits. One power supply from the Implement ECM and one power supply from the Transmission/Chassis ECM. As shown in the illustration above, each position sensor is internally connected to both of the power supply circuits. The position sensors are inside of the joystick and each switch connects to both of the sensor return circuits inside of the joystick. All of the internal components and the harness circuits that are controlled by the Implement ECM have diagnostic codes that are assigned. The ECM will activate the diagnostic code for a component when an abnormal condition is detected in the involved circuit.

When two power and two ground sources are connected to a particular component, both power or both ground circuits must fail, either internally or externally, for the component to fail to function correctly.

Position Sensors

The position sensors that are located on the inside of the assembly of the RIGHT joystick send a PWM signal to the Implement ECM. Each of the position sensors will output a PWM signal at a frequency of approximately 500 ± 100 Hz to the Implement ECM. The assignments for the axis and the details are listed below:

Blade RIGHT Lift Position Sensor – Assigned to the FORWARD/REARWARD axis. The duty cycle of the sensor signal will vary from approximately 10 ± 5 % at the full rearward position of the lever to approximately 90 ± 5 % at the full forward position of the lever. When the lever is in the CENTER position, the duty cycle will be approximately 50 ± 6 %. When the joystick is moved to a full forward detent position, the ECM will enable the float mode of the blade for the RIGHT lift hydraulic valve.

Blade Side Shift Position Sensor – Assigned to the LEFT/RIGHT axis. The duty cycle of the sensor signal will vary from approximately 10 ± 5 % when the joystick is at the FULL LEFT position to approximately 90 ± 5 % when the joystick is at the FULL RIGHT position. When the joystick is in the CENTER position, the duty cycle will be approximately 50 ± 7 %.

Blade Circle Drive Position Sensor – Assigned to the twist LEFT/RIGHT axis. The duty cycle of the sensor signal will vary from approximately 10 ± 5 % when the joystick is rotated to the FULL LEFT position to approximately 90 ± 5 % when the joystick is rotated to the FULL RIGHT position. When the joystick is in the CENTER position, the duty cycle will be approximately 50 ± 7 %.

Blade Center Shift Position Sensor – Assigned to the LEFT/RIGHT axis on the “thumbrocker” switch on the handle of the joystick. The duty cycle of the sensor signal will vary from approximately 10 ± 5 % when the “thumbrocker” switch is at the FULL LEFT position to approximately 90 ± 5 % when the “thumbrocker” switch is at the FULL RIGHT position. When the “thumbrocker” switch is in the CENTER position, the duty cycle will be approximately 50 ± 7 %.

Blade Pitch Position Sensor – Assigned to the FORWARD/REARWARD axis on the “thumbrocker” switch on the handle of the joystick. The duty cycle of the sensor signal will vary from approximately 10 ± 5 % when the “thumbrocker” switch is at the FULL LOWER position to approximately 90 ± 5 % when the “thumbrocker” switch is at the FULL UPPER position. When the “thumbrocker” switch is in the CENTER position, the duty cycle will be approximately 50 ± 7 %.

Electronic Primary Steering Control

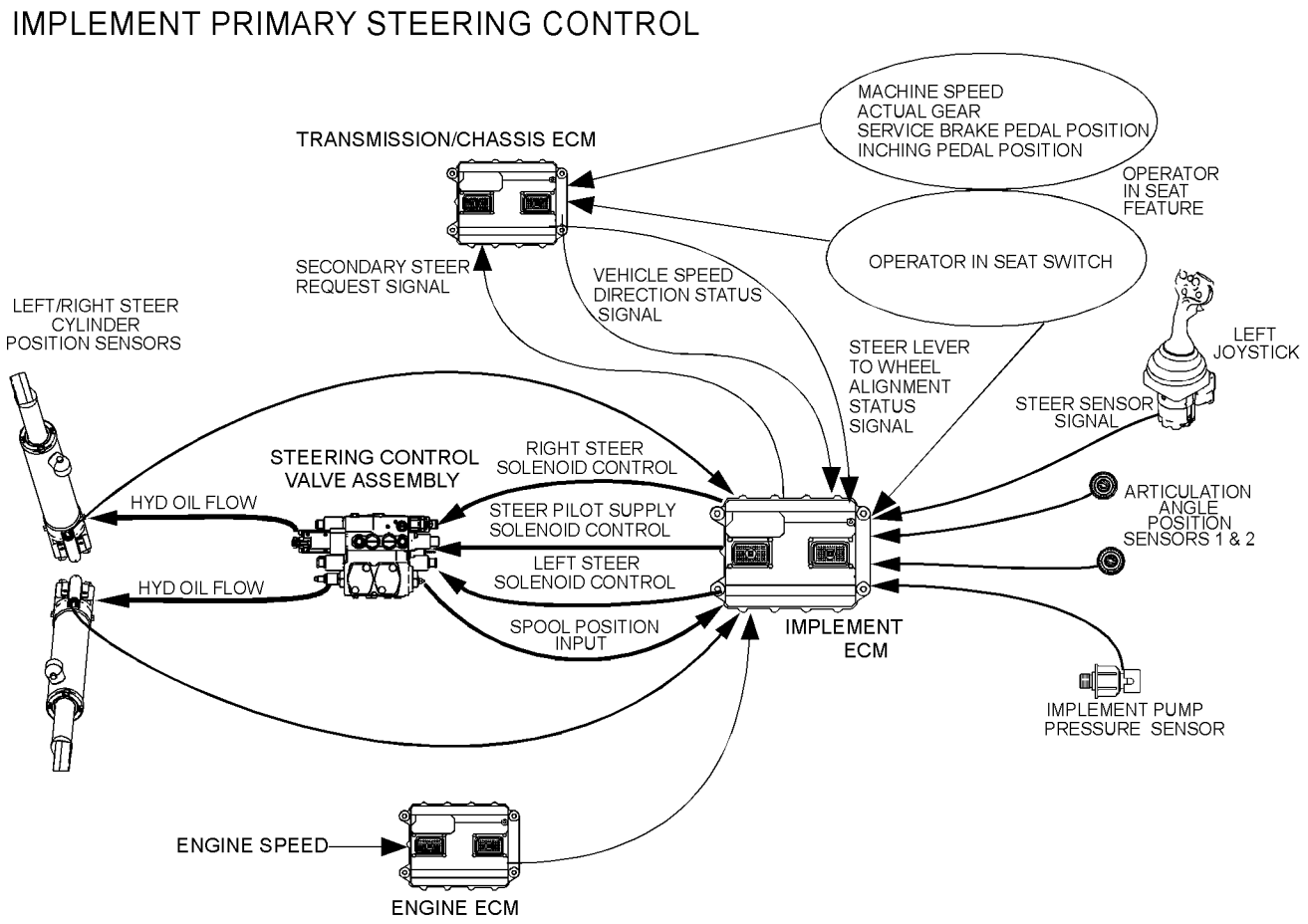


Illustration 22 g03373320

The Implement ECM controls the primary steering system. The Implement ECM uses a closed loop feedback system in order to control the position of the front wheels on the motor grader. The ECM sends a control signal to the control module for the steering valve that is based on the position of the left joystick. Then, the ECM monitors the position of the steer cylinders to adjust the command accordingly. The ECM decreases the current to the appropriate primary steering solenoid as the steering cylinders approach the position that was commanded. The signal is decreased until movement of the valve spool and movement of the cylinders is stopped. The cycle repeats as steering input from the joystick changes.

The outputs of the Implement ECM go to the LEFT and RIGHT PRIMARY SOLENOIDS and the PRIMARY ON/OFF SOLENOID. The ECM receives inputs from the SPOOL POSITION SENSOR.

The ECM will not enable the operation of the steering system until certain machine conditions are met. Steering is enabled by the Implement ECM when the following occurs:

- **The engine is ON.** - The engine must be operating.
- **Hydraulic pressure is OK.** - The main hydraulic pump pressure sensor must be indicating sufficient pressure.
- **The parking brake is ON. The transmission is in NEUTRAL.**
- **Signals from the position sensor of the steer cylinder are OK.** - The signals from both steer cylinders must be OK.
- **The machine has determined that the operator is present in the cab.** - The inputs that are used to determine that the operator is present in the cab are shown in Table 1 .

Table 1

Inputs That Are Used To Determine That the Operator is Present In the Cab	
Source of the Input	**ECM That Receives the Input**
Operator In Seat Switch	Transmission/Chassis ECM Implement ECM
Machine Speed	Transmission/Chassis ECM
Actual Gear	Transmission/Chassis ECM
The Position of the Inching Pedal	Transmission/Chassis ECM
The Position of the Service Brake Pedal	Transmission/Chassis ECM

When the above conditions are satisfied, the position of the left joystick must be aligned with the angle of the front wheels before the ECM will allow the steering system to operate. The alignment is accomplished by slowly moving the joystick through the full range of travel for the left/right axis. When the position of the joystick has aligned with the position of the front wheels, the ECM will enable the primary steering system. The alignment procedure must be performed at each engine start. Also, the alignment procedure must be performed when the parking brake is engaged and the operator leaves the seat.

Note: Steering will remain active if the machine is in motion even if the operator present status is not satisfied.

If the required conditions that are listed above are correct, other conditions that will prevent the ECM from enabling the steering follow:

- **Sweeping The Joystick Too Fast** - The left joystick must be moved through the full sideways travel in a steady motion. The full sideways motion should be done in 4 seconds or more.
- **Not Sweeping The joystick Through the Full Range Of Motion** - Ensure that the left joystick is being swept from stop to stop in the full range of motion. If the travel of the joystick is inhibited, the joystick may not reach the correct position of alignment.
- **Front Wheel Position Out of Range** - If the front wheels are positioned at an extreme angle either left or right due to a collision or other factors, the sweep of the joystick may not align. The wheels must be at an extreme angle in order for the wheels not to align. If the wheels do not align, the wheels must manually be moved back into an accepted position before the ECM will align the joystick.

Note: Actuating the function of wheel lean left and actuating the function of wheel lean right may help move the wheels into an accepted range.

Primary Steering Solenoid Currents

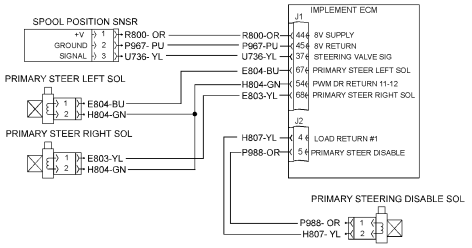


Illustration 23 g06075256

Primary Steering Solenoid Currents

The Implement ECM will output current to the appropriate solenoid based on the following:

- The signal that is sent for steering from the position sensors of the left joystick
- The input signal that is received from the position sensors for the steering cylinders

The current will adjust the position of the steering valve spool.

The current from the ECM will vary between 0 and 1 Amps.

- Turn off the power to the control module for the steering valve
- Send a request to the Transmission/Chassis ECM in order to activate the secondary steering system.

Signal for the Spool Position

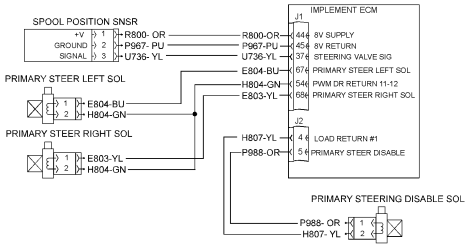


Illustration 24 g06075256

Connections of the position sensor of the steering valve spool

The Implement ECM receives an input from the steering- valve spool position sensor. The input indicates the position of the valve spool. The ECM uses this information to determine if the steering-valve spool is responding correctly to the commands from the Implement ECM.

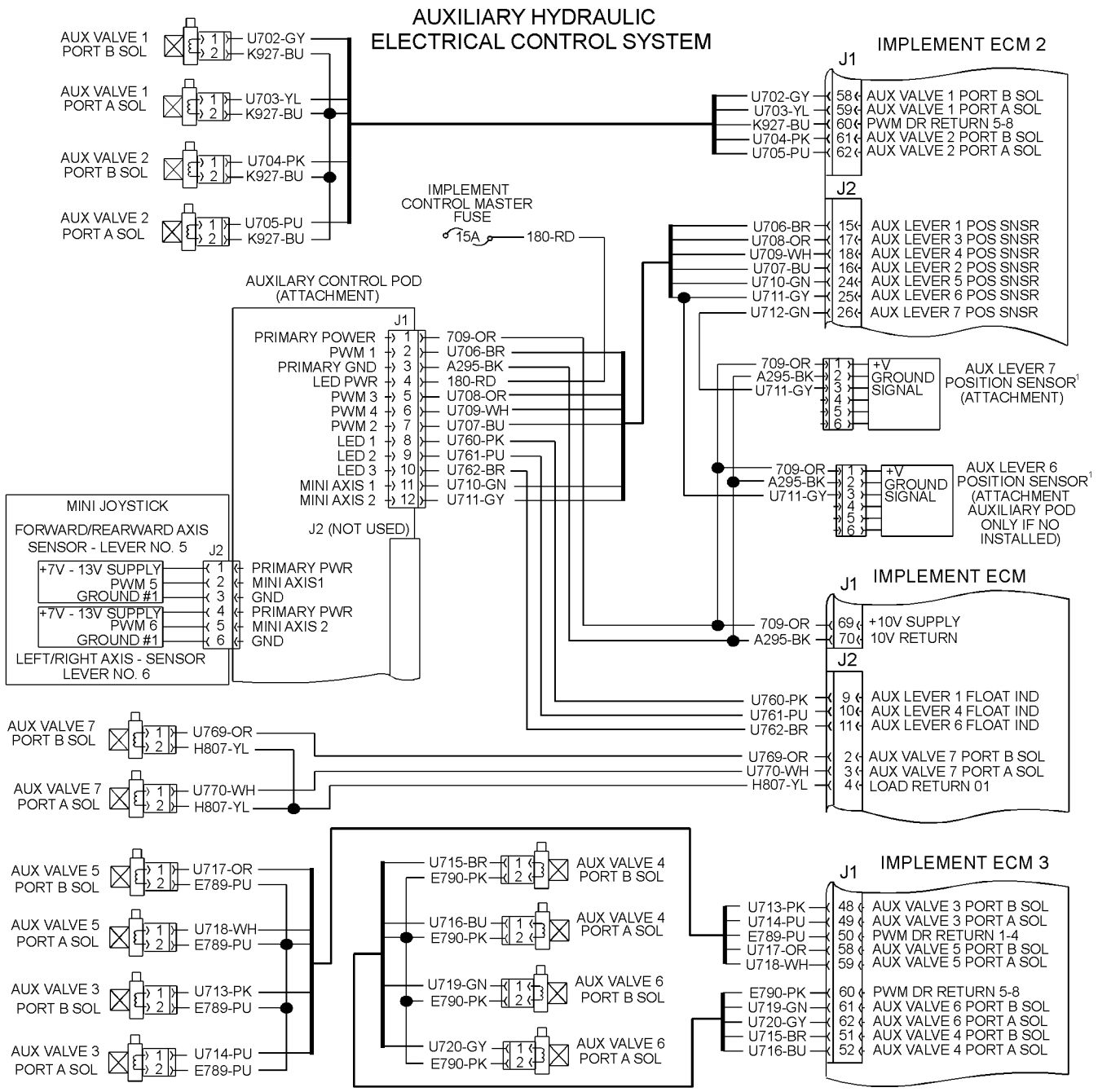
In order to indicate the position of the valve spool, the position sensor supplies an analog voltage signal to the ECM. The voltage of the signal will be between 0.5 VDC and 4.5 VDC.

When the steering system is disabled, the signal that is sent to the ECM will be approximately 2.5 VDC.

The Implement ECM monitors the voltage of the valve spool position sensor for diagnostics. The ECM will activate a diagnostic code when any of the following is detected:

- The voltage is too high.
- The voltage is too low.

Auxiliary Hydraulics



[1] Along with the assembly identified above a machine may also have the following assemblies: Auxiliary Handle with Lever 7 (right roller), Auxiliary Handle with Lever 6 (left roller), Auxiliary Handle with Levers 6 and 7, a Full Auxiliary Pod (with mini joystick) or no control handle.

Illustration 25 g01511274

Auxiliary Hydraulics Electrical Control System Component Connections

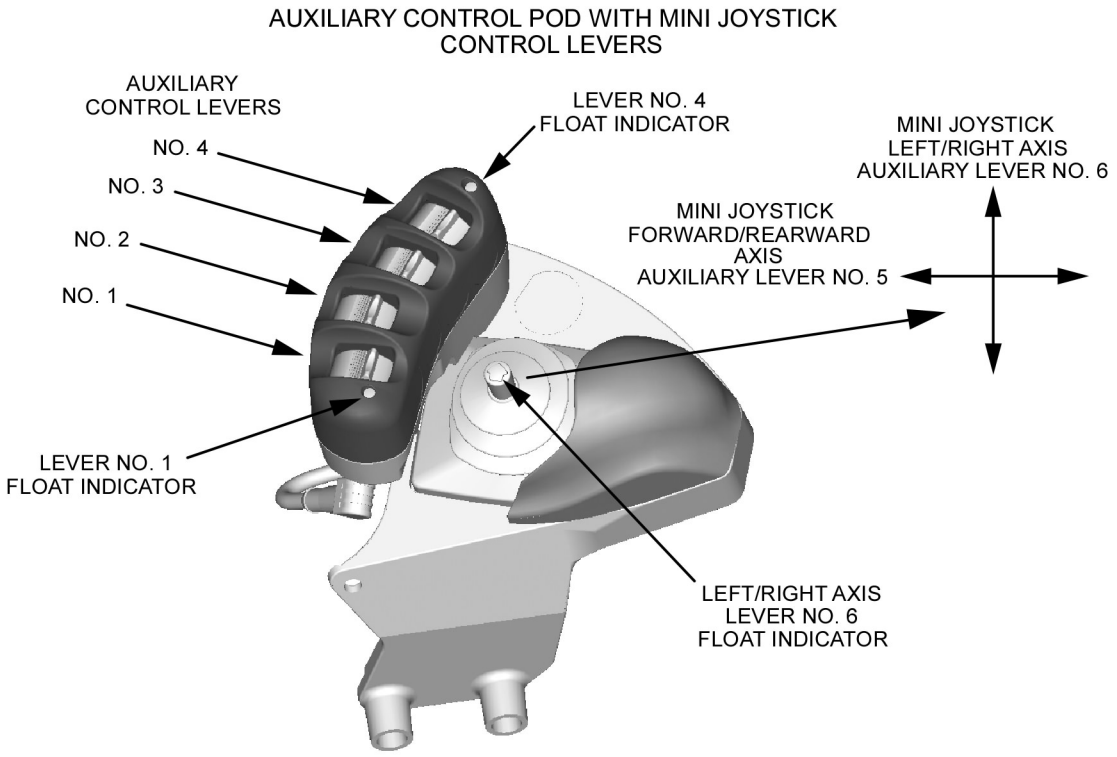


Illustration 26 g01372895

"Auxiliary Control Pod" with Mini Joystick with control levers 1, 2, 3, 4, 5, and 6

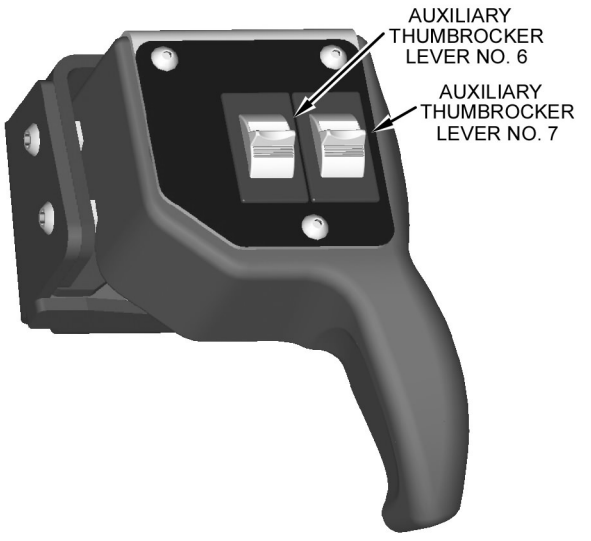


Illustration 27 g01316090

"Auxiliary Levers No. 6 and No. 7"

Note: The illustrations show all possible components that can be installed in the auxiliary hydraulic system. The components that are installed on your machine are dependent on the machine configuration.

The Implement ECM modules control the attachment auxiliary hydraulic system. Different combinations of auxiliary control levers that control the hydraulic valves can be installed on the machine. A full complement of auxiliary control levers and valves will allow seven separate auxiliary hydraulic circuits to be available for the control of implement attachments. The Implement ECM can be configured to allow any one auxiliary control lever to control any one of the auxiliary hydraulic valves that are installed on the machine.

Note: Auxiliary hydraulic valve 7 is controlled by ON/OFF solenoids. All of the other auxiliary hydraulic valves are controlled by proportional solenoids.

The Implement ECM can be configured using Cat ET. The configuring of the auxiliary hydraulic system enables the assignment of any one auxiliary control lever that is installed on the machine to control any one of the hydraulic valves that are installed on the machine. Refer to "Configuring Auxiliary Hydraulic Control" .

The configuration of the auxiliary hydraulic system will determine if the "Implement ECM 3" is installed. The solenoid outputs for two auxiliary hydraulic valves are controlled by the "Implement ECM 2" . "Implement ECM 3" controls the solenoid outputs for the other four possible auxiliary hydraulic valves. If only two auxiliary hydraulic control levers for control of the two valves are installed on the machine, "Implement ECM 3" is not needed.

Depending on the auxiliary hydraulic configuration of your machine, some of the following electrical components could be installed for control of the system:

- The Implement ECM, “Implement ECM 2” , “Implement ECM 3”
- Auxiliary Control Pod (control lever no's. 1, 2, 3 and 4)
- Stand alone auxiliary “thumbrocker” switch control lever no. 7
- Stand-alone auxiliary “thumbrocker” control combination lever no. 7 and lever no. 6 (available only if no auxiliary control pod is installed)
- Mini Joystick (only available with auxiliary control pod - adds lever no's. 5 and 6)
- Two proportional solenoids and a valve for each auxiliary control lever installed

The different combinations of auxiliary hydraulic control levers that can be installed in the system are:

- The stand-alone “thumbrocker” lever no. 7
- The stand-alone “thumbrocker” levers no. 6 and no. 7
- The auxiliary control pod (without the mini joystick)
- The auxiliary control pod (without the mini joystick) and the stand-alone “thumbrocker” lever no. 7

The status of the auxiliary hydraulic valves equipped on the machine, must be “installed” in the Cat ET configuration screen before the ECM will enable operation. Also the “Auxiliary Control Pod” enable status must be set to “enabled”.

Auxiliary Hydraulic Control Operation

Each control lever that is installed on the machine contains an internal position sensor that, when powered up, will send a constant Pulse Width Modulated (PWM) square wave signal to either the Implement ECM or the “Implement ECM 2” . The ECM that the particular signal circuit is connected to depends on the control levers that are installed. Each installed lever position sensor circuit is monitored by the ECM for diagnostics. If the ECM detects a problem in the signal circuit, the ECM will activate a diagnostic code for the circuit.

The duty cycle of the control lever PWM sensor signal changes depending on the direction and the amount of lever movement. The duty cycle is the percentage of time that the signal is high as compared to the amount of time the signal is low for one full cycle. The percentage of duty cycle signal from a typical position sensor that the ECM will recognize as valid is 10 ± 5 % to 90 ± 5 % at the extreme ends of lever travel. A control lever that is in the center or the neutral position would result in a duty cycle signal of approximately 50 ± 5 %. For more information on PWM sensor signals, refer to Diagnostic System Procedures, “Pulse Width Modulated Sensor”.

The ECM uses the PWM duty cycle signal that is received from the control lever to control two proportional solenoids for the assigned auxiliary hydraulic valve. The ECM will use a PWM output signal in order to control the amount of electrical current that is sent to the solenoids. When the PWM duty cycle signal from the lever position sensor changes, the ECM adjusts the amount of current that is sent to the solenoids. The current that is sent to the solenoids will determine the amount of pilot oil pressure that is directed to the hydraulic valve in order to move the valve spool. An increase in the amount of electrical current that is applied to the solenoids will increase the movement of the valve spool. The movement of the valve spool will result in more hydraulic oil flow to the hydraulic cylinder for the implement. When the lever is in the neutral position, the duty cycle is approximately 50 %. At this level, the ECM outputs avery small current that is not enough to cause the valve spool to move. This small current output to the solenoid enables quicker response time when a move is requested.

Hydraulic Float Function

A hydraulic float function is available for the auxiliary hydraulic valves that are assigned to auxiliary control lever 1, auxiliary control lever 4, and auxiliary control lever 6. Auxiliary control levers no. 1 and no. 4 are only available if the auxiliary control pod is installed. If the auxiliary control pod is not installed, a stand-alone control lever 6 can be installed along with a stand-alone control lever 7. The mini joystick control cannot be installed independent of the auxiliary control pod.

To enable the float function for the auxiliary control levers, the status of the float function needs changed to “installed” in the Cat ET configuration screen when the status of the control lever is “installed” .

The control levers no's. 1, 4 and 6 have a “soft detente” position on the lever travel. When the lever is moved through the SOFT DETENT position, the ECM will send a current signal to the assigned proportional solenoids that move the valve spool to the float position. Each control lever has corresponding LED indicators that are located on the control pod. If the stand-alone control lever 6 is installed, an LED indicator is installed in the cab to indicate when the lever is in the float position. The Implement ECM will illuminate the LEDs when the auxiliary valves are in the float mode.

The power for the LED float indicators is supplied directly from the “Implement Control” fuse. The LED circuits are connected to the Implement ECM sinking driver contacts. The ECM turns ON the sinking circuit for a particular LED in order to provide a ground path and illuminate the LED.

Configuring Auxiliary Hydraulic Control

When the machine is shipped from the factory with an attachment implement installed, the implement is assigned to a factory default auxiliary control lever and auxiliary valve. The Implement ECM can be electronically configured to allow any auxiliary control lever that is installed on the machine to control any auxiliary hydraulic valve that is installed on the machine. The electronic assignment of specific control levers to control specific valves can be accomplished using the Caterpillar Electronic Technician (Cat ET) service tool.

For the procedure of assigning specific control levers to specific valves and a table of the factory default assignments, refer to Testing and Adjusting, “Auxiliary Hydraulic System - Configure” in this manual.

Blade Down Force Control Function

Note: The blade down force system is only available on the 16M Motor Grader.

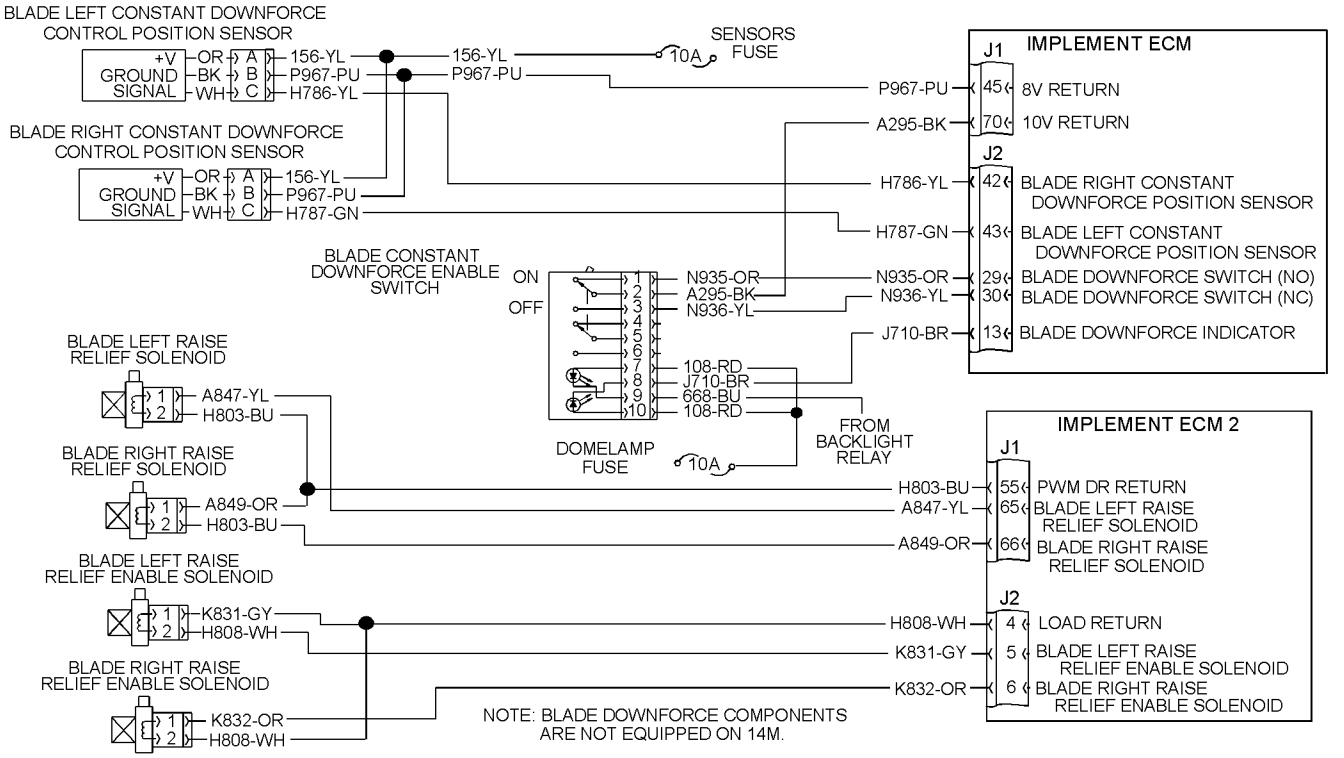


Illustration 28 g01469748

Blade Down Force System Circuit connections

The blade down force system works along with the blade float function to allow the operator to determine how much down force will be applied to the LEFT side of the blade or the RIGHT side of the blade.

The blade down force that is applied to the working surface can be adjusted from a “zero blade float” condition (no down force) to a “full blade float” condition (maximum down force). The maximum down force will allow the full weight of the blade to be applied to the work surface.

The Implement ECM and the “Implement ECM 2” control the blade down force system. The Implement ECM receives the input from the operator controls in the cab. The “Implement ECM 2” provides the outputs for the system solenoids.

The blade constant down force feature must be installed in the Cat ET “Status” screen in order for the system to be activated by the ECM.

The following conditions must be correct before the Implement ECM will activate the blade down force system:

- The engine is running.
- No diagnostic codes are active for any of the blade down force system components

Once the machine conditions are correct and the ECM detects that the blade constant down force enable switch is moved to the ON position, the LEFT joystick blade lift control or the “right” joystick blade lift control must be moved forward past the DETENT FLOAT position. When the ECM detects that the joystick has moved to the DETENT position, the ECM will activate the down force system. Once the down force function is activated, the joystick can be moved to another position and the down force system will remain active.

If the blade float mode is active when the blade constant down force enable switch is moved to the ON position, the ECM will activate the down force system without the joystick having to be moved to the DETENT position.

When the Implement ECM has activated the blade down force system, the ECM will turn ON the sinking output for the blade constant down force enable indicator in order to indicate that the system is enabled. The blade constant down force enable indicator is located in the enable switch. The blade float indicators on the “Instrument Cluster” will illuminate in order to indicate the side of the blade that is in the active mode for blade float.

When the down force system is active, the Implement ECM will disregard any automatic lift or lower commands from an installed Accugrade System.

The ECM will use the following priority for blade commands in order to control the blade:

- Manual blade lift commands from the joysticks
- Blade constant down force commands
- Automatic Accugrade commands

When the down force system is activated, a manual blade control request from the joysticks will cause the ECM to override the down force command. The down force command will remain enabled in an inactive state until the joystick is moved to the DETENT position again. The ECM will then reactivate the down force system at the prior commanded settings.

When a temporary manual blade lift command is requested, the blade float indicator will turn OFF, however, the down force enable indicator will remain illuminated in order to indicate that the blade down force system is still enabled. The blade float indicator will illuminate when the joystick is moved to the detent position again. The Blade Constant Down Force Enable Indicator will only turn OFF when the system is no longer active.

Blade Down Force Operation

Note: The following description of the down force control operation will focus on the operation of the LEFT blade constant down force components. The operation of the RIGHT blade constant down force components are controlled in the same manner.

Once the machine conditions are correct, the blade constant down force enable switch is in the ON position and the LEFT joystick has been moved to the FORWARD DETENT position. The “Implement ECM 2” will energize the blade raise relief enable ON/OFF type solenoids. These solenoids will activate a poppet valve within the blade lift control valves. When the poppet valve is active, hydraulic fluid from the rod end of the blade lift cylinders is allowed to flow to the blade LEFT raise variable relief valve.

After the “Implement ECM 2” has energized the blade raise relief enable solenoids, the Implement ECM will send a small lift command to the proportional blade LEFT lift solenoid. This will allow a small amount of hydraulic oil to be directed into the rod end of the LEFT blade lift cylinder. The result will be that the lift cylinder will provide a small amount of lift to the LEFT side of the blade.

The ECM will use the LEFT blade raise relief proportional solenoid to control the amount of hydraulic oil that is allowed to flow through the blade LEFT raise variable relief valve back to the tank. The amount of hydraulic oil that is directed to the tank from the rod end of the lift cylinder will determine how much of the small lift command is neutralized. When the amount of oil that returns to the tank is increased, the amount of blade down force that is applied to the work surface will increase.

The amount of oil that the ECM will allow to flow back to the tank through the blade left raise variable relief valve is dependent on the position of the LEFT down force dial. The dial is attached to a position sensor that will supply a PWM duty cycle input signal to the Implement ECM. This signal will indicate the position of the dial to the ECM. When the dial is moved to the FULL CLOCKWISE position (no down force), the PWM duty cycle of the signal is approximately 93 %. When the dial is moved through a detent to the FULL LEFT COUNTERCLOCKWISE position (maximum down force), the PWM duty cycle of the signal is approximately 10.6 %.

When the LEFT blade down force dial is moved in the clockwise direction from zero, the “Implement ECM 2” will send a proportional PWM current signal to the blade LEFT raise relief solenoid. The amount of electrical current that is sent by the ECM will range from 0 to 2000 mA. The amount of current that is applied to the solenoid will determine how much hydraulic oil flow is directed from the rod end of the LEFT blade lift cylinder through the blade LEFT raise variable relief valve to the tank.

When the LEFT down force dial is in the FULL LEFT COUNTERCLOCKWISE DETENT position, a minimum output current is applied to the blade LEFT raise relief solenoid by the “Implement ECM 2” . This results in the LEFT raise variable relief valve allowing the most amount of hydraulic oil to flow from the rod end of the LEFT blade lift cylinder back to the tank. This will cancel out the hydraulic oil flow from the constant 35 % lift command and will result in the maximum amount of down force (weight of the blade) applied to the work surface.

When the LEFT down force dial is in the FULL CLOCKWISE position, a maximum output current is applied to the blade LEFT raise relief solenoid by the “Implement ECM 2” . This results in the “left raise variable” relief valve allowing the least amount of hydraulic oil to flow from the rod end of the LEFT blade lift cylinder back to the tank. The hydraulic oil flow from the constant small lift command will provide more lift to the blade resulting in a minimum amount of blade down force applied to the work surface.

The Implement ECM and the “Implement ECM 2” monitor the blade down force component circuits for diagnostics. If an abnormal condition is detected in one of the circuits, the Implement ECM will activate a diagnostic code for the circuit. When this occurs, the ECM will not enable the blade down force system. If a diagnostic code for a blade down force component circuit is activated while the system is active, the ECM will disable the blade down force system.

i07244139

Location of Electrical Components

SMCS Code: 1400; 5000

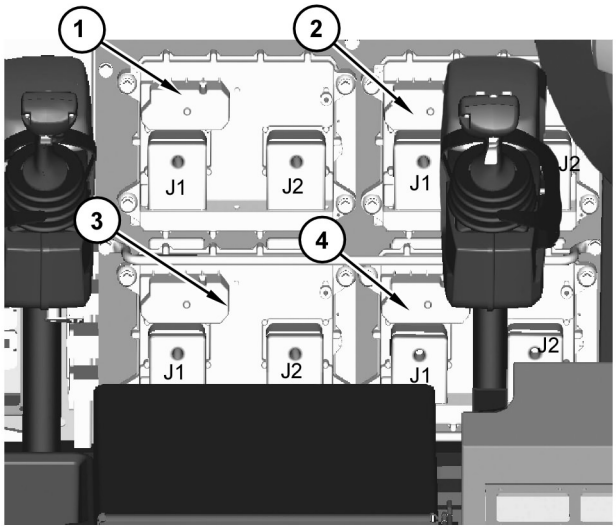


Illustration 29 g01379744

Implement and AWD Control Modules (view looking to rear of cab with seat removed)

(1) “Implement Control # 2”
(2) Implement ECM
(3) AWD ECM (models equipped with all wheel drive)
(4) Implement ECM 3 (attachment)

The three possible Implement Electronic Control Modules are mounted at the rear of the cab under the appearance cover. For machines that are equipped with All Wheel Drive (AWD), the AWD Electronic Control Module is also mounted at the rear of the cab.

The components that make up the Implement Electronic Control System are located at various places on the machine. For the locations of many of these components, refer to the Systems Operation, “Inputs” and Systems Operation, “Outputs” sections of this manual.

The locations of the electrical relays that are mounted in the cab are illustrated below.

The Electrical System Schematic of the machine that is in the Service Manual will illustrate locations for all of the electrical components and harness connectors that are installed on the machine.

Cab Relay Locations

Note: The following relay locations for cab mounted relays are correct at the time of publication of this manual. The location of the relays on some early model machines may be slightly different. During service of a particular relay, always refer to the complete Electrical System Schematic of the machine. Verify the wire numbers of the relay that are being serviced.

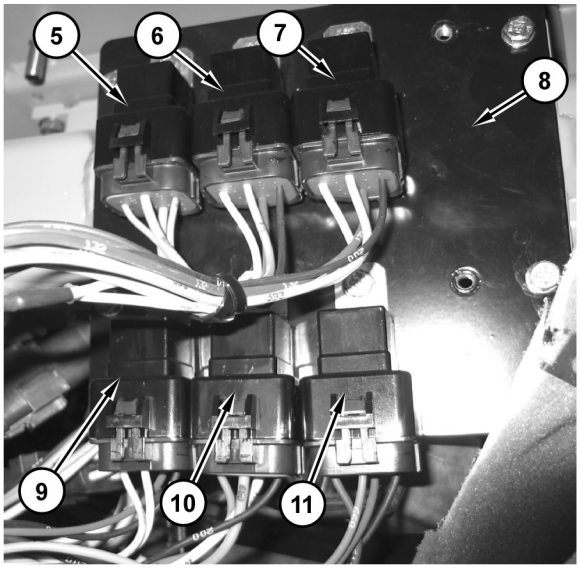


Illustration 30 g01379749

Relays that are located behind the cover on the right side headliner

(5) Power air cleaner relay
(6) Cab floodlights relay
(7) Backlight relay
(8) Mounting location of attachment heated mirror relay when installed
(9) Blade flood relay
(10) Condenser fan relay 2
(11) Condenser fan relay

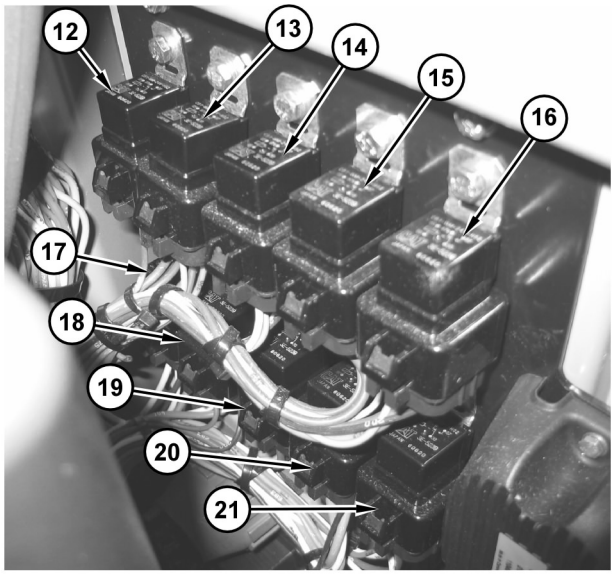


Illustration 31 g01379751

Relays that are located on the rear wall of the cab behind the right-hand console

(12) Horn relay
(13) LH position relay
(14) Diff lock relay
(15) Headlamp relay
(16) Blade flood relay
(17) Enable relay
(18) RH position relay
(19) Dimmer relay
(20) Rear flood relay
(21) Fast speed relay

Machine Fuse Locations

Note: The following fuse locations for the cab mounted and the machine fuses are correct at the time of publication of this manual. The location of the fuses on some early model machines may be slightly different. During service of a particular fuse, always refer to the complete Electrical System Schematic of the machine. Verify the wire numbers of the relay that is being serviced.

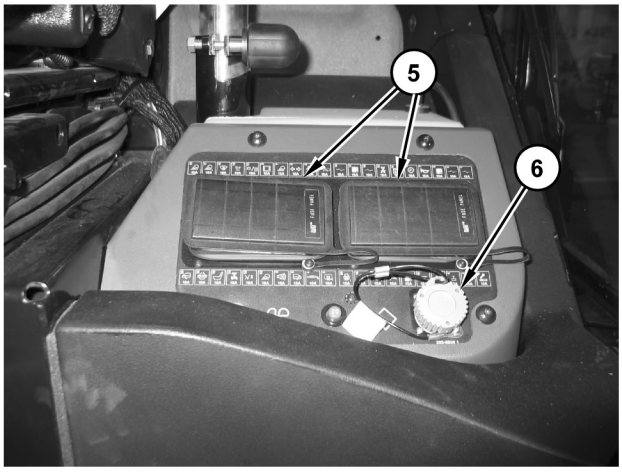


Illustration 32 g01380004

Fuse Panels and Service Plug located on the left side of the operator seat.

(5) Fuse Panels
(6) Service Connector

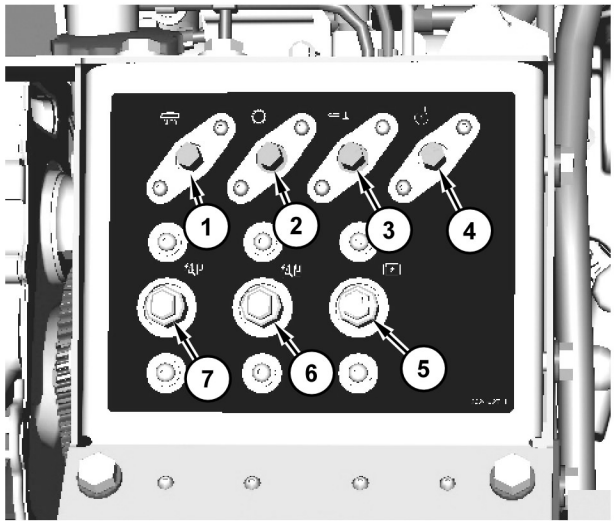


Illustration 33 g01323933

Power Breaker Box located on the left side of the machine behind the cab

(1) Accugrade Breaker (20 Amp)
(2) Transmission Control Breaker (15 Amp)
(3) Key Switch Breaker (15 Amp)
(4) Engine Control Breaker (20 Amp)
(5) Alternator Breaker (150 Amp)
(6) Load Breaker (80 Amp)
(7) Main Breaker (80 Amp)

i06969794

Electrical Input Components

SMCS Code: 1400; 5000

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

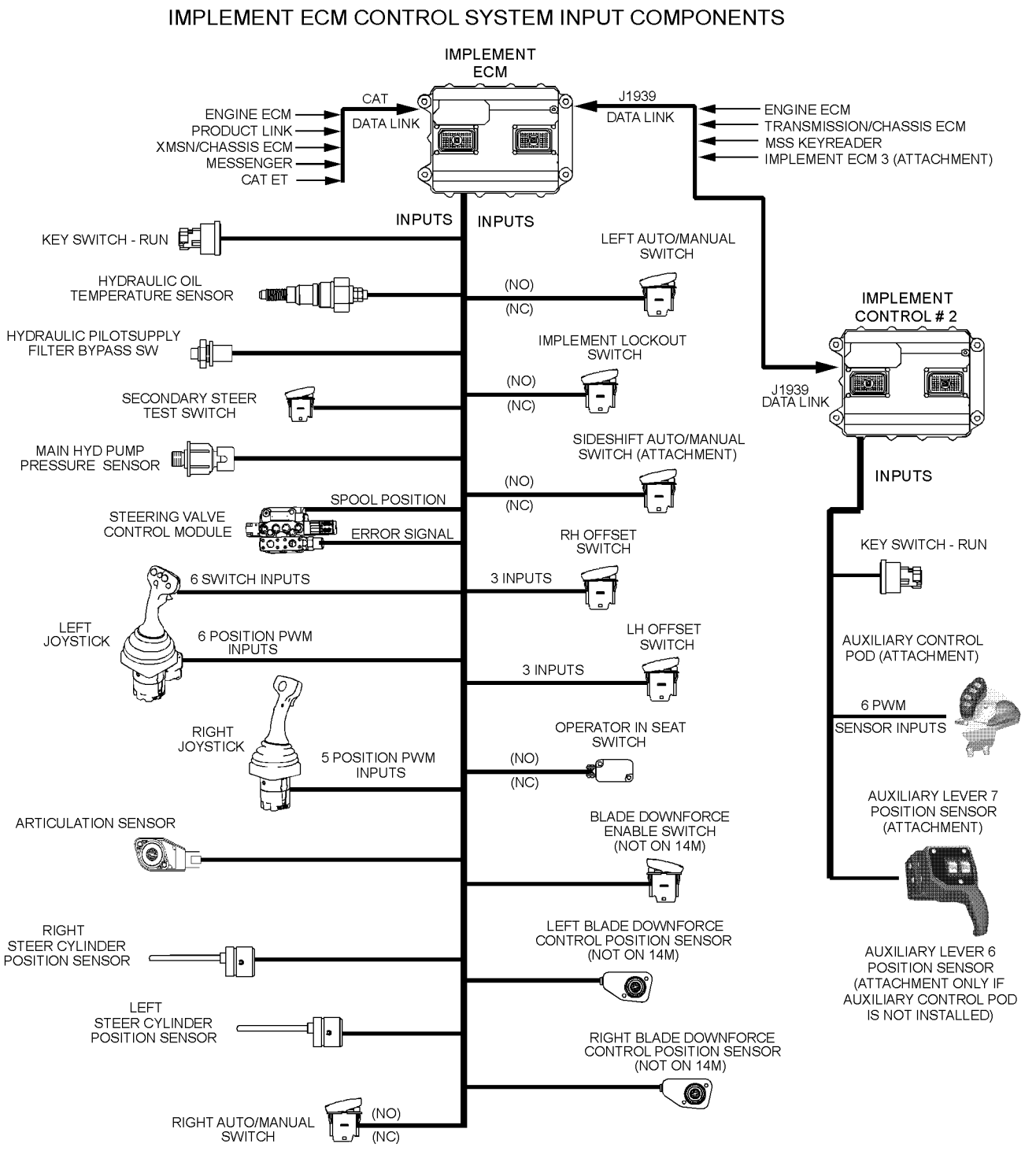


Illustration 34 g03244018

Implement ECM Control System Input Components

The Implement Electronic Control System utilizes various different types of devices that provide input data to the Implement ECM and the “Implement Control # 2” . The attachment “Implement Control # 3” is used to provide outputs for the auxiliary solenoids. The modules of the Implement ECM receive status information about the machine from the input devices. The ECM will use this information to determine the correct output action needed to control the implement functions of the machine. All the implement system components that supply inputs to the ECM modules fall into one of the following groups: switch type of inputs and sensor type inputs.

Switches provide signals to the switch inputs of the ECM. The possible outputs of a switch are an open signal, a grounded signal, or a voltage signal.

Sensors provide an electrical signal to the ECM that constantly changes. The sensor input to the ECM can be one of several different types of electrical signals including the following: pulse width modulated (PWM) signals, active analog (voltage) input signals, passive analog (resistance) input signals and frequency input signals.

The ECM modules monitor most of the circuits of the input components for diagnostics. If the ECM determines that an abnormal condition exists in one of the circuits, the ECM will log a diagnostic code for the involved component.

Sensors

Most of the input circuits of the sensor have an internal ECM “pull up voltage” that is present at the contacts of the ECM. An above normal voltage is internally connected to the input circuit of the ECM through a resistor. During normal operation, the sensor signal will hold the circuit at a certain amplitude. Loss of power to the component, disconnection, or an open circuit allows the circuit to be pulled high by the pull-up voltage of the ECM. This action will result in above normal voltage at the contact of the ECM. As a result, the ECM will activate an FMI 03 (voltage above normal) diagnostic code for the circuit that is affected.

The types of ECM input sensor circuits that have pull-up voltage present are listed below:

- Pulse Width Modulated (PWM) sensor input circuits
- Active analog (voltage) input signal circuits
- Passive analog (resistance) input signal circuits

Pulse Width Modulated (PWM) Position Sensor Operation

When powered up, the position sensors continuously send a Pulse Width Modulated (PWM) square wave signal to the ECM. Any movement on a specific axis is detected by the position sensor for that axis. The duty cycle of the sensor signal of the PWM changes depending on the direction and the amount of movement on the axis. The duty cycle is the percentage of time that the signal is high as compared to the period of the duty cycle. The greater the time that the duty cycle is high, the greater the percentage the duty cycle will be.

The percentage of duty cycle signal from a typical position sensor the ECM will recognize as valid is 10% to 90% ± 5% at the extreme ends of the axis movement. A joystick, lever, or actuator that is in the center or neutral position results in a duty cycle signal of approximately 50 ± 5%.

For more information on the position sensors for the joysticks and auxiliary controls, refer to Systems Operation, “Features”.

Left Joystick Position Sensors

The left joystick contains six internal position sensors that send input signals to the Implement ECM. Three steering position sensors also send an input signal to the Transmission/Chassis ECM. The position sensors are assigned to an axis of the joystick to monitor movement of the axis. The left joystick axis assignments are listed below.

Left/Right Axis – Steer position sensor 1, Steer position sensor 2, Steer position sensor 3

Forward/Rearward Axis – Left blade lift or lower position sensor

Rotational Axis – Machine articulation left or right

Thumb Rocker Axis – Wheel lean left or right

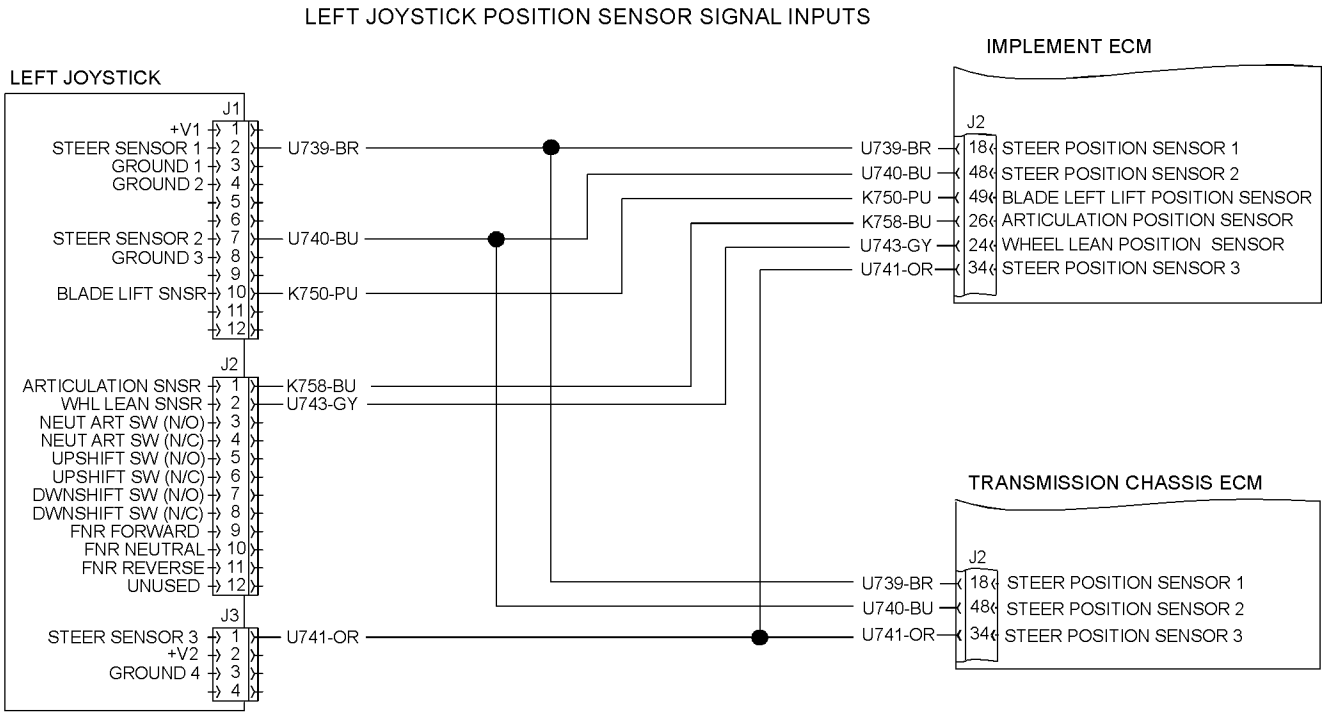


Illustration 35 g01469813

Left Joystick Position Sensor Input Connections

Note: For a complete connection diagram of the left joystick electronic control system, refer to the “System Schematics” in the back of the manual.

The Transmission/Chassis ECM monitors the steering position sensors to instantly activate the secondary steering system. If a problem is detected, the “Transmission/Chassis ECM” will activate the secondary steering system when requested by the Implement ECM.

The position sensors that are internal to the joysticks are not serviceable. If an internal joystick position sensor has failed, the joystick assembly must be replaced.

Right Joystick Position Sensors

The right joystick contains five internal position sensors that send input signals to the Implement ECM. The position sensors are assigned to a joystick axis to monitor movement of the axis. The right joystick axis assignments are listed below.

Left or Right Axis – Sideshift left or right position sensor

Forward or Rearward Axis – Right blade lift or lower position sensor

Rotational Axis – Blade circle position sensor

Thumb Rocker Forward or Rearward Axis – Blade pitch position sensor

Thumb Rocker Left or Right Axis – Circle sideshift position sensor

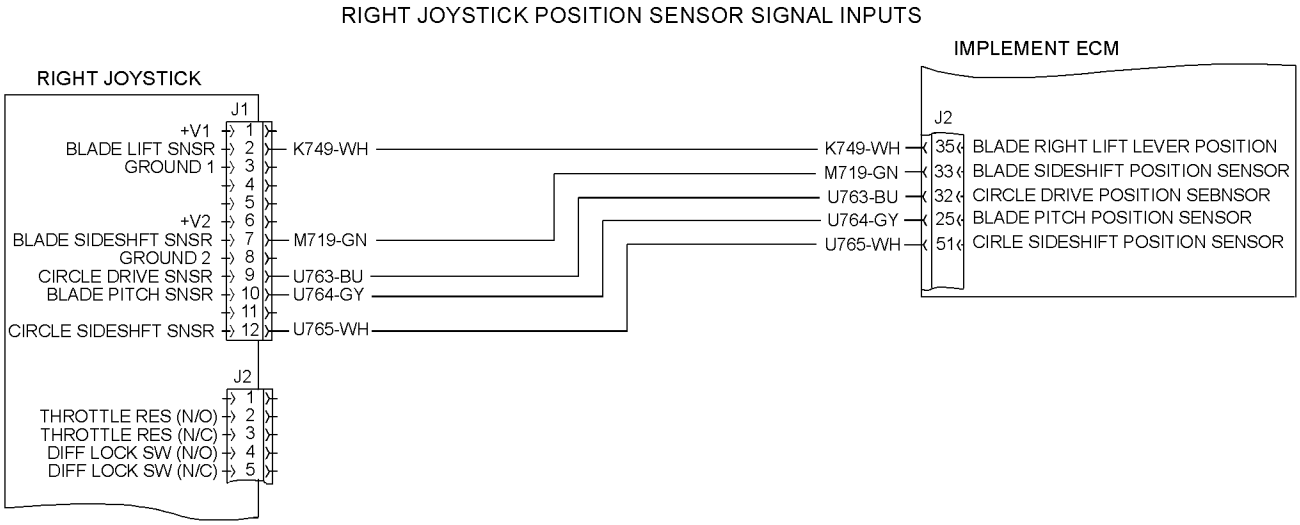


Illustration 36 g01313467

Right Joystick Position Sensor Input Connections

Note: For a complete connection diagram of the electronic control system of the right joystick, refer to the “System Schematics” in the back of the manual.

Auxiliary Hydraulics Control Position Sensors

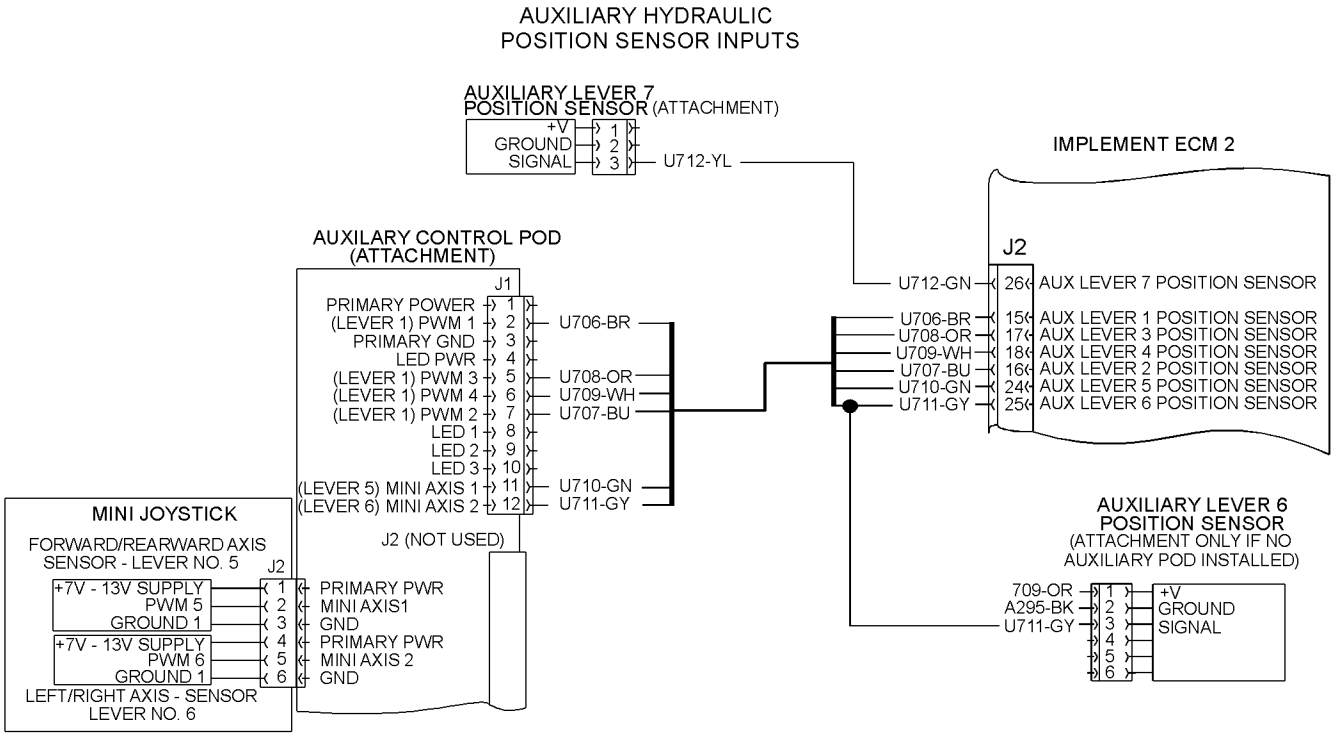


Illustration 37 g01469816

Auxiliary Hydraulic Position Sensor Input Connections

Note: For a complete connection diagram of the electronic auxiliary hydraulic control system, refer to Systems Operation, “Features” in this manual or to the “System Schematics” in the back of the manual.

The attachment auxiliary control pod contains four internal position sensors that send an input signal to the “Implement Control # 2” . Each of the position sensors is assigned to one of the four control levers.

The attachment mini joystick contains two position sensors that send an input signal to the “Implement Control # 2” . One for the forward rearward axis and one for the left or right axis

An attachment stand-alone lever 7 or attachment lever 6 and 7 combination have internal position sensors. These sensors send an input to the “Implement Control # 2” . The lever 6 signal input circuit is used by either the mini joystick left or right axis or by the stand-alone lever 6 position sensor depending on which attachment is installed.

The auxiliary hydraulic lever position sensors can be configured to control any of the installed auxiliary hydraulic valves. For more information on configuring the auxiliary hydraulic controls, refer to Testing and Adjusting, “Auxiliary Hydraulic System - Configure” in this manual.

Articulation Position Sensors

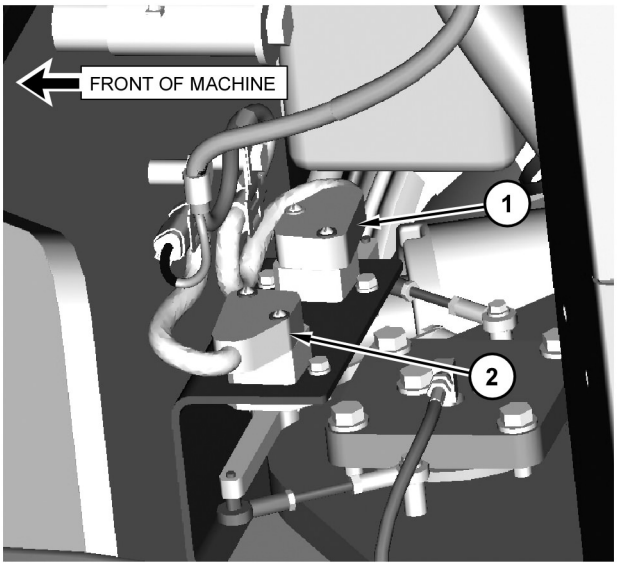


Illustration 38 g01327588

Early M Series Motor Graders were equipped with two angle position sensors for machine articulation. On the front half of the machine, in front of the articulation hitch. (View: Looking from the left side of the machine)

Left and right hand is in reference to the front of the machine.

(1) Machine Articulation Sensor #2 (right side)
(2) Machine Articulation Sensor #1 (left side)

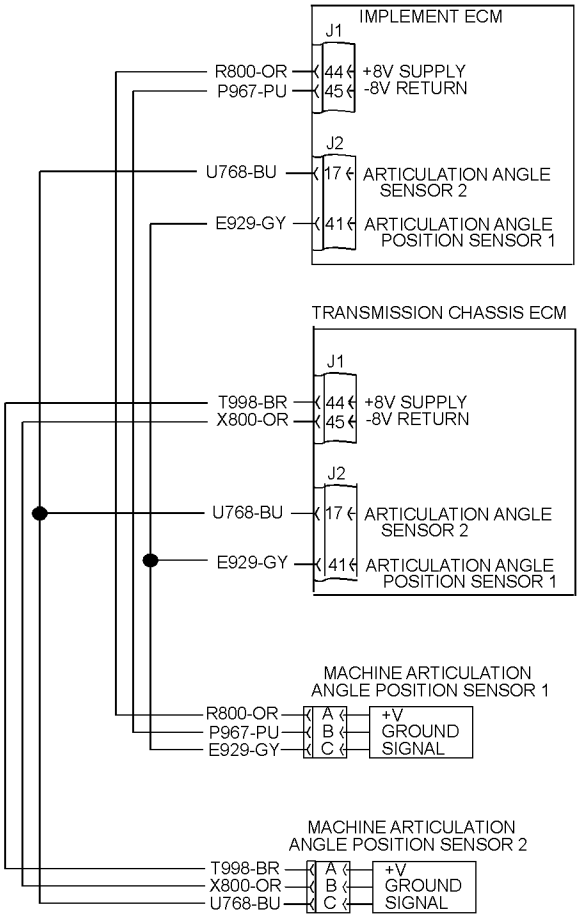


Illustration 39 g01313624

Dual Articulation Position Sensors 1 and 2 Input Circuits

The two machine articulation position sensors, for the M Series Motor Graders, are mounted on the front half of the machine. The sensors are located in front of the articulation hinge. Each position sensor will provide a PWM input to the Implement ECM and to the Transmission/Chassis ECM.

The position sensor for articulation angle (1) is powered by the 8 V sensor power supply of the Implement ECM. The position sensor for articulation angle (2) is powered by the 8 V sensor power supply of the Transmission/Chassis ECM.

The Transmission/Chassis ECM monitors the signals from the sensors to be instantly ready to activate and control the secondary steer system.

The Transmission/Chassis ECM monitors the PWM duty cycle from the articulation position sensors to determine the articulation angle of the machine. The sensor operates at a frequency of approximately 500 Hz. When the articulation angle of the machine is in the neutral position, the duty cycle from the position sensor to the ECM is approximately 55%. When the machine is articulated to the full left position, the duty cycle will be approximately 33%. When the machine is articulated to the full right position, the duty cycle will be approximately 74%.

When an abnormal condition is detected in one or both of the machine articulation position sensor circuits, the ECM will activate a diagnostic code for the affected circuit.

Single Articulation Position Sensor

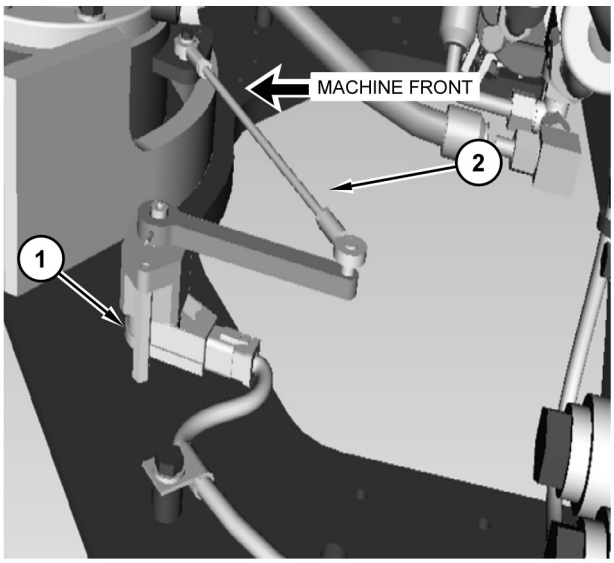


Illustration 40 g03236020

Machine Articulation Angle Position Sensor is on the left-hand side of the articulation hitch. (View from left side of machine with covers removed)

(1) Machine Articulation Sensor
(2) Mechanical linkage

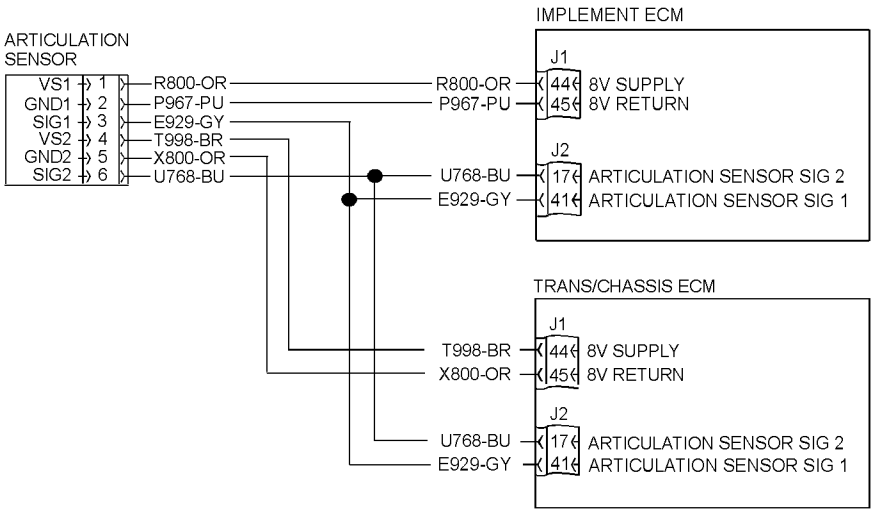


Illustration 41 g03209100

Single Articulation Position Sensor Circuit

Reference: Special Instruction, REHS7330, “Rework Procedure to Accommodate a Single Articulation Angle Position Sensor on Certain M-Series and M-Series 2 Motor Graders.{4806, 7610}”

The single “Dual Output Machine Articulation Position Sensor” is mounted on the front half of the machine at the hinge of the articulation. (Same location mount as the left-hand, articulation angle position sensor # 1, on the earlier 2-sensor configuration.) The position sensor provides a PWM signal input to the Implement ECM and to the Transmission/Chassis ECM.

The “articulation angle position sensor” is powered by the 8 VDC “Sensor Power” supply of the Implement ECM.

The Implement ECM measures the PWM duty cycle from the articulation position sensor to determine the articulation angle of the machine. The sensor operates at a frequency of approximately 500 Hz. When the articulation angle of the machine is in the neutral position, the input of the duty cycle from the position sensor to the ECM is approximately 55%. When the machine is articulated to the full left position, the duty cycle will be approximately 33%. When the machine is articulated to the full right position, the duty cycle will be approximately 74%.

The Transmission/Chassis ECM monitors the articulation angle of the machine and the gear selected for the machine. The ECM will limit the selected gear to a value no greater than “6F” or “5R” if the articulation of the machine is greater than 7°. The Transmission/Chassis ECM will limit the articulation angle to less than 7° if the gear selected for the machine is greater than “6F” or “5R” .

The monitoring of the articulation angle of the machine is not inhibited though operating the machine using the secondary steering function.

Steer Cylinder Position Sensors

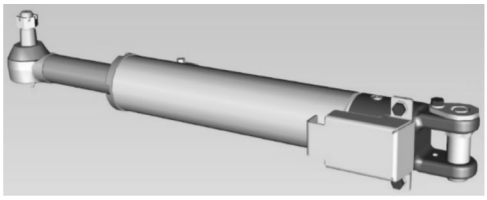


Illustration 42 g03856446

Illustration above shows new style cylinder with the new style sensor inside. Note the square connector cover.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50%. The sensor will detect a fault even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

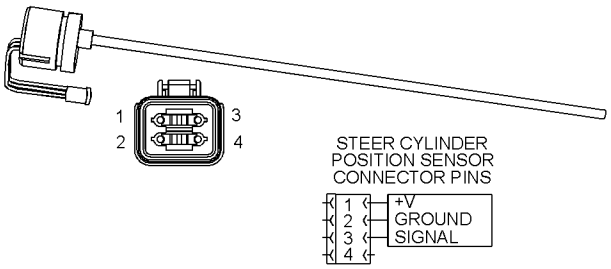


Illustration 43 g01313639

Steering Cylinder Position Sensor

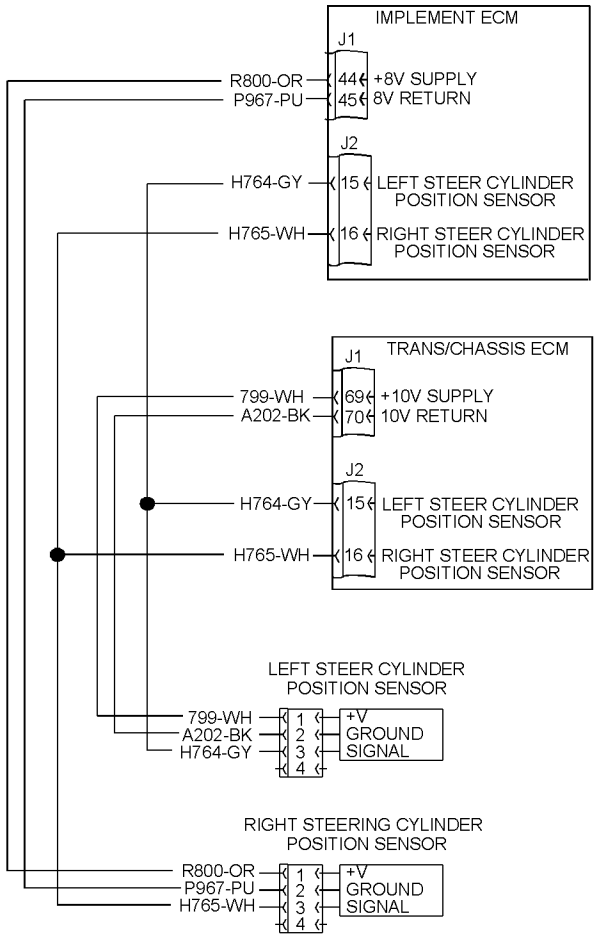


Illustration 44 g01313665

Steering Cylinder Position Sensor Circuits

The position sensors of the steering cylinder are mounted on the head end of the front steering cylinders. The position sensors provide a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM.

The position sensor of the left steering cylinder is powered by the 10 V sensor power supply of the Trans/Chassis ECM. The position sensor of the right steering cylinder is powered by the 8 V sensor power supply of the Implement ECM.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the extension length of the steering cylinder changes, the duty cycle of the PWM sensor signal changes. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The small increments will make the measurement of the changes of the duty cycle difficult.

The Implement ECM will use the signals from the position sensors in the closed-loop control for the primary steering system. The ECM sends a control signal to the control module of the steering valve that is based on the left joystick steering axis position. The ECM monitors the signal from the position sensors of the steering cylinder to adjust the command accordingly.

The Transmission/Chassis ECM uses the signals from the position sensors of the steering cylinder and the position of the steering axis of the LH joystick. The signals from the ECM control the secondary steering system when activated.

Blade Right and Blade Left Constant Down Force Position Sensors

Note: The blade down force system is only available on the 16M and 24M Series Motor Graders.

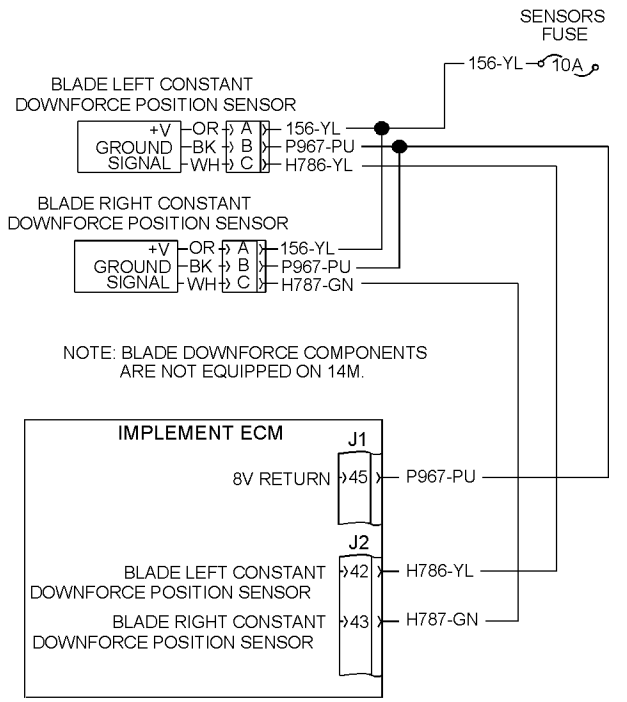


Illustration 45 g01333777

Blade Left and Blade Right Constant Down Force Dial Position Sensor input connections

The blade constant down force dial position sensors are connected to the left and the right blade down force dials. The position sensors provide a PWM duty cycle input signal to the Implement ECM that indicates the position of the blade constant down force dials.

When either of the dials are moved to the full clockwise position (no down force requested), the PWM duty cycle of the signal is approximately 93%. When the dial is moved through a detent to the full left counterclockwise position (maximum down force), the PWM duty cycle of the signal is approximately 10.6%.

When the blade down force system is enabled, the Implement ECM will send a PWM variable output current to the appropriate blade raise relief solenoid based on the signal that is received from the blade constant down force dial position sensors. This result is a specific amount of blade down force applied to the work surface.

A full counterclockwise dial position to the left detent will result in the blade being in a full down force condition such that the full weight of the blade is applied to the work surface. A full clockwise dial position for no down force will result in a zero down force condition such that little of the blade weight is applied to the work surface.

The Implement ECM monitors the blades constant down force dial position sensors circuits for diagnostics. If an abnormal condition is detected in one of the circuits, the ECM will activate a diagnostic code for the circuit. When this occurs, the ECM will not enable the blade down force system. If a diagnostic code for a blade down force component circuit is activated though the system is active, the ECM will disable the blade down force system.

For more information on the operation of the blade down force system, refer to the Systems Operation, “Features” section of this manual.

Steering Valve Control Module Inputs

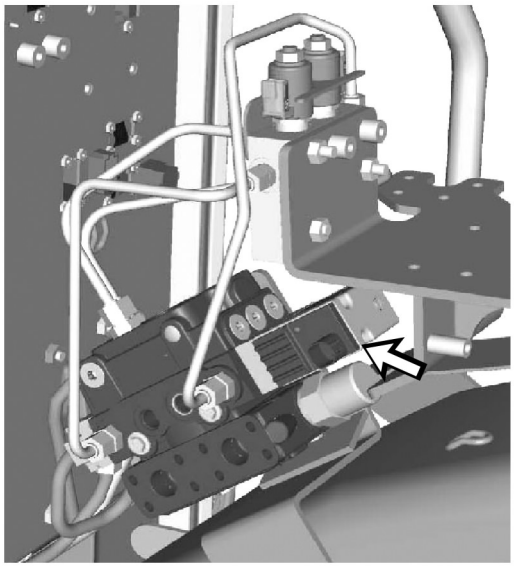


Illustration 46 g01313690

Steering Valve Control Module located in front of the cab

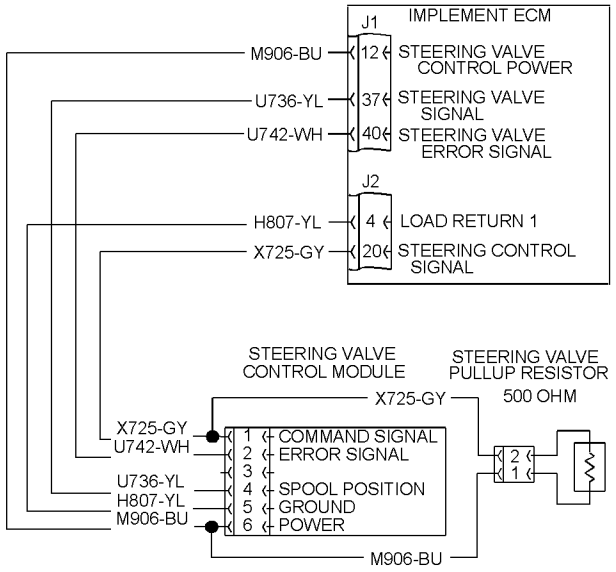


Illustration 47 g01313683

Steering Valve Control Module Circuit Connections

The control module for the steering valve provides two input signals to the Implement ECM. One input circuit is for the position sensor of the spool. The other input circuit is an error signal circuit.

The Implement ECM supplies system power to the control module of the steering valve through an ON/OFF output driver.

For more information on the operation of the primary steering system and the steering control module, refer to Systems Operation, “Features” in this manual.

Hydraulic Pump Pressure Sensor

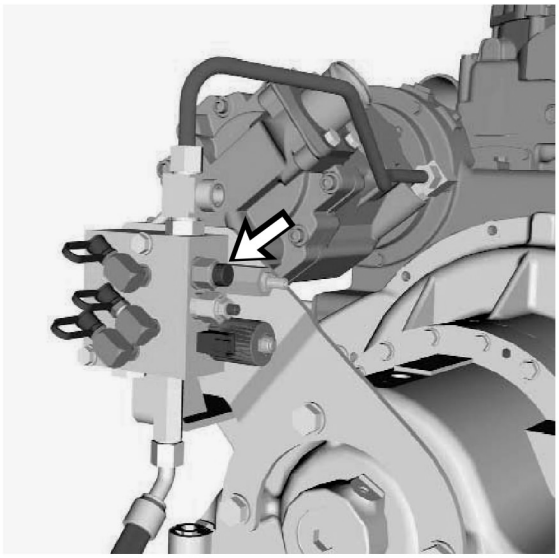


Illustration 48 g01314011

Location of the Hydraulic Pump Pressure Sensor on the Implement and Steering Control Manifold (upper left on the rear of the transmission)

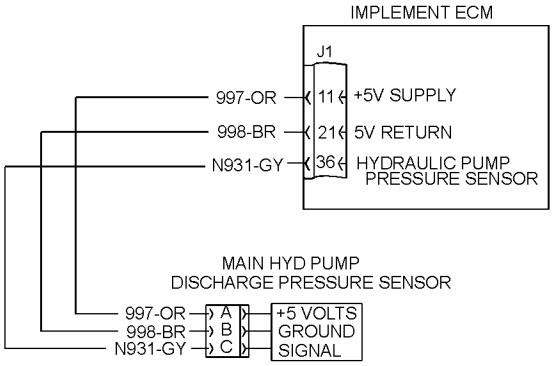


Illustration 49 g01314062

Hydraulic pump pressure sensor connections

The hydraulic pump pressure sensor provides an input to the Implement ECM to indicate the outlet pressure of the steering and implement hydraulic pump.

The pressure sensor sends a variable voltage input to the ECM that will indicate the pump outlet pressure. The sensor signal output voltage will range from 0.5 VDC when no pressure is detected to 4.5 VDC when 34500 kPa (5004 psi) pressure is detected.

The Implement ECM will use the input from the pressure sensor to determine if the pump is supplying sufficient pressure to operate the primary steering system and the implement system.

If the pump pressure is below the lower limit, the Implement ECM will send a request to the Transmission/Chassis ECM to activate the secondary steering system.

Hydraulic Oil Temperature Sensor

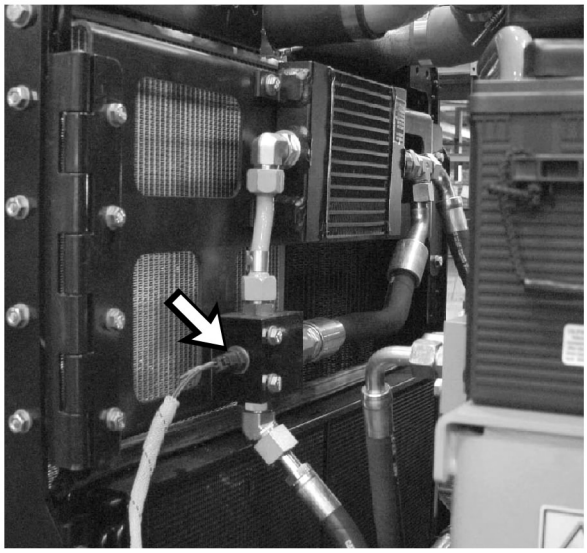


Illustration 50 g01314126

Hydraulic Oil Temperature Sensor located behind the radiator at the inlet to the hydraulic oil cooler

Note: On M Series motor graders, the hydraulic oil temperature sensor is mounted on the manifold that is on the outside of the radiator. The temperature sensor on these machines can be seen from the rear of the machine by looking through the radiator guard on the lower right side.

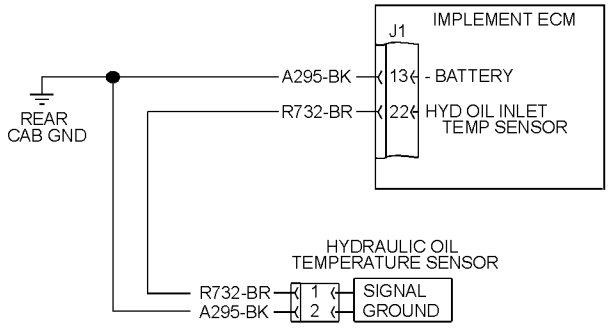


Illustration 51 g01314131

Hydraulic oil temperature sensor connections

The hydraulic oil temperature sensor allows the Implement ECM to monitor the temperature of the hydraulic oil.

The hydraulic oil temperature sensor provides a resistive voltage input signal to the ECM. The ECM will calculate the temperature of the hydraulic oil according to the value of the input signal. The voltage input signal from the sensor will ranges from 4.9 VDC at −40 °C (−40.0 °F) to 0.18 VDC at 150 °C (302.0 °F). The ECM will activate the FMI 03 diagnostic code when the input signal from the sensor is 5.0 VDC.

Switches

Switches will provide one of the following types of input signals to the ECM:

- An Open signal
- A Ground signal
- A +Battery or voltage signal

The contacts of a switch have two states of contact. The switch contacts are open or the switch contacts are closed.

- When switch contacts are open, no signal is provided to the corresponding input of the ECM. This “no signal” condition is also referred to as floating.
- When switch contacts are closed, either a ground signal or a +battery signal is sent to the corresponding input of the ECM.

Switch-to-ground type input circuits have an internal ECM “pull up voltage” that is present at the ECM contacts. An above normal voltage is internally connected to the input circuit of the ECM through a resistor that allows the ECM to detect a problem in the switch circuit. During normal operation, the switch signal will hold the circuit low, however, circuit conditions such as a disconnection or an open circuit will allow the circuit to be pulled high by the ECM pull up voltage. This will result in an above normal voltage at the contact of the ECM. If this action occurs when the ECM is expecting the circuit to be low, the ECM will activate a diagnostic code for the circuit.

Switch to +battery type input circuits have an internal ECM “pull down voltage” that is present at the contacts of the ECM. A below normal voltage is internally connected to the input circuit of the ECM through a resistor. This allows the ECM to detect a problem in the switch circuit. The circuit will be held high when the switch contacts are closed to a +battery source. If the circuit is open or has a bad connection, the pull down voltage will pull the circuit low. If this action occurs when the ECM is expecting the circuit to be high, the ECM will activate a diagnostic code for the circuit.

The ECM monitors the input circuits of the switch for the following circuits unless otherwise noted.

Key Start Switch

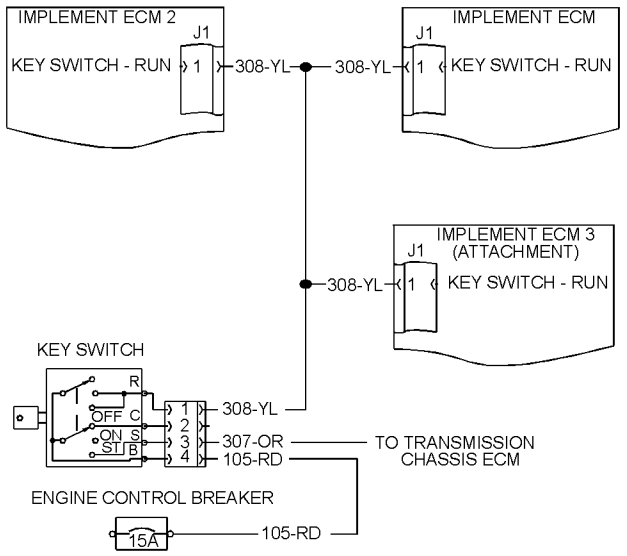


Illustration 52 g01314199

Key start switch connections

Each of the possible three modules of the Implement ECM monitor the status of the key start switch. When the key start switch is moved to the ON position or the START position, system power is supplied to the ECM modules at the connector contact J1-1.

The ECM module uses this input signal to determine when to activate or to deactivate the ECM “sleep mode” .

The key start switch circuit is not monitored for diagnostics by the Implement ECM.

Operator In Seat Switch

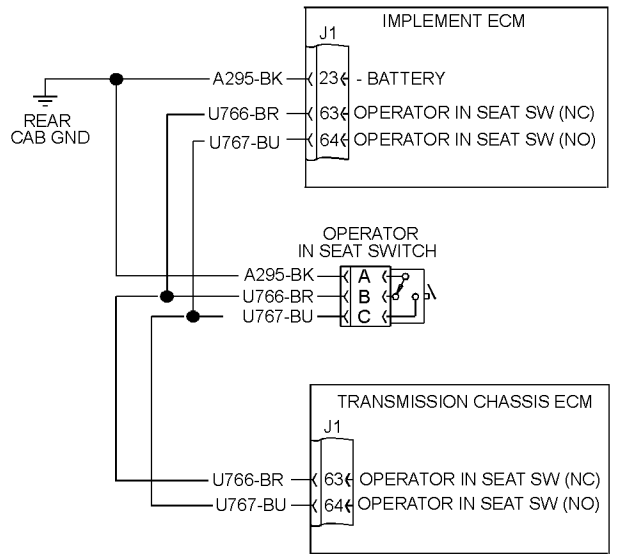


Illustration 53 g01422635

“Operator In Seat” switch connections

The “operator in seat” switch supplies two switch-to-ground type inputs to the Implement ECM and to the Transmission/Chassis ECM. The switch is located under the operator seat.

The Implement ECM will not enable the primary steering system or enable any of the implement systems, allow a shift of the machine out of neutral, or allow the disengagement of the parking brake when all of the following conditions are true:the “operator in seat” switch is not engaged, the transmission output speed is zero, the actual gear of the machine is neutral and the inching pedal is not pressed.

Auto Articulation Switch

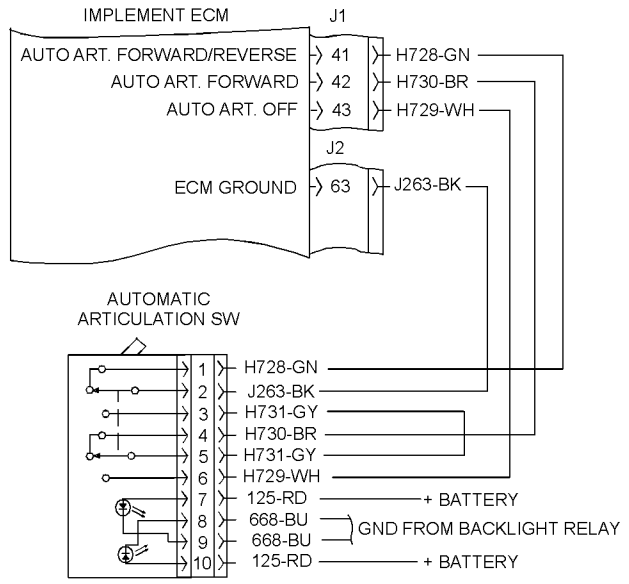


Illustration 54 g03867875

Schematic of the Automatic Articulation Switch connection to the Implement ECM

The Auto Neutral Articulation Switch supplies two, switch to ground, inputs to the Implement ECM 2. When activated, if articulation is allowed, the Implement ECM 2 will activate the correct solenoids to return the machine articulation to center. The switch is on the left joystick handle.

The automatic neutral articulation switch is connected to the ground that is supplied by the 5 V sensor return of the Transmission/Chassis ECM and the Implement ECM 2. The switch must lose both grounds to disrupt the switch operation. The illustration above indicates the power and ground connections for the switch.

During machine operation, when the rocker switch is in the center position, the Auto Neutral Articulation feature will not be enabled.

During machine operation, when the upper half of the rocker switch is depressed, the angle of machine articulation will follow the position of the front wheels as commanded by the steering joystick in gears 1F to 4F.

During machine operation, when the lower half of the rocker switch is depressed, the angle of machine articulation will follow the position of the front wheels in gears 1F to 4F and in gears 1R to 3R.

An articulation “return to center” command or a manual articulation command through the left-hand joystick controls, will always suspend the auto articulation function. The function will become active again if the rocker switch is not in the OFF position, the machine is in an accepted gear, and the steering angle realigns with the articulation angle.

Refer to the electrical schematic for your machine for more information on this switch circuit.

Implement Lockout Switch

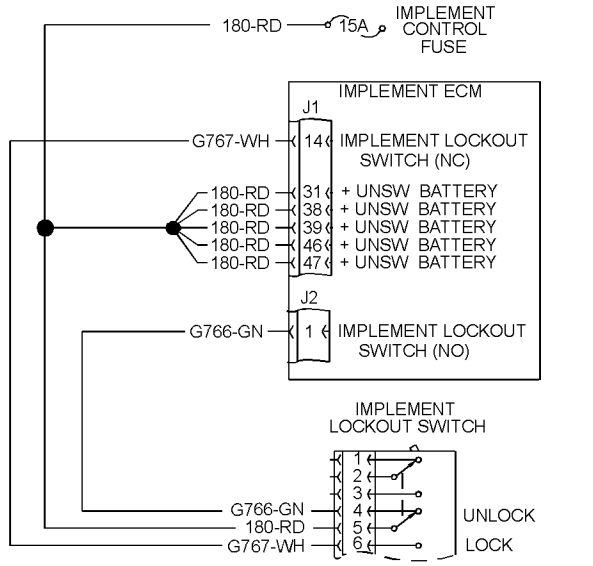


Illustration 55 g01314202

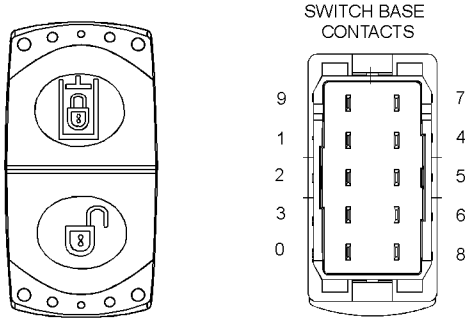


Illustration 56 g01314300

Implement Lockout Switch

The implement lockout switch informs the ECM that the operator wants to disable the hydraulics for the implements or that the operator wants to enable the hydraulics for the implements. The switch is a two-pole, double-throw rocker switch. The switch is on the right-hand console in the cab.

One pole of the switch is used to provide to switch to +battery inputs to the ECM to indicate the status of the switch. During normal operation, one of the inputs is open. The other input is closed to the +battery.

When the Implement ECM detects +battery voltage at the “LOCK” contact, the ECM deactivates the implement lockout solenoid which will block the pilot hydraulics for the implement controls.

Secondary Steer Test Switch

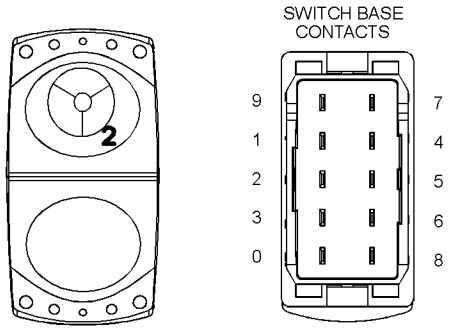


Illustration 57 g01333781

Secondary Steering Test Switch

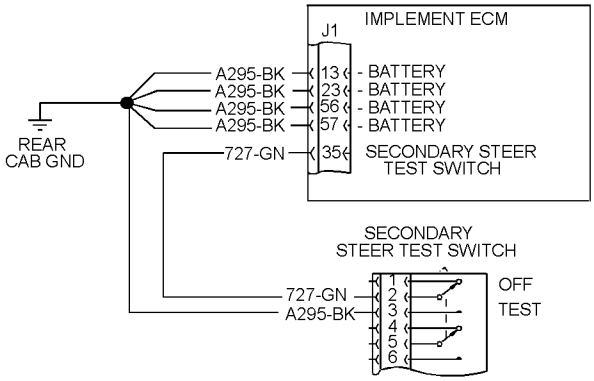


Illustration 58 g01314338

Secondary Steer Test Switch connections

The secondary steering test switch enables the operator to test the operation of the secondary steering system manually. The switch is a two-pole, double-throw rocker switch. One pole of the switch is used for the circuit of the secondary steering test signal. The other pole is not used.

The input circuit of the switch is connected to a switch-to-ground input contact at the Implement ECM. The ECM pull-up voltage holds the circuit high. When the switch is actuated, the circuit is grounded through the switch. When the Implement ECM detects the grounded circuit, the ECM will send a secondary steering test request to the Transmission/ Chassis ECM. If the secondary steering system does not respond as requested, an event code will be activated.

The test switch of the secondary steering circuit is not monitored for diagnostics by the Implement ECM.

Blade Constant Down Force Enable Switch

Note: The blade down force system is not available on the 14M Motor Grader.

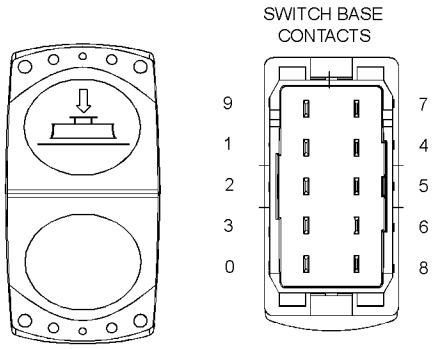


Illustration 59 g01333780

Blade Constant Down force enable switch

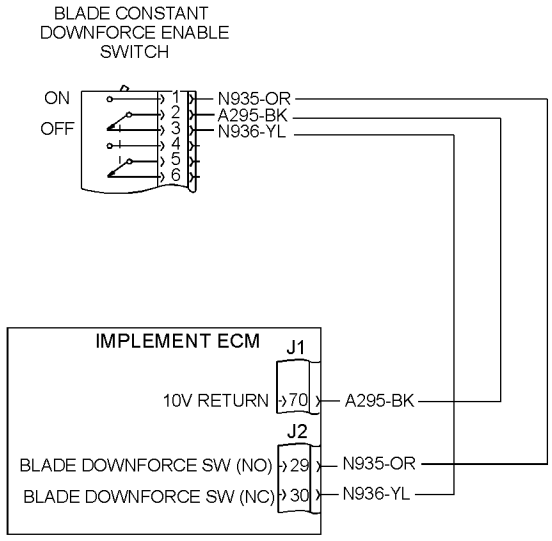


Illustration 60 g01333779

Blade Constant Down force enable switch input connections

The blade constant down force enable switch is used to signal to the Implement ECM that the operator has requested that the blade down force system to be activated.

The switch provides a switch-to-ground type of input to the ECM. One pole of the switch is used to provide the two inputs to the ECM. The other pole of the switch is not used. During normal operation, one of the switch inputs is open to ground. The other input is closed to the return circuit of the ECM (ECM ground).

The Implement ECM expects one of the circuits of the switch input to be grounded always. If both of the switch circuits are grounded at same time or if both of the switch circuits are open at the same time, the ECM will activate a diagnostic code for the switch circuits.

When the Implement ECM detects that the ON input circuit is grounded, the ECM will enable the blade down force system if certain machine conditions are correct.

For more information on the operation of the blade down force system, refer to the Systems Operation, “Features” section of this manual.

“Pilot Oil Supply Filter Bypass” Switch

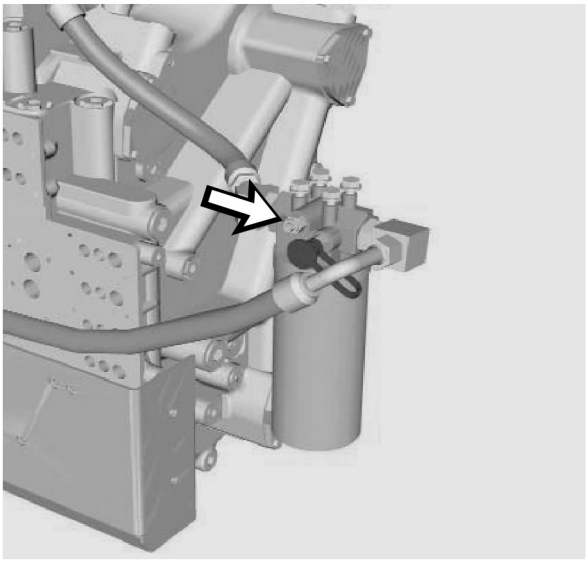


Illustration 61 g01314534

The “Pilot Oil Supply Filter Bypass” Switch is on the left side of the machine behind the transmission.

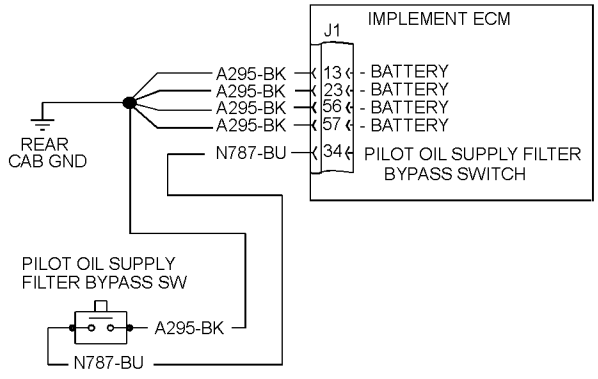


Illustration 62 g01314535

“Pilot Oil Supply Filter Bypass” switch connections

The “pilot oil supply filter bypass” switch is used to indicate to the Implement ECM that the filter is plugged.

The switch input circuit is connected to a switch-to-ground input contact at the Implement ECM. The ECM pull-up voltage holds the circuit high. When the oil pressure increases due to a plugged filter, the switch is actuated. When activated, the circuit is grounded through the switch. When the Implement ECM detects the grounded circuit, the ECM will activate an event code message for a plugged filter.

The “pilot oil supply filter bypass” switch circuit is not monitored for diagnostics by the Implement ECM.

Stable Blade Inertial Measurement Unit Sensor (If Equipped)

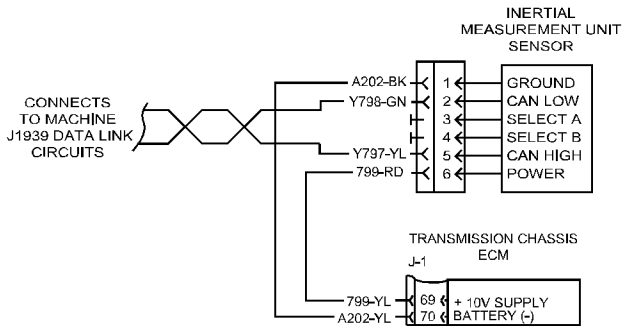


Illustration 63 g06006948

Stable Blade Inertial Measurement Unit Sensor connections

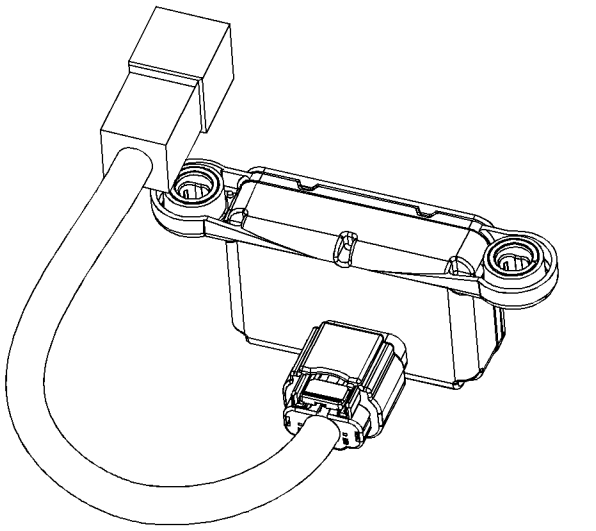


Illustration 64 g03884899

The Inertial Measurement Unit (IMU) Sensor is used with the Stable Blade feature. The sensor will send signals that indicate machine movement on the X, Y, and Z axis. These movements correspond to the machine rocking side to side, up and down and acceleration. Stable Blade will only use the up and down movement from the IMU sensor. The signals are sent on the J1939 CAN Data Link to the Transmission/Chassis ECM. The ECM will command the Engine ECM to reduce the engine speed based on the amount of machine movement. The decreased engine speed will reduce machine bounce and provide improved grading performance. The Stable Blade feature will only be active when enabled and the throttle lock is in the AUTO position. Stable Blade is only active in first gear forward through fifth gear forward. The feature provides the most benefit in higher working gears when the higher machine speed results in increased machine bounce.

- The Stable Blade feature will be active when the feature is ENABLED and the Throttle Lock is in Auto.
- When the Stable Blade feature is active, a pop-up message for “Stable Blade ON” will display for 3 seconds.
- When the Stable Blade feature is active, the “Ride Control” icon, on the display, will be ON.
- The forward gears where the feature can be active are 1F to 5F.
- If a higher gear is selected, a pop-up message for “Stable Blade OFF will display for 3 seconds.”. The feature will reactivate when back in the acceptable gear range.
- The Stable Blade feature is active can be ENABLED or DISABLED using the Message Display. From “Settings”, select “Stable Blade”. From “Stable Blade Setting”, use the UP or DOWN keys to toggle.
- The Stable Blade Sensitivity setting can be changed using the Message Display. From “Settings”, select “Stable Blade”. From “Stable Blade Setting” go to “Stable Blade Sensitivity”. Use the SIDE to SIDE keys to increase or decrease the sensitivity setting.
- The Stable Blade Sensitivity setting can also be accessed in the Cross Slope menu as the last menu option.

Accugrade Control Switches

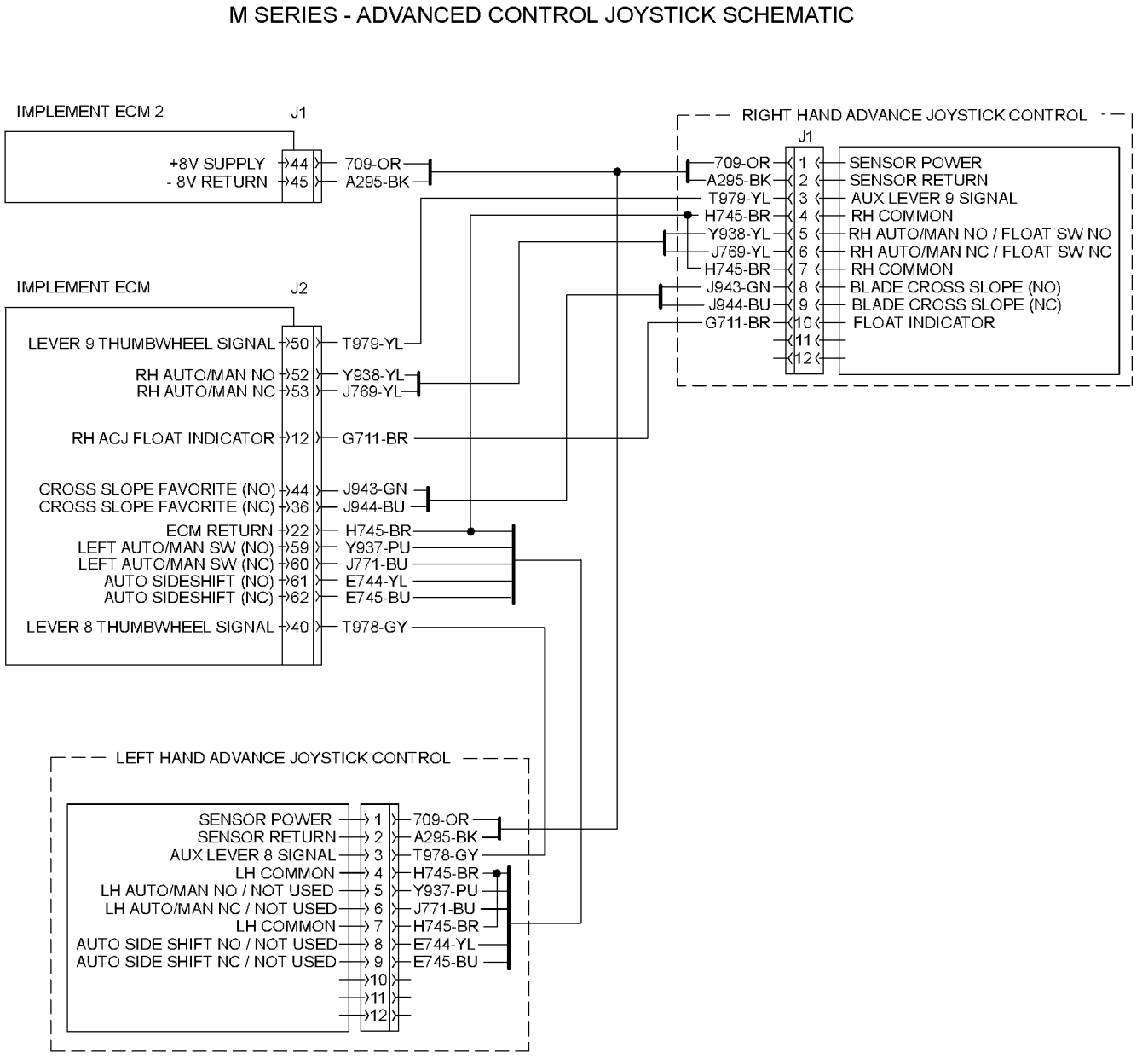


Illustration 65 g03856877

M Series Advanced Control Joystick schematic

Advanced Control Joystick (ACJ) can be used with Grade Control or Auxiliary Hydraulics. ACJ's are standard on machines with Grade Control and optional with Auxiliary Hydraulics.

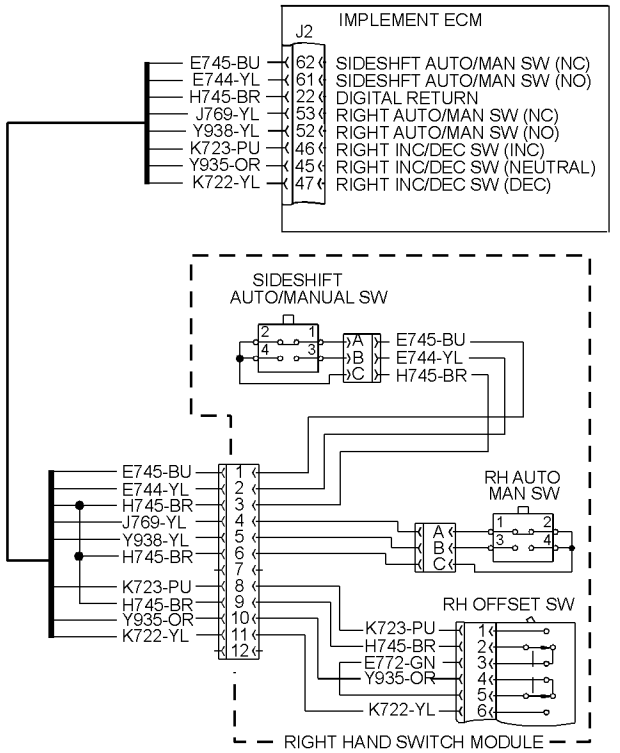


Illustration 66 g01314706

Right-Hand Switch Module

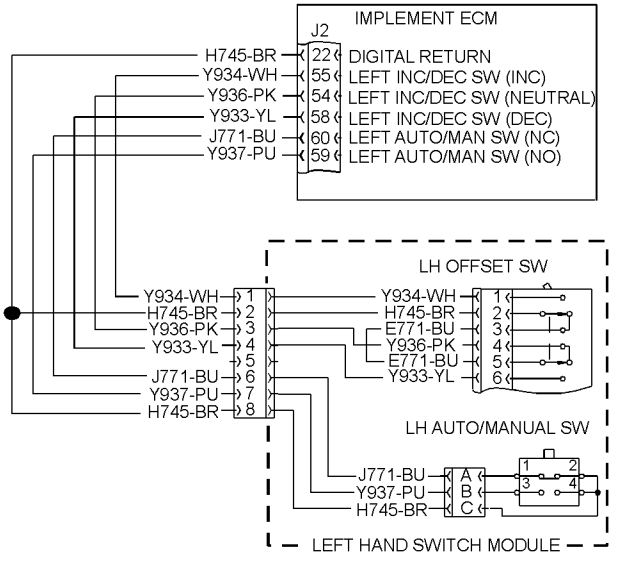


Illustration 67 g01314708

Left-Hand Switch Module

The right hand and the left-hand switch modules are installed on the machine when the Accugrade control system is installed on the machine. The switch modules are located outside of the left joystick and the right joystick.

The switches on the left and the right switch modules enable the manual adjustment of the increment, decrement, and auto/manual mode selection under Accugrade control.

The left hand and the right hand offset switches provide three inputs to the Implement ECM. The left auto/manual and right auto/manual switches and the sideshift auto/manual switch provide two inputs to the Implement ECM.

Each of the switch input circuits for all the switches are switch-to-ground type inputs to the ECM. The Implement ECM provides a return circuit (ECM ground) on one side of the switch contacts. When the switch contacts are open, the pull-up voltage of the ECM holds the circuit high. When the switch is actuated and the contacts close, the circuit is grounded through the switch contacts. The Implement ECM detects the grounded circuit and the Implement ECM activates the appropriate output to one of the solenoids of the blade control.

The switch circuits for the switches on the left and right switch modules are not monitored for diagnostics by the Implement ECM.

i07038415

Electrical Input Components

SMCS Code: 1400; 5000

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

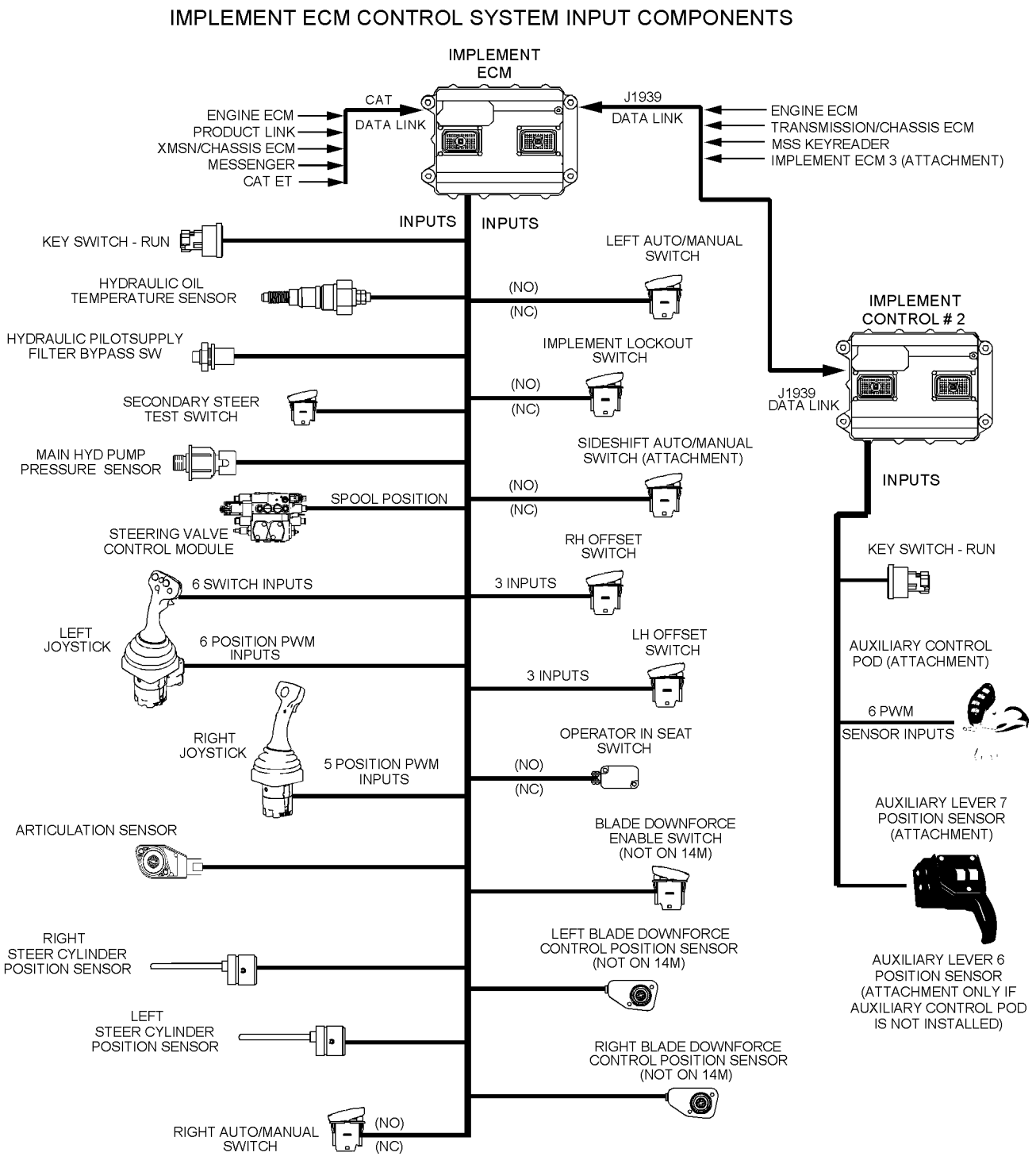


Illustration 68 g06076198

Implement ECM Control System Input Components

The Implement Electronic Control System utilizes various different types of devices that provide input data to the Implement ECM and the “Implement Control # 2” . The attachment “Implement Control # 3” is used to provide outputs for the auxiliary solenoids. The modules of the Implement ECM receive status information about the machine from the input devices. The ECM will use this information to determine the correct output action needed to control the implement functions of the machine. All the implement system components that supply inputs to the ECM modules fall into one of the following groups: switch type of inputs and sensor type inputs.

Switches provide signals to the switch inputs of the ECM. The possible outputs of a switch are an open signal, a grounded signal, or a voltage signal.

Sensors provide an electrical signal to the ECM that constantly changes. The sensor input to the ECM can be one of several different types of electrical signals including the following: pulse width modulated (PWM) signals, active analog (voltage) input signals, passive analog (resistance) input signals and frequency input signals.

The ECM modules monitor most of the circuits of the input components for diagnostics. If the ECM determines that an abnormal condition exists in one of the circuits, the ECM will log a diagnostic code for the involved component.

Sensors

Most of the input circuits of the sensor have an internal ECM “pull up voltage” that is present at the contacts of the ECM. An above normal voltage is internally connected to the input circuit of the ECM through a resistor. During normal operation, the sensor signal will hold the circuit at a certain amplitude. Loss of power to the component, disconnection, or an open circuit allows the circuit to be pulled high by the pull-up voltage of the ECM. This action will result in above normal voltage at the contact of the ECM. As a result, the ECM will activate an FMI 03 (voltage above normal) diagnostic code for the circuit that is affected.

The types of ECM input sensor circuits that have pull-up voltage present are listed below:

- Pulse Width Modulated (PWM) sensor input circuits
- Active analog (voltage) input signal circuits
- Passive analog (resistance) input signal circuits

Pulse Width Modulated (PWM) Position Sensor Operation

When powered up, the position sensors continuously send a Pulse Width Modulated (PWM) square wave signal to the ECM. Any movement on a specific axis is detected by the position sensor for that axis. The duty cycle of the sensor signal of the PWM changes depending on the direction and the amount of movement on the axis. The duty cycle is the percentage of time that the signal is high as compared to the period of the duty cycle. The greater the time that the duty cycle is high, the greater the percentage the duty cycle will be.

The percentage of duty cycle signal from a typical position sensor the ECM will recognize as valid is 10% to 90% ± 5% at the extreme ends of the axis movement. A joystick, lever, or actuator that is in the center or neutral position results in a duty cycle signal of approximately 50 ± 5%.

For more information on the position sensors for the joysticks and auxiliary controls, refer to Systems Operation, “Features”.

Left Joystick Position Sensors

The left joystick contains six internal position sensors that send input signals to the Implement ECM. Three steering position sensors also send an input signal to the Transmission/Chassis ECM. The position sensors are assigned to an axis of the joystick to monitor movement of the axis. The left joystick axis assignments are listed below.

Left/Right Axis – Steer position sensor 1, Steer position sensor 2, Steer position sensor 3

Forward/Rearward Axis – Left blade lift or lower position sensor

Rotational Axis – Machine articulation left or right

Thumb Rocker Axis – Wheel lean left or right

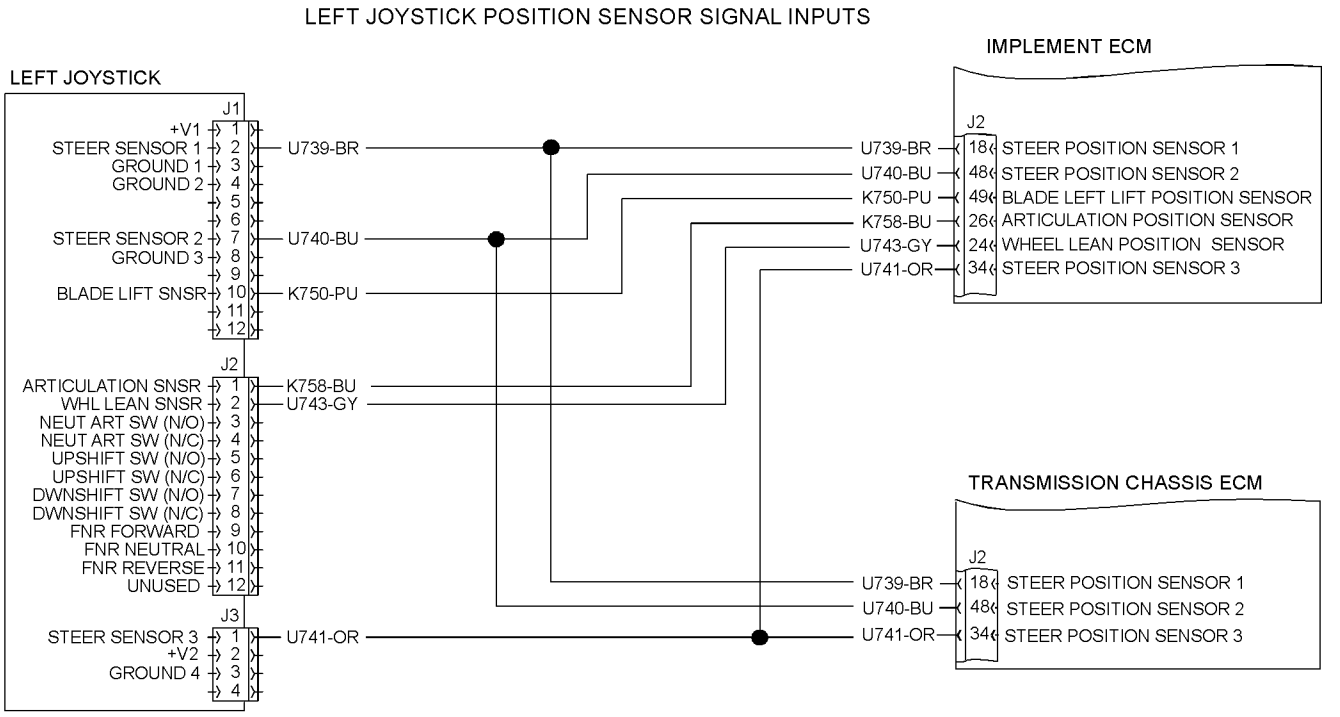


Illustration 69 g01469813

Left Joystick Position Sensor Input Connections

Note: For a complete connection diagram of the left joystick electronic control system, refer to the “System Schematics” in the back of the manual.

The Transmission/Chassis ECM monitors the steering position sensors to instantly activate the secondary steering system. If a problem is detected, the “Transmission/Chassis ECM” will activate the secondary steering system when requested by the Implement ECM.

The position sensors that are internal to the joysticks are not serviceable. If an internal joystick position sensor has failed, the joystick assembly must be replaced.

Right Joystick Position Sensors

The right joystick contains five internal position sensors that send input signals to the Implement ECM. The position sensors are assigned to a joystick axis to monitor movement of the axis. The right joystick axis assignments are listed below.

Left or Right Axis – Sideshift left or right position sensor

Forward or Rearward Axis – Right blade lift or lower position sensor

Rotational Axis – Blade circle position sensor

Thumb Rocker Forward or Rearward Axis – Blade pitch position sensor

Thumb Rocker Left or Right Axis – Circle sideshift position sensor

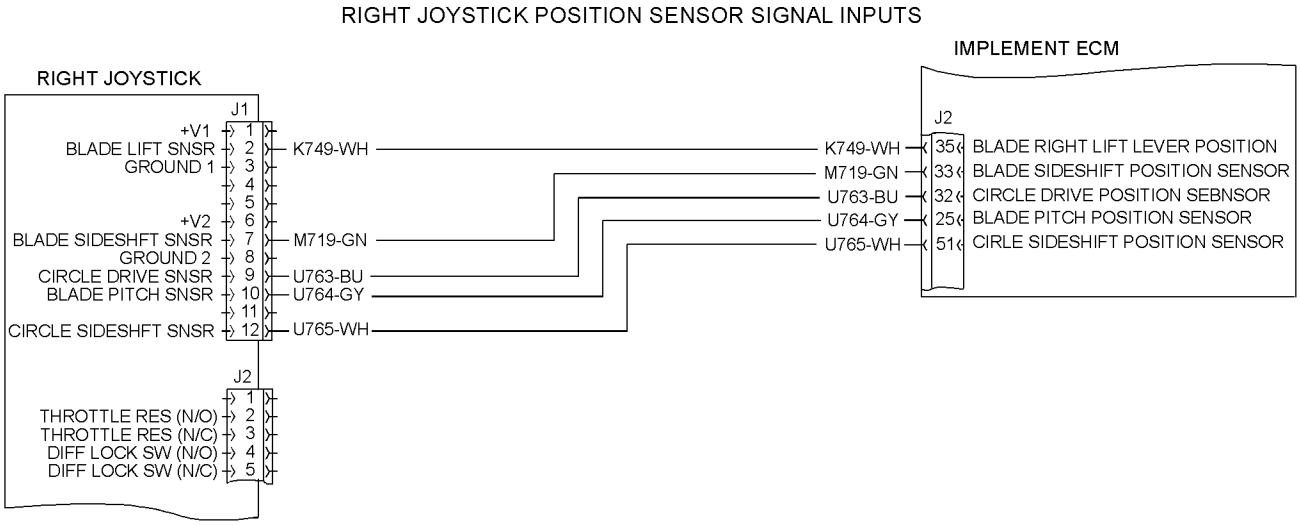


Illustration 70 g01313467

Right Joystick Position Sensor Input Connections

Note: For a complete connection diagram of the electronic control system of the right joystick, refer to the “System Schematics” in the back of the manual.

Auxiliary Hydraulics Control Position Sensors

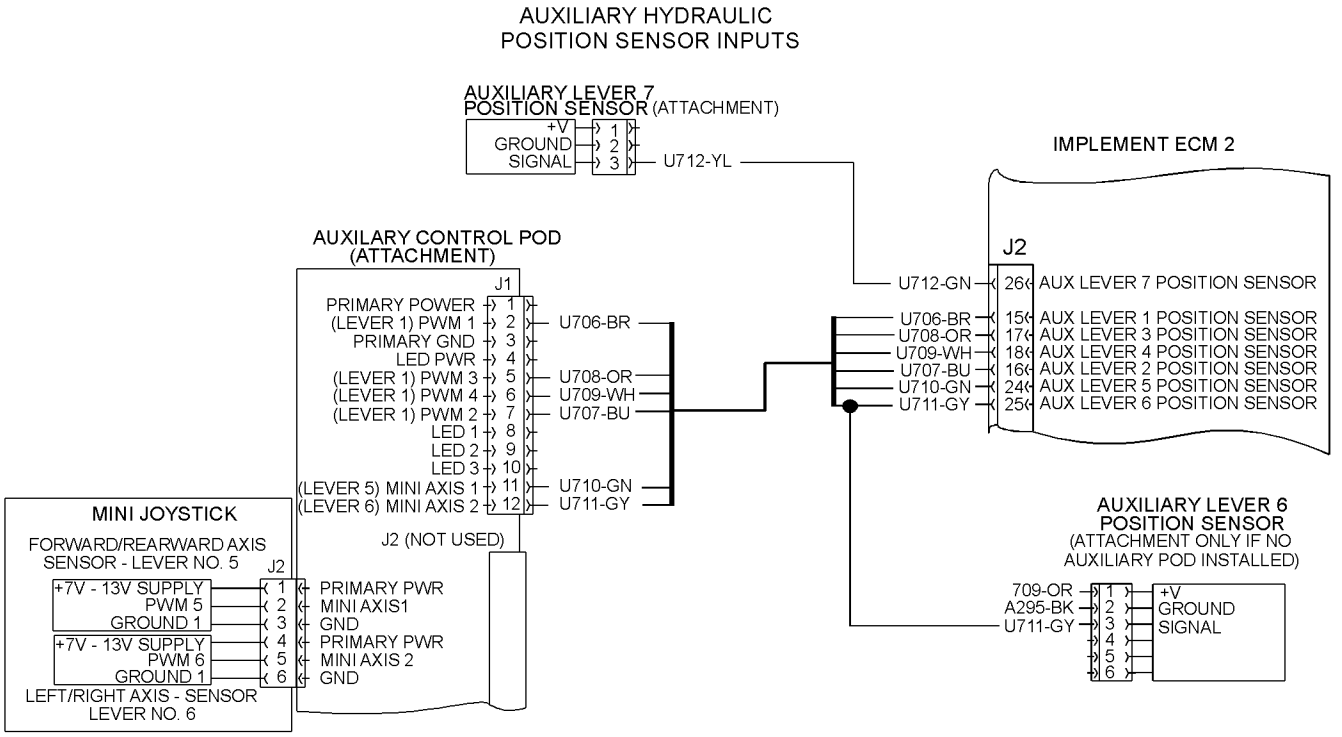


Illustration 71 g01469816

Auxiliary Hydraulic Position Sensor Input Connections

Note: For a complete connection diagram of the electronic auxiliary hydraulic control system, refer to Systems Operation, “Features” in this manual or to the “System Schematics” in the back of the manual.

The attachment auxiliary control pod contains four internal position sensors that send an input signal to the “Implement Control # 2” . Each of the position sensors is assigned to one of the four control levers.

The attachment mini joystick contains two position sensors that send an input signal to the “Implement Control # 2” . One for the forward rearward axis and one for the left or right axis

An attachment stand-alone lever 7 or attachment lever 6 and 7 combination have internal position sensors. These sensors send an input to the “Implement Control # 2” . The lever 6 signal input circuit is used by either the mini joystick left or right axis or by the stand-alone lever 6 position sensor depending on which attachment is installed.

The auxiliary hydraulic lever position sensors can be configured to control any of the installed auxiliary hydraulic valves. For more information on configuring the auxiliary hydraulic controls, refer to Testing and Adjusting, “Auxiliary Hydraulic System - Configure” in this manual.

Articulation Position Sensors

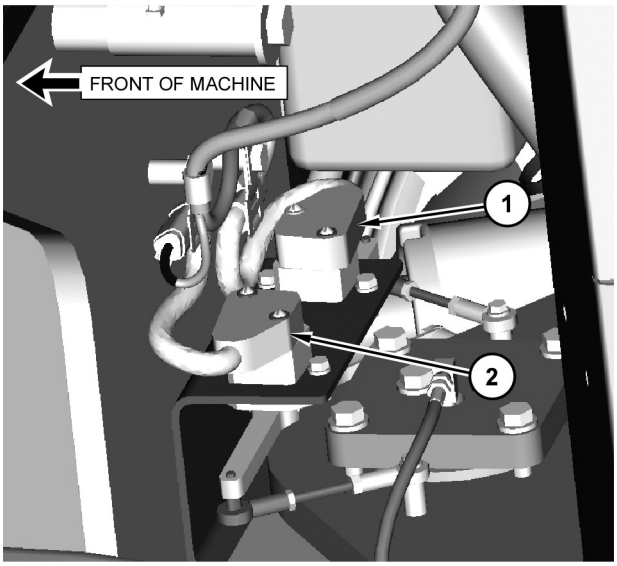


Illustration 72 g01327588

Early M Series Motor Graders were equipped with two angle position sensors for machine articulation. On the front half of the machine, in front of the articulation hitch. (View: Looking from the left side of the machine)

Left and right hand is in reference to the front of the machine.

(1) Machine Articulation Sensor #2 (right side)
(2) Machine Articulation Sensor #1 (left side)

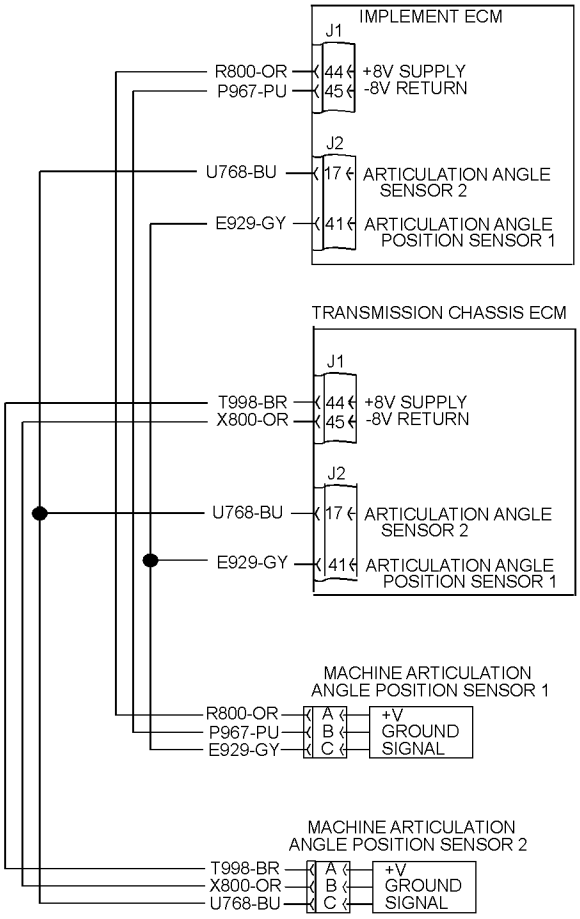


Illustration 73 g01313624

Dual Articulation Position Sensors 1 and 2 Input Circuits

The two machine articulation position sensors, for the M Series Motor Graders, are mounted on the front half of the machine. The sensors are located in front of the articulation hinge. Each position sensor will provide a PWM input to the Implement ECM and to the Transmission/Chassis ECM.

The position sensor for articulation angle (1) is powered by the 8 V sensor power supply of the Implement ECM. The position sensor for articulation angle (2) is powered by the 8 V sensor power supply of the Transmission/Chassis ECM.

The Transmission/Chassis ECM monitors the signals from the sensors to be instantly ready to activate and control the secondary steer system.

The Transmission/Chassis ECM monitors the PWM duty cycle from the articulation position sensors to determine the articulation angle of the machine. The sensor operates at a frequency of approximately 500 Hz. When the articulation angle of the machine is in the neutral position, the duty cycle from the position sensor to the ECM is approximately 55%. When the machine is articulated to the full left position, the duty cycle will be approximately 33%. When the machine is articulated to the full right position, the duty cycle will be approximately 74%.

When an abnormal condition is detected in one or both of the machine articulation position sensor circuits, the ECM will activate a diagnostic code for the affected circuit.

Single Articulation Position Sensor

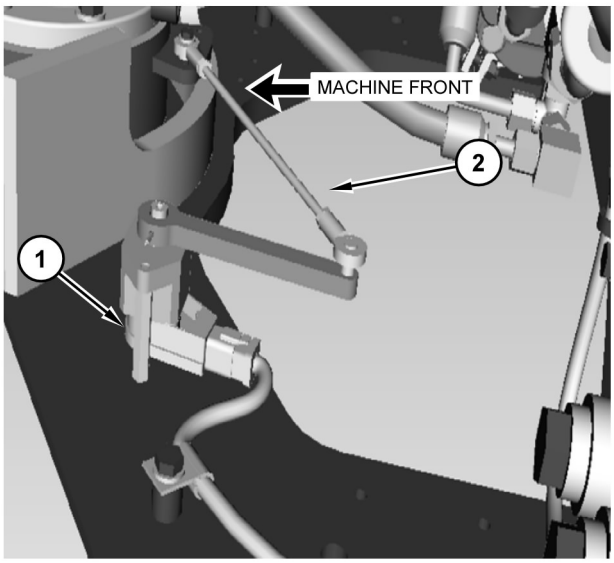


Illustration 74 g03236020

Machine Articulation Angle Position Sensor is on the left-hand side of the articulation hitch. (View from left side of machine with covers removed)

(1) Machine Articulation Sensor
(2) Mechanical linkage

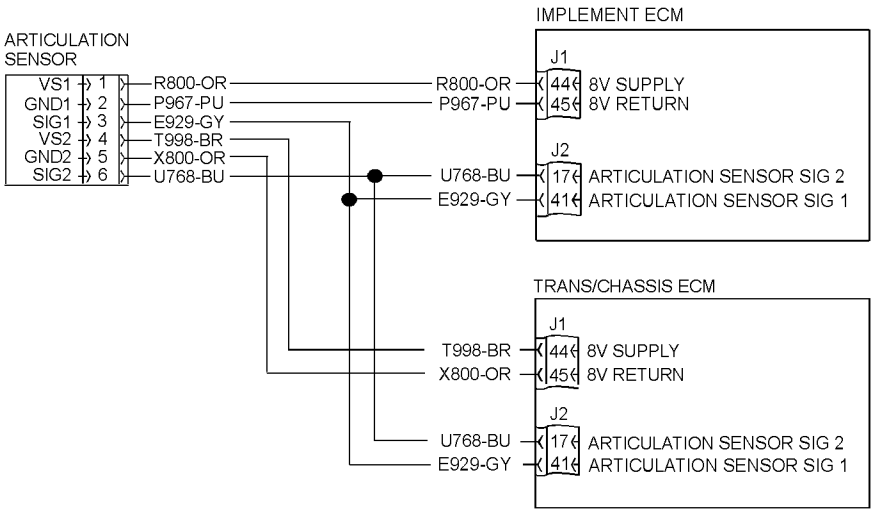


Illustration 75 g03209100

Single Articulation Position Sensor Circuit

Reference: Special Instruction, REHS7330, “Rework Procedure to Accommodate a Single Articulation Angle Position Sensor on Certain M-Series and M-Series 2 Motor Graders.{4806, 7610}”

The single “Dual Output Machine Articulation Position Sensor” is mounted on the front half of the machine at the hinge of the articulation. (Same location mount as the left-hand, articulation angle position sensor # 1, on the earlier 2-sensor configuration.) The position sensor provides a PWM signal input to the Implement ECM and to the Transmission/Chassis ECM.

The “articulation angle position sensor” is powered by the 8 VDC “Sensor Power” supply of the Implement ECM.

The Implement ECM measures the PWM duty cycle from the articulation position sensor to determine the articulation angle of the machine. The sensor operates at a frequency of approximately 500 Hz. When the articulation angle of the machine is in the neutral position, the input of the duty cycle from the position sensor to the ECM is approximately 55%. When the machine is articulated to the full left position, the duty cycle will be approximately 33%. When the machine is articulated to the full right position, the duty cycle will be approximately 74%.

The Transmission/Chassis ECM monitors the articulation angle of the machine and the gear selected for the machine. The ECM will limit the selected gear to a value no greater than “6F” or “5R” if the articulation of the machine is greater than 7°. The Transmission/Chassis ECM will limit the articulation angle to less than 7° if the gear selected for the machine is greater than “6F” or “5R” .

The monitoring of the articulation angle of the machine is not inhibited though operating the machine using the secondary steering function.

Steer Cylinder Position Sensors

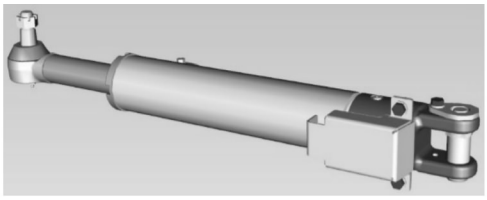


Illustration 76 g03856446

Illustration above shows new style cylinder with the new style sensor inside. Note the square connector cover.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50%. The sensor will detect a fault even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

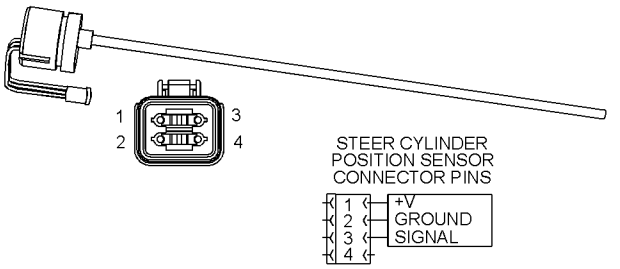


Illustration 77 g01313639

Steering Cylinder Position Sensor

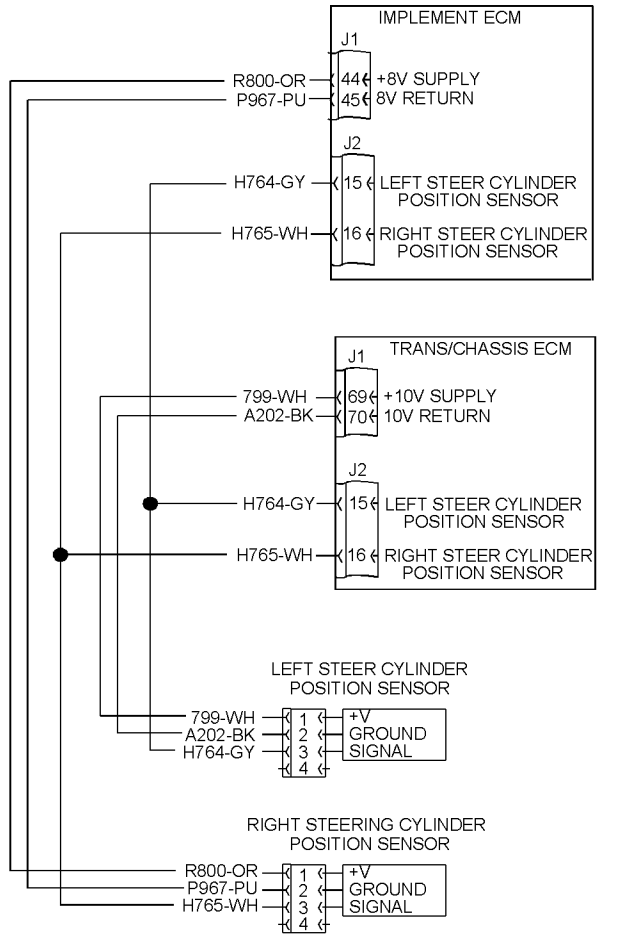


Illustration 78 g01313665

Steering Cylinder Position Sensor Circuits

The position sensors of the steering cylinder are mounted on the head end of the front steering cylinders. The position sensors provide a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the extension length of the steering cylinder changes, the duty cycle of the PWM sensor signal changes. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The small increments will make the measurement of the changes of the duty cycle difficult.

The Implement ECM will use the signals from the position sensors in the closed-loop control for the primary steering system. The ECM sends a control signal to the control module of the steering valve that is based on the left joystick steering axis position. The ECM monitors the signal from the position sensors of the steering cylinder to adjust the command accordingly.

The Transmission/Chassis ECM uses the signals from the position sensors of the steering cylinder and the position of the steering axis of the LH joystick. The signals from the ECM control the secondary steering system when activated.

Blade Right and Blade Left Constant Down Force Position Sensors

Note: The blade down force system is only available on the 16M and 24M Series Motor Graders.

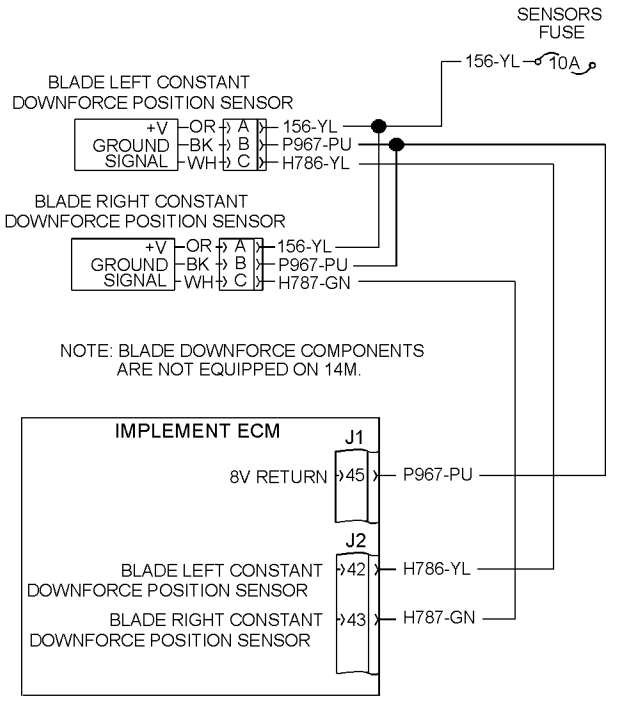


Illustration 79 g01333777

Blade Left and Blade Right Constant Down Force Dial Position Sensor input connections

The blade constant down force dial position sensors are connected to the left and the right blade down force dials. The position sensors provide a PWM duty cycle input signal to the Implement ECM that indicates the position of the blade constant down force dials.

When either of the dials are moved to the full clockwise position (no down force requested), the PWM duty cycle of the signal is approximately 93%. When the dial is moved through a detent to the full left counterclockwise position (maximum down force), the PWM duty cycle of the signal is approximately 10.6%.

When the blade down force system is enabled, the Implement ECM will send a PWM variable output current to the appropriate blade raise relief solenoid based on the signal that is received from the blade constant down force dial position sensors. This result is a specific amount of blade down force applied to the work surface.

A full counterclockwise dial position to the left detent will result in the blade being in a full down force condition such that the full weight of the blade is applied to the work surface. A full clockwise dial position for no down force will result in a zero down force condition such that little of the blade weight is applied to the work surface.

The Implement ECM monitors the blades constant down force dial position sensors circuits for diagnostics. If an abnormal condition is detected in one of the circuits, the ECM will activate a diagnostic code for the circuit. When this occurs, the ECM will not enable the blade down force system. If a diagnostic code for a blade down force component circuit is activated though the system is active, the ECM will disable the blade down force system.

For more information on the operation of the blade down force system, refer to the Systems Operation, “Features” section of this manual.

Steering Valve Control Module Inputs

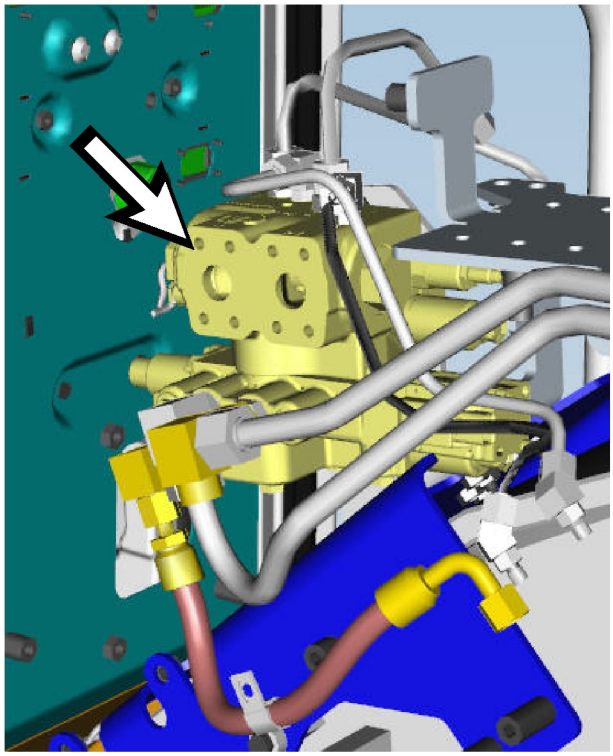


Illustration 80 g06084112

Steering Valve Control Module located in front of the cab

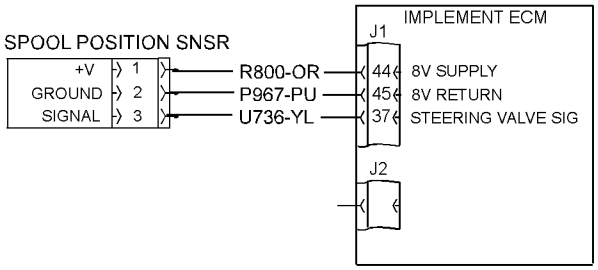


Illustration 81 g06076218

Steering Valve Control Module Circuit Connections

The control module for the steering valve provides an input signal to the Implement ECM. The input circuit is for the position sensor of the spool.

The Implement ECM supplies system power to the control module of the steering valve through an ON/OFF output driver.

For more information on the operation of the primary steering system and the steering control module, refer to Systems Operation, “Features” in this manual.

Hydraulic Pump Pressure Sensor

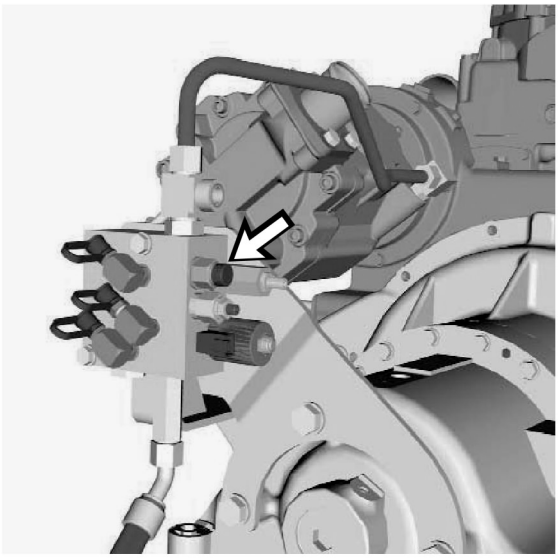


Illustration 82 g01314011

Location of the Hydraulic Pump Pressure Sensor on the Implement and Steering Control Manifold (upper left on the rear of the transmission)

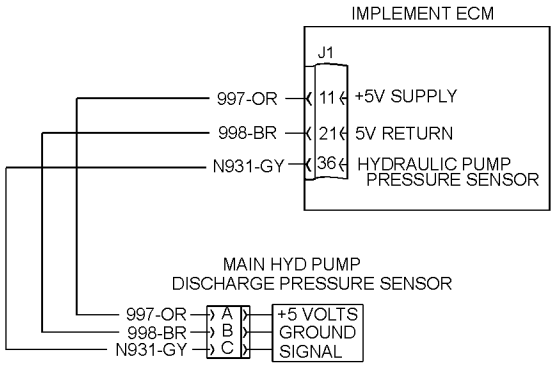


Illustration 83 g01314062

Hydraulic pump pressure sensor connections

The hydraulic pump pressure sensor provides an input to the Implement ECM to indicate the outlet pressure of the steering and implement hydraulic pump.

The pressure sensor sends a variable voltage input to the ECM that will indicate the pump outlet pressure. The sensor signal output voltage will range from 0.5 VDC when no pressure is detected to 4.5 VDC when 34500 kPa (5004 psi) pressure is detected.

The Implement ECM will use the input from the pressure sensor to determine if the pump is supplying sufficient pressure to operate the primary steering system and the implement system.

If the pump pressure is below the lower limit, the Implement ECM will send a request to the Transmission/Chassis ECM to activate the secondary steering system.

Hydraulic Oil Temperature Sensor

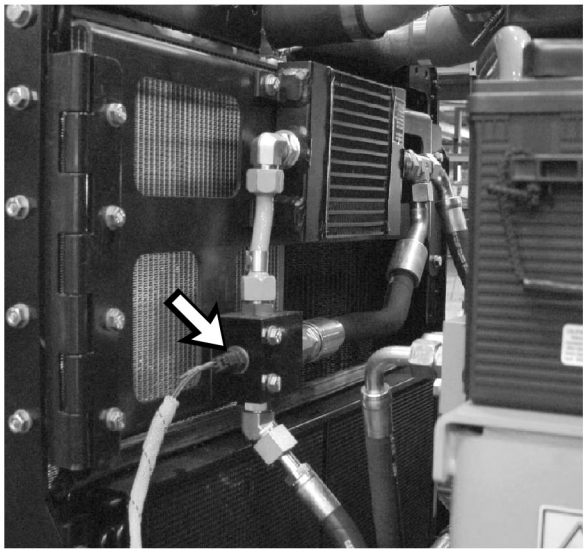


Illustration 84 g01314126

Hydraulic Oil Temperature Sensor located behind the radiator at the inlet to the hydraulic oil cooler

Note: On M Series motor graders, the hydraulic oil temperature sensor is mounted on the manifold that is on the outside of the radiator. The temperature sensor on these machines can be seen from the rear of the machine by looking through the radiator guard on the lower right side.

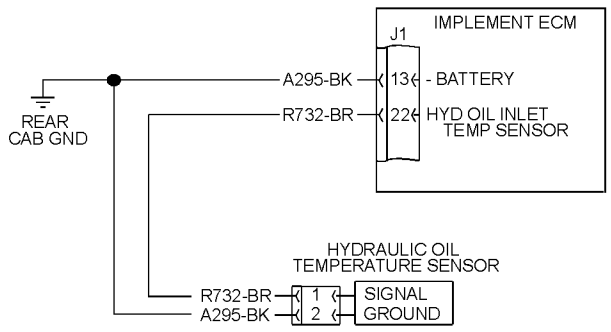


Illustration 85 g01314131

Hydraulic oil temperature sensor connections

The hydraulic oil temperature sensor allows the Implement ECM to monitor the temperature of the hydraulic oil.

The hydraulic oil temperature sensor provides a resistive voltage input signal to the ECM. The ECM will calculate the temperature of the hydraulic oil according to the value of the input signal. The voltage input signal from the sensor will ranges from 4.9 VDC at −40 °C (−40.0 °F) to 0.18 VDC at 150 °C (302.0 °F). The ECM will activate the FMI 03 diagnostic code when the input signal from the sensor is 5.0 VDC.

Switches

Switches will provide one of the following types of input signals to the ECM:

- An Open signal
- A Ground signal
- A +Battery or voltage signal

The contacts of a switch have two states of contact. The switch contacts are open or the switch contacts are closed.

- When switch contacts are open, no signal is provided to the corresponding input of the ECM. This “no signal” condition is also referred to as floating.
- When switch contacts are closed, either a ground signal or a +battery signal is sent to the corresponding input of the ECM.

Switch-to-ground type input circuits have an internal ECM “pull up voltage” that is present at the ECM contacts. An above normal voltage is internally connected to the input circuit of the ECM through a resistor that allows the ECM to detect a problem in the switch circuit. During normal operation, the switch signal will hold the circuit low, however, circuit conditions such as a disconnection or an open circuit will allow the circuit to be pulled high by the ECM pull up voltage. This will result in an above normal voltage at the contact of the ECM. If this action occurs when the ECM is expecting the circuit to be low, the ECM will activate a diagnostic code for the circuit.

Switch to +battery type input circuits have an internal ECM “pull down voltage” that is present at the contacts of the ECM. A below normal voltage is internally connected to the input circuit of the ECM through a resistor. This allows the ECM to detect a problem in the switch circuit. The circuit will be held high when the switch contacts are closed to a +battery source. If the circuit is open or has a bad connection, the pull down voltage will pull the circuit low. If this action occurs when the ECM is expecting the circuit to be high, the ECM will activate a diagnostic code for the circuit.

The ECM monitors the input circuits of the switch for the following circuits unless otherwise noted.

Key Start Switch

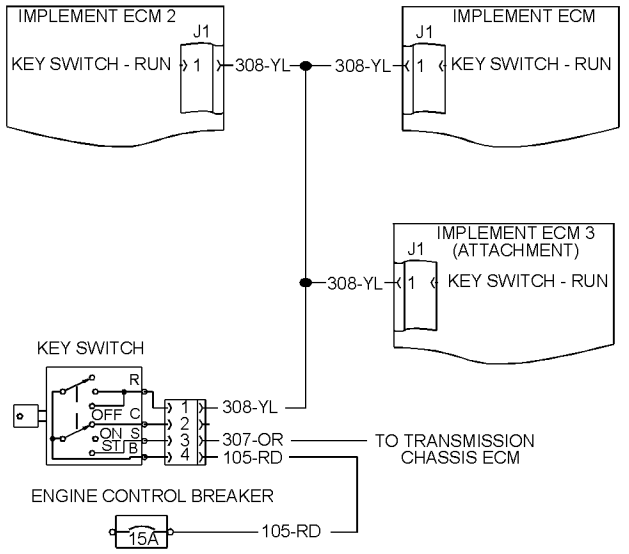


Illustration 86 g01314199

Key start switch connections

Each of the possible three modules of the Implement ECM monitor the status of the key start switch. When the key start switch is moved to the ON position or the START position, system power is supplied to the ECM modules at the connector contact J1-1.

The ECM module uses this input signal to determine when to activate or to deactivate the ECM “sleep mode” .

The key start switch circuit is not monitored for diagnostics by the Implement ECM.

Operator In Seat Switch

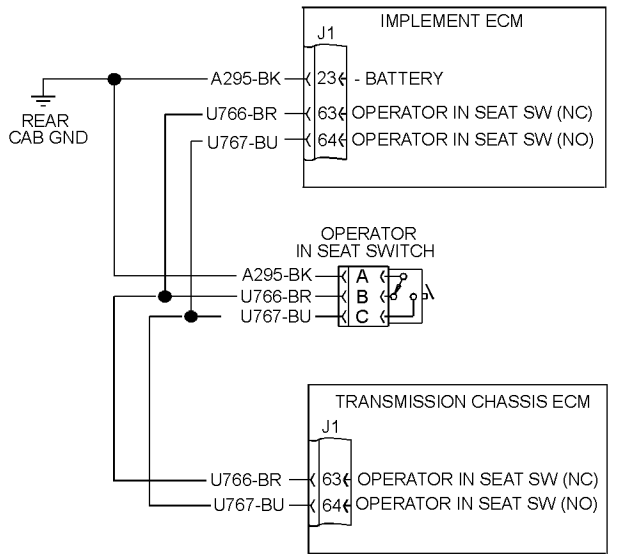


Illustration 87 g01422635

"Operator In Seat" switch connections

The "operator in seat" switch supplies two switch-to-ground type inputs to the Implement ECM and to the Transmission/Chassis ECM. The switch is located under the operator seat.

The Implement ECM will not enable the primary steering system or enable any of the implement systems, allow a shift of the machine out of neutral, or allow the disengagement of the parking brake when all of the following conditions are true:the "operator in seat" switch is not engaged, the transmission output speed is zero, the actual gear of the machine is neutral and the inching pedal is not pressed.

Auto Articulation Switch

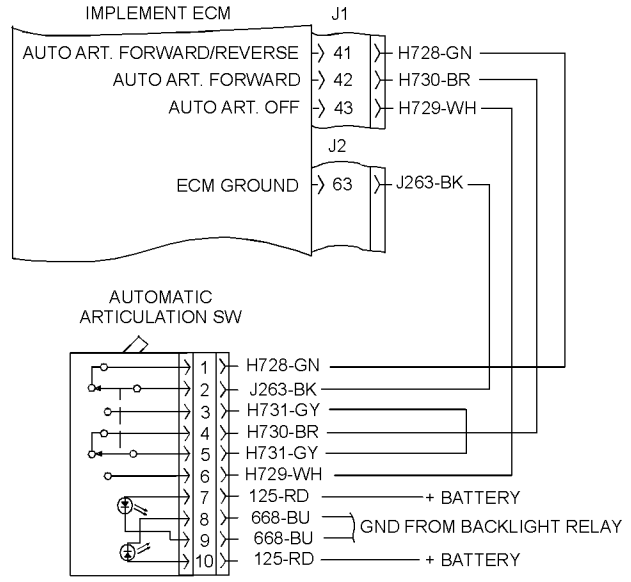


Illustration 88 g03867875

Schematic of the Automatic Articulation Switch connection to the Implement ECM

The Auto Neutral Articulation Switch supplies two, switch to ground, inputs to the Implement ECM 2. When activated, if articulation is allowed, the Implement ECM 2 will activate the correct solenoids to return the machine articulation to center. The switch is on the left joystick handle.

The automatic neutral articulation switch is connected to the ground that is supplied by the 5 V sensor return of the Transmission/Chassis ECM and the Implement ECM 2. The switch must lose both grounds to disrupt the switch operation. The illustration above indicates the power and ground connections for the switch.

During machine operation, when the rocker switch is in the center position, the Auto Neutral Articulation feature will not be enabled.

During machine operation, when the upper half of the rocker switch is depressed, the angle of machine articulation will follow the position of the front wheels as commanded by the steering joystick in gears 1F to 4F.

During machine operation, when the lower half of the rocker switch is depressed, the angle of machine articulation will follow the position of the front wheels in gears 1F to 4F and in gears 1R to 3R.

An articulation "return to center" command or a manual articulation command through the left-hand joystick controls, will always suspend the auto articulation function. The function will become active again if the rocker switch is not in the OFF position, the machine is in an accepted gear, and the steering angle realigns with the articulation angle.

Refer to the electrical schematic for your machine for more information on this switch circuit.

Implement Lockout Switch

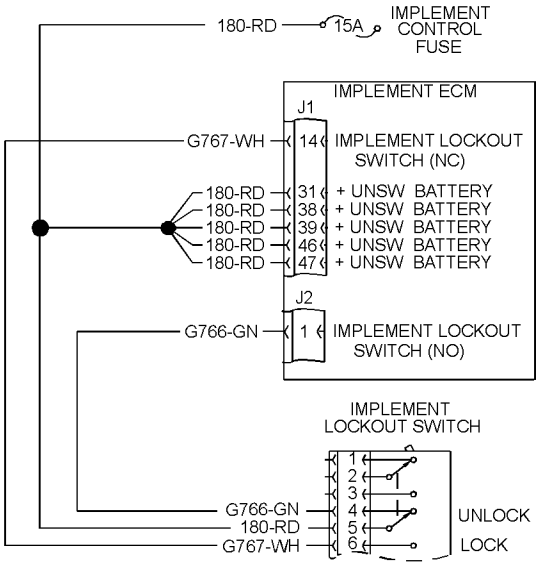


Illustration 89 g01314202

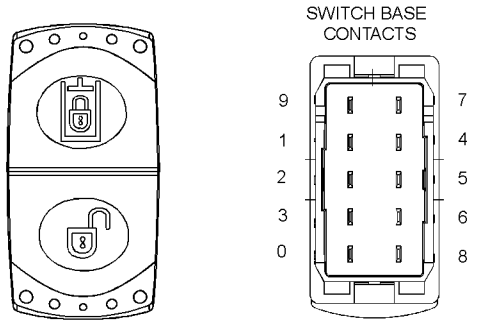


Illustration 90 g01314300

Implement Lockout Switch

The implement lockout switch informs the ECM that the operator wants to disable the hydraulics for the implements or that the operator wants to enable the hydraulics for the implements. The switch is a two-pole, double-throw rocker switch. The switch is on the right-hand console in the cab.

One pole of the switch is used to provide to switch to +battery inputs to the ECM to indicate the status of the switch. During normal operation, one of the inputs is open. The other input is closed to the +battery.

When the Implement ECM detects +battery voltage at the “LOCK” contact, the ECM deactivates the implement lockout solenoid which will block the pilot hydraulics for the implement controls.

Secondary Steer Test Switch

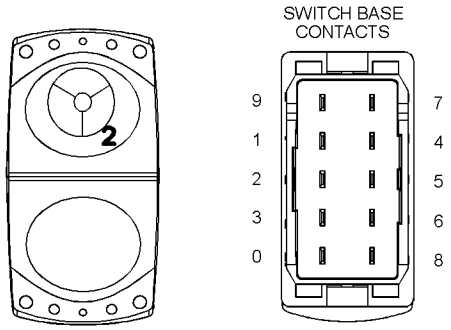


Illustration 91 g01333781

Secondary Steering Test Switch

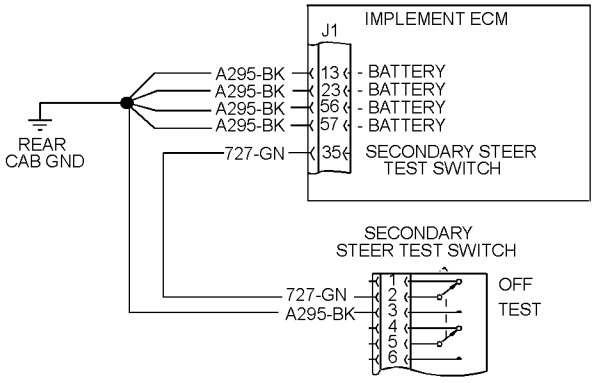


Illustration 92 g01314338

Secondary Steer Test Switch connections

The secondary steering test switch enables the operator to test the operation of the secondary steering system manually. The switch is a two-pole, double-throw rocker switch. One pole of the switch is used for the circuit of the secondary steering test signal. The other pole is not used.

The input circuit of the switch is connected to a switch-to-ground input contact at the Implement ECM. The ECM pull-up voltage holds the circuit high. When the switch is actuated, the circuit is grounded through the switch. When the Implement ECM detects the grounded circuit, the ECM will send a secondary steering test request to the Transmission/ Chassis ECM. If the secondary steering system does not respond as requested, an event code will be activated.

The test switch of the secondary steering circuit is not monitored for diagnostics by the Implement ECM.

Blade Constant Down Force Enable Switch

Note: The blade down force system is not available on the 14M Motor Grader.

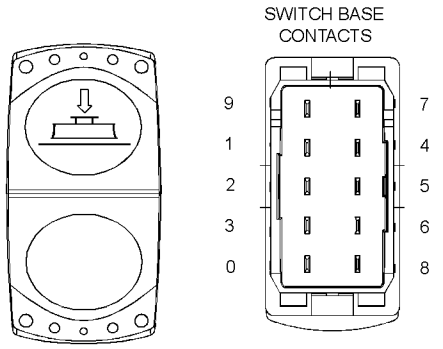


Illustration 93 g01333780

Blade Constant Down force enable switch

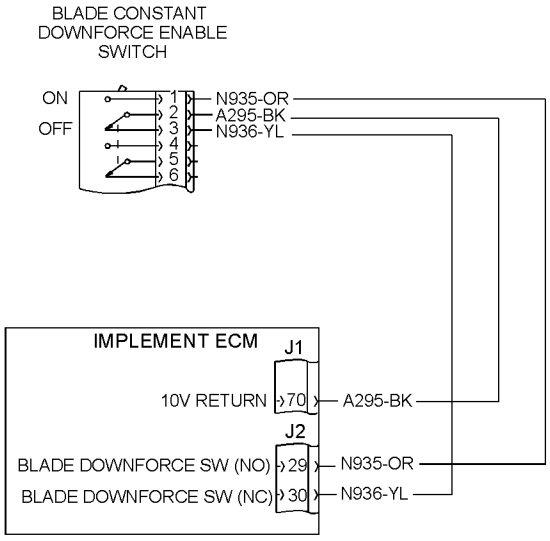


Illustration 94 g01333779

Blade Constant Down force enable switch input connections

The blade constant down force enable switch is used to signal to the Implement ECM that the operator has requested that the blade down force system to be activated.

The switch provides a switch-to-ground type of input to the ECM. One pole of the switch is used to provide the two inputs to the ECM. The other pole of the switch is not used. During normal operation, one of the switch inputs is open to ground. The other input is closed to the return circuit of the ECM (ECM ground).

The Implement ECM expects one of the circuits of the switch input to be grounded always. If both of the switch circuits are grounded at same time or if both of the switch circuits are open at the same time, the ECM will activate a diagnostic code for the switch circuits.

When the Implement ECM detects that the ON input circuit is grounded, the ECM will enable the blade down force system if certain machine conditions are correct.

For more information on the operation of the blade down force system, refer to the Systems Operation, “Features” section of this manual.

“Pilot Oil Supply Filter Bypass” Switch

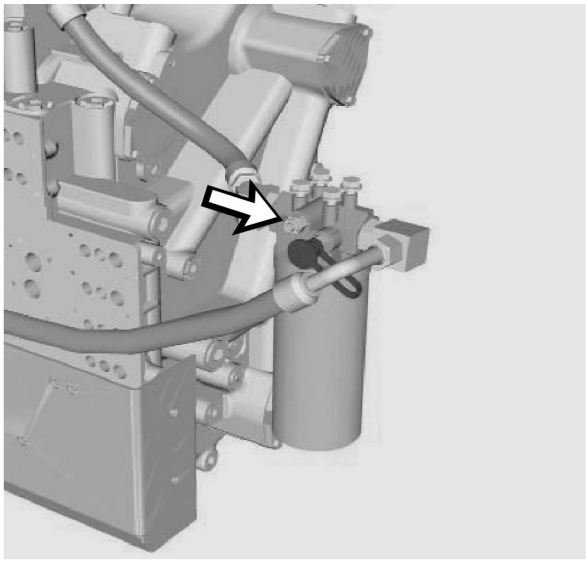


Illustration 95 g01314534

The “Pilot Oil Supply Filter Bypass” Switch is on the left side of the machine behind the transmission.

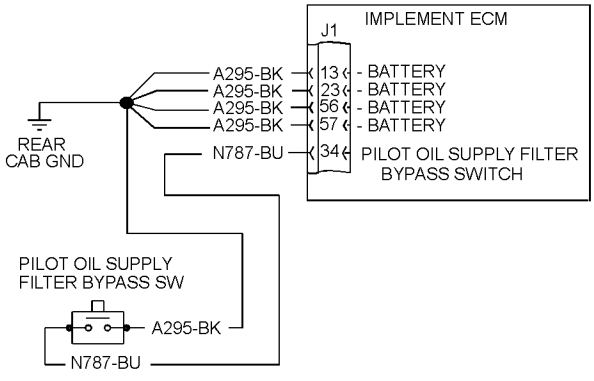


Illustration 96 g01314535

“Pilot Oil Supply Filter Bypass” switch connections

The “pilot oil supply filter bypass” switch is used to indicate to the Implement ECM that the filter is plugged.

The switch input circuit is connected to a switch-to-ground input contact at the Implement ECM. The ECM pull-up voltage holds the circuit high. When the oil pressure increases due to a plugged filter, the switch is actuated. When activated, the circuit is grounded through the switch. When the Implement ECM detects the grounded circuit, the ECM will activate an event code message for a plugged filter.

The “pilot oil supply filter bypass” switch circuit is not monitored for diagnostics by the Implement ECM.

Stable Blade Inertial Measurement Unit Sensor (If Equipped)

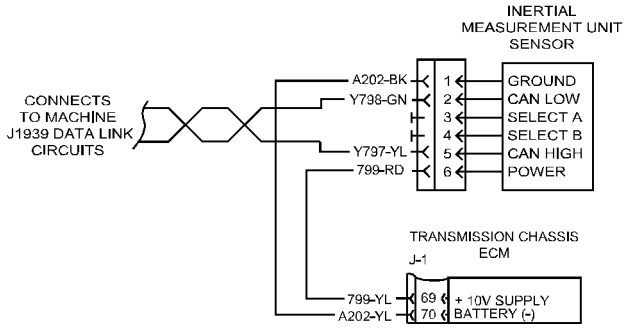


Illustration 97 g06006948

Stable Blade Inertial Measurement Unit Sensor connections

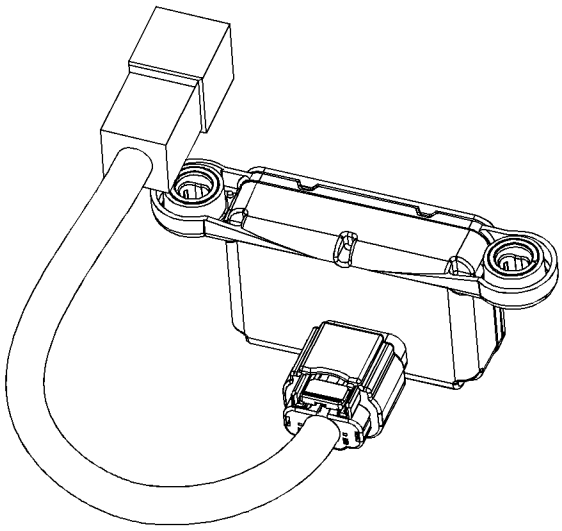


Illustration 98 g03884899

The Inertial Measurement Unit (IMU) Sensor is used with the Stable Blade feature. The sensor will send signals that indicate machine movement on the X, Y, and Z axis. These movements correspond to the machine rocking side to side, up and down and acceleration. Stable Blade will only use the up and down movement from the IMU sensor. The signals are sent on the J1939 CAN Data Link to the Transmission/Chassis ECM. The ECM will command the Engine ECM to reduce the engine speed based on the amount of machine movement. The decreased engine speed will reduce machine bounce and provide improved grading performance. The Stable Blade feature will only be active when enabled and the throttle lock is in the AUTO position. Stable Blade is only active in first gear forward through fifth gear forward. The feature provides the most benefit in higher working gears when the higher machine speed results in increased machine bounce.

- The Stable Blade feature will be active when the feature is ENABLED and the Throttle Lock is in Auto.
- When the Stable Blade feature is active, a pop-up message for “Stable Blade ON” will display for 3 seconds.
- When the Stable Blade feature is active, the “Ride Control” icon, on the display, will be ON.
- The forward gears where the feature can be active are 1F to 5F.
- If a higher gear is selected, a pop-up message for “Stable Blade OFF will display for 3 seconds.”. The feature will reactivate when back in the acceptable gear range.

- The Stable Blade feature is active can be ENABLED or DISABLED using the Message Display. From “Settings”, select “Stable Blade”. From “Stable Blade Setting”, use the UP or DOWN keys to toggle.
- The Stable Blade Sensitivity setting can be changed using the Message Display. From “Settings”, select “Stable Blade”. From “Stable Blade Setting” go to “Stable Blade Sensitivity”. Use the SIDE to SIDE keys to increase or decrease the sensitivity setting.
- The Stable Blade Sensitivity setting can also be accessed in the Cross Slope menu as the last menu option.

Accugrade Control Switches

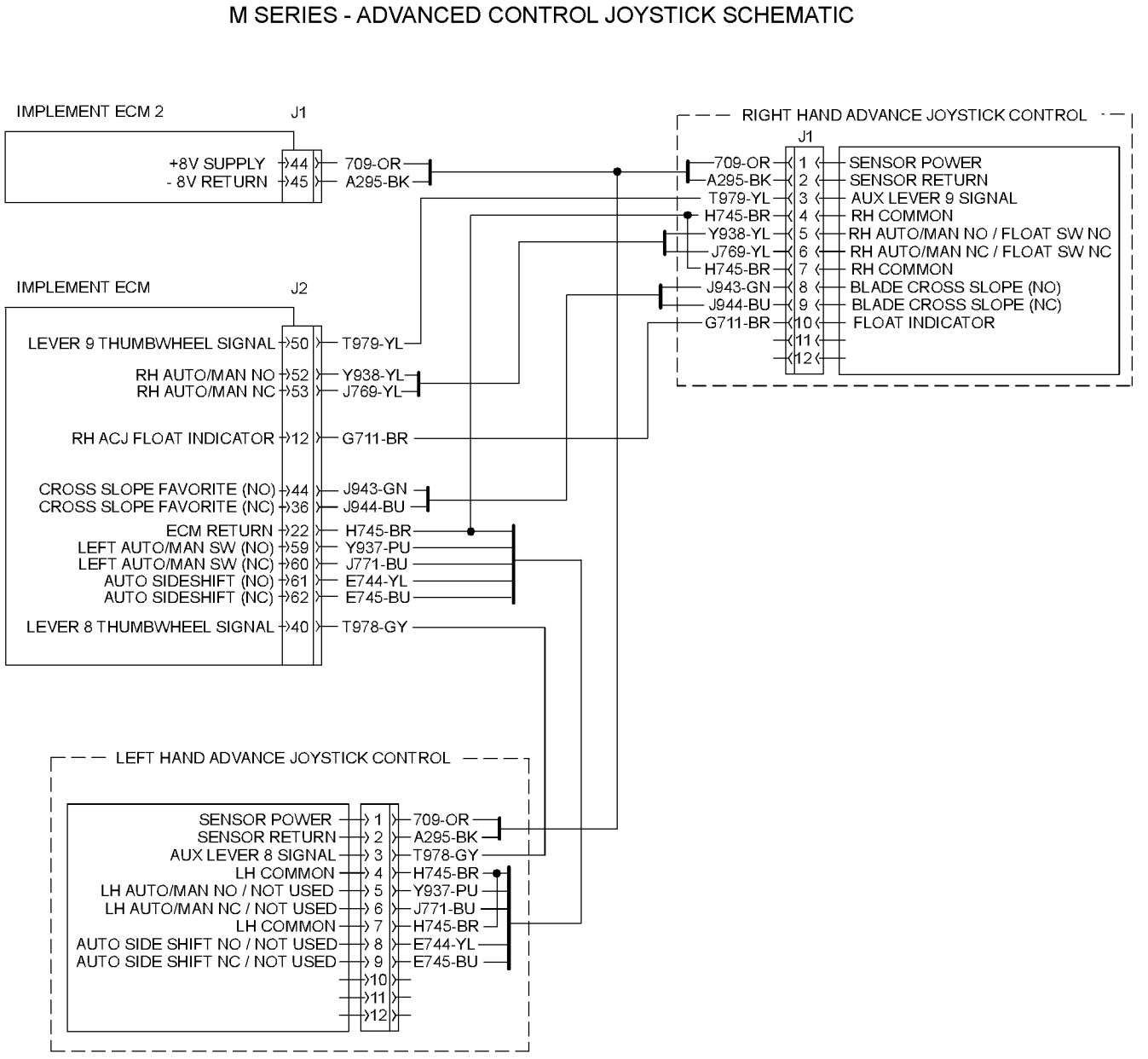


Illustration 99 g03856877

M Series Advanced Control Joystick schematic

Advanced Control Joystick (ACJ) can be used with Grade Control or Auxiliary Hydraulics. ACJ's are standard on machines with Grade Control and optional with Auxiliary Hydraulics.

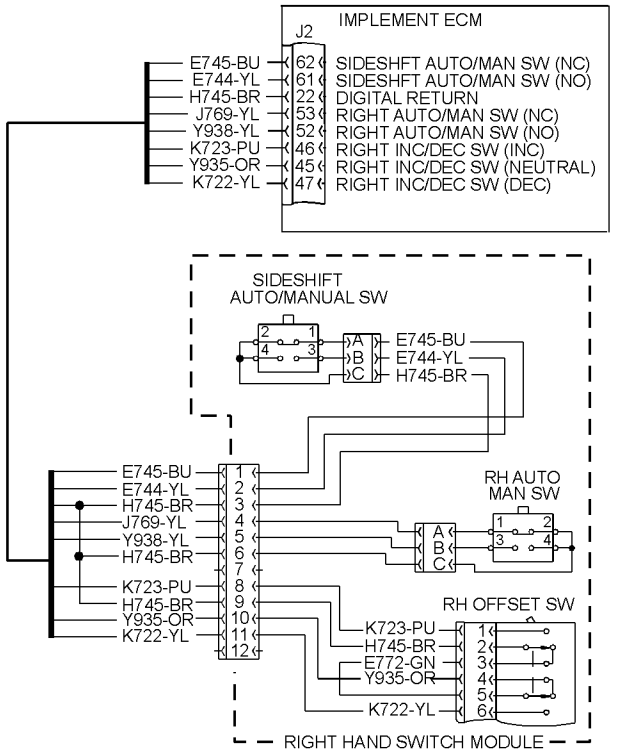


Illustration 100 g01314706

Right-Hand Switch Module

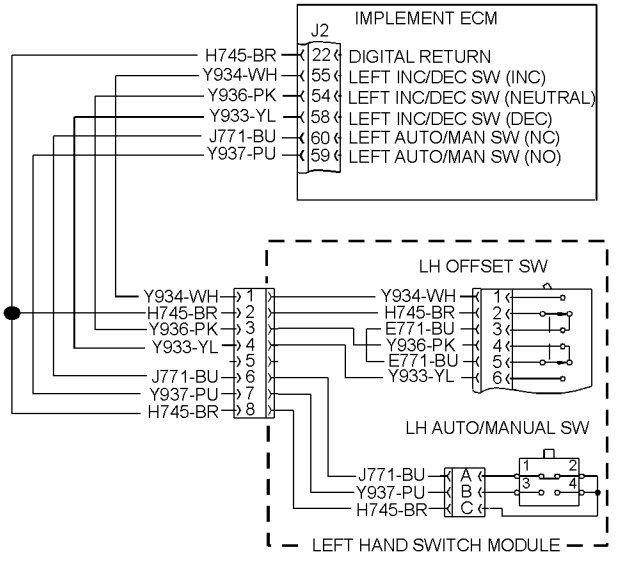


Illustration 101 g01314708

Left-Hand Switch Module

The right hand and the left-hand switch modules are installed on the machine when the Accugrade control system is installed on the machine. The switch modules are located outside of the left joystick and the right joystick.

The switches on the left and the right switch modules enable the manual adjustment of the increment, decrement, and auto/manual mode selection under Accugrade control.

The left hand and the right hand offset switches provide three inputs to the Implement ECM. The left auto/manual and right auto/manual switches and the sideshift auto/manual switch provide two inputs to the Implement ECM.

Each of the switch input circuits for all the switches are switch-to-ground type inputs to the ECM. The Implement ECM provides a return circuit (ECM ground) on one side of the switch contacts. When the switch contacts are open, the pull-up voltage of the ECM holds the circuit high. When the switch is actuated and the contacts close, the circuit is grounded through the switch contacts. The Implement ECM detects the grounded circuit and the Implement ECM activates the appropriate output to one of the solenoids of the blade control.

The switch circuits for the switches on the left and right switch modules are not monitored for diagnostics by the Implement ECM.

i06682550

Electronic Control Module

SMCS Code: 7610-II

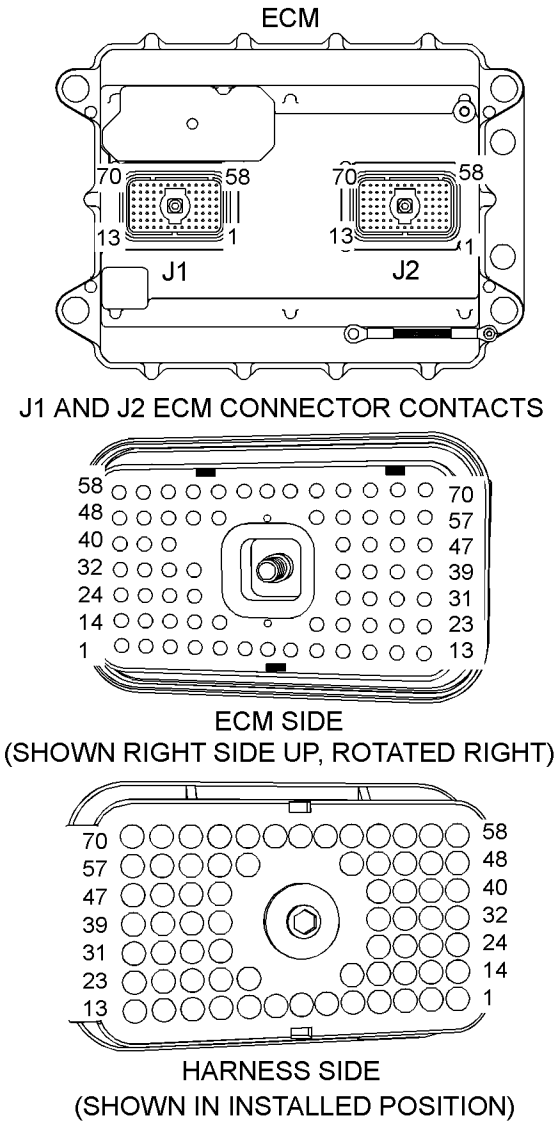


Illustration 102 g01309473

The M Series Motor Graders can be equipped with either two or three Implement ECM modules depending on the configuration of the machine. The Implement ECM modules are mounted inside the cab behind the seat.

The ECM will make decisions that are based on input data and programming parameters that have been flashed to the ECM memory. After the ECM modules receive the input data, the Implement ECM modules determine the correct response. The Implement ECM modules then send an output signal to the appropriate device. The internal input circuits and the internal output circuits of the ECM are connected to the machine wiring harness by two 70 contact connectors (J1 and J2).

Note: The ECM is not serviceable. If the ECM is damaged, the ECM must be replaced. The failure rate for the ECM is low. Contact your dealership's Technical Communicator for possible consultation with Caterpillar before replacing the ECM. Replace the ECM only after all the other possible causes of a particular problem have been investigated.

ECM Pull-Up Voltage

To aid in diagnostics of certain types of electrical circuits that are controlled by the ECM, an internal “pull-up voltage” is connected to sensor signal input contacts. An above normal voltage is internally connected to the ECM signal input circuit through a resistor.

During normal operation, the switch or sensor signal will perform one of the following:

- Hold the circuit low.
- Hold the circuit at a certain signal amplitude.

The following circuit conditions will allow the circuit to be pulled high by the ECM pull-up voltage:

- A loss of power to the component
- A disconnect or an open circuit

The above conditions will result in an above normal voltage at the contact of the ECM. When the circuit is pulled high by the ECM pull-up voltage, an FMI 03 diagnostic code indicates that the following condition exists:

- Voltage is above normal

The types of ECM input circuits that have pull-up voltage present are:

- Pulse Width Modulated (PWM) sensor input circuits
- Switch-to-ground switch input circuits
- Active analog (voltage) input signal circuits
- Passive analog (resistance) input signal circuits

ECM Pull-Down Voltage

To aid in diagnostics of electrical circuits that are controlled by the ECM, an internal “pull-down” voltage is connected to ECM switch to battery type input circuits.

During normal operation, the switch contacts that are allowing the connection to a voltage source will hold the circuit high. The following circuit conditions will allow the circuit to be pulled low by the ECM pull-down voltage:

- A loss of power to the switch supply voltage
- A disconnection in the switch circuit
- An open circuit

The above conditions will result in a below normal voltage at the contact of the ECM. When the circuit is pulled low by the ECM pull-down voltage, an FMI 04 diagnostic code indicates that the condition exists:

- Voltage is below normal

Inputs

The machine has several different types of input devices. The ECM receives machine status information from the input devices. The ECM determines the correct output action that is required based on memory and software parameters. The machine utilizes the following types of inputs:

- Switch type
- Sensor type

Switches provide signals to the switch inputs of the ECM. The possible outputs of a switch are listed: an open signal, a grounded signal and + battery signal.

Sensors provide an electrical signal to the ECM that constantly changes. The sensor input to the ECM can be one of several different types of electrical signals such as:

- Pulse Width Modulated (PWM) signals
- Voltage signals
- Frequency input signals

Note: All possible inputs to the Implement ECM modules are listed in the tables for the 70-pin connectors.

Outputs

The ECM sends electrical signals through the outputs. The outputs can create an action or the outputs can provide information to the ECM. The ECM can send output signals to the system components in one of several different electrical signal types such as:

- Driver outputs
- Sinking driver outputs
- Sensor power supply outputs
- Data link outputs

Note: All possible outputs for each of the Implement ECM modules are listed in the tables for the 70-pin connectors.

Input/Output

Communication between the Implement ECM modules and between the other ECM modules on the machine is conducted over data link circuits. The data link circuits allow the sharing of information with other electronic control modules. The data link circuits are bidirectional.

The ECM supports two types of data link systems.

- Cat Data Link
- SAE J1939 Data Link

The two types of data links are the main structure for communication between all the control modules on the machine. A machine may have more than one CAN data link. Dedicated CAN data link circuits can be used for communication between specific controls on the machine.

The Implement ECM communicates with the Accugrade ECM over a dedicated Accugrade CAN data link circuit. Communication between the Implement ECM modules and the other ECM modules on the machine are conducted over the J1939 data link circuit that is connected to each control module. The ECM modules use the Cat data link to send and to receive information from the Caterpillar Electronic Technician (ET).

A module identifier (MID) is assigned to each Implement ECM. The MID codes for the Implement ECM modules are listed below:

Implement ECM – MID 082

Implement ECM 2 – MID 145

Implement ECM 3 – MID 147

Note: All diagnostic codes for the components in the implement control system are activated by the Implement ECM (MID 082).

Note: The following tables list every possible connection for each of three possible Implement ECM modules. Depending on the attachments that are installed on your machine, Implement ECM 3 and some of the listed circuits may not be present.

Table 2

Implement ECM Connector J1 (MID 082) Contact Descriptions[1]		
No.	**Function**	**Type**
1	Key Switch Run	Input
10	Cat Data Link +	Input/Output
11	+5 Volt Supply	Power Supply
13	- Battery	System Ground
14	Implement Lockout SW (N/C)	STB Input[2]
20	Cat Data Link -	Input/Output
21	5 VDC Power Supply Return	ECM Ground
24	Backlight Sense	STG[3] Input
26	Location Code 0	Open
27	Location Code 1	Ground
28	Location Code 2	Open
31	+Battery	System Power
32	ECM Location Code Enable	Ground
34	Hyd Pilot Supply Filter Bypass SW	STG Input
35	Secondary Steering Test SW	STG Input
36	Hyd Pump Press Sensor	Active Analog Input
37	Steering Valve Spool Position Signal	Active Analog Input
38	+Battery	System Power
39	+Battery	System Power
40	Steering Valve Error Signal	STG Input
44	+8 Volt Supply	Power Supply
45	8 Volt Return	ECM Ground
46	+Battery	System Power
47	+Battery	System Power
48	Blade Pitch Forward Solenoid	PWM Driver Output
49	Blade Pitch Rearward Solenoid	PWM Driver Output
50	PWM Driver Return 1-4	Solenoid Return
51	Articulate Left Solenoid	PWM Driver Output
52	Articulate Right Solenoid	PWM Driver Output
54	PWM Driver Return 11-12	Solenoid Return
55	PWM Driver Return 9-12	Solenoid Return
56	- Battery	System Ground

(continued)

(Table 2, contd)

Implement ECM Connector J1 (MID 082) Contact Descriptions[1]		
No.	**Function**	**Type**
57	- Battery	System Ground
58	Blade Left Raise Solenoid	PWM Driver Output
59	Blade Right Raise Solenoid	PWM Output
60	PWM Driver Return 5-8	Solenoid Return
61	Blade Left Lower Solenoid	PWM Driver Output
62	Blade Right Lower Solenoid	PWM Driver Output
63	Operator Seat SW (N/C)	STG Input
64	Operator Seat SW (N/O)	STG Input
65	Blade Sideshift Left Solenoid	PWM Driver Output
66	Blade Sideshift Right Solenoid	PWM Driver Output
67[4]	Wheel Lean Left Solenoid	PWM Driver Output
68[4]	Wheel Lean Right Solenoid	PWM Driver Output
67[5]	Left Primary Steer Solenoid	PWM Driver Output
68[5]	Right Primary Steer Solenoid	PWM Driver Output
69	+10V Supply	Power Supply
70	-Battery	System Ground

(1) Contacts that are not listed are not used.
(2) Switch to +battery.
(3) Switch to ground.
(4) **S/N:** B921–368; R9A1–UP; R9B1–UP; B9C1–UP; R9C1–UP; B9D1–4762; B9E1–1143; B9F1–UP; B9G1–UP; D9G1–1585; B9H1–UP; R9H1–UP; B9J1–UP; R9J1–UP; B9L1–UP; B9M1–UP; B9N1–UP; B9R1–UP; B9T1–UP; D9T1–1438; B9W1–UP; D9W1–UP
(5) **S/N:** B92369–UP; B9D4763–UP; B9E1144–UP; D9G1586–UP; D9T1439–UP

Table 3

Implement ECM Connector J2 (MID 082) Contact Descriptions[1]		
No.	**Function**	**Type**
1	Implement Lockout SW (N/C)	STB[2] Input
2	Auxiliary Valve 7 - Solenoid 1	On/Off Output
3	Auxiliary Valve 7 - Solenoid 2	On/Off Output

(continued)

(Table 3, contd)

Implement ECM Connector J2 (MID 082) Contact Descriptions[1]		
No.	**Function**	**Type**
4	Solenoid Return 1	ECM Ground
5[3]	Pilot Steer Solenoid	On/Off Output
7	Implement Pilot Supply Solenoid	On/Off Output
8	Solenoid Return 2	ECM Ground
9	Aux Lever 1 Float Indicator	Sinking Output
10	Aux Lever 4 Float Indicator	Sinking Output
11	Aux Lever 6 Float Indicator	Sinking Output
13	Blade Force Indicator	Sinking Output[5]
15	Left Steer Cylinder Position Sensor	PWM Input
16	Right Steer Cylinder Position Sensor	PWM Input
17	Articulation Angle Position Sensor 2	PWM Input
18	Steer Lever Position Sensor 1	PWM Input
19	Secondary Steer Request Signal	Sinking Output
20	Steer Control Signal	Sinking Output
21	Backlight Relay	Sinking Output
22	Digital Return	Sensor Return
25	Blade Pitch Input Position Sensor	PWM Input
26	Articulation Lever Position Sensor	PWM Input
28	Auto Neutral Articulation SW (N/O)	STG[4] Input
29	Blade Down Force SW (N/O)	STG Input[5]
30	Blade Down Force SW (N/C)	STG Input[5]
32	Circle Drive Lever Position Sensor	PWM Input
33	Blade Sideshift Lever Position Sensor	PWM Input
34	Steer Lever Position Sensor 3	PWM Input
35	Blade Right Lift Lever Position Sensor	PWM Input

(continued)

(Table 3, contd)

Implement ECM Connector J2 (MID 082) Contact Descriptions[1]		
No.	**Function**	**Type**
41	Articulation Angle Position Sensor 1	PWM Input
42	Left Blade Downforce Control	PWM Input[5]
43	Right Blade Downforce control	PWM Input[5]
45	Right Increment/Decrement SW (Neutral)	STG Input
46	Right Increment/Decrement SW (Inc)	STG Input
47	Right Increment/Decrement SW (Dec)	STG Input
48	Steer Lever Position Sensor 2	PWM Input
49	Blade Left Lift Lever Position Sensor	PWM Input
51	Circle Sideshift Input Position Sensor	PWM Input
52	Right Auto/Manual SW (N/O)	STG Input
53	Right Auto/Manual SW (N/C)	STG Input
54	Left Increment/Decrement SW (Neutral)	STG Input
55	Left Increment/Decrement SW (Inc)	STG Input
58	Left Increment/Decrement SW (Dec)	STG Input
59	Left Auto/Manual SW (N/O)	STG Input
60	Left Auto/Manual SW (N/C)	STG Input
61	Sideshift Auto/Manual SW (N/O)	STG Input
62	Sideshift Auto/Manual SW (N/C)	STG Input
64	Accugrade CAN Data Link +	Input/Output
65	Accugrade CAN Data Link -	Input/Output
67	J1939 Data Link High	Input/Output
68	J1939 Data Link Low	Input/Output

(1) Contacts that are not listed are not used.
(2) Switch to + battery.

(continued)

(Table 3, contd)

(3) **S/N:** B92369–UP; B9D4763–UP; B9E1144–UP; D9G1586–UP; D9T1439–UP

(4) Switch to ground.

(5) The blade downforce function is not available on the 14M.

Table 4

Implement Control # 2 ConnectorJ1 (MID 145) Contact Descriptions(1)		
No.	**Function**	**Type**
1	Key Switch Run	Input
10	Cat Data Link +	Input/Output
13	- Battery	System Ground
20	Cat Data Link -	Input/Output
23	- Battery	System Ground
26	Location Code 0	Ground
27	Location Code 1	Ground
28	Location Code 2	Open
31	+Battery	System Power
38	+Battery	System Power
39	+Battery	System Power
46	+Battery	System Power
47	+Battery	System Power
48	Circle Sideshift Left Solenoid	PWM Driver Output
49	Circle Sideshift Right Solenoid	PWM Driver Output
50	PWM Driver Return 1-4	Solenoid Return
51	Circle Left Solenoid	PWM Driver Output
52	Circle Right Solenoid	PWM Driver Output
55	PWM Driver Return 9-12	Solenoid Return
56	- Battery	System Ground
57	- Battery	System Ground
58	Auxiliary Valve 1 - Solenoid 1	PWM Driver Output
59	Auxiliary Valve 1 - Solenoid 2	PWM Output
60	PWM Driver Return 5-8	Solenoid Return
61	Auxiliary Valve 2 - Solenoid 1	PWM Driver Output
62	Auxiliary Valve 2 - Solenoid 2	PWM Driver Output
65	Left Blade Downforce Proportional Solenoid Valve	PWM Driver Output (2)
66	Left Blade Downforce Proportional Solenoid Valve	PWM Driver Output (2)
67(3)	Wheel Lean Left Solenoid	PWM Driver Output

(continued)

(Table 4, contd)

Implement Control # 2 ConnectorJ1 (MID 145) Contact Descriptions(1)		
No.	**Function**	**Type**
68(3)	Wheel Lean Right Solenoid	PWM Driver Output
70	-Battery	System Ground

(1) Contacts that are not listed are not used.

(2) The blade downforce function is not available on the 14M.

(3) **S/N:** B92369–UP; B9D4763–UP; B9E1144–UP; D9G1586–UP; D9T1439–UP

Table 5

Implement ECM 2 Connector J2 (MID 145) Contact Descriptions(1)		
No.	**Function**	**Type**
4	Solenoid Return 1	ECM Ground
5	Left Blade Downforce Enable Solenoid Valve	On/Off Output(2)
6	Right Blade Downforce Enable Solenoid Valve	On/Off Output(2)
8	Solenoid Return 2	ECM Ground
15	Auxiliary Valve Lever 1 Position Sensor	PWM Input
16	Auxiliary Valve Lever 2 Position Sensor	PWM Input
17	Auxiliary Valve Lever 3 Position Sensor	PWM Input
18	Auxiliary Valve Lever 4 Position Sensor	PWM Input
24	Auxiliary Valve Lever 5 Position Sensor	PWM Input
25	Auxiliary Valve Lever 6 Position Sensor	PWM Input
26	Auxiliary Valve Lever 7 Position Sensor	PWM Input
67	J1939 Data Link High	Input/Output
68	J1939 Data Link Low	Input/Output

(1) Contacts that are not listed are not used.

(2) The blade downforce function is not available on the 14M.

Table 6

Implement Control # 3 ConnectorJ1 (MID 147) Contact Descriptions(1)		
No.	**Function**	**Type**
1	Key Switch Run	Input
10	Cat Data Link +	Input/Output

(continued)

(Table 6, contd)

Implement Control # 3 ConnectorJ1 (MID 147) Contact Descriptions[1]		
No.	**Function**	**Type**
13	- Battery	System Ground
20	Cat Data Link -	Input/Output
23	- Battery	System Ground
26	Location Code 0	Ground
27	Location Code 1	Open
28	Location Code 2	Ground
31	+Battery	System Power
38	+Battery	System Power
39	+Battery	System Power
46	+Battery	System Power
47	+Battery	System Power
48	Auxiliary Valve 3 - Solenoid 1	PWM Driver Output
49	Auxiliary Valve 3 - Solenoid 2	PWM Driver Output
50	PWM Driver Return 1-4	Solenoid Return
51	Auxiliary Valve 4 - Solenoid 1	PWM Driver Output
52	Auxiliary Valve 4 - Solenoid 2	PWM Driver Output
56	- Battery	System Ground
57	- Battery	System Ground
58	Auxiliary Valve 5 - Solenoid 1	PWM Driver Output
59	Auxiliary Valve 5 - Solenoid 2	PWM Output
60	PWM Driver Return 5-8	Solenoid Return
61	Auxiliary Valve 6 - Solenoid 1	PWM Driver Output
62	Auxiliary Valve 6 - Solenoid 2	PWM Driver Output
70	-Battery	System Ground

(1) Contacts that are not listed are not used.

Table 7

Implement Control # 3 Connector J2 (MID 147) Contact Descriptions[1]		
No.	**Function**	**Type**
67	J1939 Data Link High	Input/Output
68	J1939 Data Link Low	Input/Output

(1) Contacts that are not listed are not used.

i06690239

Electrical Output Components

SMCS Code: 1400; 5000

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

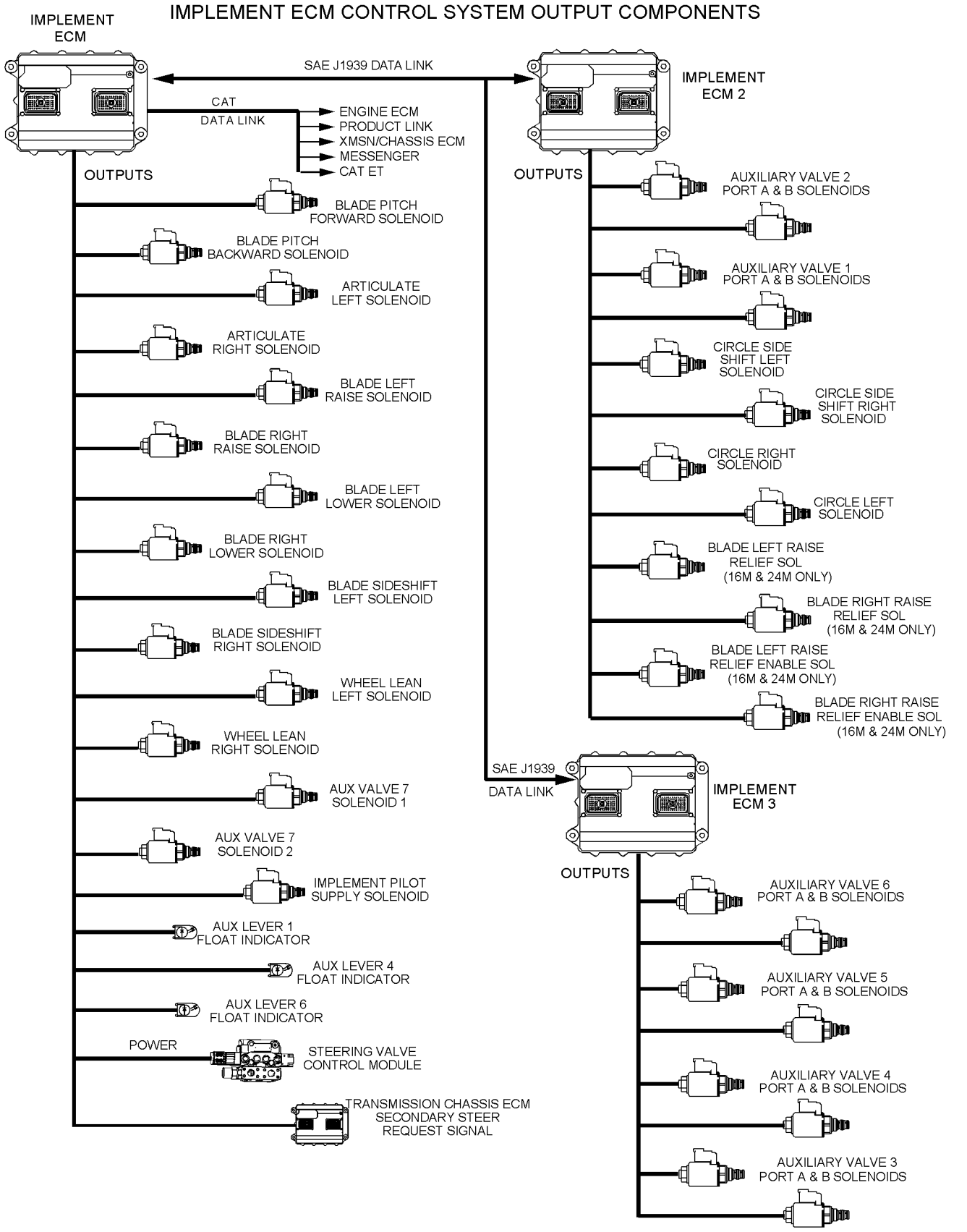


Illustration 103 g06081823

Outputs

The modules of the Implement ECM use output circuits to send electrical control signals to output components. The output signals can create an action or the output signals can provide information to the ECM. The ECM will use different types of output signals to control the system components. The types of electrical signal are the following:

- PWM proportional driver outputs
- ON/OFF driver outputs
- Sinking driver outputs
- Sensor power supply outputs
- Data link outputs

The ECM monitors the circuits of the output components. If the ECM determines that an abnormal condition exists in one of the circuits, the ECM will log a diagnostic code for the involved component.

Steering Valve Control Module Outputs

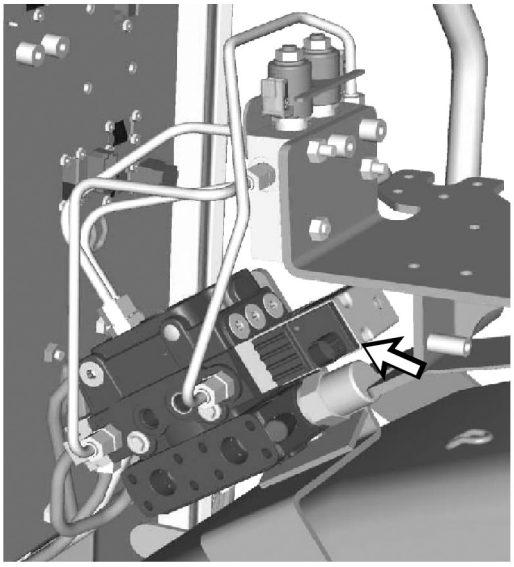


Illustration 104 g01313690

Steering Valve Control Module located in front of the cab

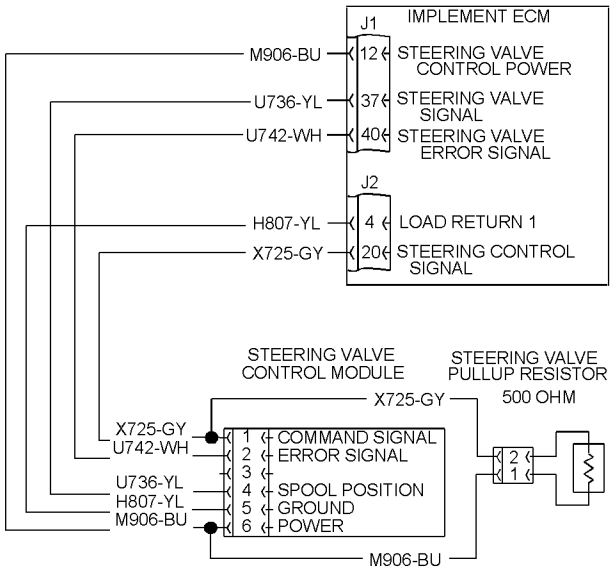


Illustration 105 g01313683

Connections of the “Steering Valve Control Module” Circuit

Steering Valve Control Power Supply

The Implement ECM supplies power for operation of the control module of the steering valve through an ON/OFF output driver. The power supplied to the steering module must be between 8.5 VDC and 36 VDC, however, the ECM will not allow the power to drop below 18.0 VDC without activating a diagnostic code for low system voltage. When the key start switch is in the ON position or the engine is started, the ECM will turn ON the power output for the steering valve control module.

Steering Valve Control Module Control Signal

The Implement ECM uses a “closed loop” feedback system to control the position of the front wheels on the motor grader. The Implement ECM continually monitors the position of the steer cylinders and the position of the left joystick (steering axis) and the Implement ECM outputs a control signal to the control module of the steering valve.

The outputs of the Implement ECM go to the control module of the steering valve. The outputs are for the operating power and the steering signal command. The ECM receives inputs from the control module of the steering valve. The inputs are for the position sensor for the spool and the signal of error.

The Implement ECM uses a Pulse Width Modulated output signal for the control signal to the control module of the steering valve. The duty cycle of the control signal will range between 25 ± 5 percent and 75 ± 5 percent. When the left joystick is stationary in any position on the left or the right axis and the front wheels are aligned with the position of the joystick, the duty cycle of the control signal will be 50 ± 5 percent until the joystick is moved to another position.

When the joystick is moved in the left direction, the duty cycle of the control signal increases from 50 ± 5 percent to a maximum of 75 ± 5 percent. When the joystick is moved in the right direction, the duty cycle of the control signal decreases from 50 ± 5 percent to a minimum of 25 ± 5 percent.

The Implement ECM provides power to the control module of the steering valve through an ON/OFF output driver. The module for the steering operates between 8.5 VDC and 36 VDC. However, the ECM will not allow the system voltage to go below 18.0 VDC without activating a diagnostic code for low system voltage.

Secondary Steering Request Signal

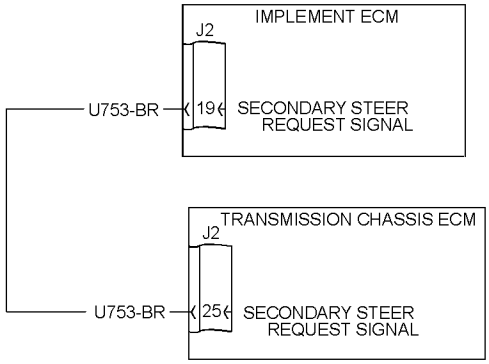


Illustration 106 g01305868

Connections of “Secondary Steering Request Input” Circuit

The circuit for the “secondary steering request” is a “hard wired” circuit that is connected between the Implement ECM and the Transmission/Chassis ECM. When the Implement ECM detects a problem in the primary steering circuit, the Implement ECM will send a PWM signal to the Transmission/Chassis ECM through the circuit requesting activation of specific components in the secondary steer system or requesting that the complete secondary steer system be activated.

The Implement ECM will send a signal to the Transmission/Chassis ECM to activate the secondary steering system when any of the following system conditions are detected:

- Primary steer valve diagnostic.
- An active CID 2202 FMI 12 (Steering Valve Control Module Error) diagnostic code.
- A failure of the main hydraulic pump.
- Steering motion is detected when no primary steering command is present.
- Steering motion is not detected when a primary steering command is present.
- Steering motion is detected in the wrong direction.
- A manual secondary steering test has been requested.
- An automatic secondary steering pump test is performed at initial engine start-up.

The Transmission/Chassis ECM will activate the secondary steering system without receiving a signal from the Implement ECM when the following condition is present:

- An active CID 2199 (Secondary Steering Request Signal from the Implement ECM) diagnostic code.

When the Implement ECM sends a PWM secondary steering request signal to the Transmission/Chassis ECM, the duty cycle of the PWM signal will determine which specific secondary steering system components will be active. During normal operation, the Implement ECM maintains a 20 percent duty cycle on the “steer request” circuit. When a secondary steering test is requested or when the Implement ECM has detected a problem in the primary steering system, the secondary steering request signal will be one of the following duty cycle signals:

20 percent PWM duty cycle – Normal operation, no request to activate.

40 percent PWM duty cycle – Request to activate the “secondary steering pump” motor only.

60 percent PWM duty cycle – Request to activate the “secondary steering pilot” solenoid valves only.

80 percent PWM duty cycle – Request to activate the “secondary steering pump” and the “secondary steering pilot” solenoid valves.

When a 40 percent duty cycle request is received by the Transmission/Chassis ECM, the ECM will energize the secondary steering relay. This will allow system power to pass through the relay contacts which will energize the secondary steering motor relay. System power from the power control box will then be supplied to the secondary steering pump motor which turns the secondary steering pump. When a pump request only is received, the secondary steering pump will supply hydraulic pressure and flow to the primary steering system. Under these circumstances, the secondary steering pump motor will overheat if operated for more than a short period of time.

When a 60 percent duty cycle request is received by the Transmission/Chassis ECM, the ECM will activate the proportional secondary steering pilot solenoid valves in order to control the hydraulic oil flow to the steer cylinders. The ECM will use a PWM output signal in order to energize the secondary steering solenoids. The Transmission/Chassis ECM will vary the amount of electrical current that is sent to the solenoids in order to control the angle of the front wheels.

When the secondary steering solenoids are energized, pilot hydraulic oil pressure is directed to the same main hydraulic valve that is used for the primary steering system. The control module for the steering valve that is used for operation of the primary steering system is not used when the secondary steering solenoids are active.

When an 80 percent duty cycle request is received by the Transmission/Chassis ECM, the ECM will energize the secondary steering relay in order to energize the secondary steering pump motor. The ECM will also activate the proportional “secondary steering pilot” solenoids.

Auxiliary Hydraulics LED Float Indicators

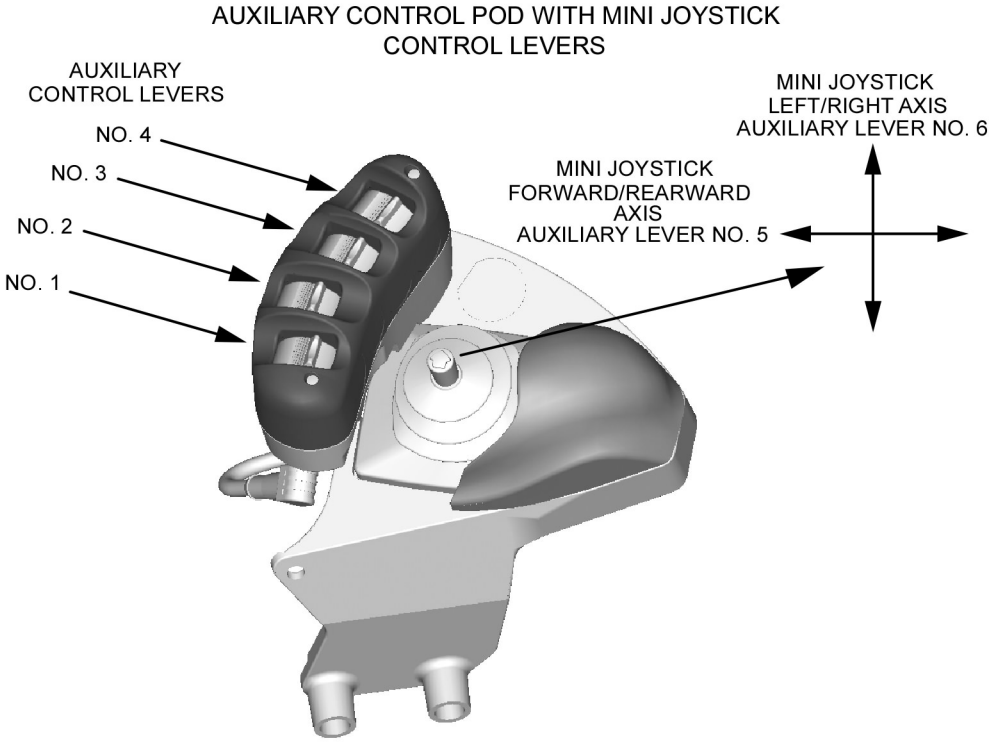


Illustration 107 g01514563

Auxiliary Control Pod Float Indicators

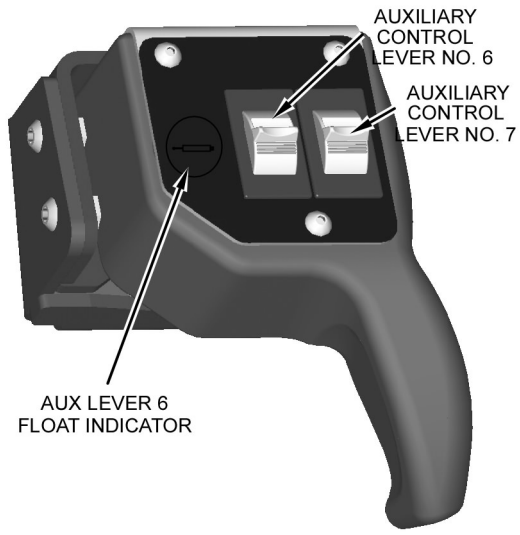


Illustration 108 g01422775

Auxiliary Control Float Indicators and Levers for No. 6 and No. 7.

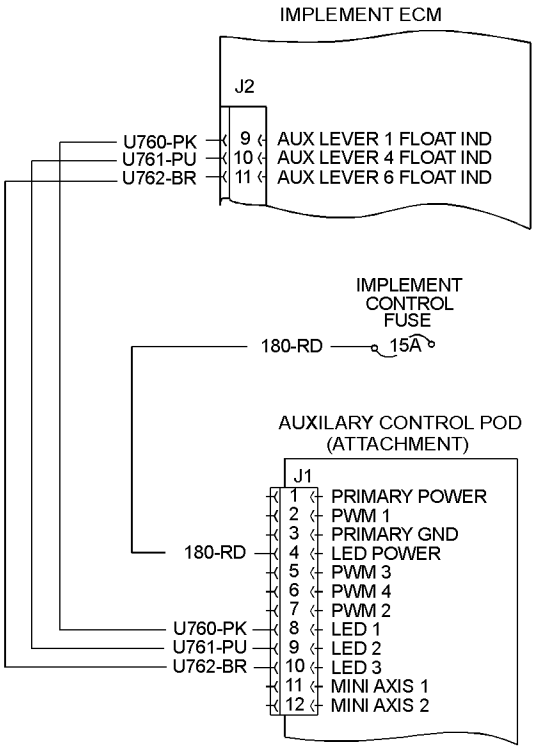


Illustration 109 g01314848

Auxiliary Control Pod Float Indicator connections

The Implement ECM will activate the output for the auxiliary hydraulics control levers when the lever is in the FLOAT position.

Power is supplied to the three Light Emitting Diode (LED) indicators by the “Implement” control fuse through a connection at the connector of the auxiliary control pod. The LED circuits are connected to ECM sinking driver outputs. When the Implement ECM detects that one of the control levers are moved to the FLOAT position, the ECM will turn ON the sinking driver for the circuit to provide a path to ground and illuminate the LED.

Proportional Solenoid Valves

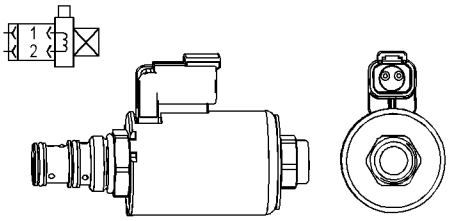


Illustration 110 g01315069

Typical Proportional Solenoid Valve

To control the proportional solenoid valves in an electronic hydraulic control system, the ECM will output a Pulse Width Modulated (PWM) signal to energize the solenoids. The ECM will vary the duty cycle of the PWM signal to control the amount of electrical current that is sent to the proportional solenoids. A PWM duty cycle is the percentage of time that the signal is high as compared to the amount of time that the signal is low. As the duration of the high signal increases, the percentage of the duty cycle and the amount of electrical current in the circuit both increase.

The ECM will apply the correct current amount dependent on the position of the joystick or the auxiliary control levers. The distance of travel of the solenoid valve plunger is proportional to the electrical current that is sent by the ECM. The position of the valve plunger controls the amount of pilot oil pressure that is applied to the valve spool. As the ECM increases the current to a solenoid, the spool allows more hydraulic oil flow to the hydraulic cylinders. This will cause the rate of movement of the implement to increase. As the ECM decreases the current to a solenoid, the pilot oil flow decreases, the spool allows less hydraulic oil flow to the hydraulic cylinders and the movement of the implement will decrease.

Blade Control Proportional Solenoid Valves

Note: The solenoids that are on the rear valve stack and the front valve stack are installed on the opposite side of the valve port that each solenoid controls. The port A solenoid is installed on the opposite side of the valve hydraulic port A. The port B solenoid is installed on the opposite side of the valve hydraulic port B. Refer to the illustrations for the solenoid and valve locations for the front stack and the rear stack.

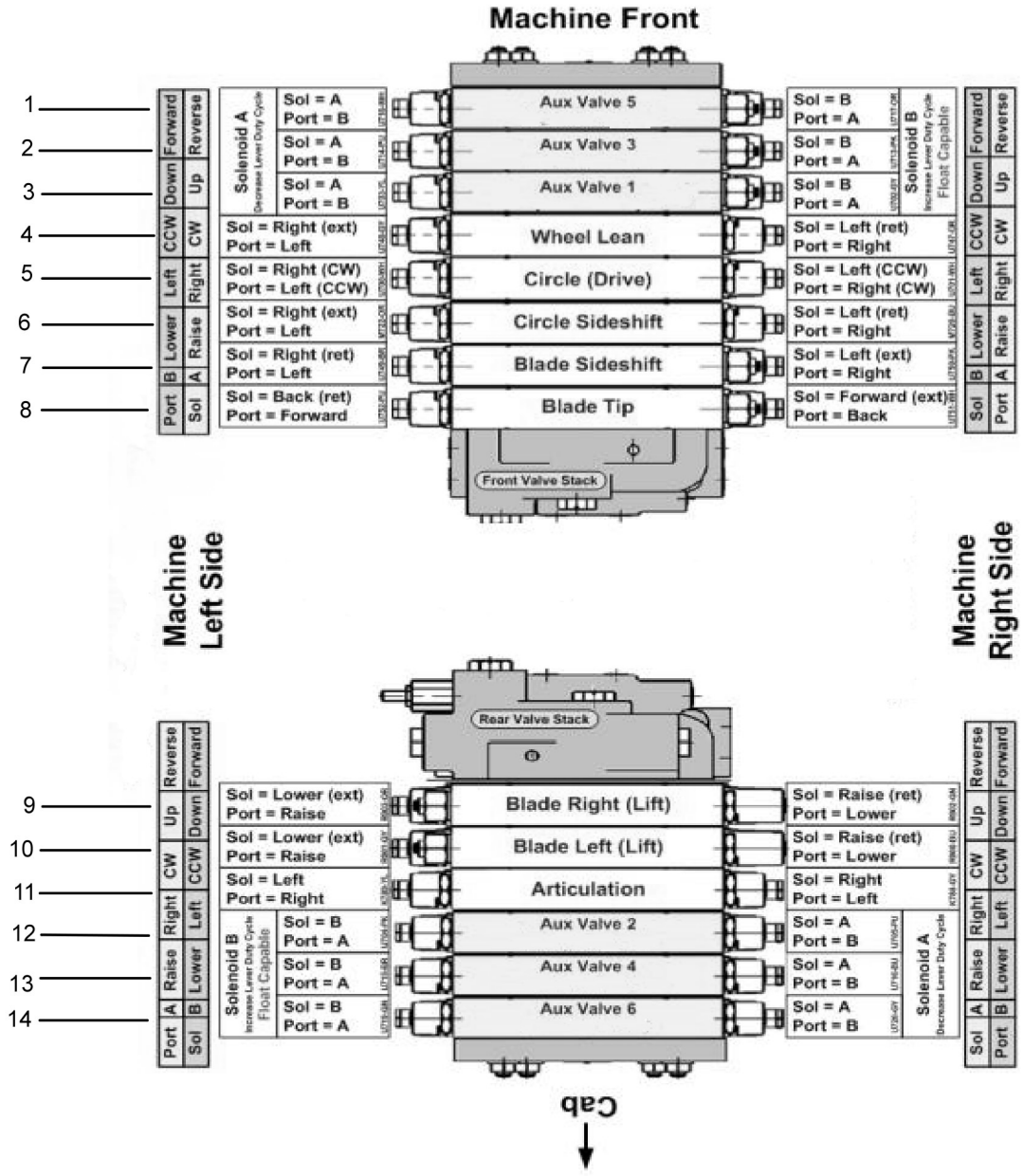


Illustration 111 g01436867

Front Hydraulic Valve Stack and Rear Hydraulic Valve Stack located on top of the frame rail (view looking toward cab - solenoids are called out from this view)

(1) Auxiliary solenoid valve 5 (port B sol on right, port A sol on left)
(2) Auxiliary solenoid valve 3 (port B sol on right, port A sol on left)
(3) Auxiliary solenoid valve 1 (port B sol on right, port A sol on left)
(4) Wheel lean solenoid valve (lean right sol on right, lean left sol on left)
(5) Circle solenoid valve (circle right sol on right, circle left sol on left)
(6) Circle sideshift solenoid valve (sideshift right sol on right, sideshift left sol on left)

(7) Blade sideshift solenoid valve (blade sideshift right sol on right, blade sideshift left sol on left)
(8) Blade tip solenoid valve (rearward sol on right, forward sol on left)
(9) Right blade lift/lower solenoid valve (lower sol on right, raise sol on left)
(10) Left blade lift/lower solenoid valve (lower sol on right, raise sol on left)
(11) Machine articulation solenoid valve (articulation left sol on right, articulation right sol on left)
(12) Auxiliary solenoid valve 2 (port A sol on right, port B sol on left)
(13) Auxiliary solenoid valve 4 (port A sol on right, port B sol on left)
(14) Auxiliary solenoid valve 6 (port A sol on right, port B sol on left)

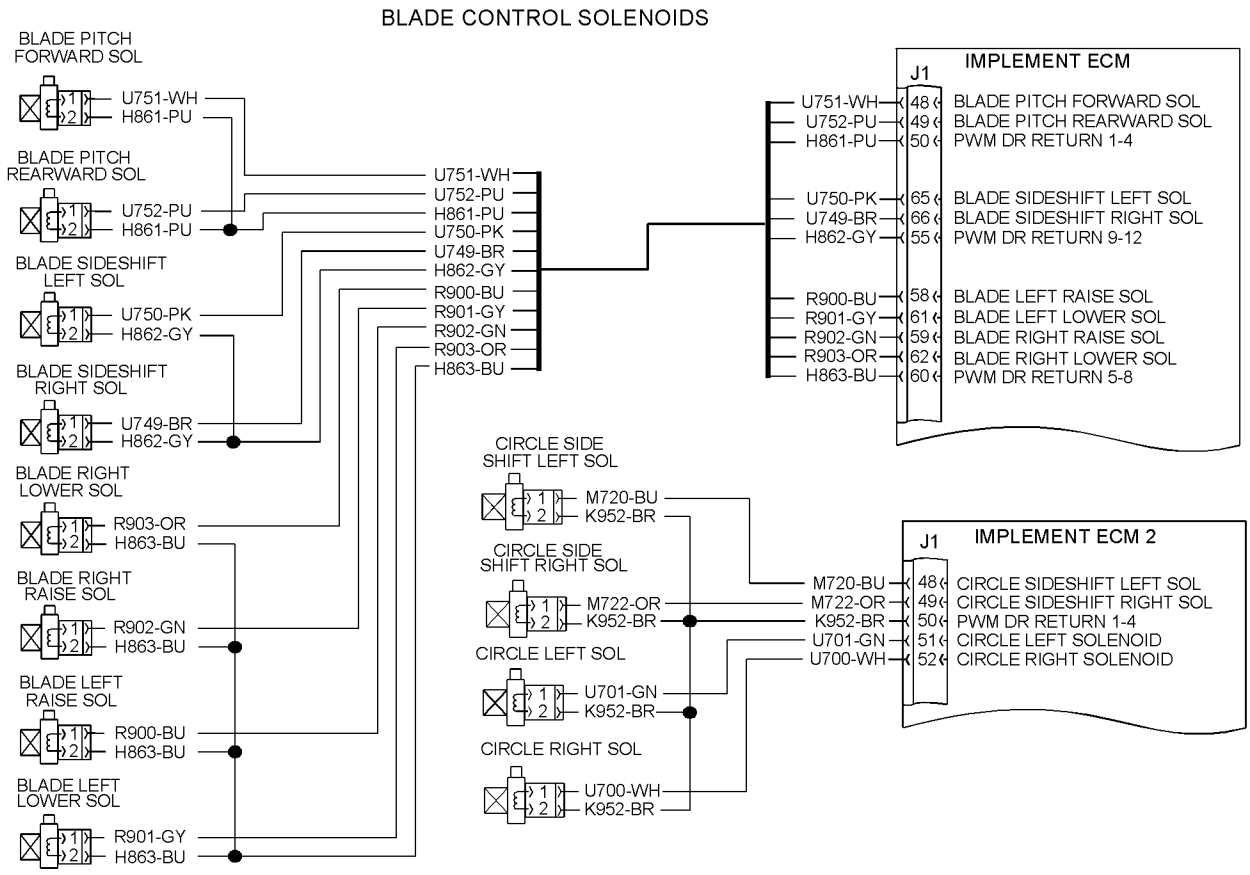


Illustration 112 g01314866

Blade Control Solenoid connections

The blade control solenoids are located in the front hydraulic valve stack and the rear hydraulic valve stack.

The solenoid valves that are used to control the blade are proportional solenoid valves. The modules of the Implement ECM control these solenoids electronically according to PWM input signals from the position sensors in the left joystick and the right joystick.

Auxiliary Hydraulic Proportional Solenoid Valves

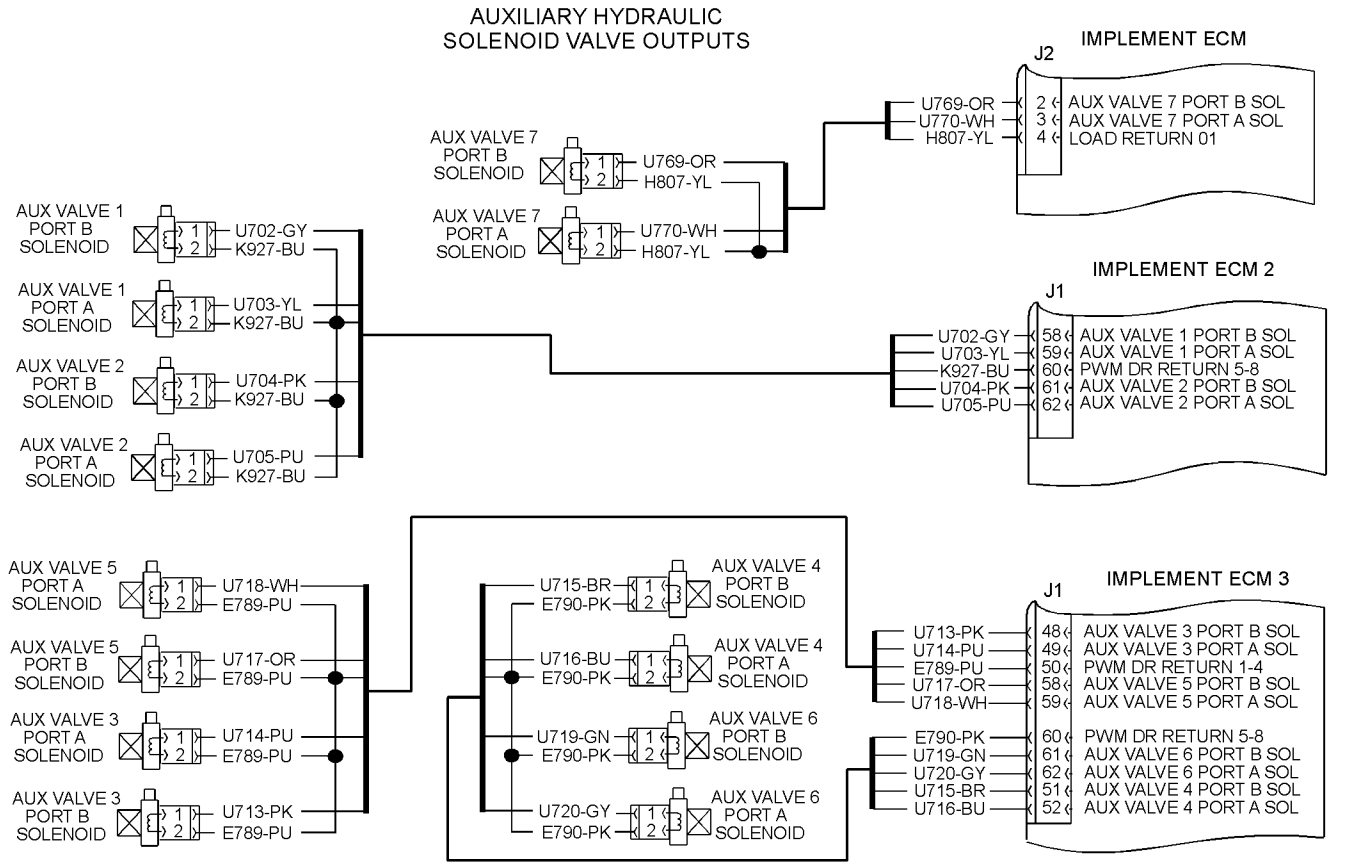


Illustration 113 g01315212

Auxiliary hydraulic solenoid valve outputs

The auxiliary valve proportional solenoid valves are controlled by two or three modules of the Implement ECM. The number of auxiliary solenoid valves that are installed on the machine will determine if the Implement ECM 3 is installed.

The Implement ECM modules control the solenoid valves according to the input that is received from the auxiliary control lever position sensors. The auxiliary control levers can be configured to control any of the installed auxiliary solenoid valves.

To control the proportional valves in an electronic hydraulic control system, the ECM will output a pulse width modulated (PWM) signal to energize the solenoids. The ECM will vary the duty cycle of the PWM signal to control the amount of electrical current that is sent to the proportional solenoids. A PWM duty cycle is the percentage of time the signal is HIGH in relation to the period of the cycle. As the duration of the HIGH signal increases, the percentage of the duty cycle and the amount of electrical current in the circuit increases proportionally.

The ECM will apply the correct current amount dependent on the position of the joystick or the auxiliary control levers. The distance of travel of the solenoid valve plunger is proportional to the electrical current that is sent by the ECM. Motor Grader functions are controlled from a bank of solenoids located on the frame rail at the front of the machine. The solenoids are controlled from inputs from the right “(A port side)” and the left “(B port side)” in relation to the position of the operator. As the lever duty cycle increases the ECM sends current to the “B port” of the solenoid. In the case where the duty cycle of the PWM signal is decreasing the ECM sends current to the “A port” of the solenoid.

Wheel Lean Proportional Solenoid Valve

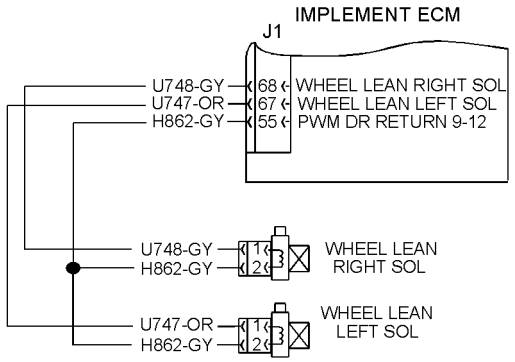


Illustration 114 g06081826

The wheel lean proportional solenoid valves are controlled by the Implement ECM. The Implement ECM controls the solenoid valves according to the input that is received from the wheel lean push-button position sensors on the left joystick.

Machine Articulation Proportional Solenoid Valve

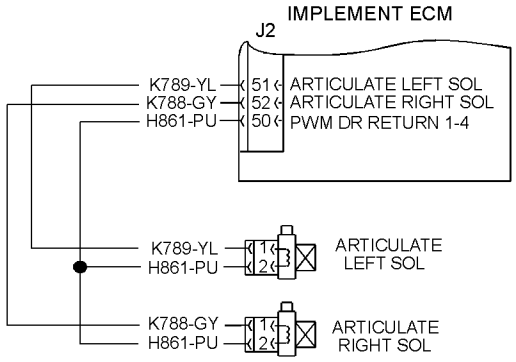


Illustration 115 g01315236

The machine articulation proportional solenoid valves are controlled by the Implement ECM. The Implement ECM controls the solenoid valves according to the input that is received from the twist axis position sensors on the left joystick.

Blade Downforce Relief Solenoid Valves

Note: The blade downforce system is not available on the 14M Motor Grader.

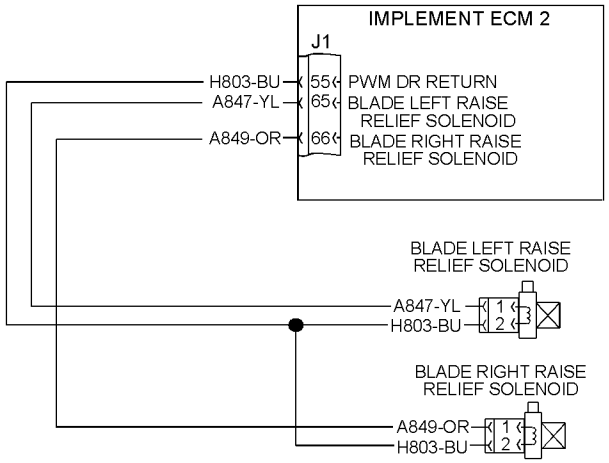


Illustration 116 g01333782

Blade Raise Relief Solenoid output connections

The left and the right blade raise relief solenoids are used for the operation of the blade constant downforce system. The “Implement Control # 2” will control the solenoids based on input from the left and the right blade constant downforce dial position sensors that is received by the Implement ECM. The Implement ECM will communicate the correct output for the solenoid to the “Implement Control # 2” over the J1939 Data Link.

When the one of the left blade downforce dials is moved in the clockwise direction from zero, the “Implement Control # 2” will send a proportional PWM current signal to the appropriate blade raise relief solenoid. The amount of electrical current that is sent by the ECM will range from 0 to 2000 mA depending on the position sensor signal from the downforce dial. The amount of current that is applied to the solenoid will determine the amount of hydraulic oil that is directed from the rod end of either the right or the left blade lift hydraulic cylinder through the right or the left blade raise variable relief valve back to the hydraulic tank.

The amount of hydraulic oil that is allowed to flow back to the tank from the rod end of the blade lift hydraulic cylinder will determine how much downforce is applied to either the right side or the left side of the blade.

For more information on the operation of the blade downforce system, refer to the Systems Operation, “Features” section of this manual.

On/Off Solenoids

Implement Pilot Supply Solenoid

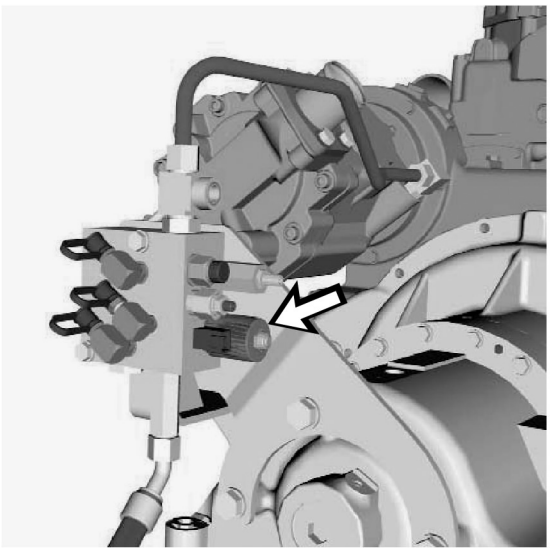


Illustration 117 g01315269

Implement Pilot Supply Solenoid located on the implement and steering control manifold behind the implement and steering pump

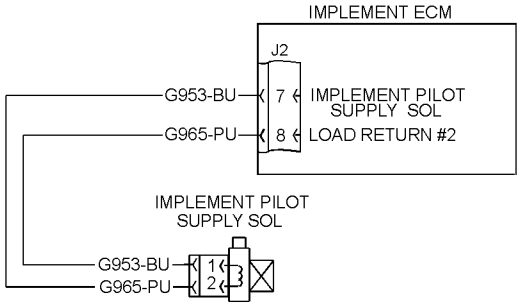


Illustration 118 g01315274

Implement Pilot Supply Solenoid output connections

The implement pilot supply solenoid is controlled by the Implement ECM. The energize circuit for the solenoid is connected to an ECM ON/OFF output driver.

The Implement ECM controls the solenoid according to the input signal from the Implement lockout switch. When the ECM energizes the solenoid, pilot oil is supplied to the implement pilot hydraulics system. When the solenoid is not energized, the pilot oil for the implement pilot hydraulics system is blocked.

Blade Downforce Raise Relief Enable Solenoids

Note: The blade downforce system is not available on the 14M Motor Grader.

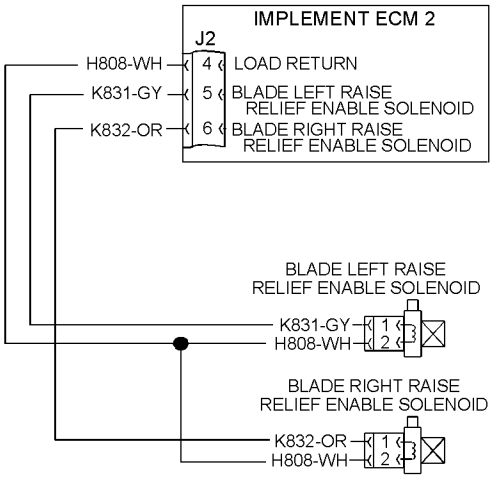


Illustration 119 g01333783

Blade Raise Relief Enable Solenoid output connections

The left and the right blade raise relief enable solenoids are used for the operation of the blade constant downforce system. The “Implement Control # 2” will turn ON or will turn OFF the solenoids based on input from blade constant downforce enable switch that is received by the Implement ECM. The Implement ECM will communicate the correct output for the solenoids to the “Implement Control # 2” over the J1939 Data Link.

When the machine conditions are correct and the blade constant downforce enable switch is in the ON position, the Implement ECM 2 will energize the right and the left blade raise relief enable ON/OFF type solenoids. These solenoids will activate a poppet valve within the right blade lift hydraulic valve and the left blade lift hydraulic valve. When the poppet valve is active, hydraulic fluid from the rod end of the blade lift cylinders is allowed to flow to the blade raise variable relief valves. This configuration enables the left and the right blade raise relief solenoids to control how much hydraulic oil is returned to the hydraulic tank through the relief valve to control the downforce on the blade.

For more information on the operation of the blade downforce system, refer to the Systems Operation, “Features” section of this manual.

i06691384

Electrical Output Components

SMCS Code: 1400; 5000

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

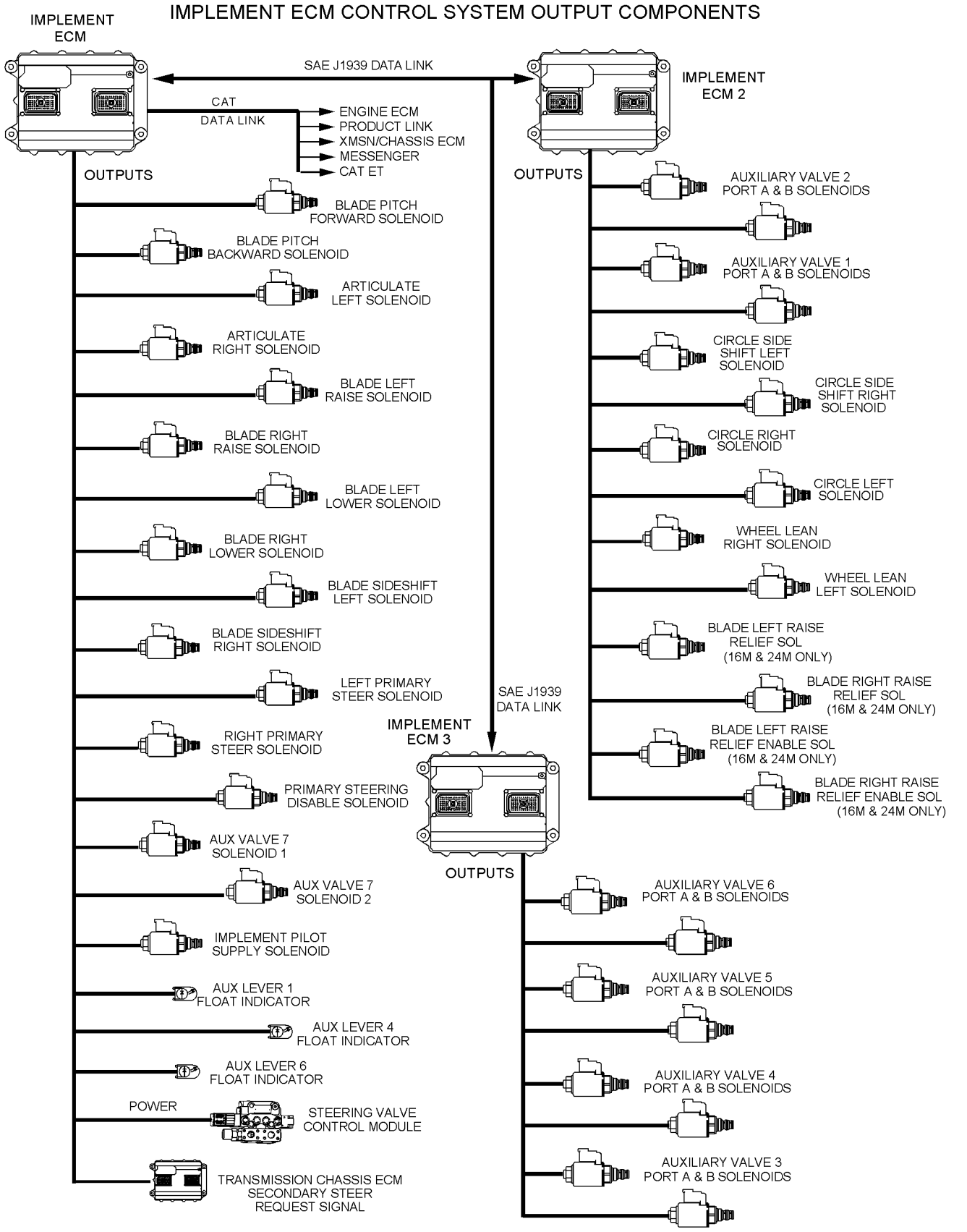


Illustration 120 g06076642

Implement ECM Control System Output Components

Outputs

The modules of the Implement ECM use output circuits to send electrical control signals to output components. The output signals can create an action or the output signals can provide information to the ECM. The ECM will use different types of output signals to control the system components. The types of electrical signal are the following:

- PWM proportional driver outputs
- ON/OFF driver outputs
- Sinking driver outputs
- Sensor power supply outputs
- Data link outputs

The ECM monitors the circuits of the output components. If the ECM determines that an abnormal condition exists in one of the circuits, the ECM will log a diagnostic code for the involved component.

Steering Valve Control Module Outputs

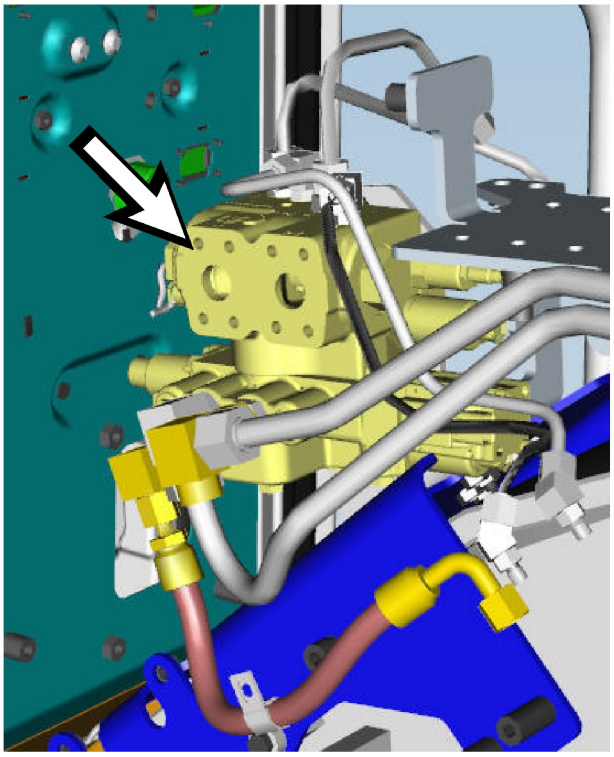


Illustration 121 g06084112

Steering Valve Control Module located in front of the cab

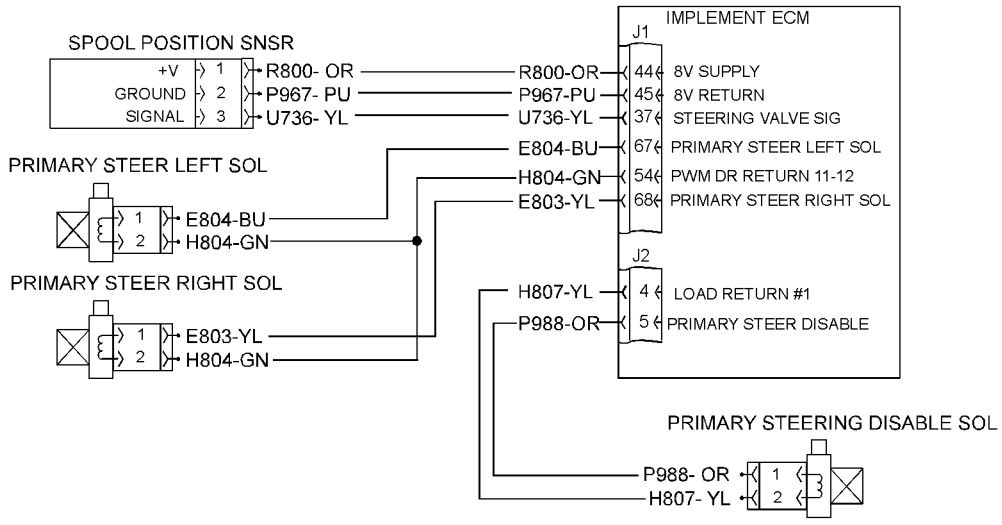


Illustration 122 g06075256

Connections of the Steering Spool Position Sensor Circuit

Current Drivers for Primary Proportional Solenoids

The Implement ECM uses a "closed loop" algorithm to control the position of the front wheels on the motor grader. The Implement ECM monitors the position of the steering cylinders and the position of the steering axis of the left joystick. The Implement ECM provides a current command to the appropriate solenoid based on the difference in the commanded and actual position. The current will vary between 0 and 1 A for each solenoid.

Current Driver for Primary Steering Pilot On/Off Solenoid

The Implement ECM provides current to the primary steering pilot on/off solenoid to enable or disable the pilot supply for the primary proportional steering solenoids based on machine conditions.

At key start switch ON, power will be supplied to the left joystick. However, the ECM will not activate the ON/OFF output until the following conditions are met:

- Engine ON - The engine must be operating.
- Parking brake ON, transmission in NEUTRAL - Machine speed is zero. (The Transmission ECM will not allow the parking brake to release or a transmission directional shift out of NEUTRAL until the Implement ECM enables the steering system.)
- Operator Present - The ECM must detect an operator is present using the operator in seat sender or other indicators discussed later in this section.

Secondary Steering Request Signal

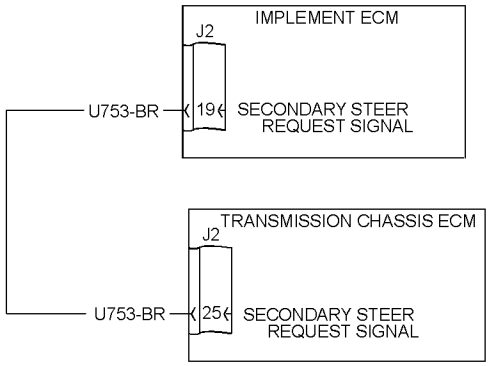


Illustration 123 g01305868

Connections of “Secondary Steering Request Input” Circuit

The request circuit for the secondary steer is a hard wired circuit that is connected between the Implement ECM and the Transmission/Chassis ECM. When the Implement ECM detects a problem in the primary steering circuit, the Implement ECM will send a PWM signal to the Transmission/Chassis ECM. This PWM signal is sent through the circuit which requests the activation of specific components or the complete system of the secondary steer.

The Implement ECM will send a request signal to the Transmission/Chassis ECM to activate the secondary steering system when any of the following machine conditions are detected:

- An active diagnostic code CID 2203 (Primary Steering Valve Spool Displacement Line)
- CID 1471 and CID 1472 and CID 1473 for the left joystick steering axis position sensors 1, 2, 3. All three CID's must be active at the same time. (If the Implement ECM and the Transmission ECM have both activated these codes at the same time, all steering will be disabled. If only the Transmission ECM activates these codes, primary steering will remain enabled.)
- CID 2177 diagnostic code for the primary steer pilot supply solenoid circuit.
- CID 3284 or CID 3285 for the left-hand or the right-hand primary steering solenoids.
- A failure of the main hydraulic pump.
- Unexpected Spool Response.
- No Spool Response with Command.
- A manual secondary steer test has been requested.

The Transmission/Chassis ECM will activate the secondary steering system without receiving a request signal from the Implement ECM when the following condition is present:

- An active diagnostic code CID 2199 (Secondary Steering Request Signal from the Implement ECM)

A specific component of the secondary steering system is activated, based on the duty cycle of the PWM signal. When a secondary steer test is requested or when the Implement ECM has detected a problem in the primary steering system, the secondary steer request signal will be one of the following duty cycle signals:

20 percent PWM duty cycle – There will not be any request to activate. Normal operation

60 percent PWM duty cycle – There will be a request to activate the secondary steer pilot solenoid valves.

When a 60 percent duty cycle request is received by the Transmission/Chassis ECM, the ECM will activate the proportional secondary steer pilot solenoid valves to control the hydraulic oil flow to the steer cylinders. The ECM will use an output signal of the PWM to energize the secondary steering solenoids. The Transmission/Chassis ECM will vary the amount of electrical current sent to the solenoids to control the angle of the front wheels.

When the secondary steering solenoids are energized, pilot hydraulic oil pressure is directed to the same main hydraulic valve used for the primary steering system. The control module of the steering valve used for operation of the primary steering system is not used when the secondary steering solenoids are active.

Auxiliary Hydraulics LED Float Indicators

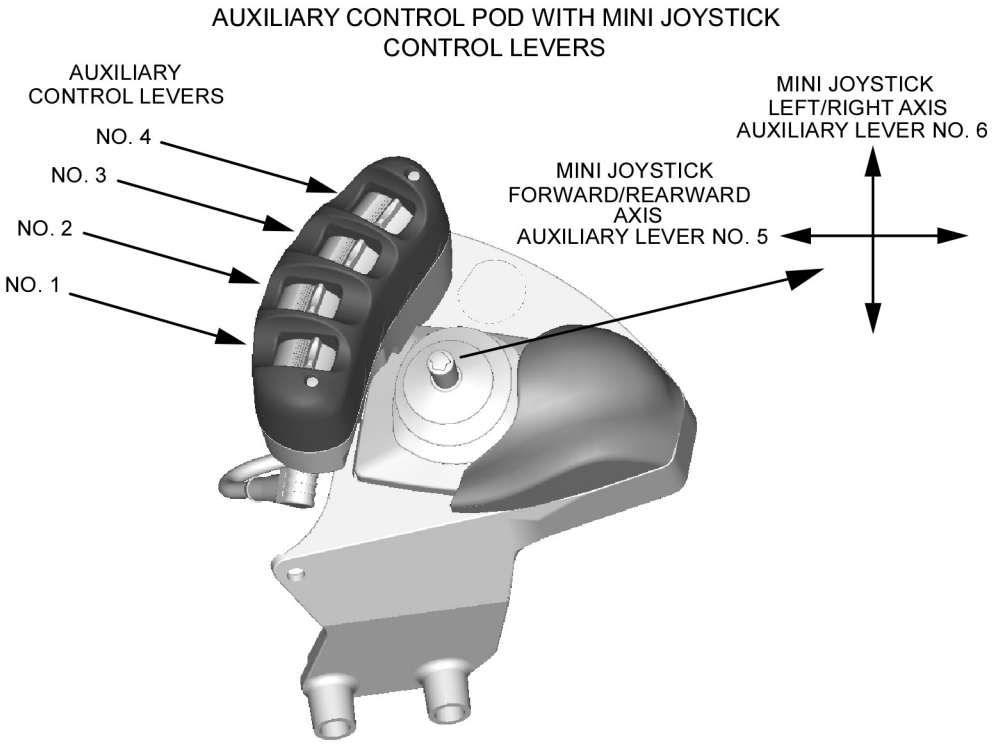


Illustration 124 g01514563

Auxiliary Control Pod Float Indicators

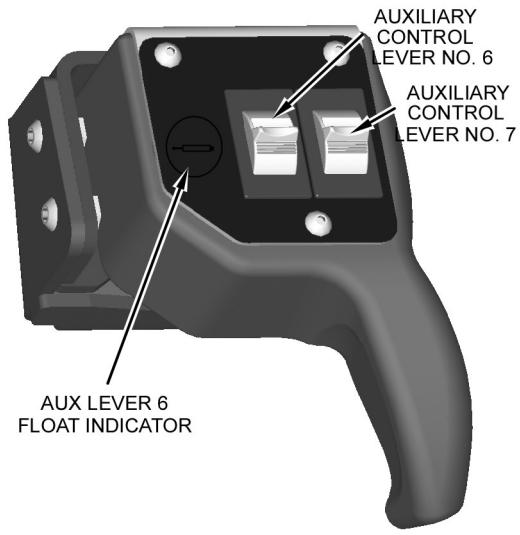


Illustration 125 g01422775

Auxiliary Control Float Indicators and Levers for No. 6 and No. 7.

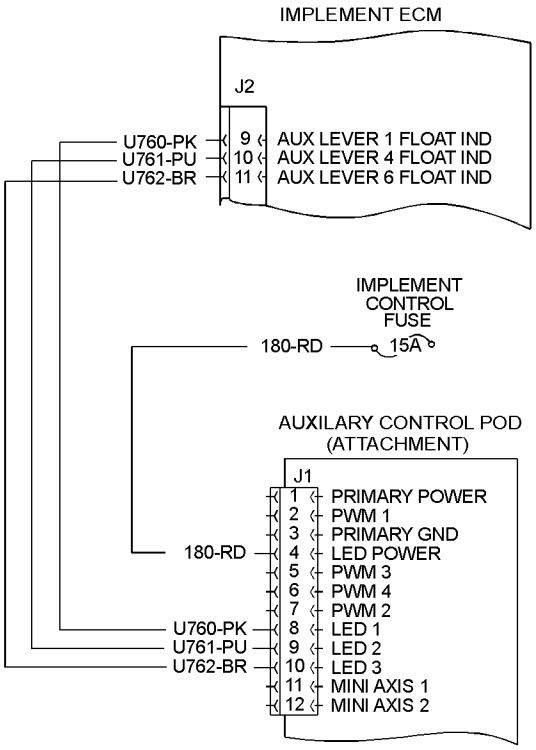


Illustration 126 g01314848

Auxiliary Control Pod Float Indicator connections

The Implement ECM will activate the output for the auxiliary hydraulics control levers when the lever is in the FLOAT position.

Power is supplied to the three Light Emitting Diode (LED) indicators by the “Implement” control fuse through a connection at the connector of the auxiliary control pod. The LED circuits are connected to ECM sinking driver outputs. When the Implement ECM detects that one of the control levers are moved to the FLOAT position, the ECM will turn ON the sinking driver for the circuit to provide a path to ground and illuminate the LED.

Proportional Solenoid Valves

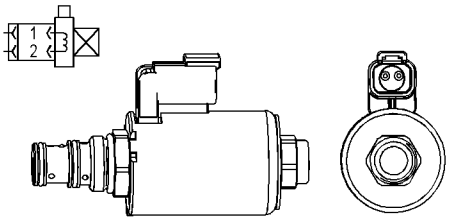


Illustration 127 g01315069

Typical Proportional Solenoid Valve

To control the proportional solenoid valves in an electronic hydraulic control system, the ECM will output a Pulse Width Modulated (PWM) signal to energize the solenoids. The ECM will vary the duty cycle of the PWM signal to control the amount of electrical current that is sent to the proportional solenoids. A PWM duty cycle is the percentage of time that the signal is high as compared to the amount of time that the signal is low. As the duration of the high signal increases, the percentage of the duty cycle and the amount of electrical current in the circuit both increase.

The ECM will apply the correct current amount dependent on the position of the joystick or the auxiliary control levers. The distance of travel of the solenoid valve plunger is proportional to the electrical current that is sent by the ECM. The position of the valve plunger controls the amount of pilot oil pressure that is applied to the valve spool. As the ECM increases the current to a solenoid, the spool allows more hydraulic oil flow to the hydraulic cylinders. This will cause the rate of movement of the implement to increase. As the ECM decreases the current to a solenoid, the pilot oil flow decreases, the spool allows less hydraulic oil flow to the hydraulic cylinders, and the movement of the implement will decrease.

Blade Control Proportional Solenoid Valves

Note: The solenoids that are on the rear valve stack and the front valve stack are installed on the opposite side of the valve port that each solenoid controls. The port A solenoid is installed on the opposite side of the valve hydraulic port A. The port B solenoid is installed on the opposite side of the valve hydraulic port B. Refer to the illustrations for the solenoid and valve locations for the front stack and the rear stack.

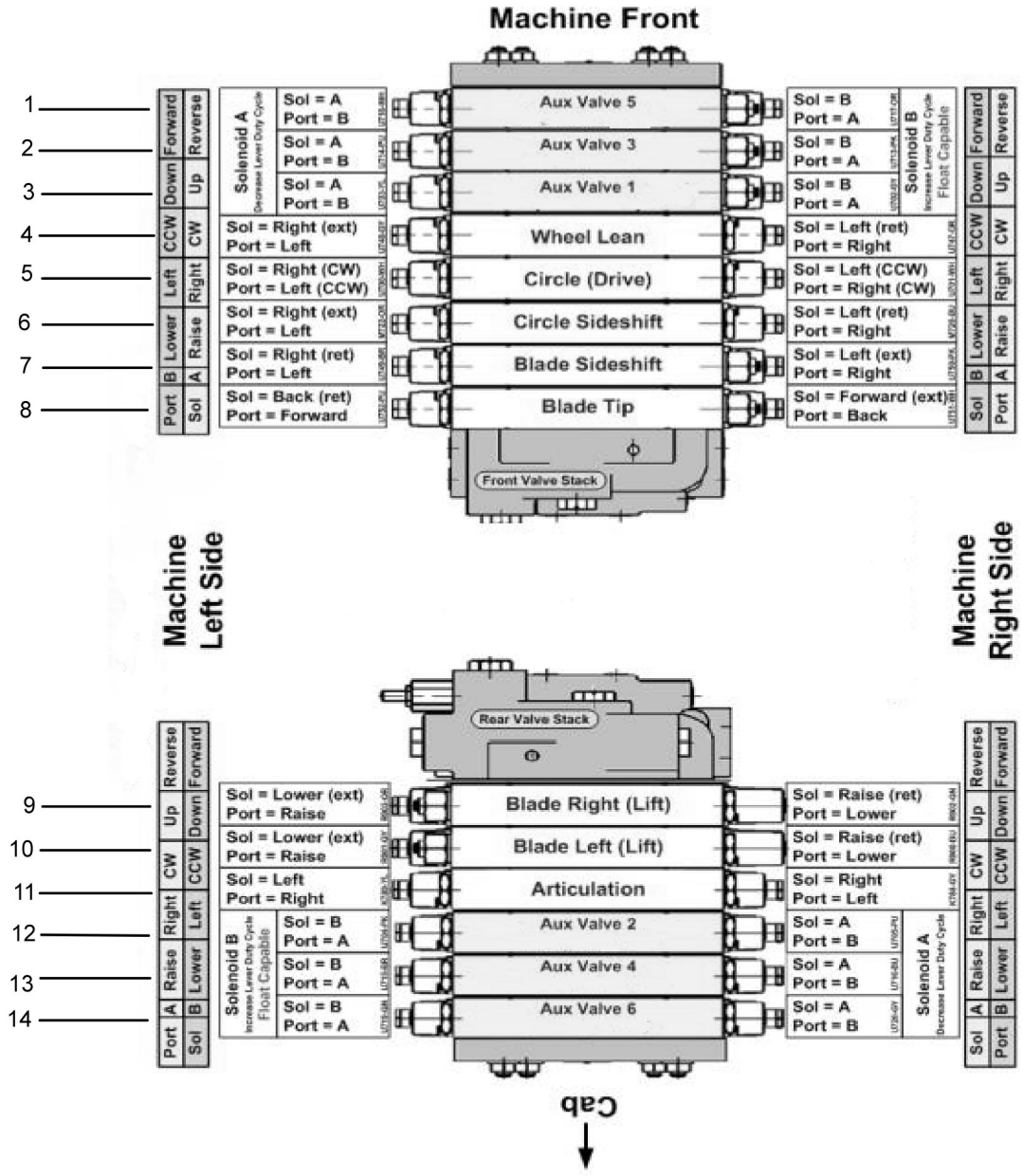


Illustration 128 g01436867

Front Hydraulic Valve Stack and Rear Hydraulic Valve Stack located on top of the frame rail (view looking toward cab - solenoids are called out from this view)

(1) Auxiliary solenoid valve 5 (port B sol on right, port A sol on left)
(2) Auxiliary solenoid valve 3 (port B sol on right, port A sol on left)
(3) Auxiliary solenoid valve 1 (port B sol on right, port A sol on left)
(4) Wheel lean solenoid valve (lean right sol on right, lean left sol on left)
(5) Circle solenoid valve (circle right sol on right, circle left sol on left)
(6) Circle sideshift solenoid valve (sideshift right sol on right, sideshift left sol on left)

(7) Blade sideshift solenoid valve (blade sideshift right sol on right, blade sideshift left sol on left)
(8) Blade tip solenoid valve (rearward sol on right, forward sol on left)
(9) Right blade lift/lower solenoid valve (lower sol on right, raise sol on left)
(10) Left blade lift/lower solenoid valve (lower sol on right, raise sol on left)
(11) Machine articulation solenoid valve (articulation left sol on right, articulation right sol on left)
(12) Auxiliary solenoid valve 2 (port A sol on right, port B sol on left)
(13) Auxiliary solenoid valve 4 (port A sol on right, port B sol on left)
(14) Auxiliary solenoid valve 6 (port A sol on right, port B sol on left)

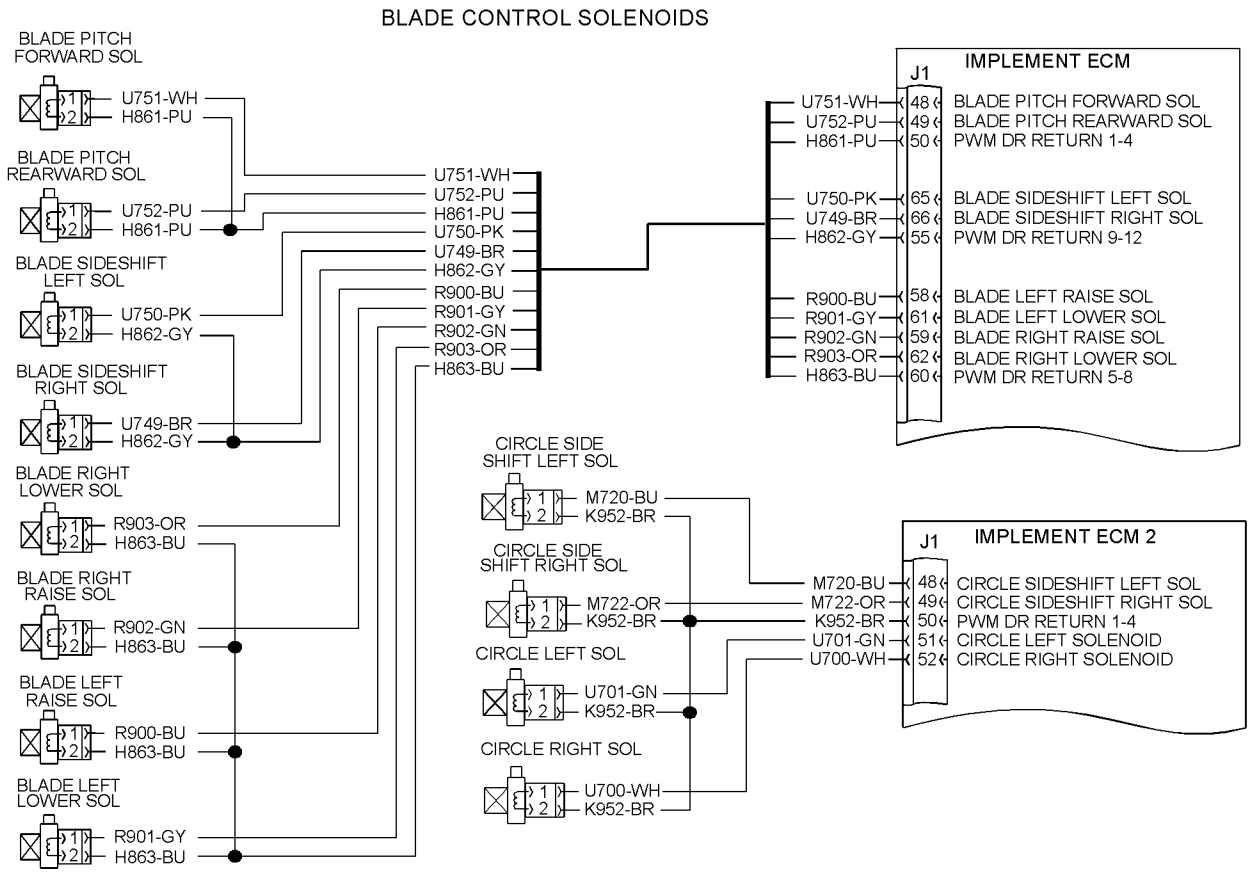


Illustration 129 g01314866

Blade Control Solenoid connections

The blade control solenoids are located in the front hydraulic valve stack and the rear hydraulic valve stack.

The solenoid valves that are used to control the blade are proportional solenoid valves. The modules of the Implement ECM control these solenoids electronically according to PWM input signals from the position sensors in the left joystick and the right joystick.

Auxiliary Hydraulic Proportional Solenoid Valves

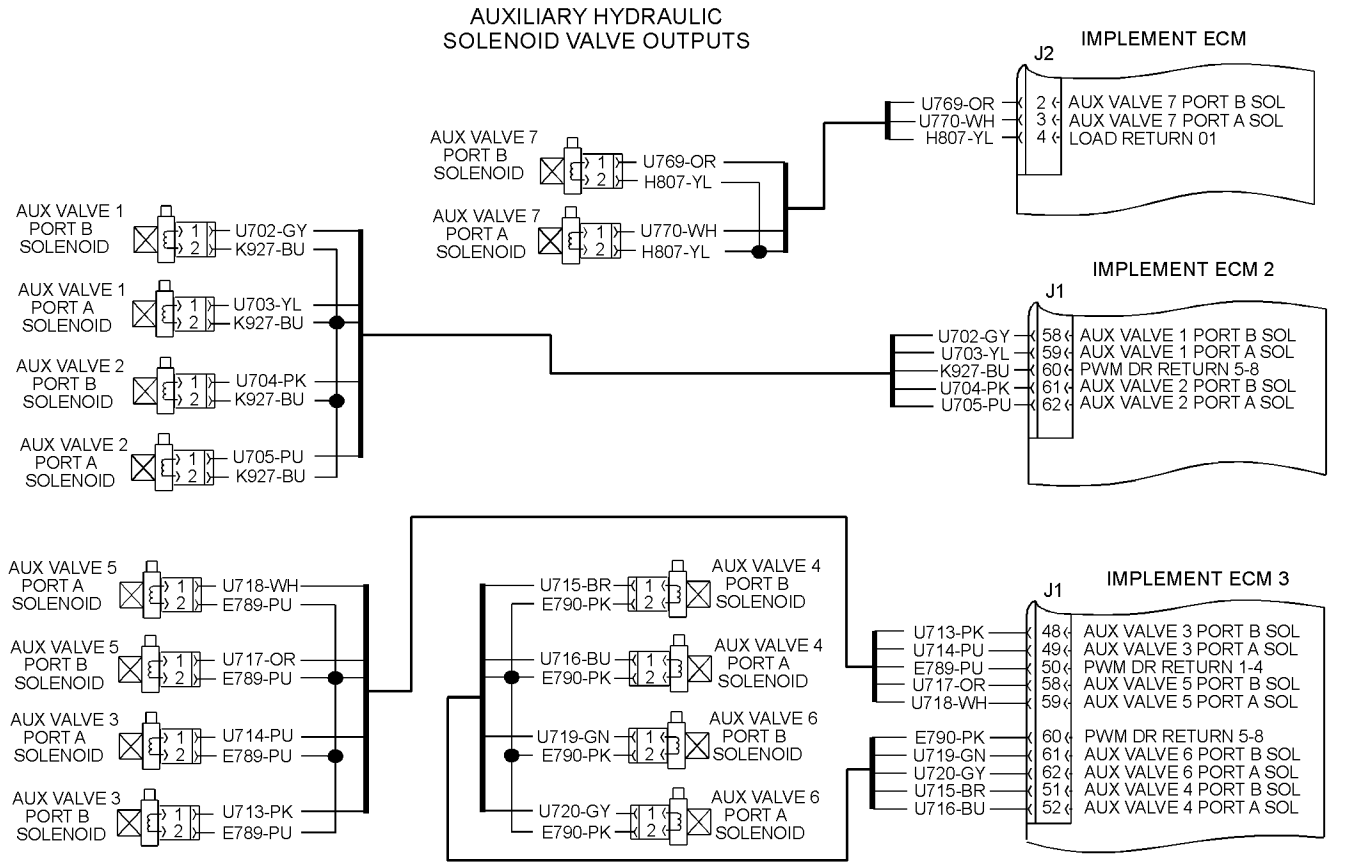


Illustration 130 g01315212

Auxiliary hydraulic solenoid valve outputs

The auxiliary valve proportional solenoid valves are controlled by two or three modules of the Implement ECM. The number of auxiliary solenoid valves that are installed on the machine will determine if the Implement ECM 3 is installed.

The Implement ECM modules control the solenoid valves according to the input that is received from the auxiliary control lever position sensors. The auxiliary control levers can be configured to control any of the installed auxiliary solenoid valves.

To control the proportional valves in an electronic hydraulic control system, the ECM will output a pulse width modulated (PWM) signal to energize the solenoids. The ECM will vary the duty cycle of the PWM signal to control the amount of electrical current that is sent to the proportional solenoids. A PWM duty cycle is the percentage of time the signal is HIGH in relation to the period of the cycle. As the duration of the HIGH signal increases, the percentage of the duty cycle and the amount of electrical current in the circuit increases proportionally.

The ECM will apply the correct current amount dependent on the position of the joystick or the auxiliary control levers. The distance of travel of the solenoid valve plunger is proportional to the electrical current that is sent by the ECM. Motor Grader functions are controlled from a bank of solenoids located on the frame rail at the front of the machine. The solenoids are controlled from inputs from the right “(A port side)” and the left “(B port side)” in relation to the position of the operator. As the lever duty cycle increases the ECM sends current to the “B port” of the solenoid. In the case where the duty cycle of the PWM signal is decreasing the ECM sends current to the “A port” of the solenoid.

Wheel Lean Proportional Solenoid Valve

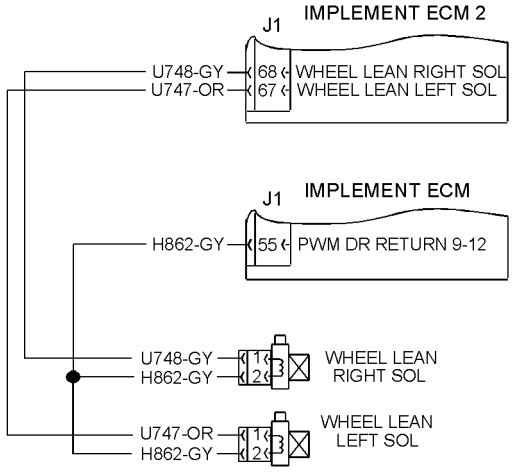


Illustration 131 g06081835

The wheel lean proportional solenoid valves are controlled by the Implement ECM. The Implement ECM controls the solenoid valves according to the input that is received from the wheel lean push-button position sensors on the left joystick.

Machine Articulation Proportional Solenoid Valve

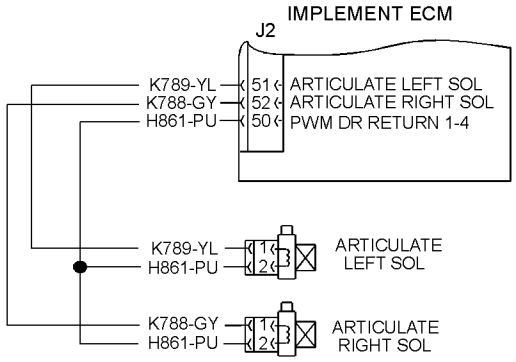


Illustration 132 g01315236

The machine articulation proportional solenoid valves are controlled by the Implement ECM. The Implement ECM controls the solenoid valves according to the input that is received from the twist axis position sensors on the left joystick.

Blade Downforce Relief Solenoid Valves

Note: The blade downforce system is not available on the 14M Motor Grader.

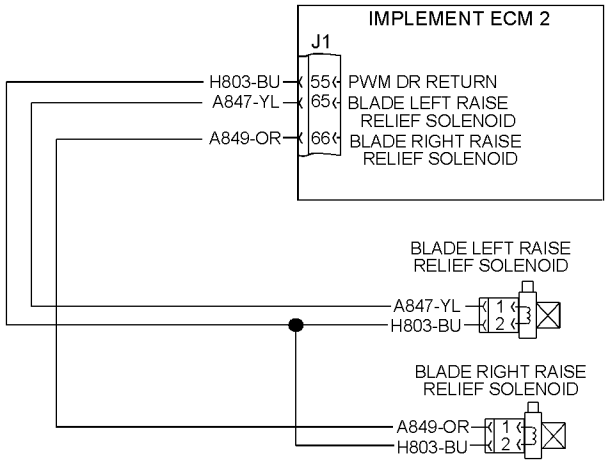


Illustration 133 g01333782

Blade Raise Relief Solenoid output connections

The left and the right blade raise relief solenoids are used for the operation of the blade constant downforce system. The “Implement Control # 2” will control the solenoids based on input from the left and the right blade constant downforce dial position sensors that is received by the Implement ECM. The Implement ECM will communicate the correct output for the solenoid to the “Implement Control # 2” over the J1939 Data Link.

When the one of the left blade downforce dials is moved in the clockwise direction from zero, the “Implement Control # 2” will send a proportional PWM current signal to the appropriate blade raise relief solenoid. The amount of electrical current that is sent by the ECM will range from 0 mA to 2000 mA depending on the position sensor signal from the downforce dial. The amount of current that is applied to the solenoid will determine the amount of hydraulic oil that is directed from the rod end of either the right or the left blade lift hydraulic cylinder through the right or the left blade raise variable relief valve back to the hydraulic tank.

The amount of hydraulic oil that is allowed to flow back to the tank from the rod end of the blade lift hydraulic cylinder will determine how much downforce is applied to either the right side or the left side of the blade.

For more information on the operation of the blade downforce system, refer to the Systems Operation, “Features” section of this manual.

On/Off Solenoids

Implement Pilot Supply Solenoid

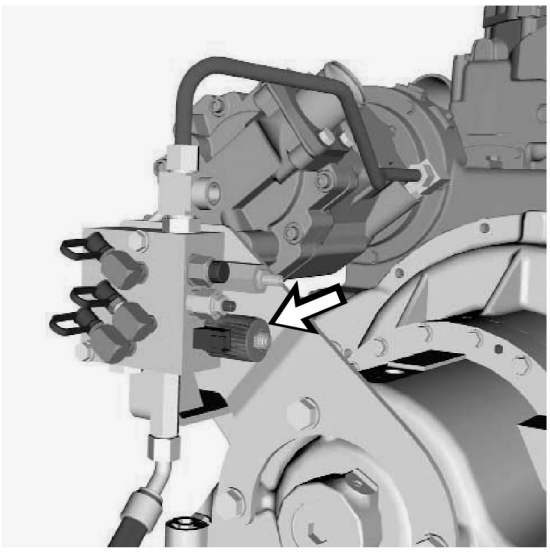


Illustration 134 g01315269

Implement Pilot Supply Solenoid located on the implement and steering control manifold behind the implement and steering pump

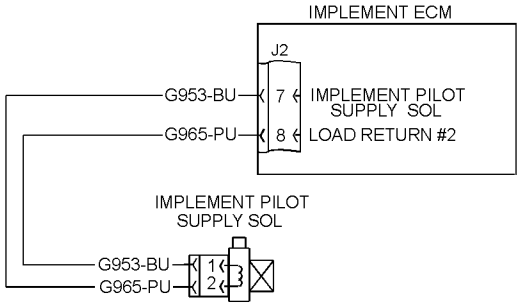


Illustration 135 g01315274

Implement Pilot Supply Solenoid output connections

The implement pilot supply solenoid is controlled by the Implement ECM. The energize circuit for the solenoid is connected to an ECM ON/OFF output driver.

The Implement ECM controls the solenoid according to the input signal from the Implement lockout switch. When the ECM energizes the solenoid, pilot oil is supplied to the implement pilot hydraulics system. When the solenoid is not energized, the pilot oil for the implement pilot hydraulics system is blocked.

Blade Downforce Raise Relief Enable Solenoids

Note: The blade downforce system is not available on the 14M Motor Grader.

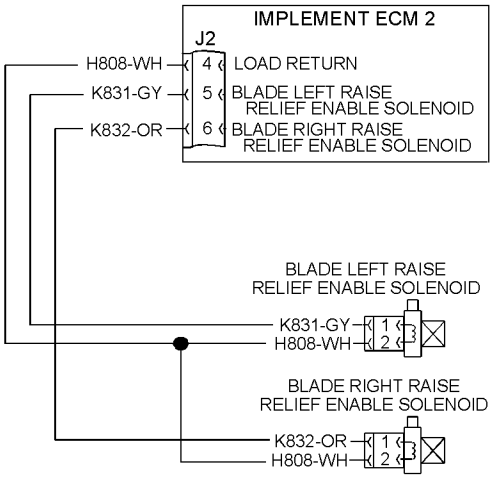


Illustration 136 g01333783

Blade Raise Relief Enable Solenoid output connections

The left and the right blade raise relief enable solenoids are used for the operation of the blade constant downforce system. The “Implement Control # 2” will turn ON or will turn OFF the solenoids based on input from blade constant downforce enable switch that is received by the Implement ECM. The Implement ECM will communicate the correct output for the solenoids to the “Implement Control # 2” over the J1939 Data Link.

When the machine conditions are correct and the blade constant downforce enable switch is in the ON position, the Implement ECM 2 will energize the right and the left blade raise relief enable ON/OFF type solenoids. These solenoids will activate a poppet valve within the right blade lift hydraulic valve and the left blade lift hydraulic valve. When the poppet valve is active, hydraulic fluid from the rod end of the blade lift cylinders is allowed to flow to the blade raise variable relief valves. This configuration enables the left and the right blade raise relief solenoids to control how much hydraulic oil is returned to the hydraulic tank through the relief valve to control the downforce on the blade.

For more information on the operation of the blade downforce system, refer to the Systems Operation, “Features” section of this manual.

i02857140

Data Link

SMCS Code: 7610-II

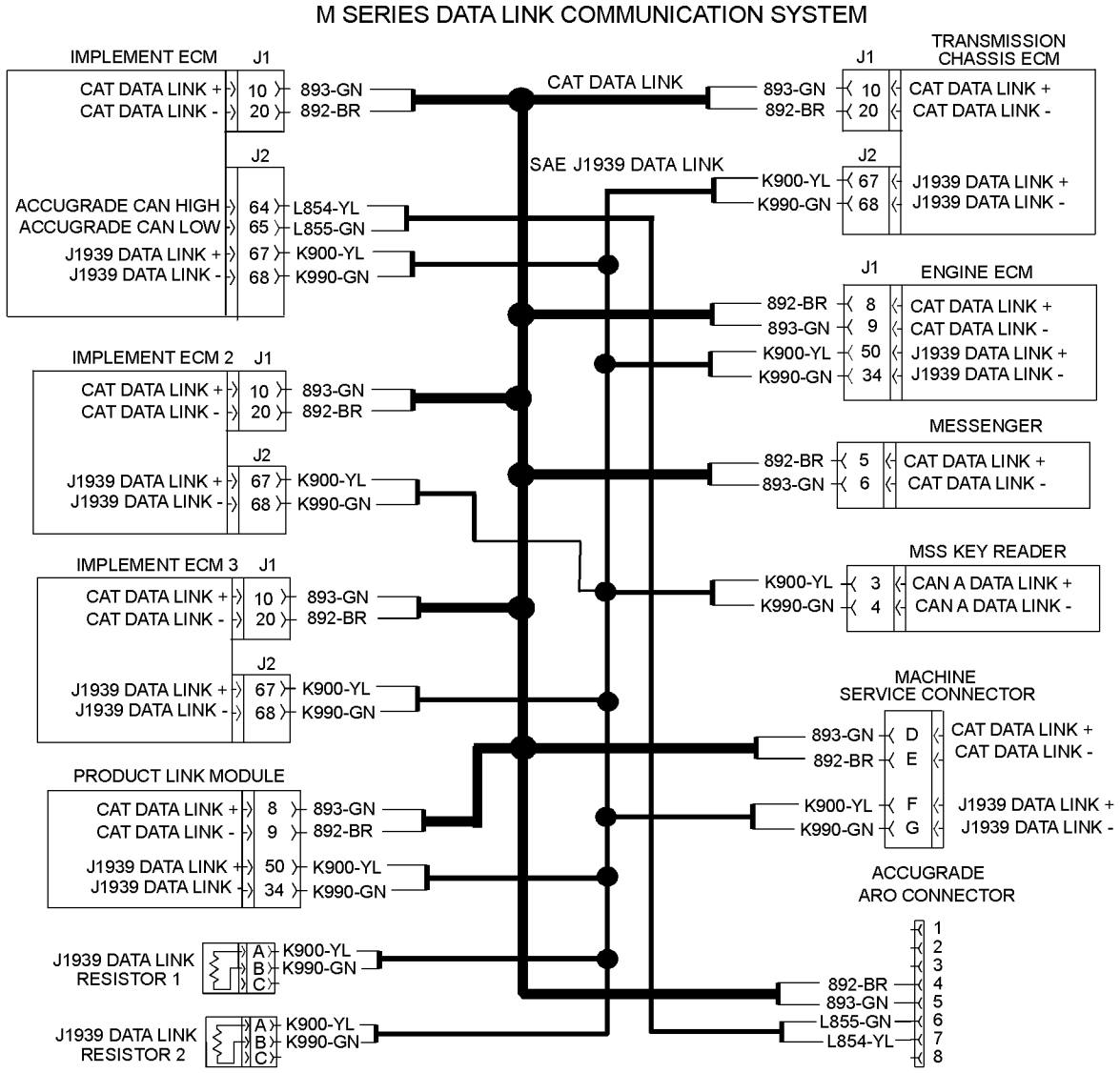


Illustration 137 g01423261

M Series Data Link Communication System

The Implement ECMs use two data link systems for communication between the Implement ECMs and for communication with the other electronic control modules that are on the machine. The systems of data links also allow communication with service tools. In addition, a dedicated data link is present between the first Implement ECM and the Accugrade ARO connector.

The data link is bidirectional. The Implement ECMs can send information and the Implement ECMs can receive information. The data link is not a visible component. The data link consists of internal ECM circuits, the related harness wiring and the harness connectors.

The Implement ECMs communicate over the two data link communication systems that are present on the machine. The two types of systems are listed below.

Cat Data Link – The Cat Data Link is used to send information about the status of the system between control modules and the Caterpillar Electronic Technician (ET). All diagnostic codes of the implement system are activated by the Cat Data Link.

SAE J1939 Data Link – The SAE J1939 Data Link is a high-speed data link system. The J1939 Data Link is used for high-speed system operation communication between the ECM controls and the control modules of other machine systems.

In the event of a failure of the SAE J1939 Data Link system, the Cat Data Link is used as a backup system for operational communication.

Data Link Diagnostics

Both of the data link systems on the machine are monitored by the Implement ECM for abnormal internal circuit conditions or external circuit conditions. The ECM will activate diagnostic codes for a specific control module and data link circuit when an abnormal condition is detected.

When the Implement ECM detects an abnormal condition in a data link circuit, the ECM will activate a “companion” diagnostic code along with the diagnostic code for the involved control module in order to alert the technician to which data link system is involved. The companion codes for the implement system are listed below:

CID 0247 - FMI 09 or FMI 14 – SAE J1939 Data Link

CID 0248 - FMI 09 or FMI 14 – Cat Data Link

An example of how the companion codes are used by the Implement ECM for the data link circuits:

The Implement ECM is communicating with the Transmission/Chassis ECM over the SAE J1939 Data Link circuit, however, some expected data is not being communicated. The Implement ECM will activate the CID 0296 FMI 14 diagnostic code (Special Instruction - not receiving expected information) for the Transmission/Chassis ECM. The Implement will also activate the CID 0247 - FMI 14 companion diagnostic code (SAE J1939 Data Link) in order to indicate which data link circuit is involved. The companion diagnostic code will clear when the primary diagnostic code is cleared.

A CID 0247 or a CID 0248 companion diagnostic code will always be activated when any of the following module communication codes is activated by the Implement ECM.

CID 0296 – Transmission/Chassis ECM

CID 0588 – Messenger System Display

CID 0590 – Engine ECM

Troubleshooting Section

Introduction

i06689032

General Information

SMCS Code: 5700

The diagnostics for the Implement Electronic Control System can be accessed through the Messenger or the Caterpillar Electronic Technician (Cat ET). Troubleshooting the system requires additional information from the Service Manual for the machine. The following list of references should be used to troubleshoot the systems of the machine:

Table 8

Related Service Manuals	
Title	**Form Number**
M Series Motor Grader Service Manual	RENR 9030
14M Power Train Electrical Control System	RENR 9004
14M Implement and Steering Hydraulic System	RENR 8484
Motor Graders Monitoring System	RENR 9034
Additional References	
14M Electrical System Schematic	RENR 9023
14M Hydraulic System Schematic	RENR 9028
Accugrade GPS System For Motor Graders	SEBU 8003
Accugrade Laser System For Motor Graders	SEBU 8276

As a reference, a simplified implement electrical system schematic is included at the end of this manual. For a complete representation of the machine that is being diagnosed, refer to the Electrical System Schematic in the Service Manual of the machine.

When the troubleshooting procedure instructs you to “REPAIR THE HARNESS OR REPLACE THE HARNESS”, use the Electrical System Schematic in the Service Manual of the machine to trace the circuit. Perform resistance checks at the harness connectors to locate harness failures. Always check the ground circuit at the machine harness connector for the components. Less than five ohms of resistance is required between the ground contacts of the connector and the frame ground. Excessive ground resistance that is greater than five ohms can cause an incorrect diagnosis of the system.

During troubleshooting, inspect all harness connections before any component is replaced. If these connections are not clean and tight, permanent electrical problems or intermittent electrical problems can result. Check that the wires are pushed into the connectors completely. Make sure that the connections are tight before other tests are made.

Failure of an electrical component can cause the failure of other components. Always attempt to correct the cause of an electrical system failure before you replace a component. If wire insulation is punctured during troubleshooting, repair the damage. Seal the damaged wires with 8T-0065 RTV Silicone Sealant. Cover the sealant with two layers of 1P-0810 Electrical Tape

ECM Pull Up Voltage

To aid in diagnostics of certain types of electrical circuits that are controlled by the ECM, an internal “pull up voltage” is connected to ECM switch and sensor signal input contacts. An above normal voltage is internally connected to the ECM signal input circuit through a resister.

During normal operation, the switch or sensor signal will hold the circuit low or at a certain signal amplitude, however, circuit conditions such as a loss of power to the component, a disconnection or an open circuit will allow the circuit to be pulled high by the ECM pull up voltage. This will result in an above normal voltage condition at the ECM contact. As a result, the ECM will activate an FMI 03 (voltage above normal) diagnostic code for the affected circuit.

The types of ECM input circuits that have pull-up voltage present are:

- Pulse Width Modulated (PWM) sensor input circuits
- Switch to ground switch input circuits
- Active analog (voltage) input signal circuits
- Passive analog (resistance) input signal circuits

The ECM pull-up voltage should always be considered when troubleshooting one of the circuit types that are listed.

ECM Pull Down Voltage

To aid in diagnostics of electrical circuits that are controlled by the ECM, an internal “pull down voltage” is connected to ECM switch to battery type input circuits.

During normal operation, the switch contacts that are allowing the connection to a voltage source will hold the circuit high. When circuit conditions such as a loss of power to the switch supply voltage, a disconnection in the switch circuit or an open circuit will allow the circuit to be pulled low by the ECM pull-down voltage. This will result in a below normal voltage condition at the ECM contact. As a result, the ECM will activate an FMI 04 (voltage below normal) diagnostic code for the affected circuit.

The ECM pull-down voltage should always be considered when troubleshooting a switch to battery type of input circuit.

Cab Relay Locations

Note: The following relay locations for cab-mounted relays are correct at the time of publication of this manual. The location of the relays on some early model machines may be slightly different. When servicing a particular relay, always refer to the complete Machine Electrical System Schematic to verify the wire numbers of the relay that is being serviced.

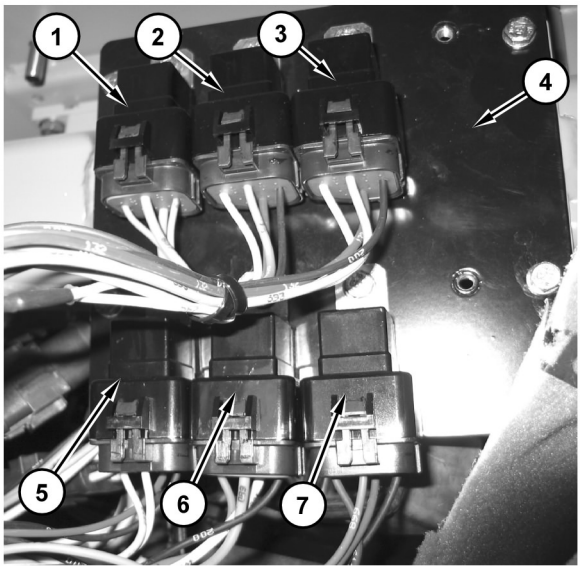


Illustration 138 g01379724

Relays that are located behind the cover on the right side headliner

(1) Power air cleaner relay
(2) Cab floodlights relay
(3) Backlight relay
(4) Mounting location of attachment heated mirror relay when installed
(5) Blade flood relay
(6) Condenser fan relay 2
(7) Condenser fan relay

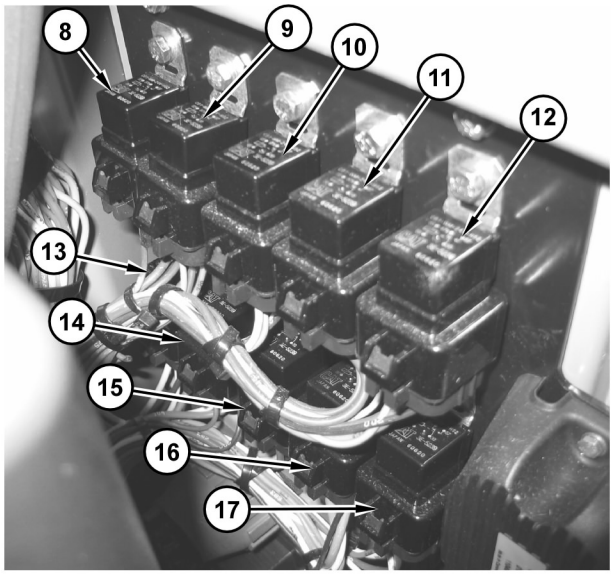


Illustration 139 g01379730

Relays that are on the rear wall of the cab behind the right-hand console

(8) Horn relay
(9) L. H. position relay
(10) Diff lock relay
(11) Headlamp relay
(12) Blade flood relay
(13) Enable relay
(14) R.H. position relay
(15) Dimmer relay
(16) Rear flood relay
(17) Fast speed relay

i02627448

Service Tools

SMCS Code: 0785

The following service tools can be used to aid in troubleshooting the electrical system.

Table 9

Service Tools	
Part Number	**Part**
	Caterpillar Electronic Technician (Cat ET)
6V-7070 9U-7330	Digital Multimeter
8T-3224	Needle Tip Group
7X-1710	Multimeter Probe Group
8T-8726	Adapter Cable Assembly
151-6320	Removal Tool
9U-7246	Connector Repair Kit DT
4C-3406	Connector Repair Kit
4C-8195	Control Service Tool (Switch Box)

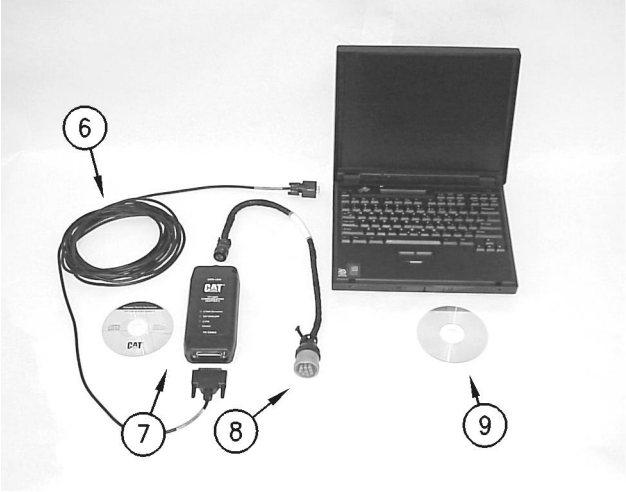


Illustration 140 g00774942

Connections for the Communication Adapter II and the Caterpillar Electronic Technician (ET)

The components that are needed in order to use the Communication Adapter II and the Caterpillar Electronic Technician (ET) in order to determine diagnostic codes are listed:

(6) Cable
(7) 171-4400 Communication Adapter II
(8) Service diagnostic cable.
(9) Current version of Cat ET software and an IBM-COMPATIBLE personal computer

Reference: See Special Publication, NEHS0758, “Communications Adapter II User's Manual Contains Software”.

Note: Caterpillar Electronic Technician (ET) is a software program that can be used on an IBM compatible personal computer.

In order to use the Cat ET, order the following materials: Special Publication, JERD2124, “ET Single Use Program License”, Special Publication, JEHP1026, “Information and Requirements Sheet”, 7X-1425 Data Link Cable and the Data Subscription and Special Publication, JERD2142, “Data Subscription”. The Special Publication, JEHP1026, “Information and Requirements Sheet” lists the required hardware and the features of the Cat ET.

The Cat ET is not required in order to determine the diagnostic codes and the Cat ET is not required in order to clear the diagnostic codes. However, the process of determining the diagnostic codes is easier and faster by using the Cat ET. The Cat ET can also display information on the history of a diagnostic code and the parameter status of diagnostic codes. These features allow the Cat ET to be a useful tool for troubleshooting.

The Cat ET is used to communicate to the electronic control module over the data link by connecting to the machine diagnostic connector. For more information and the locations of the connectors, see Troubleshooting, “Electrical Components and Connector Locations” and the Electrical System Schematic in your machine's Service Manual.

For instructions on servicing Sure Seal connectors, see Special Instruction, SMHS7531. For instructions on servicing Deutsch connectors, see Special Instruction, SEHS9615.

Use the digital multimeter for measuring resistance or for measuring voltage. For instructions about the use of the 6V-7070 Digital Multimeter, see Special Instruction, SEHS7734. The 7X-1710 Multimeter Probes are used to measure the voltage at the connectors without disconnecting the connectors. The probe ends are pushed into the back of the connector along the wire. The 151-6320 Removal Tool is used to remove a wire and socket or pin from the connector body. The 8T-8726 Adapter Cable has a breakout with 3 pins. The adapter cable is used for measurements in the sensor circuits.

Note: Except for harness tests, using continuity testers such as the 8T-0500 Continuity Tester or voltage testers such as the 5P-7277 Voltage Tester is not recommended for today's Caterpillar electrical circuits.

i02755989

Connector Locations

SMCS Code: 7553-546-WW

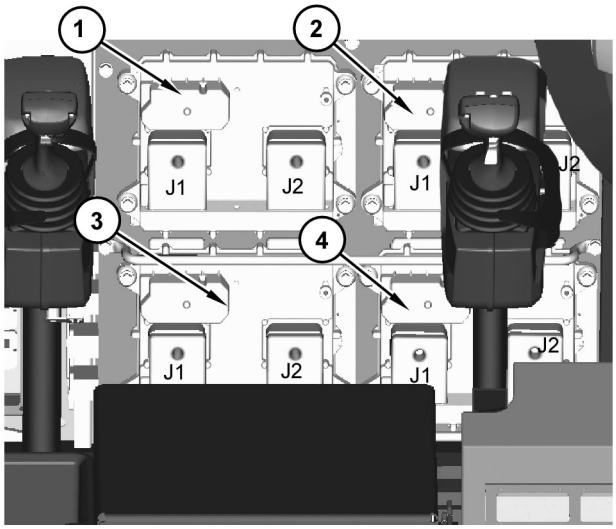


Illustration 141 g01380001

Implement and AWD Control Modules (view: looking to rear of cab with seat removed)

(1) Implement ECM
(2) Implement ECM 2
(3) AWD ECM (models equipped with all wheel drive)
(4) Implement ECM 3 (attachment)

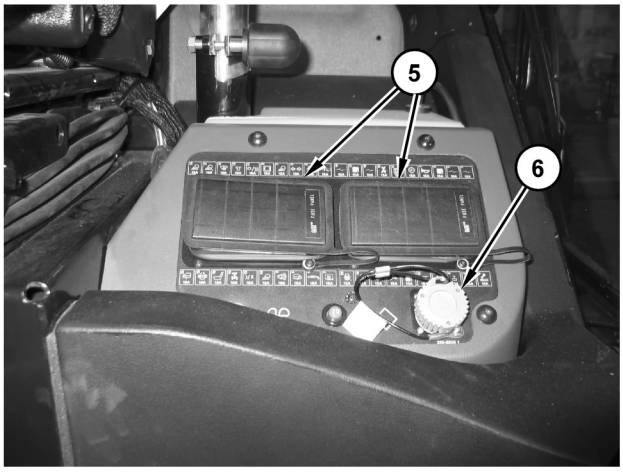


Illustration 142 g01380004

Fuse Panels and Service Plug on the left side of the operator seat

(5) Fuse panels
(6) Service Connector

The Implement ECMs are located behind the operator seat under the appearance cover. The J1 and J2 connectors for each ECM is shown in the illustration. The machine service connector for the Cat ET connection is located on the left side of the operators seat in the cab.

When a procedure requires that the machine electrical system should be turned OFF, move the key switch to the OFF position and move the electrical disconnect switch to the OFF position.

In order to locate machine wiring harness connectors on the machine, the Electrical System Schematic, Parts Manual and Operation and Maintenance Manual for the machine that is being serviced should be used.

The following information is a guide to reading the component location tables on the back of the Electrical System Schematic.

- The “Component Location” table uses white circles or light gray circles in order to mark the locations in the profile of the machine and in the area views. Alphabetical letters in the “Machine Location” column indicate a general area of the machine. Refer to the corresponding footnote at the end of the table for a description of the location.
- The “Harness Connector Location” table uses white circles or light gray circles in order to mark the locations in the general view and in the area views. Alphabetical letters in the “Machine Location” column indicate a general area of the machine. Refer to the corresponding footnote at the end of the table for a description of the location.

ECM Connector Contact Numbers

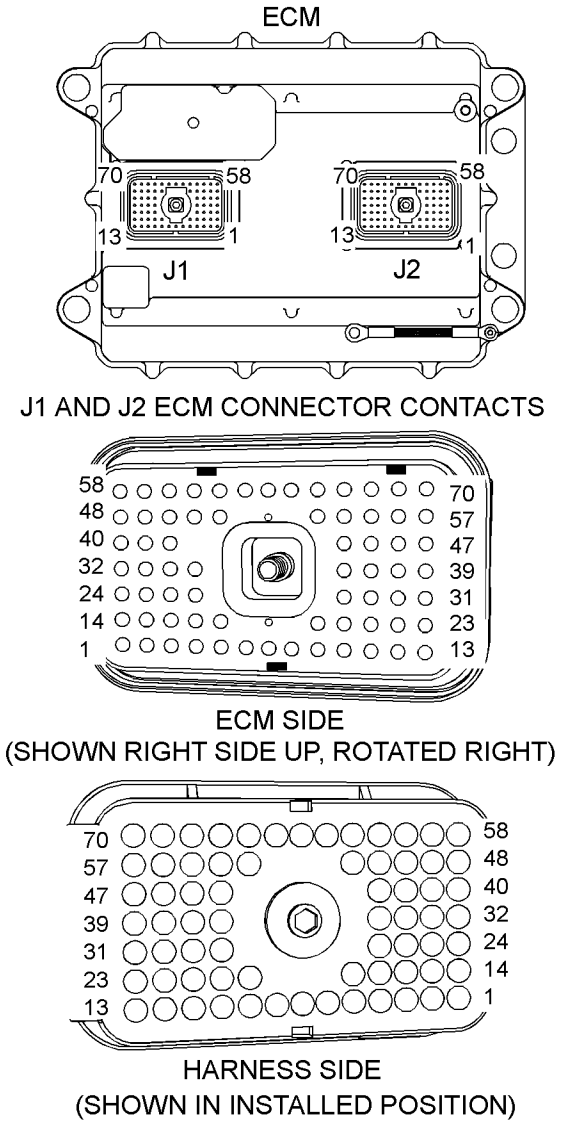


Illustration 143 g01309473

The M Series Motor Graders can be equipped with either two or three Implement ECMs depending on the configuration of the machine.

i02785188

Diagnostic Capabilities

SMCS Code: 5700

The diagnostic information for the implement ECM can be accessed with the technician with the Caterpillar Electronic Technician (Cat ET) service tool or by using the Messenger display.

The Caterpillar Electronic Technician (Cat ET)

Illustration 144 g01277712

Connections for the Caterpillar Electronic Technician (Cat ET)

The Cat ET service tool is a software program that is used in order to perform the following:

- Access data that is used by an ECM to control a machine system.
- View data that is used by an ECM to control a machine system.
- Monitor data that is used by an ECM to control a machine system.
- Change the data that is used by an ECM to control a machine system.

The service technician can use the Cat ET in order to perform maintenance on the machine. Some of the options that are available with the Cat ET are listed below:

- View the active diagnostic codes and logged diagnostic codes. See Troubleshooting, “Using the Caterpillar Electronic Technician to Determine Diagnostic Codes”.
- Viewing the active event codes and logged event codes
- View the status of parameters.
- Clear logged diagnostic codes
- Perform calibrations of machine systems.
- Program the ECM (Flash). This is done with the “WINflash” program. See Testing and Adjusting, “Electronic Control Module (ECM) - Flash Program”.
- Print reports.

The following list contains some of the diagnostic functions and programming functions that are performed by the service tools.

- The failures of the ECM system are displayed.
- The status of most of the inputs and the outputs are displayed.
- The settings for the ECM are displayed.
- Display the status of the input and output parameters in real time.
- Display the clock hour of the internal diagnostic clock.
- The number of occurrences and the clock hour of the first occurrence and the last occurrence is displayed for each logged diagnostic code.
- The definition for each logged diagnostic code and each event is displayed.
- Load new FLASH software.

See Troubleshooting, “Diagnostic Code List” for the list of diagnostic codes for the ECM.

- Active diagnostic codes
- Logged diagnostic codes

Event Codes

Logged Event Codes

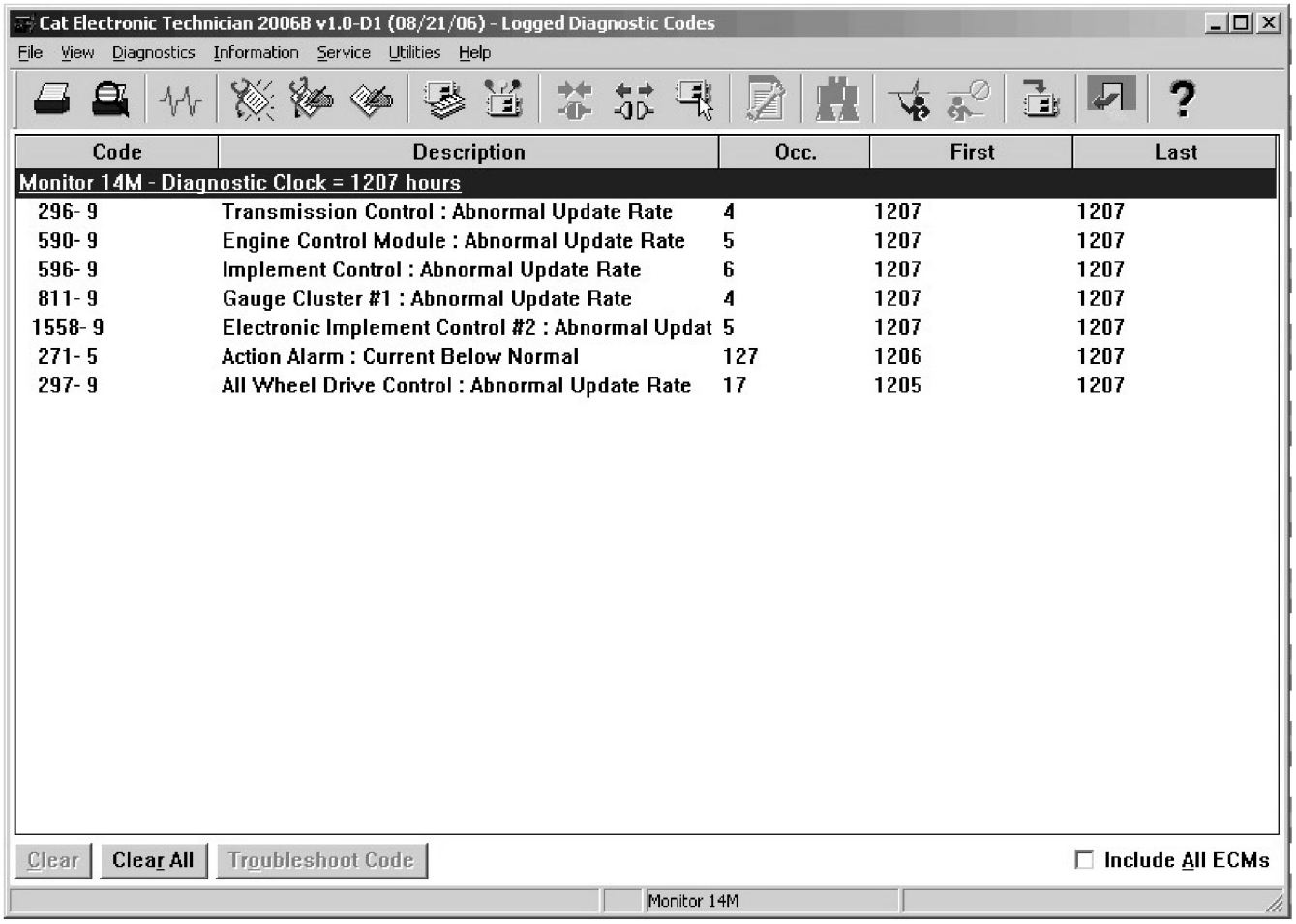


Illustration 145 g01308956

Typical ET screen for logged events

An indicator for logged events is provided. The indicator allows the service technician to keep track of event codes that are intermittent. The data for the logged event will include the following information:

- An event identifier (EID)
- A text description of the problem
- The number of occurrences of the problem
- A time stamp will display the first occurrence of the problem.
- A time stamp will display the last occurrence of the problem.

Status Groups For The Electronic Technician

The Status groups are lists of machine parameters. The status of the parameters are shown in real time.

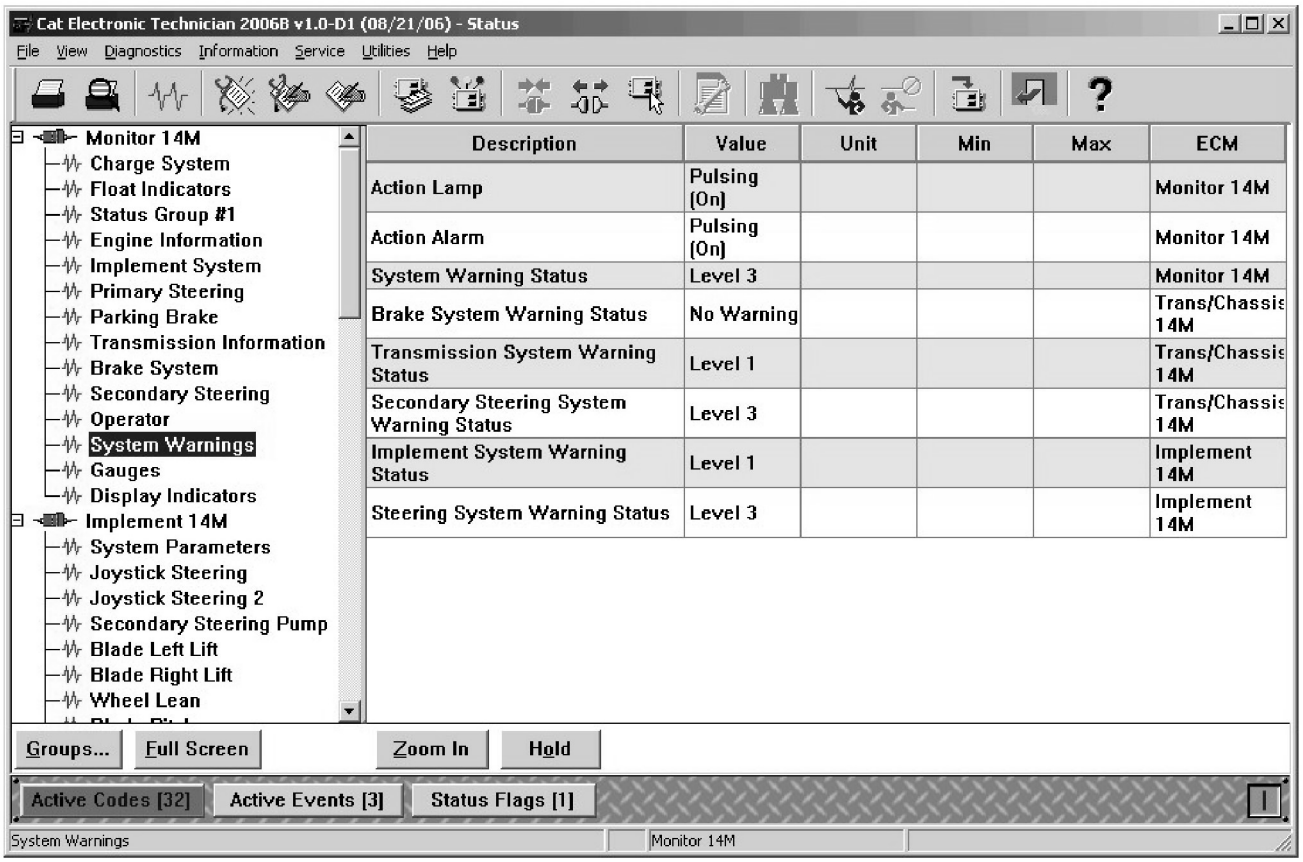


Illustration 146 g01308958

Typical ET Status Screen

Messenger

Illustration 147 g01391428

Messenger Display Module

The display of messenger is located on the right console inside the cab. The Messenger monitors the operation of the machine.

The Messenger allows the technician to access the following diagnostic information:

- View Logged Events and Diagnostic Codes.
- View Active Events and Diagnostic Codes.
- View the status of system components.
- View the system parameters.

Some warnings will generate a detailed message that will appear on the Messenger display.

Accessing Diagnostic Codes With The Messenger

Perform the following steps in order to view the active diagnostic codes and perform the following steps in order to view the logged diagnostic codes:

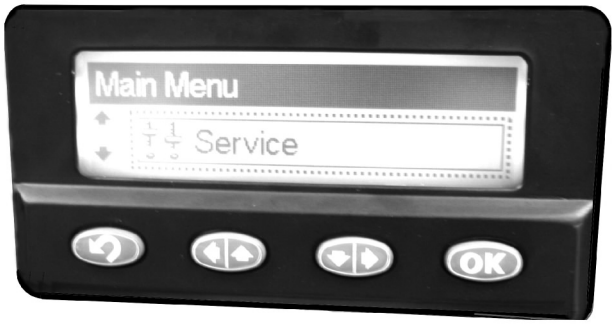


Illustration 148 g01391429

Messenger Main Menu

1. From the Messenger Main Menu page, scroll to “Service” menu and press the “OK” button.

Illustration 149 g01391431

Messenger Service Menu

2. From the Messenger Service Menu page, the first option in the service menu will be “Diagnostics/Events” . Press “OK” in order to view the list of Active codes and Logged codes.

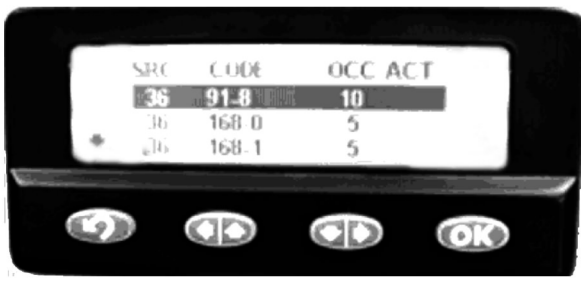


Illustration 150 g01299326

The Messenger Diagnostics/Events List screen

3. The Messenger Diagnostics/Events List screen shows the following:

SRC – Source

CODE – MID, CID, FMI, EID and WCI

OCC – The number of occurrences of the codes

ACT – The fact that the code is active

Pressing “OK” on any of these codes will display the Diagnostic/Event screen.

Note: If the code is Active, there will be an “A” in the “ACT” column.

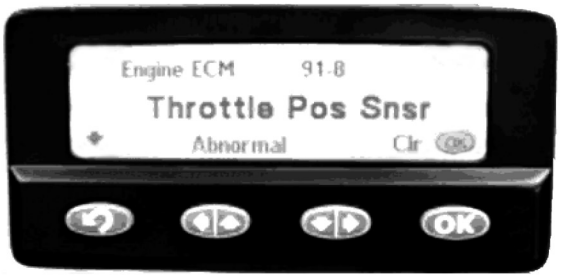


Illustration 151 g01299332

The Messenger Diagnostic/Event Detail screen

The Messenger Diagnostic/Event Detail screen will display the following:

- Source of the failure
- Code CID, FMI, EID and WCI
- Text description of failed component
- Text description of the type of failure

Symptom Troubleshooting

i07793150

Symptom Troubleshooting

SMCS Code: 5050-035; 7000-035

Use the following guidelines when troubleshooting a symptom.

Know the Machine

Understand the operation of the machine. Know if the symptom is a characteristic of normal operation or if the symptom is a failure.

Read the Systems Operation information to understand the systems of the machine. Understand the interaction of the machine systems.

Understand the Symptom

Speak with the operator about the symptom. Inspect the machine and look for problems. Notice any unusual odors in the air. Listen for unusual noises. Acquire the following Information:

- The performance of the machine prior to the failure.
- First occurrence of the symptom.
- The operating conditions at the time of the failure.
- The sequence of events prior to the failure (order of the occurrences).
- The troubleshooting steps that have been taken.
- The history of repairs of the machine.
- The preventive maintenance of the machine.
- Related service information about current problems that affect the serial number of the machine.

Perform the “Visual Inspection” steps.

Verify the Symptom

When possible, attempt to duplicate the symptom. Operate the machine and repeat the conditions that caused the failure. Check the gauges inside the cab. Notice any unusual odors in the air. Listen for unusual noises.

Determine if the ECM has detected any faults. A diagnostic code is used to specify each detected fault.

Determine Possible Causes

Use the information from the operator and your inspection. Attempt to identify a common cause if there is more than one symptom.

If the problem is not resolved after troubleshooting the diagnostic codes, continue troubleshooting using the “Symptom Troubleshooting” section of this manual. Identify the component that is the most probable cause of the symptom.

Test and Repair the System

Use the tests and procedures in this manual to verify the cause of the symptom. Once the cause has been identified, repair the failure. Test the system again to verify that the symptom is resolved.

Provide Feedback to Caterpillar

Share your troubleshooting information with Caterpillar. Use the form in “SIS” or “CBT” feedback to write a brief description about the symptom, testing, and repair. Include your phone number or e-mail address so that you can be contacted. This feedback information helps Caterpillar improve service information.

i04046111

Emerging Symptom Information

SMCS Code: 5050-035; 7000-035

This space is for new symptom information for this product.

Note: Use the Service Information System on the Web in order to find the most up-to-date information.

Share your troubleshooting knowledge of symptoms. Use the feedback form in “SIS” or “CBT” to write a brief description about the symptom, testing, and repair of the machine. Your feedback information will help Caterpillar improve the symptom information for this product.

i02957559

Indicator Lamp Does Not Illuminate

SMCS Code: 7400-038-IND

System Operation Description:

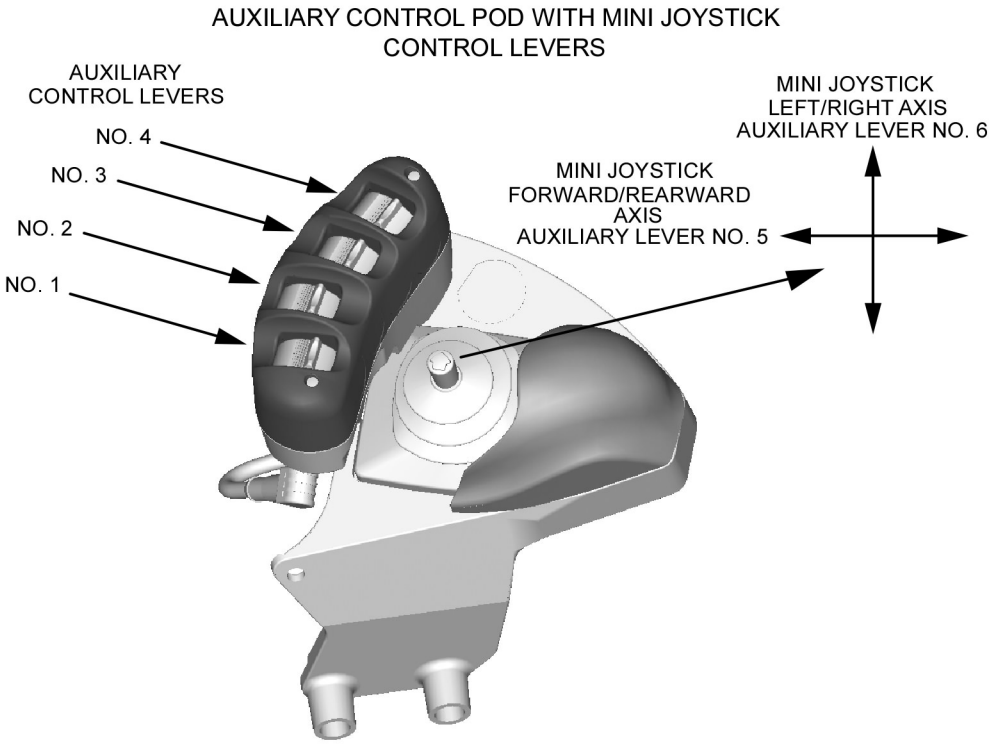


Illustration 152 g01372839

“Auxiliary Control Pod” with mini joystick

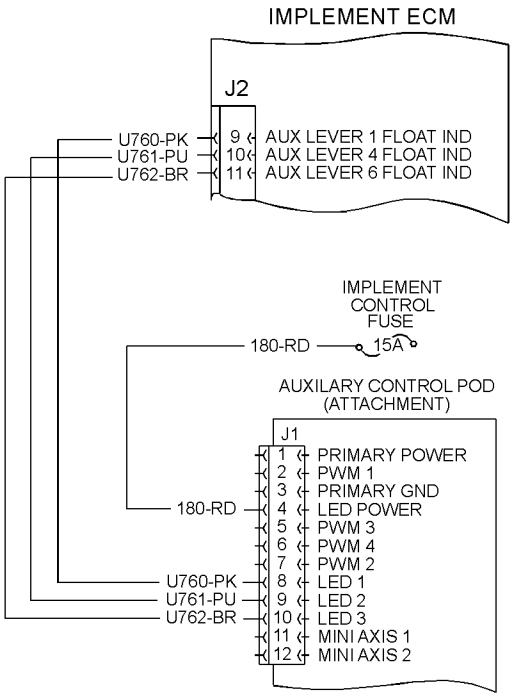


Illustration 153 g01319572

Connections of “Auxiliary Hydraulic Control Lever LED Float” Indicator

The auxiliary hydraulic “LED float mode” indicators are controlled by the Implement ECM. The circuits for the LED are not monitored by the ECM for diagnostics.

The power for the circuits of the LED are supplied to the “auxiliary control pod” connector through the 15 amp control fuse of the Implement ECM. The indicator circuits are connected to sinking outputs of the ECM. When the ECM detects that the one of the “auxiliary control” levers is in the FLOAT position, the ECM will turn ON the sinking output. This allows a path to ground for the power circuit through the LED which will cause the LED to illuminate.

Conditions that could cause an LED indicator to be OFF when the auxiliary control lever is in the float mode are listed below:

- The supply fuse is open.
- The power supply circuit is open or has a poor connection
- The sinking LED circuit is open or has a poor connection
- The LED has failed.
- The ECM has failed. This is not likely

When the control lever is in the float position and the LED indicator is OFF, perform the following troubleshooting procedure.

Note: Verify that the the control lever is in the FLOAT position and the LED should be ON before performing this procedure.

Test Step 1. CHECK THE POWER CIRCUIT FOR AN OPEN

Note: We will verify that the implement control fuse is not open, however, it is unlikely that the Implement Control fuse would be open. If the control fuse of the Implement ECM is open, the Implement ECM will not function. The control fuse of the Implement ECM also supplies system power to the Implement ECM.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Pull the implement control fuse out of the fuse holder and check the fuse for an open condition. If the fuse is open, replace the fuse. If the fuse is not open, leave the fuse out of the fuse holder and proceed to the next step.

C. Disconnect the machine harness connector from the “auxiliary control pod” .

D. With the implement control fuse out of the fuse holder, measure the resistance between the load contact (wire 180-RD(Red)) of the fuse holder and the harness connector power contact J1-4 (wire 180-RD(Red)) for the auxiliary control pod.

Expected Result:

The resistance measurement is less than 5.0 ohms.

Results:

- OK – The resistance measurement is less than 5.0 ohms. The resistance measurement does not indicate an open or a bad connection in the power circuit in the machine harness.Proceed to Test Step 2.
- NOT OK – The resistance measurement is greater than 5.0 ohms. The resistance measurement does indicate an open connection or a bad connection in the power circuit of the machine harness.

  Repair: There is an open connection or a bad connection in the LED power supply circuit in the machine harness. A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but the connection is not a good connection.

Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in power supply circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 2. CHECK THE LED, THE ECM AND THE CIRCUIT

The disconnect switch and the key start switch remain in the OFF position.

A. Reinstall the fuse that was removed in the last test step.

B. Connect the machine harness connector to the “auxiliary control pod” .

C. Use a 151-6320 Removal Tool to remove the involved LED circuit wire from the ECM J2 connector. The J2 connector remains connected to the ECM.

D. Connect one end of a jumper wire to the disconnected LED circuit wire. Connect the other end of the jumper wire to a good frame ground contact.

E. Turn the disconnect switch and the key start switch to the ON position.

Expected Result:

The LED indicator is illuminated when the jumper wire was connected to frame ground.

Results:

- YES – The LED indicator is illuminated when the jumper wire was connected to frame ground. The LED and the circuit wire are operating correctly. The ECM could be causing the problem.

  Repair: Verify that the LED indicator is supposed to be ON. Ensure that the correct control lever is in the full forward float position.

  Exit this procedure and perform this procedure again. If the indication is that the ECM is causing the problem, contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The LED indicator is still not illuminated when the jumper wire was connected to frame ground. The ECM is not causing the problem. Reinstall the LED circuit wire that was removed from the ECM connector.Proceed to Test Step 3.

Test Step 3. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the machine harness connector from the auxiliary control pod.

C. At the machine harness connector for the auxiliary control pod, connect a jumper wire between the LED circuit contact that is not working and one of the other two LED circuit contacts.

D. Disconnect the machine harness connector J2 from the Implement ECM.

E. At the machine harness connector J2 for the ECM, measure the resistance between the two circuits that are jumpered at the control pod connector.

Expected Result:

The resistance measurement is less than 5.0 ohms.

Results:

- OK – The resistance measurement is less than 5.0 ohms. The resistance measurement does not indicate an open or a bad connection in the LED circuit in the machine harness.

  Repair: The LED may have failed.

  Exit this procedure and perform this procedure again. If the indication is that the LED has failed, replace the auxiliary control pod. The LED circuits are not serviceable.

  STOP.

- NOT OK – The resistance measurement is greater than 5.0 ohms. The resistance measurement does indicate an open connection or a bad connection in the LED circuit in the machine harness.

  Repair: There is an open or a bad connection in the LED circuit in the machine harness. A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but the connection is not a good connection.

Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the LED circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

i02957597

Indicator Lamp Is On Continuously

SMCS Code: 7400-038-IND

System Operation Description:

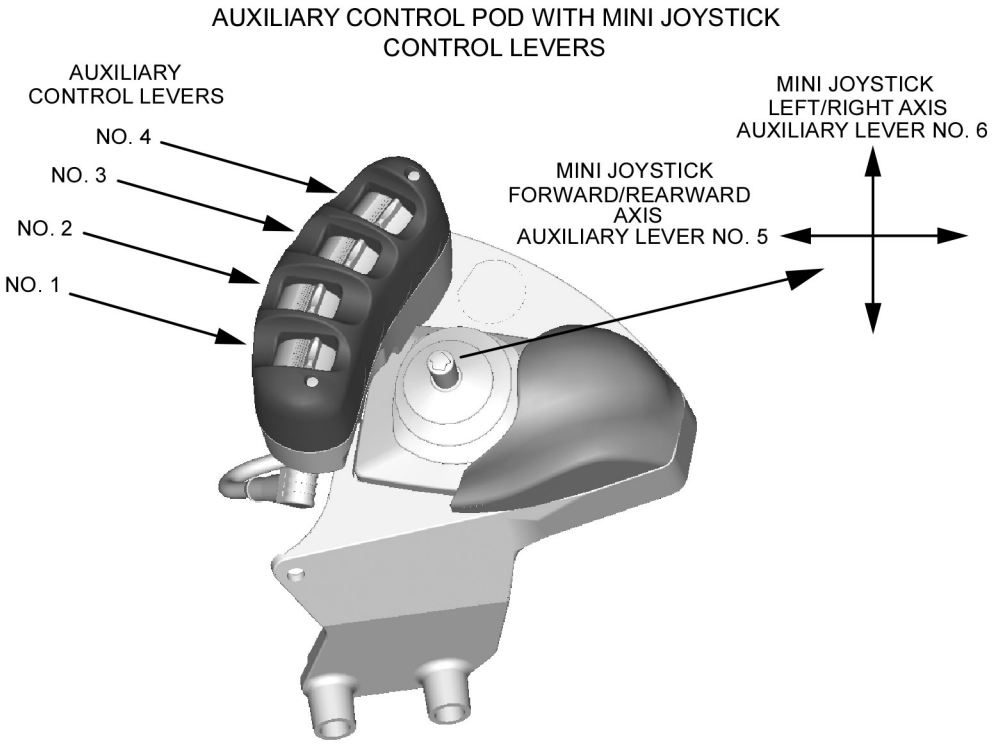


Illustration 154 g01372839

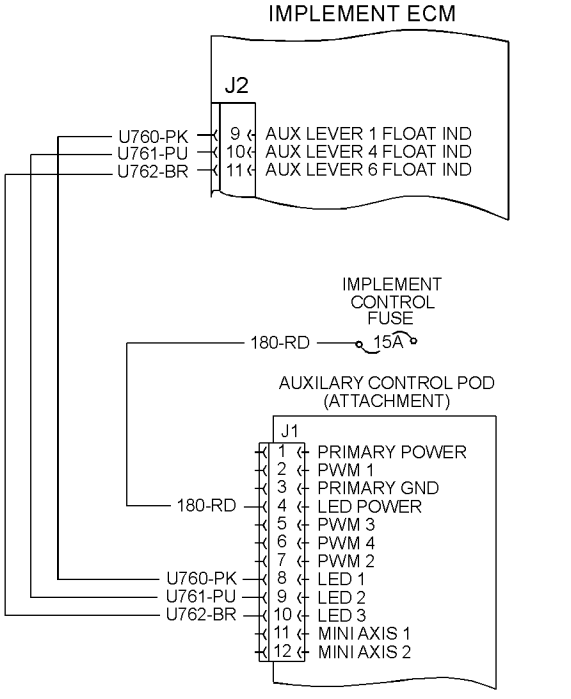


Illustration 155 g01319572

Connections of “Auxiliary Hydraulic Control Lever LED Float” Indicator

The auxiliary hydraulic LED float mode indicators are controlled by the Implement ECM. The LED circuits are not monitored by the ECM for diagnostics.

System power for the LEDs is supplied to the auxiliary control pod connector through the 15 amp implement control fuse. The indicator circuits are connected to ECM sinking outputs. When the ECM detects that the one of the auxiliary control levers is in the float position, the ECM will turn ON the sinking output. This allows a path to ground for the power circuit through the LED which will cause the LED to illuminate.

Conditions that could cause an LED indicator to be ON when the auxiliary control lever is not in the float mode are listed:

- The LED sinking output circuit is shorted to a ground source in the machine harness.
- The ECM has failed. This is not likely.

When an LED circuit is ON and the control lever is not in the float position, perform the following troubleshooting procedure.

Test Step 1. CHECK THE CIRCUIT FOR A SHORT TO GROUND

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the machine harness connector from the “auxiliary control pod” .

C. Disconnect the machine harness ECM connectors J1 and J2 from the Implement ECM.

D. At the machine harness ECM connectors, measure the resistance from the involved LED circuit contact J2-9, J2-10 or J2-11 to frame ground. Measure the resistance from the LED contact to all of the other contacts that are used in the J1 and J2 ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurement does not indicate a short to frame ground or to another circuit in the machine harness.Proceed to Test Step 2.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short to frame ground or to another ground circuit in the machine harness.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are involved in the LED circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Check the machine harness for areas where the there is contact with the machine frame. Look for worn insulation or missing insulation on the wire. Repair the machine harness or replace the machine harness.

  Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

A. Reconnect the ECM connectors to the ECM and reconnect the harness connector to the auxiliary control pod.

B. Turn the disconnect switch and the key start switch to the ON position.

C. With the LED float indicator ON, use a 151 - 6320 Removal Tool to remove the involved LED circuit wire from the ECM J2 connector. The J2 connector remains connected to the ECM.

Expected Result:

The LED indicator is still illuminated.

Results:

- YES – The LED indicator is still illuminated. Disconnecting the circuit wire from the ECM connector did not cause the LED to turn OFF. The ECM is not causing the problem.

  Repair: The LED circuit wire is grounded to another source in the machine harness or to frame ground.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are involved in the LED circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Check the machine harness for areas where the there is contact with the machine frame. Look for worn or missing insulation on the wire. Repair the machine harness or replace the machine harness.

  Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

- NO – The LED indicator is no longer illuminated when the circuit wire is disconnected from the ECM connector. Disconnecting the circuit wire from the ECM connector caused the LED to turn OFF. The ECM is could be causing the problem.

  Repair: Verify that the LED indicator is not supposed to be ON.

  Exit this procedure and perform this procedure again. If the indication is that the ECM is causing the problem, contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05980047

Steering Direction Is Opposite of Expected Direction

SMCS Code: 4300-035

Immediate safe shutdown required

The E256 (3) event is activated when the steering cylinder position sensor or spool position sensor indicates movement in the opposite direction from commanded flow.

Potential causes of the E256 Event Code are as follows:

- Mechanical problem with the steering valve
- Electrical problem with the steering valve
- Mechanical problem with the front axle linkage
- External forces applied to the front wheels
- Hydraulic hose connections are reversed
- Secondary solenoids electrical connections are reversed

Preliminary checks before troubleshooting:

1. Overview of the machine.

- Troubleshoot all other steering diagnostics codes prior to using this troubleshooting.
- Ensure all the latest steering Product Improvements have been performed prior to using this troubleshooting.
- Determine if the codes or the most recent codes are occurring only on the primary steering ECM. (Implement ECM for M-Series or Implement 2 for M-Series 2). This quick check will verify if the problem is with components that are in only the primary steer system (actuator, wiring, resistor) or with components shared with both primary and secondary steer system (pump, steering valve, steer cylinders).
- Check to make sure oil viscosity setting in ET matches the oil that is in the machine.

2. Obtain information from the operator.

- Did the front wheels of the machine come into contact with an immovable object or in a heavy, high load underfoot condition at the time the event was activated with no other diagnostics. If so the steering system could be performing as designed. Linkage movement was intended to prevent structural damage.
- Find out if ground conditions could be causing the code. Refer to SEPD1354 for conditions that can cause the code.
- Find out what the machine was doing when the code occurred, Example roading, fine blading, heavy blading, and so on.
- What was the machine speed when the code occurred. This information can help determine if the code is being generated due to lack of spool movement vs lack of wheel movement. For 120 - 14 size machines the software looks at spool position below 9 kph and steering cylinder position above 9 kph. For 16 and 24 size machines the software looks at spool position below 15 kph and steering cylinder position above 15 kph.
- Find out what the hydraulic oil temperature was when the code occurred.

Note: Use the following flowchart to troubleshoot this event:

E256 - Steering Output Detected in Wrong Direction

Note: With February 2014 and later software steering alignment and operator presence will need to be detected for the steering actuator to be turned ON

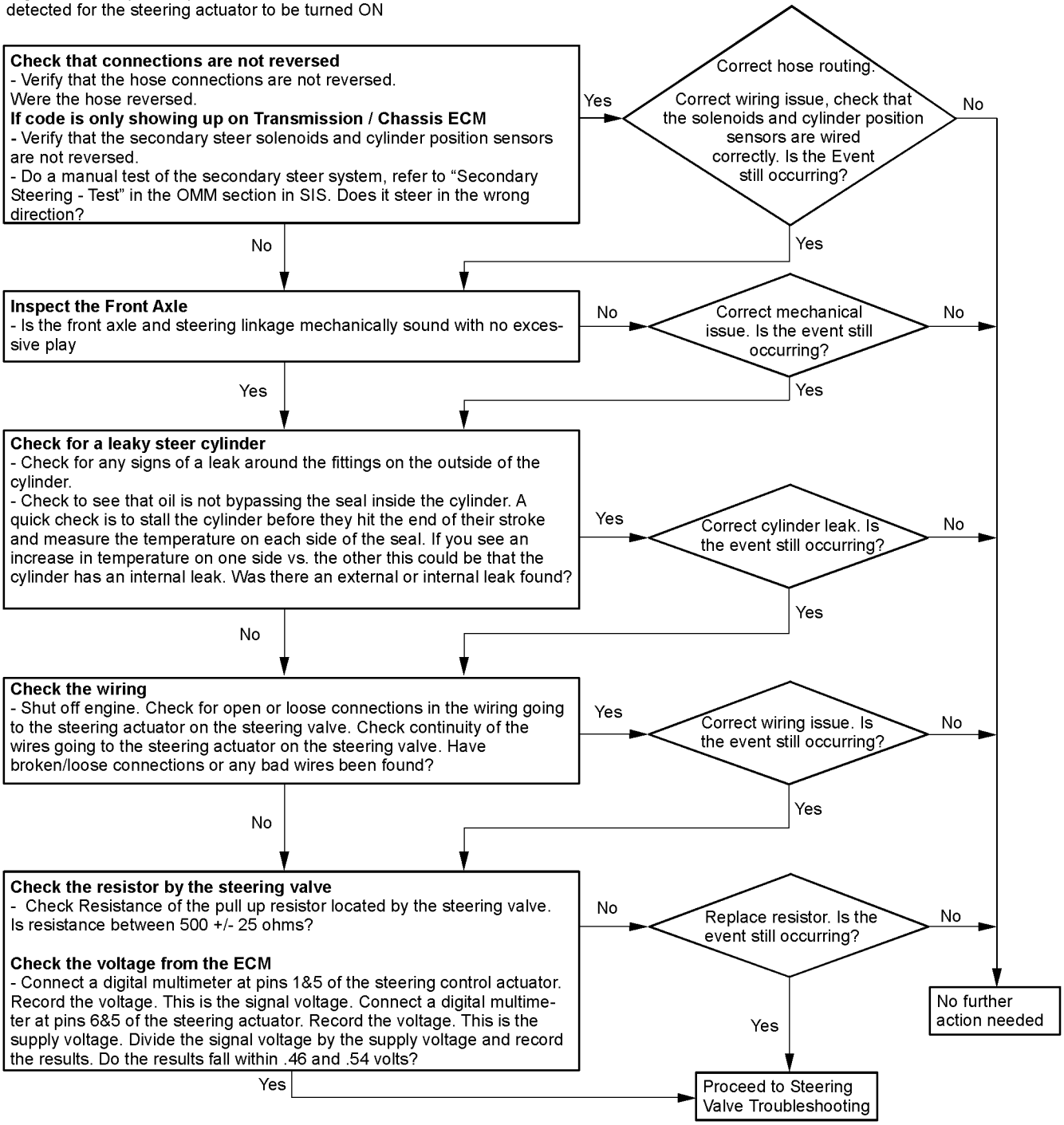


Illustration 156 g03648045

Flowchart 1 - E256- Steering Output Detected in Wrong Direction

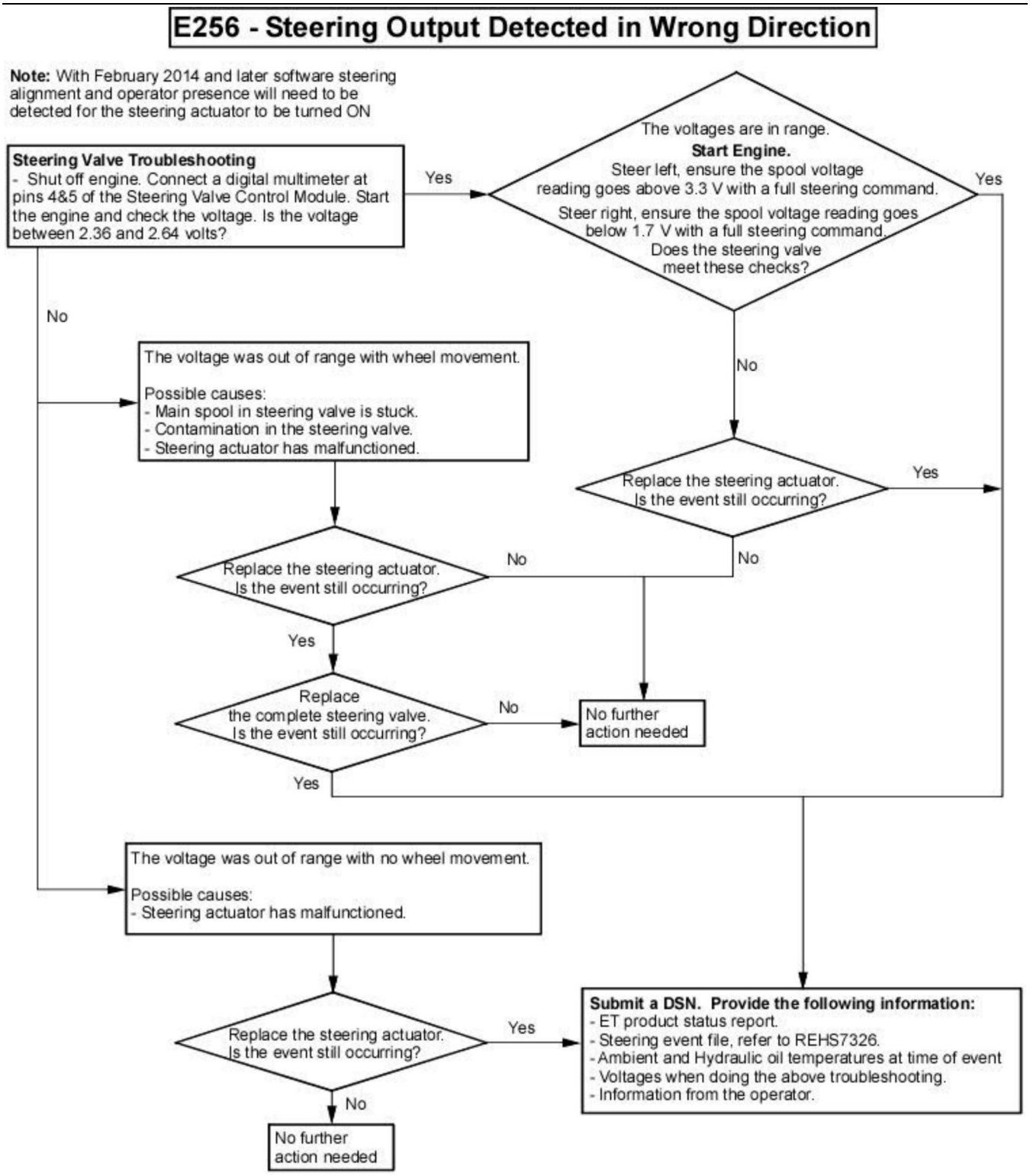


Illustration 157 g03745978

Flowchart 2 - E256- Steering Output Detected in Wrong Direction

i05745449

Steering Does Not Function

SMCS Code: 4300-035

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Immediate safe shutdown required

The E258 (3) Event is activated when steering is commanded and the front wheels are not moving.

Potential causes of the E258 Event Code are as follows:

- Mechanical problem with the steering valve
- Electrical problem with the steering valve
- Mechanical problem with the front axle linkage
- Front wheels are physically blocked and will not respond to command
- Loss of load signal

Preliminary checks before troubleshooting:

1. Overview of the machine.

- Troubleshoot all other steering diagnostics codes prior to using this troubleshooting.
- Ensure all the latest steering Product Improvements have been performed prior to using this troubleshooting.
- Determine if the majority of the codes or the most recent codes are occurring only on the primary steering ECM (Implement ECM for M-Series or Implement 2 for M-Series 2). This is a quick check to verify if the problem is with components that are in only the primary steer system (actuator, wiring, resistor) or components shared with both primary and secondary steer system (pump, steering valve, steer cylinders).
- Check to make sure oil viscosity setting in ET matches the oil that is in the machine.

2. Obtain information from the operator.

- Did the front wheels of the machine come into contact with an immovable object or in a heavy, high load underfoot condition at the time the event was activated with no other diagnostics. If so the steering system could be performing as designed. Linkage movement was intended to prevent structural damage.
- Find out if ground conditions could be causing the code. Refer to SEPD1354 for conditions that can cause the code.
- Find out what the machine was doing when the code occurred, Example roading, fine blading, heavy blading, and so on.
- What was the machine speed when the code occurred. This can help determine if the code is being generated due to lack of spool movement vs lack of wheel movement. For 120 - 14 size machines the software looks at spool position below 9 kph and steering cylinder position above 9 kph. For 16 and 24 size machines the software looks at spool position below 15 kph and steering cylinder position above 15 kph.
- Find out what the hydraulic oil temperature was when the code occurred.

Note: Use the following flowchart to troubleshoot this event:

E258 - No Steering Detected With Command Given

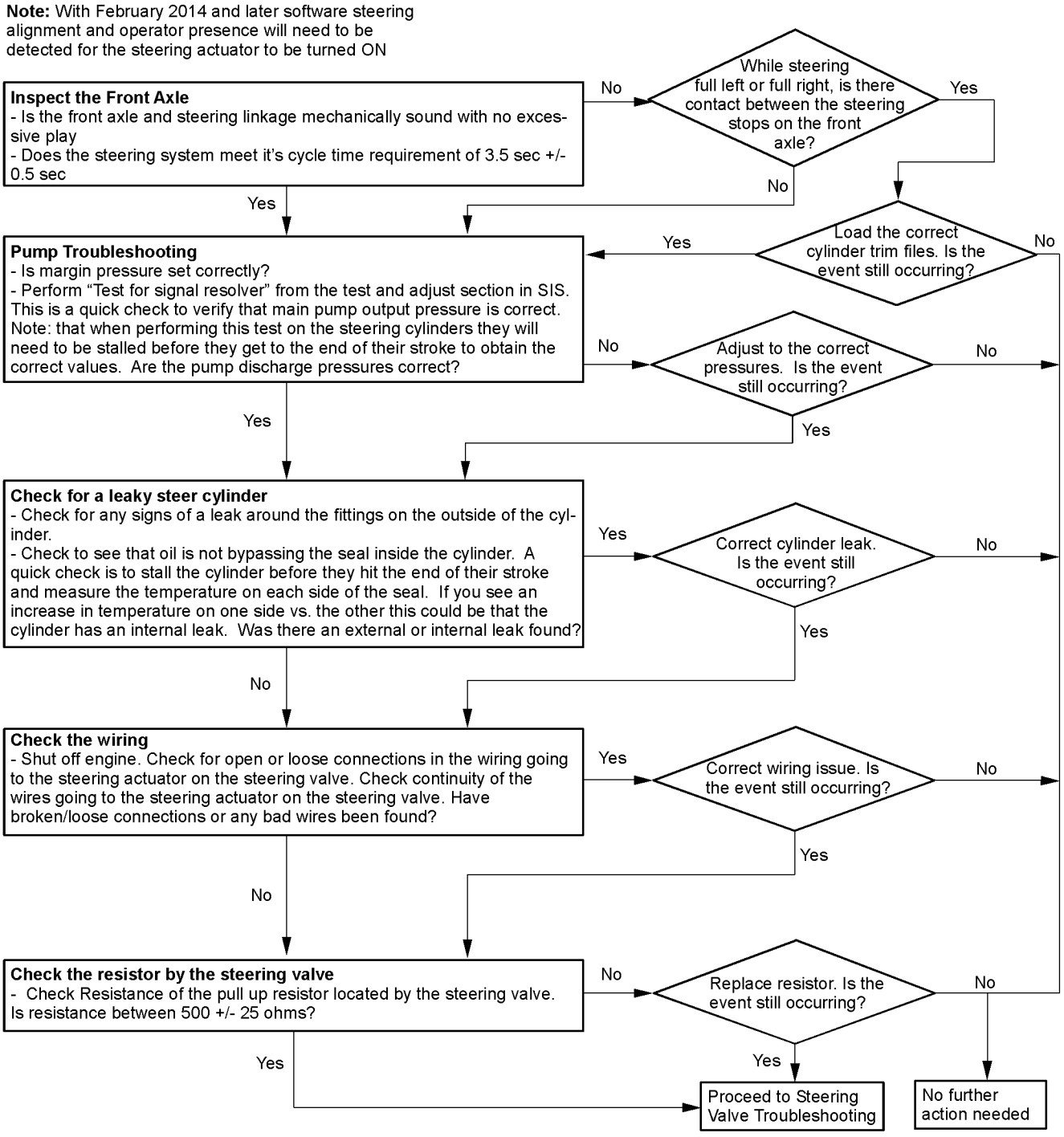


Illustration 158 g03648676

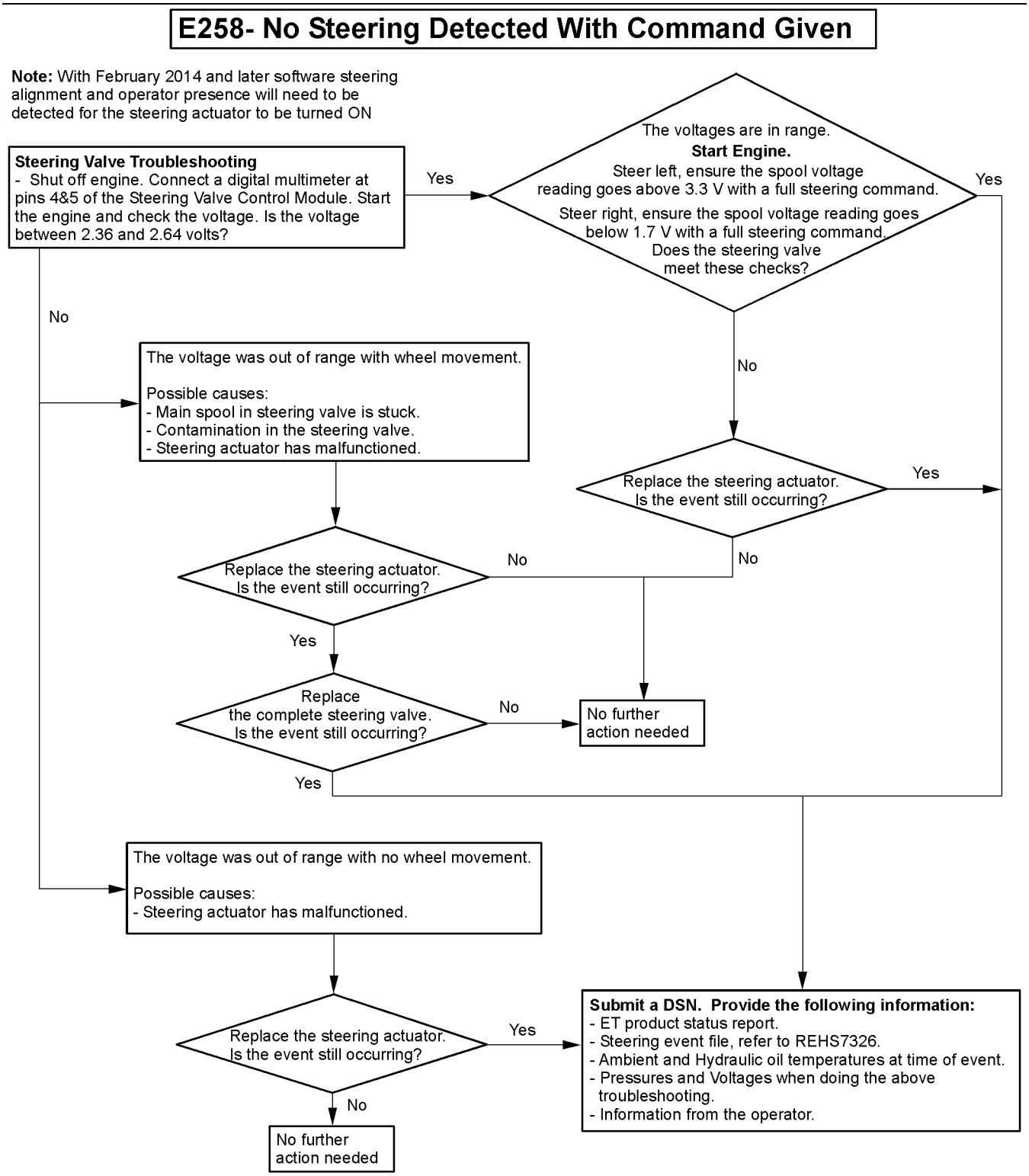


Illustration 159 g03648677

i08068510

Steering Does Not Function

SMCS Code: 4300-035

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Immediate safe shutdown required

The E258 (3) Event is activated when steering is commanded and the front wheels are not moving.

Note: Use the following flowchart to troubleshoot this event:

E258 (3) – No Steering Detected with Command Given
Troubleshoot all primary steering system events and any steering diagnostics prior to using this chart.

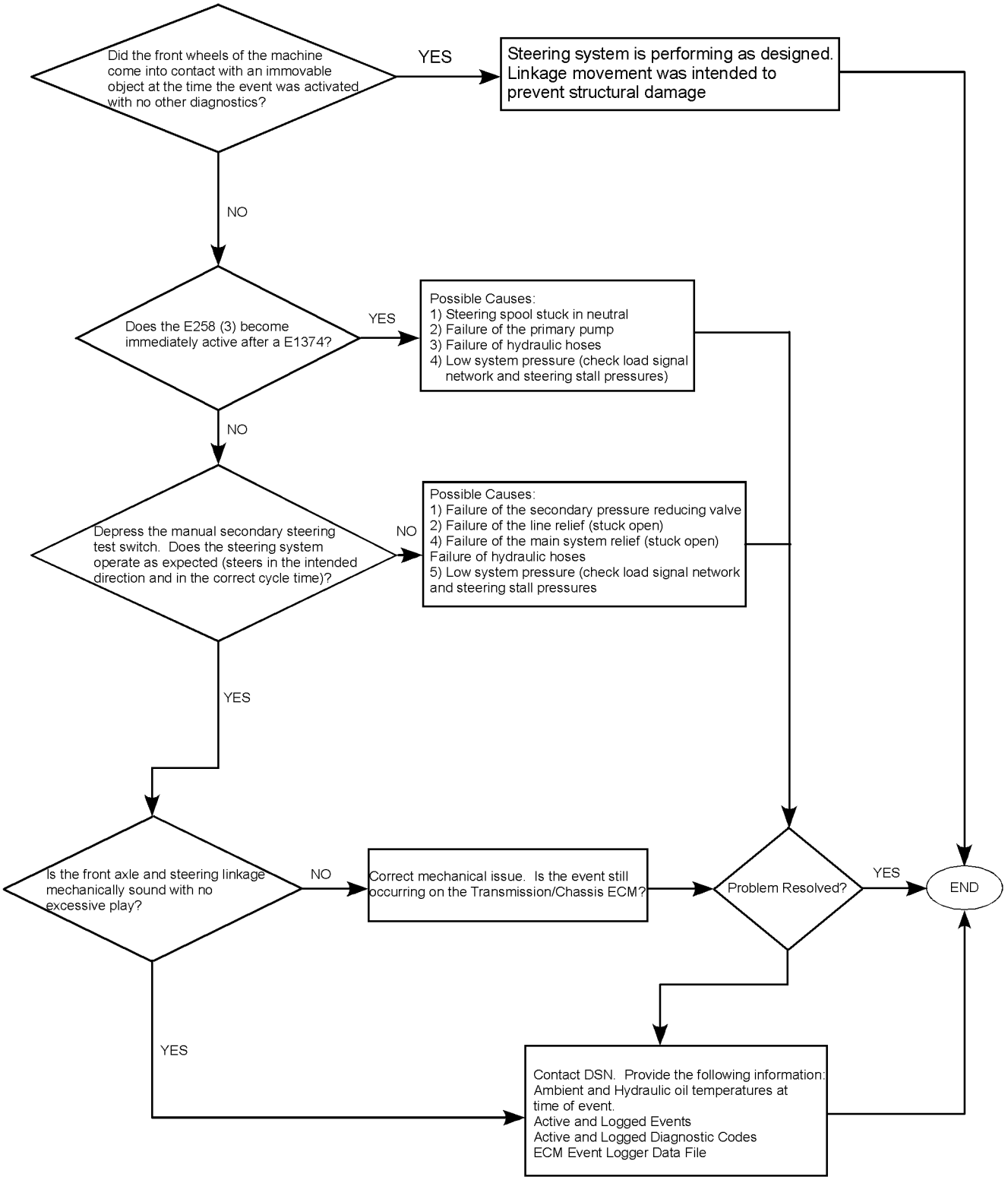


Illustration 160 g06533045

i05745303

Steering Movement Without Request

SMCS Code: 4300-035

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Immediate safe shutdown required

The E257 (3) event is activated when the steering cylinder position sensor or spool position sensor indicates movement without a command.

Potential causes of the E257 Event Code are as follows:

- Mechanical problem with the steering valve
- Electrical problem with the steering valve
- Mechanical problem with the front axle linkage
- External forces applied to the front wheels

Preliminary checks before troubleshooting:

1. Overview of the machine.

- Troubleshoot all other steering diagnostics codes prior to using this troubleshooting.
- Ensure all the latest steering Product Improvements have been performed prior to using this troubleshooting.
- Determine if the majority of the codes or the most recent codes are occurring only on the primary steering ECM (Implement ECM for M-Series or Implement 2 for M-Series 2). This is a quick check to verify if the problem is with components that are in only the primary steer system (actuator, wiring, resistor) or components shared with both primary and secondary steer system (pump, steering valve, steer cylinders).
- Check to make sure oil viscosity setting in ET matches the oil that is in the machine.

2. Obtain information from the operator.

- Did the front wheels of the machine come into contact with an immovable object or in a heavy, high load underfoot condition at the time the event was activated with no other diagnostics. If so the steering system could be performing as designed. Linkage movement was intended to prevent structural damage.
- Find out if ground conditions could be causing the code. Refer to SEPD1354 for conditions that can cause the code.
- Find out what the machine was doing when the code occurred, Example roading, fine blading, heavy blading, and so on.
- What was the machine speed when the code occurred. This can help determine if the code is being generated due to lack of spool movement vs lack of wheel movement. For 120 - 14 size machines the software looks at spool position below 9 kph and steering cylinder position above 9 kph. For 16 and 24 size machines the software looks at spool position below 15 kph and steering cylinder position above 15 kph.
- Find out what the hydraulic oil temperature was when the code occurred.

Note: Use the following flowchart to troubleshoot this event:

E257 - Steering Detected With No Command Given

Note: With February 2014 and later software steering alignment and operator presence will need to be detected for the steering actuator to be turned ON

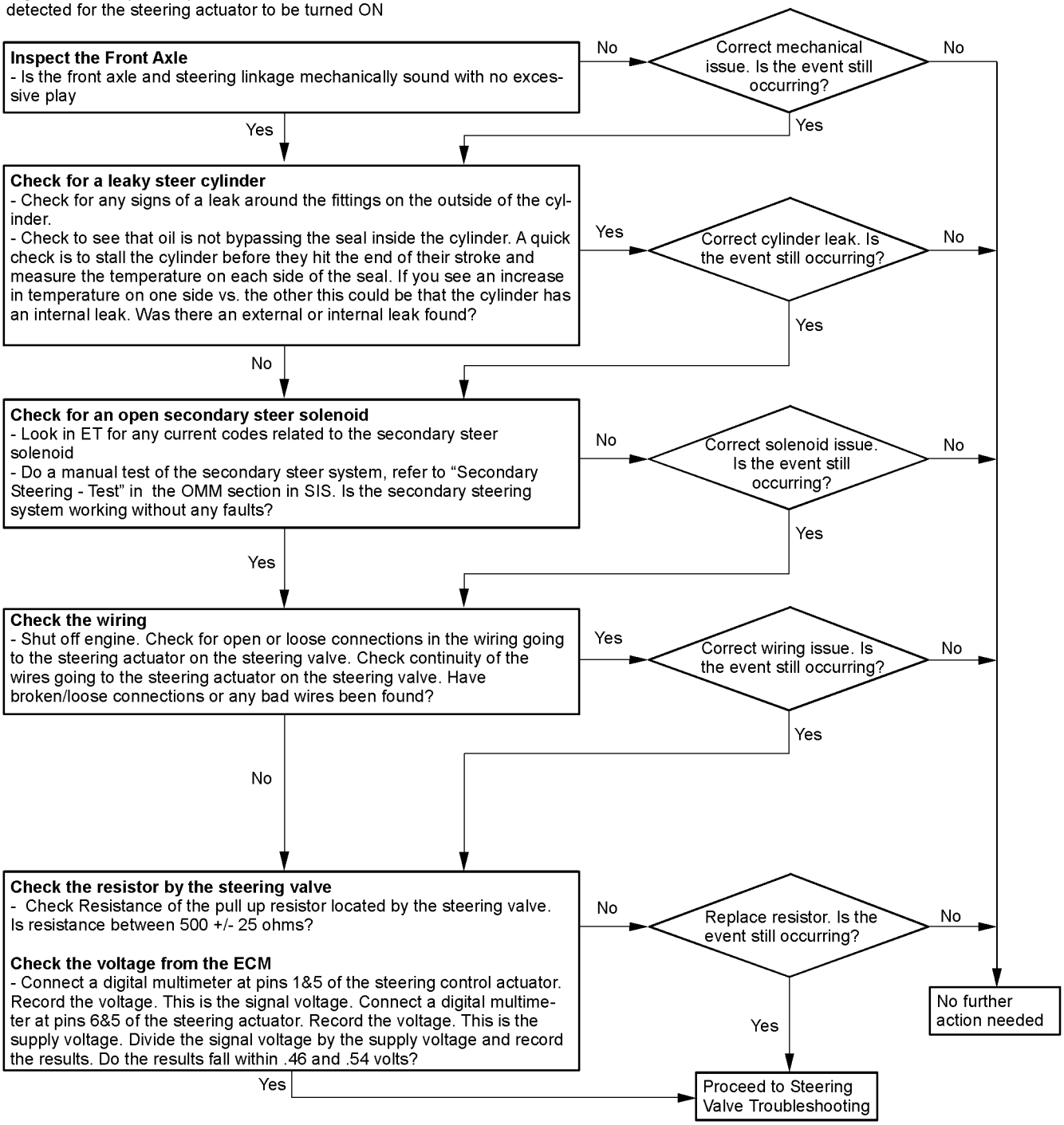


Illustration 161 g03648636

E257- Steering Detected With No Command Given

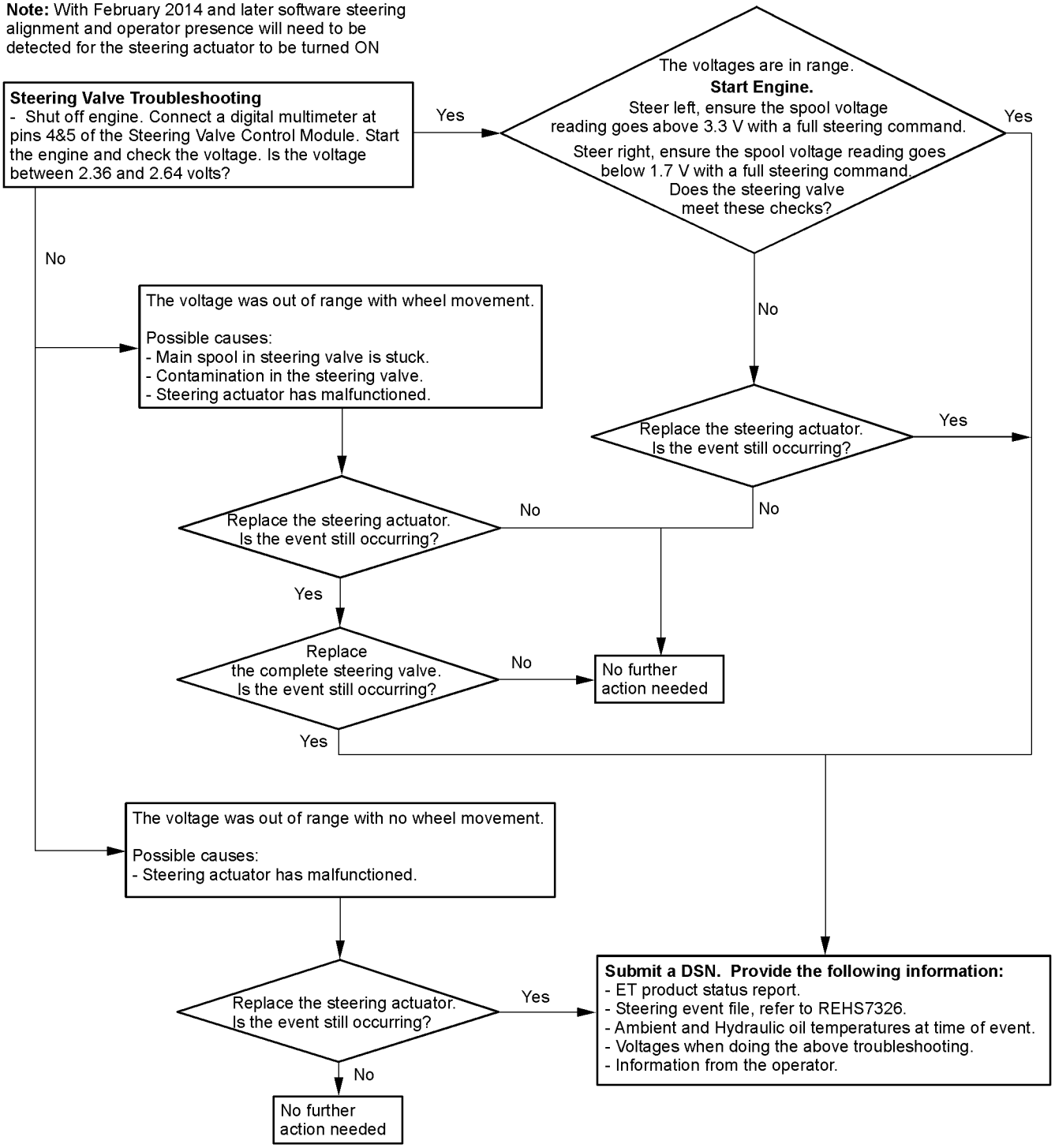


Illustration 162 g03648656

i08069339

Steering Movement Without Request

SMCS Code: 4300-035

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Immediate safe shutdown required.

E257 (3) Event is activated when the steering cylinder position sensor is indicating cylinder movement without a command.

Note: Use the following flowchart to troubleshoot this event:

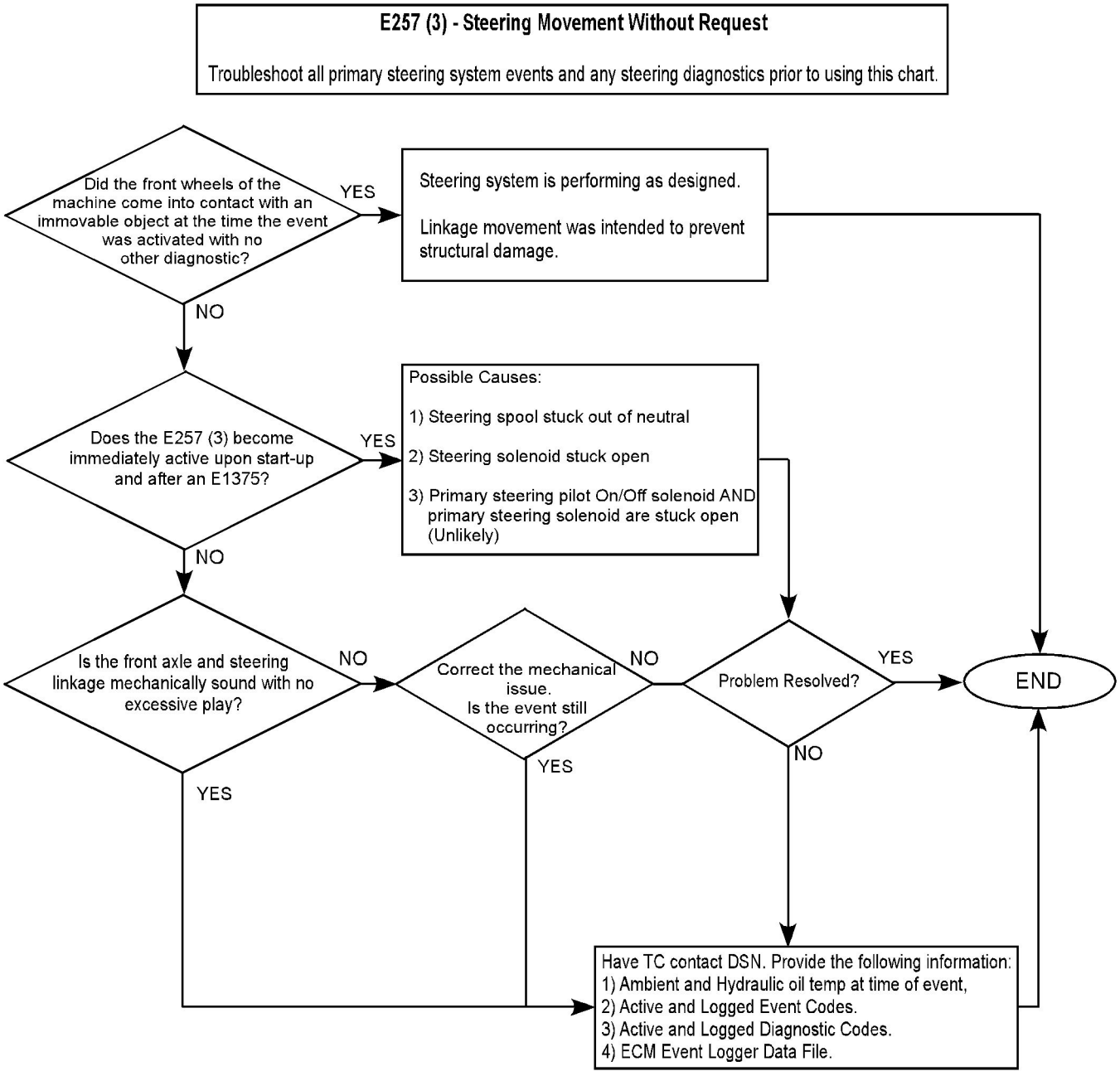


Illustration 163 g06533372

i05758311

Steering Spool Does Not Respond

SMCS Code: 4307-035

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Immediate safe shutdown required

The E1374 (3) event is activated when the steering spool was detected not to move in the commanded direction. This event can only be triggered on the Implement ECM for M-Series or Implement 2 for M-Series 2.

Potential causes of the E1374(3) Event Code are as follows:

- Mechanical problem with the steering valve
- Electrical problem with the steering valve
- Pump not responding to command

Preliminary checks before troubleshooting:

1. Overview of the machine

- Troubleshoot all other steering diagnostics codes prior to using this troubleshooting
- Ensure all the latest steering Product Improvements have been performed prior to using this troubleshooting
- Check to make sure oil viscosity setting in ET matches the oil in the machine

2. Obtain information from the operator

- Find out what the machine was doing when the code occurred, Ex. roading, fine blading, heavy blading and so on.
- Find out what the hydraulic oil temperature was when the code occurred

Use the following flowchart to troubleshoot this event:

E1374 - Steering Spool Does Not Respond

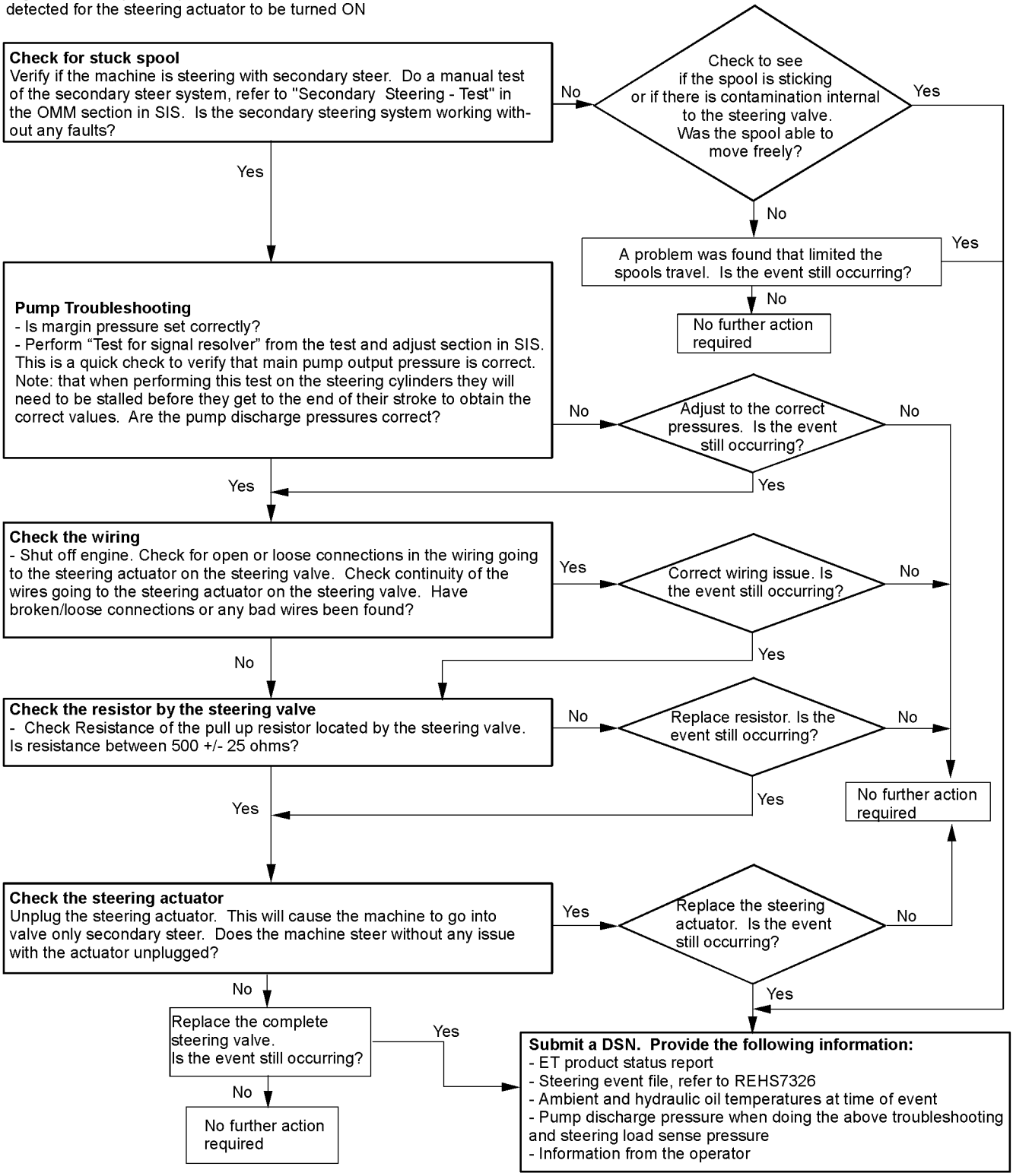


Illustration 164 g03655780

i08069445

Steering Spool Does Not Respond

SMCS Code: 4307-035

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Immediate safe shutdown required

E1374 (3) on the Implement ECM is a Steering System Event triggered when the steering spool was detected not to move in the commanded direction. The event can only be triggered on the Implement ECM. Any steering diagnostics shall be troubleshot first.

Potential causes of the E1374(3) Event Code are as follows:

- Steering stuck in neutral (contamination)
- Primary steering solenoid issue or failure (stuck closed)
- Primary pilot On/Off solenoid issue or failure (stuck closed)
- Primary pilot supply pressure issue or failure (supply low)
- Spool position sensor failure (failed in range)

Note: E1374 (3) - Spool Not Responding to Command. Troubleshoot all primary steering system events and any steering diagnostics prior to using this chart.

Use the following flowchart to troubleshoot this event:

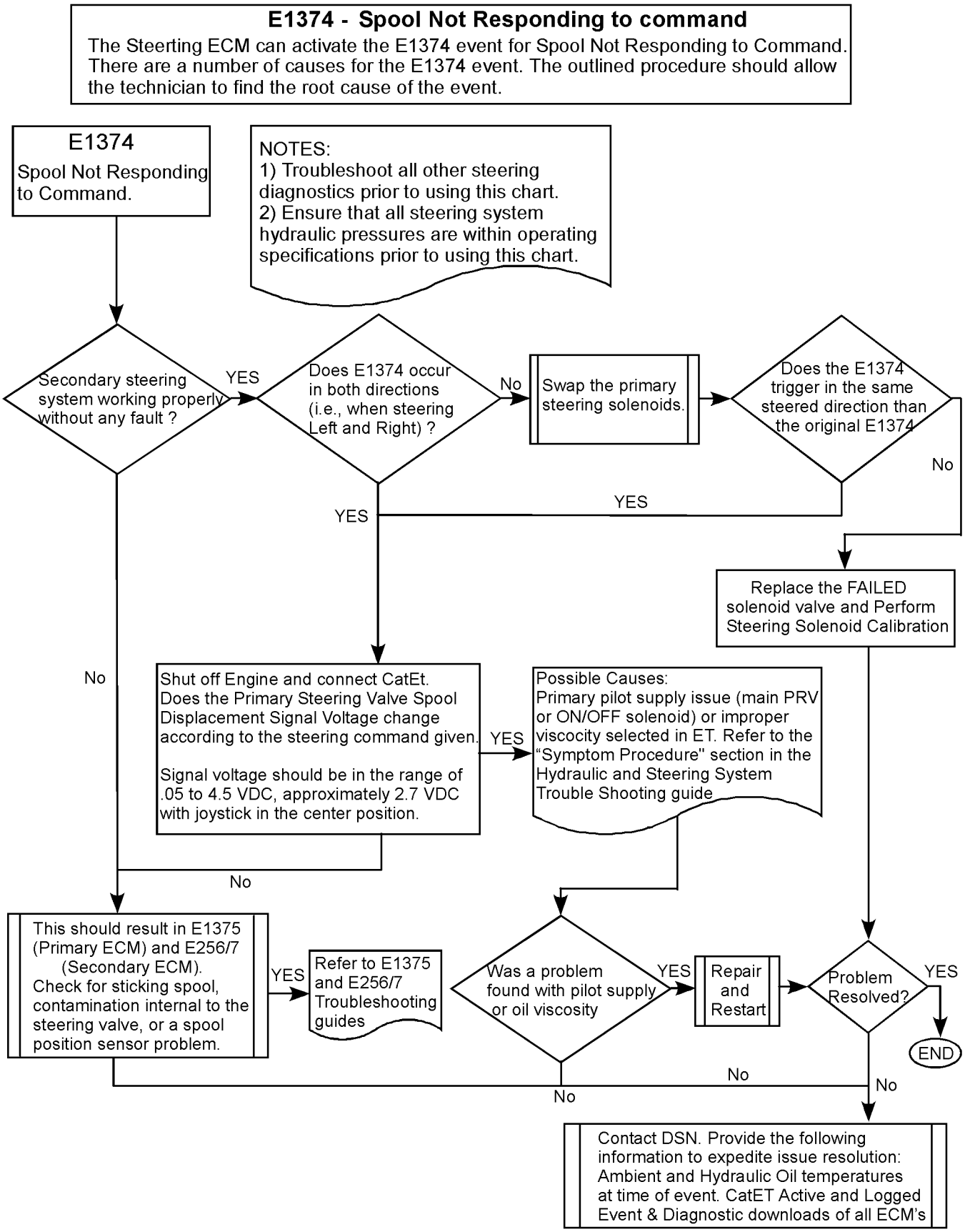


Illustration 165 g06533483

i05760872

Steering Spool Response Is Unexpected

SMCS Code: 4307-035

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Immediate safe shutdown required

The E1375 (3) event is activated when the steering spool was detected to behave in an unexpected manner to the command. This event can only be triggered on the Implement ECM for M-Series or Implement 2 for M-Series 2.

Potential causes of the E1375 Event Code are as follows:

- Mechanical problem with the steering valve
- Electrical problem with the steering valve

Preliminary checks before troubleshooting:

1. Overview of the machine

- Troubleshoot all other steering diagnostics codes prior to using this troubleshooting
- Ensure all the latest steering Product Improvements have been performed prior to using this troubleshooting
- Check to make sure oil viscosity setting in ET matches the oil in the machine

2. Obtain information from the operator

- Find out what the machine was doing when the code occurred, Ex. roading, fine blading, heavy blading and so on
- Find out what the hydraulic oil temperature was when the code occurred

E1375- Unexpected Spool Response

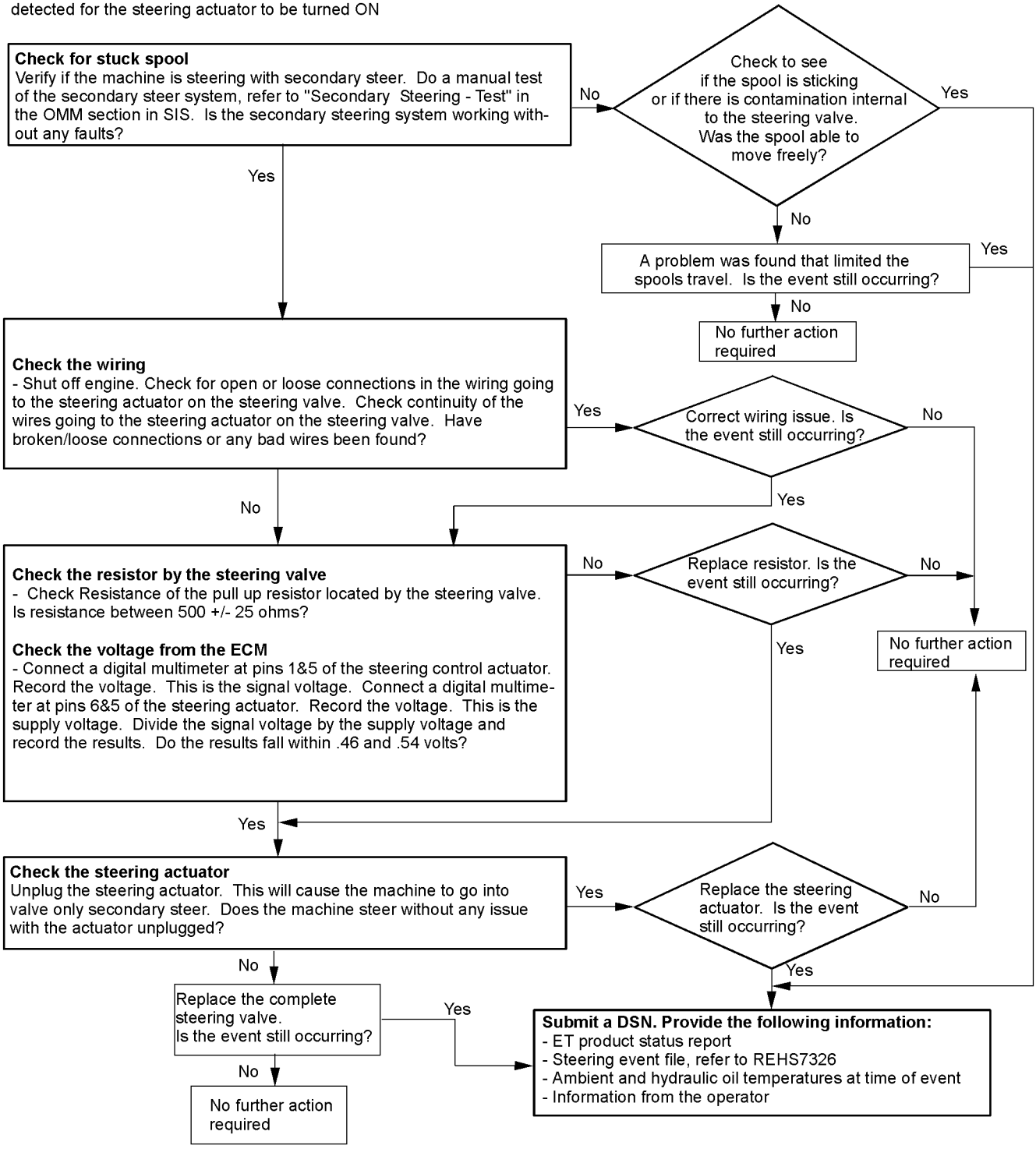


Illustration 166 g03655838

i08069491

Steering Spool Response Is Unexpected

SMCS Code: 4307-035

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

The E1375 (3) event code on the Implement ECM is a Steering System Event triggered when the steering spool was detected to behave in an unexpected manner to the command. The event can only be triggered on the Implement ECM. Any steering diagnostics shall be troubleshot first. Possible causes for E1375 (3):

- Steering-stem stuck out of neutral (contamination)
- Primary or secondary steering solenoid issue or failure (stuck open)
- Primary pilot On/Off solenoid issue or failure (stuck open)
- Spool position sensor failure (failed in range)

E1375 - Unexpected Spool Response

The Steerting ECM can activate the E1375 event for Unexpected Spool Response. There are a number of causes for the E1375 event. The outlined procedure should allow the technician to find the root cause of the event.

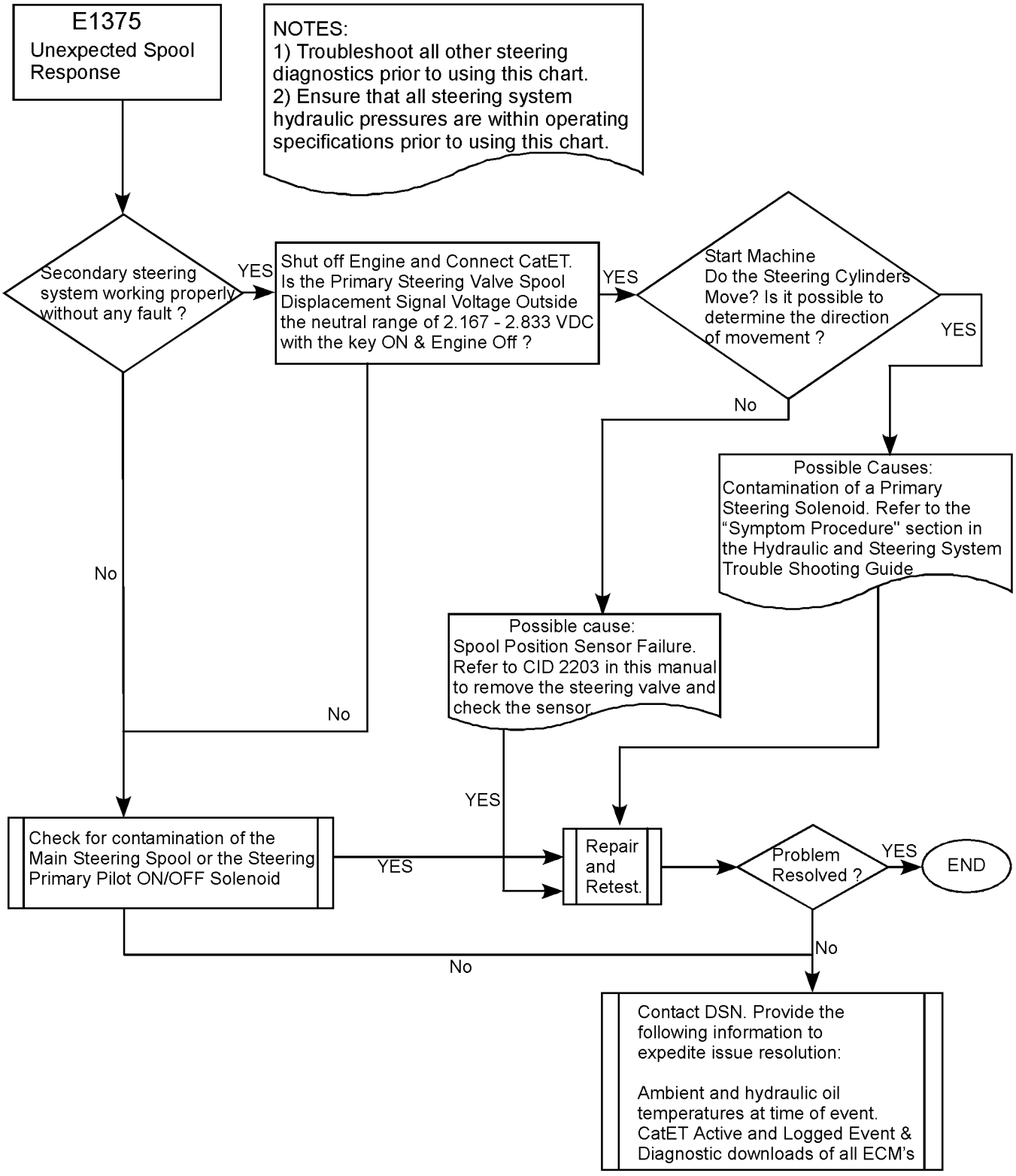


Illustration 167 g06533530

i06683533

Event Code List

SMCS Code: 7569

Event codes alert the operator or the technician that an abnormal operating condition exists in one of the machine systems.

When the Implement ECM activates an event code, the operator will be alerted by the Messenger. Most active events will be logged by the ECM. Some events are active only. Events that are active only are not logged by the ECM. The active events and the logged events can be viewed by use of the Messenger or by use of the Caterpillar Electronic Technician (Cat ® ET) Service Tool.

Warning Levels

The ECM will assign one of three warnings levels to an active event code. The levels are based on the severity of the abnormal system condition. Each warning level requires a specific response from the operator. The warning levels and required operator response are listed below.

Level 1

Warning level 1 alerts the operator that a machine system requires attention. The operator should check that the involved system condition or the operator should perform maintenance on the involved system at the earliest possible time.

Level 2

Warning level 2 requires changing the operation of the machine or performing a maintenance procedure. Failure to correct the problem related to this warning may result in damage to the components of the machine system that are involved.

Level 2S

Warning level 2S requires an immediate change in machine operation to avoid possible damage to the system of the machine.

Level 3

Warning level 3 requires an immediate safe shutdown of the machine to avoid damage to the machine or injury to personnel around the machine. The problem that caused the event must be corrected before machine operation can resume.

Indications and System Response

Messenger

The Messenger will alert the operator when an event code is active. Event codes are activated in one of three warning levels according to the severity of the condition.

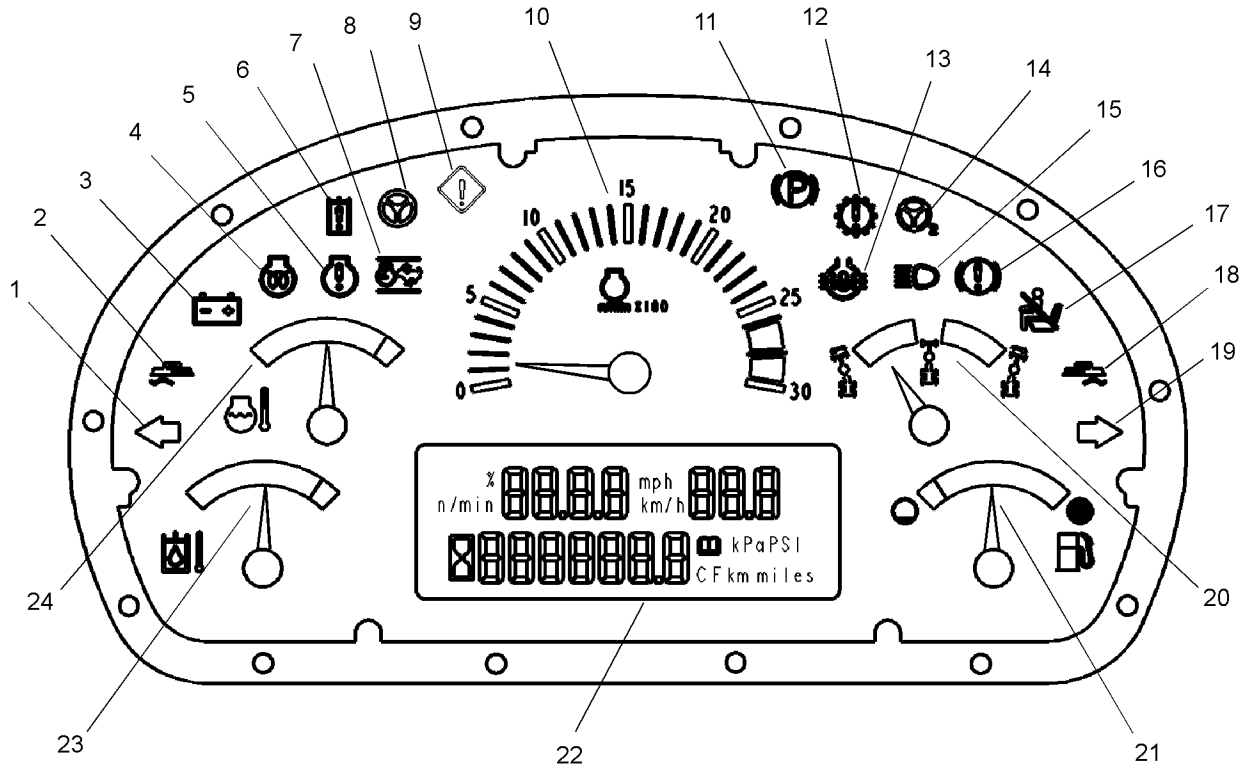


Illustration 168 g01309167

Indicators

(1) Left turn signal
(2) Left blade float
(3) Battery charge
(4) “Electric engine preheat”
(5) Engine system
(6) Implement system
(7) Throttle lock
(8) Primary steering
(9) Action light
(10) Analog tachometer
(11) Parking brake
(12) Transmission system
(13) Differential lock
(14) Steering system
(15) High beam
(16) Brake system
(17) Operator not present
(18) Right blade float
(19) Right turn signal
(20) Articulation angle gauge
(21) Fuel level gauge
(22) LCD display
(23) Hydraulic oil temperature gauge
(24) Coolant temperature gauge

The warning indicators for the subsystem on the Instrument Cluster will illuminate when an event is activated for a particular subsystem. When level 1 events are active, the warning indicator of the subsystem will be the only type of indicator that will illuminate.

The action Indicator will flash red when a level 2 warning or level 3 warning is active. If communication between Messenger and the Instrument Cluster fails, the action lamp will flash yellow.

The action alarm is driven as an output directly from the Instrument Cluster. If a level 3 warning is active, the action alarm will sound a tone (pulsing). The action alarm will sound these tones to alert the machine operator that immediate action is required.

If two warnings of a different level are active at the same time, the highest level warning will be displayed.

The response of the Messenger to these warning levels is shown in the following table.

Table 10

WARNING OPERATION					
	Warning Indications				
Warning Level	Warning Indicators	Action Indicator	Action Alarm Sounds	Required Operator Action	Possible Result (1)
1	ON	OFF	OFF	No immediate action is required. The system needs attention soon.	No harmful or damaging effects.
2	ON	Flash ON and OFF	OFF	Change machine operation or perform maintenance to the system.	Damage to system components.
2S	ON	ON	ON	Immediately change the machine operation.	Severe damage to system components.
3	ON	Flash ON and OFF	Pulse ON and OFF	Immediately perform a safe engine shutdown.	Operator injury or severe damage to components.

(1) Possible result if action by the operator is not taken.

Cat® Electronic Technician (Cat ET) Service Tool

When an abnormal implement condition occurs, the status screen on the Cat ® ET Service Tool indicates that there is an active event.

Event codes are displayed on the Cat ET Service Tool in the following format:

EXXXX Description of the code

The “E” means that the code is an event code. The “XXXX” is a numeric identifier. The numeric identifier is followed by a description of the code.

Active event codes are listed in ascending numerical order. The code with the lowest number is listed first. The active event code is removed from the list when the condition is no longer present.

Logged Event Codes

Some event codes are logged in the ECM memory. Some event codes are active only. The logged event codes are listed in chronological order. The most recent code is listed first.

A logged code is cleared from memory when one of the following conditions occur:

- The service technician manually clears the code.
- The code does not reoccur for 1000 hours.
- A new code is logged and there are already ten logged codes in memory. In this case, the oldest logged code is cleared.

Note: Always clear logged event codes after investigating and correcting the problem which generated the code.

Troubleshooting

Perform the following steps to troubleshoot an event:

1. Obtain the following information from the operator:

- The event and the time of the event
- Determine the operating conditions of the engine at the time of the event. Conditions such as engine rpm and load may be important.
- Determine if there are any systems that were installed by the dealer or by the customer that could cause the event.

2. Verify that the event is not due to normal machine operation. Verify that the event is not due to error of the operator.

3. Check all fluid levels and all oil levels.

4. Troubleshoot and repair any active diagnostic codes.

Implement ECM Event Code List

The following table lists the event codes that apply to the implement control system. The recommended response is listed. Use Cat ® ET to determine the event codes that are active or logged. Refer to the Systems Operation, Troubleshooting, Testing and Adjusting, RENR8484, “Hydraulic and Steering System” for additional details.

Table 11

Event Codes for Electronic Implement Control (MID 082)		
Code (Level)	**Description**	**Possible Cause / Recommended Response**
E192 (3)	Steering System Malfunction	**Immediate safe shutdown required.** Activates when ECM does not receive expectant steering position signals. The following active diagnostic codes (CID) will cause E192 to activate: 262 (5 Volt Sensor DC Power Supply) 585 (Transmission Output Speed Sensor #1) * 597 (Main Hydraulic Pump Discharge Pressure Sensor) 673 (Transmission Output Speed Sensor #2) * 674 (Transmission Intermediate Speed Sensor #1) ** 675 (Transmission Intermediate Speed Sensor #2) ** 1471 (Steering Control Position Sensor #1) 1472 (Steering Control Position Sensor #2) 1473 (Steering Control Position Sensor #3) 2175 (Secondary Steering System Steer Left Solenoid) 2176 (Secondary Steering System Steer Right Solenoid) 1674 (Solenoid Return #1) 2200 (Left Steering Cylinder Position Sensor) 2201 (Right Steering Cylinder Position Sensor) 2202 (Primary Steering Valve Control Module) 2650 (Primary Steering Valve Control Module Power Supply Output) *** Note:** CID 585 and CID 673 must BOTH be present to set an E192. **** Note:** CID 674 and CID 675 must BOTH be present to set an E192. Investigate and resolve the cause of the listed active diagnostic code. Then, reset the active event with a key start switch cycle.
E256 (3)	Steering Output Detected in the Wrong Direction	**Immediate safe shutdown required.** Usually occurs after servicing. Possible causes: · Hydraulic hose connections are reversed. · Secondary solenoids electrical connections are reversed. · Hydraulic steering valve is malfunctioning. Refer to Troubleshooting, “Steering Direction is Opposite of Expected Direction” for additional troubleshooting.
E257 (3)	Steering Output Detected With No Command	**Immediate safe shutdown is required.** Front wheels moving without command. Possible causes: · Operating the machine in rough terrain is forcing unexpected movement of the front wheels. · Hydraulic steering control valve problem. · Short circuit in the steering command control signal circuit. Refer to Troubleshooting, “Steering Movement Without Request” for additional troubleshooting.

(continued)

(Table 11, contd)

Event Codes for Electronic Implement Control (MID 082)		
Code (Level)	**Description**	**Possible Cause / Recommended Response**
E258 (3)	No Steering Detected With Command Given	**Immediate safe shutdown is required.** No front wheel movement is detected when commanded. Possible causes: · Mechanical problem in the steering control valve. · Mechanical steering linkage is physically blocked. · Front wheels are physically blocked and will not respond to command. · Loss of load signal. Refer to Troubleshooting, “Steering Does Not Function” for additional troubleshooting.
E263 (3)	Low Main Pump Pressure	**Immediate safe shutdown is required.** · Check the level of the hydraulic oil. · Check for possible hydraulic pump failure. · Verify that the hydraulic pressure sensor is accurate. Compare the pressure sensor reading to the reading of a calibrated hydraulic pressure gauge that is hooked to the same hydraulic circuit. If the pressure sensor is accurate, do not replace the pressure sensor. Troubleshoot the hydraulic system. Refer to Systems Operation Troubleshooting Testing and Adjusting, RENR8459, “Hydraulic and Steering System” and Systems Operation Troubleshooting Testing and Adjusting, RENR8469, “Hydraulic and Steering System” and Systems Operation Troubleshooting Testing and Adjusting, RENR8484, “Hydraulic and Steering System”.
E455 (1)	Hydraulic Pilot Supply Filter Plugged	Replace the return hydraulic oil filter. To test, connect a calibrated hydraulic pressure gauge into the correct hydraulic circuit. Verify that the hydraulic pressure sensor is accurate. Refer to Systems Operation Troubleshooting Testing and Adjusting, RENR8484, “Hydraulic and Steering System”.
E560 (3)	Secondary Steering Pump Not Responding To Command	**Immediate safe shutdown required.** Secondary steering test results in insufficient pump pressure. Possible Causes: · Electrical problem in the secondary steering pump motor circuit. · Mechanical problem with the secondary steering pump. Refer to Systems Operation Troubleshooting Testing and Adjusting, RENR9004 for additional details.
E562(1) (1)	Steering Lever Has Not Been Aligned To Wheel Steering Angle	Left joystick must be “swept” fully left and right to align the front wheel angle with the correct joystick position for that angle. Aligned occurs when the machine is started. Also when the machine is parked, the operator leaves the seat and the joystick is moved. Possible causes for not aligning: · Operator present switch is indicating no operator in the seat. Operator must be seated. · Left Joystick is being swept too fast. Sweep slower. · Wheels are out of the accepted angle (extreme angle). Manually move the wheels into the accepted range.

(continued)

(Table 11, contd)

Event Codes for Electronic Implement Control (MID 082)		
Code (Level)	**Description**	**Possible Cause / Recommended Response**
E598(1) (2)	Steering Limited Due to Cold Hydraulic Oil	Allow machine to warm up at low idle before operating or operate the machine in a low gear until oil is warm.
E599(1) (2S)	Gear Too High For Steering with Cold Oil	**Immediately slow the machine down and place in low gear.** Allow machine to warm up at low idle before operating or operate the machine in a low gear until oil is warm.
E794 (3)	Steering Systems Not Synchronized	**Immediate safe shutdown is required.** One ECM (Implement or Trans/Chassis) does not have steering alignment between joystick and steering cylinders and the other ECM is aligned. Can be caused by rapid key ON/OFF/ON cycle. Shut down the machine, restart the machine, and align the steering (see EID 562 above). Check for data link communication, CID diagnostic codes: 247 (SAE J1939 Data Link) 296 (Transmission Control) 590 (Engine Control Module) . Resolve any active fault and restart machine. Can be caused by activation of the following CID diagnostic codes: 1471 (Steering Control Position Sensor #1) 1472 (Steering Control Position Sensor #2) 1473 (Steering Control Position Sensor #3) 2200 (Left Steering Cylinder Position Sensor) 2201 (Right Steering Cylinder Position Sensor) Or a failure of the Implement ECM. Resolve and clear any active fault. Restart machine and align steering errors.
E795(1) (1)	Machine Speed Excessive for Machine Articulation Angle	The articulation angle of the machine is greater than 5.5°. The machine will not operate in high gears. Decrease the articulation angle to operate in the high gears.
E796 (1)	Machine articulation angle limited due to machine speed	When the machine is operating in the high gears, the articulation angle of the machine is restricted. Operate the machine in lower gears to increase the machine articulation angle.
E861 (1)	Clock Manual Alignment Required	The ECM internal clock is also known as an electronic service hour meter. The implement hour meter is too far out of alignment with other ECM hour meters Event will occur when an ECM has been replaced. Use the Cat ET to synchronize the ECM hour meters. At the top menu, click “Service” , and Synchronize Service Hour Meters from the drop-down menu. Next, click the Synchronize button to synchronize all the service hour meters on the machine. A pop-up dialog box will inform you of a successful synchronization of each ECM
E878 (2)	High Hydraulic Oil Temperature	**Reduce hydraulic load.** Activated when the hydraulic oil temperature is 93 °C (199.4 °F). Deactivated when oil temperature decreases to 90 °C (194.0 °F) · Modify the operation of the machine to reduce system load. · Check hydraulic oil level. · Check the cooling system of the hydraulic oil.

(continued)

(Table 11, contd)

Event Codes for Electronic Implement Control (MID 082)		
Code (Level)	**Description**	**Possible Cause / Recommended Response**
E878 (3)	High Hydraulic Oil Temperature	**Immediate safe shutdown is required.** Activated when the hydraulic oil temperature is 99 °C (210.2 °F). Deactivated when oil temperature decreases to 90 °C (194.0 °F) · Modify the operation of the machine to reduce system load. · Check hydraulic oil level. · Check the cooling system of the hydraulic oil.
E1256 (3)	Key Input Off While Machine in Operation	May occur if the key is turned off while the machine is operating. If this condition occurs while the machine key switch is in the “ON” position, check the key switch circuit for a failure.
E1374 (3)	Steering Valve Spool Not Responding to Command	**Immediate safe shutdown is required.** Triggered when the steering spool was detected not to move in the commanded direction. Possible causes: · Steering stuck in neutral (contamination) · Primary steering solenoid issue or failure (stuck closed) · Primary pilot On/Off solenoid issue or failure (stuck closed) · Primary pilot supply pressure issue or failure (supply low) · Spool position sensor failure (failed in range) Refer to Troubleshooting, “Steering Spool Does Not Respond” in this manual for additional troubleshooting.
E1375 (3)	Unexpected Steering Valve Spool Movement Detected	**Immediate safe shutdown is required.** Triggered when the steering spool was detected to behave in an unexpected manner to the command Possible causes: · Steering-stem stuck out of neutral (contamination) · Primary or secondary steering solenoid issue or failure (stuck open) · Primary pilot On/Off solenoid issue or failure (stuck open) · Spool position sensor failure (failed in range) Refer to Troubleshooting, “Steering Spool Response Is Unexpected” in this manual for additional troubleshooting.
E2085 (1)	Invalid Articulation Response Detected	The machine has articulated more than 3.5° with no command within a 3 minute time period. Once the time period ends, the time period resets and the ECM uses the current articulation angle as a reference point to determine the 3.5° movement without command. Possible Causes: · Mechanical problem in the hydraulic valve. Valve may be stuck. · If pilot valve is stuck, implement lockout activation will stop the articulation. · If main valve is stuck, implement lockout activation will not stop the articulation. · Sensor drift. · A problem with the hydraulic cylinders.

(1) Code may be active only, will never be logged.

Table 12

Event Codes for Electronic Implement Control #2 (MID 145)		
Code (Level)	**Description**	**Possible Cause / Recommended Response**
E861 (1)	Clock Manual Alignment Required	The ECM internal clock, also known as an electronic service hour meter is too far out of alignment with other ECM hour meters. Event commonly occurs when an ECM has been replaced. Use Cat ET and align the clock with the other control modules manually. At the top menu, click “Service” , and Synchronize Service Hour Meters from the drop-down menu. Next, click the Synchronize button to synchronize all the service hour meters on the machine. A pop-up dialog box will inform you of a successful synchronization of each ECM.

Diagnostic Code Procedures

i06677768

Diagnostic Code List

SMCS Code: 7569

For the Implement Control System, all diagnostic codes are activated by the Implement ECM (MID 082). Any abnormal circuit conditions that are detected by the Implement ECM 2 or the Implement ECM 3 are communicated to the Implement ECM on the SAE J1939 Data Link.

Module Identifier (MID)

The module identifier (MID) identifies the electronic control module that activated the diagnostic code. Each electronic control module on the machine has a unique MID. Use the following chart to match the MID for each diagnostic code to a specific electronic control module. The chart for the Module Identifier (MID) is located on the Electrical System Schematic for your machine. See the chart if the MID is not shown on the display of your machine. After the operator determines the electronic control module that has detected the failure, see the service manual module for that particular ECM for more troubleshooting information. The service manual for each ECM is part of the Service Manual for the machine.

Use the Messenger or the Caterpillar Electronic Technician (Cat ® ET) to view the active diagnostic codes for the Implement ECM. Perform the procedure that corresponds to the Module Identifier (MID), the Component Identifier (CID) and the Failure Mode Identifier (FMI) of the diagnostic code.

Table 13

Module Identifiers	
MID	**Description**
27	Transmission/Chassis ECM
82	Implement ECM
145	Implement ECM 2

The following table is a list of all the possible diagnostic codes for the Implement Electronic Control System that the Implement ECM can activate.

Table 14

Implement ECM Diagnostic Code List (MID 82)	
CID 0041 - 8 VDC Sensor Power Supply	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 0075 - Steering Oil Temperature Sensor	
FMI 03	Voltage above normal
CID 0168 - Electrical System Voltage	
FMI 00	The data is valid, but above the normal operating range
FMI 01	Voltage below normal
FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 0246 - Proprietary CAN Data Link	
FMI 09	Abnormal update
FMI 14	Special Instruction
CID 0247 - SAE J1939 Data Link	
FMI 09	Abnormal update
FMI 14	Special Instruction
CID 0248 Cat Data Link	
FMI 09	Abnormal update
FMI 14	Special Instruction
CID 0262 - 5 V Sensor DC Power Supply	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 0296 Transmission Chassis ECM	
FMI 09	Abnormal update
FMI 12	Bad Device or component
FMI 14	Special Instruction
CID 0358 - Implement Pilot Pressure Supply Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
CID 0490 - Implement Lockout Switch	
FMI 03	Voltage above normal
FMI 04	Voltage below normal

(continued)

(Table 14, contd)

CID 0588 - Monitoring System Display	
FMI 09	Abnormal update
FMI 14	Special Instruction
CID 0590 - Engine Electronic Control Module	
FMI 09	Abnormal update
FMI 14	Special Instruction
CID 0597 - Main Hydraulic Pump Discharge Pressure Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 14	Special Instruction
CID 0600 - Hydraulic Oil Temperature Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 0615 - Machine Articulation Angle Position Sensor	
FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
FMI 13	Out of calibration
FMI 14	Special Instruction
CID 0967 - Machine Application	
FMI 02	Data erratic, intermittent, or incorrect
FMI 09	Abnormal update
CID 0908 - Blade Rotation Position Sensor	
FMI 09	Abnormal update
FMI 13	Out of calibration
CID 1326 - Location Code	
FMI 02	Data erratic, intermittent, or incorrect
CID 1471 - Steering Control Position Sensor 1	
FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
FMI 14	Special instruction
CID 1472 - Steering Control Position Sensor 2	
FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal

(continued)

(Table 14, contd)

FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
FMI 14	Special instruction
CID 1473 - Steering Control Position Sensor 3	
FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
FMI 14	Special instruction
CID 1482 - 10 V Sensor DC Power Supply	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 1558 - Electronic Implement Control 2	
FMI 09	Abnormal update
CID 2113 - Operator In Seat Switch	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 2143 - Electronic Implement Control 3	
FMI 09	Abnormal update
CID 2146 - Articulation Lever Position Sensor	
FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2147 - Automatic Neutral Articulation Switch	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 2150 - Blade Left Lift Lever Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2151 - Blade Right Lift Lever Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2152 - Wheel Lean Control Position Sensor	

(continued)

(Table 14, contd)

FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2153 - Blade Pitch Control Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2154 - Blade Sideshift Lever Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2155 - Circle Drive Lever Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2156 - Circle Sideshift Control Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2160 - Blade Left Raise Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2161 - Blade Right Raise Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2162 -Blade Left Lower Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2163 - Blade Right Lower Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal

(continued)

(Table 14, contd)

FMI 13	Out of calibration
CID 2165 - Blade Sideshift Left Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2166 - Blade Sideshift Right Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2167 - Circle Left Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2168 - Circle Right Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2169 - Circle Sideshift Left Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2170 - Circle Sideshift Right Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2171 - Articulate Left Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2172 - Articulate Right Solenoid Valve	

(continued)

(Table 14, contd)

FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2173 - Wheel Lean Left Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2174 - Wheel Lean Right Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2177 - Primary Steering Disable Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
CID 2181 - Blade Pitch Forward Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2182 - Blade Pitch Backward Solenoid Valve	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2200 - Left Steering Cylinder Position Sensor	
FMI 00	Data Valid but above normal operational range
FMI 01	Voltage below normal
FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
FMI 13	Out of calibration
FMI 14	Special instruction
CID 2201 - Right Steering Cylinder Position Sensor	

(continued)

(Table 14, contd)

FMI 00	Data Valid but above normal operational range
FMI 01	Data Valid but below normal operational range
FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
FMI 13	Out of calibration
FMI 14	Special instruction
CID 2202 - Steering Valve Control Module	
FMI 12	Bad device or component
CID 2203 - Steering Valve Control Module Spool Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 2204 - Auxiliary Lever 1 Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2205 - Auxiliary Lever 2 Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2206 - Auxiliary Lever 3 Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2207 - Auxiliary Lever 4 Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2208 - Auxiliary Lever 5 Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2209 - Auxiliary Lever 6 Position Sensor	
FMI 03	Voltage above normal

(continued)

(Table 14, contd)

FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2210 -Auxiliary Lever 7 Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2211 - Auxiliary Valve 1 - Port B Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2212 - Auxiliary Valve 1 - Port A Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2213 - Auxiliary Valve 2 - Port B Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2214 - Auxiliary Valve 2 - Port A Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2215 - Auxiliary Valve 3 - Port B Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2216 - Auxiliary Valve 3 - Port A Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2217 - Auxiliary Valve 4 - Port B Solenoid	
FMI 03	Voltage above normal

(continued)

(Table 14, contd)

FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2218 - Auxiliary Valve 4 - Port A Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2219 - Auxiliary Valve 5 - Port B Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2220 - Auxiliary Valve 5 - Port A Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2221 - Auxiliary Valve 6 - Port B Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2222 - Auxiliary Valve 6 - Port A Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 2223 - Auxiliary Valve 7- Port B Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
CID 2224 - Auxiliary Valve 7 - Port A Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
CID 2252 - Machine Articulation Angle Sensor 2	

(continued)

(Table 14, contd)

FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
FMI 13	Out of calibration
FMI 14	Special instruction
CID 2258 - Left Blade Control Module Switch	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 07	Mechanical system not responding properly
CID 2259 - Right Blade Control Module Switch	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 07	Mechanical system not responding properly
CID 2260 - SS Blade Control Mode Switch	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 2261 - Left Desired Grade Offset Switch	
FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 07	Mechanical system not responding properly
CID 2262 - Right Desired Grade Offset Switch	
FMI 02	Data erratic, intermittent, or incorrect
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 07	Mechanical system not responding properly
CID 2650 - Steering Valve Control Module Power Supply	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
CID 2746 - Blade Left Constant Down Force Control(1)	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2747 - Blade Right Constant Down Force Control(1)	
FMI 03	Voltage above normal

(continued)

(Table 14, contd)

FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 2748 - Blade Constant Down Force Enable Switch(1)	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 2749 - Blade Left Raise Relief Enable Solenoid(1)	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
CID 2750 - Blade Right Raise Relief Enable Solenoid(1)	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
CID 2751 - Blade Left Raise Relief Solenoid(1)	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
CID 2752 - Blade Right Raise Relief Solenoid(1)	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
CID 2954 - Unknown Implement Control	
FMI 14	Special Instruction
CID 3284 - Primary Steer Left Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 3285 - Primary Steer Right Solenoid	
FMI 03	Voltage above normal
FMI 05	Current below normal
FMI 06	Current above normal
FMI 13	Out of calibration
CID 3694 - Blade Slope Sensor	
FMI 09	Abnormal update
FMI 13	Out of calibration

(continued)

(Table 14, contd)

CID 4386 - Auxiliary Lever # 8 Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period
CID 4387 - Auxiliary Lever # 9 Position Sensor	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 08	Abnormal frequency, pulse width, or period

(1) Blade down force system is not available on the 14M.

Table 15

Implement ECM 2 Diagnostic Code List (MID 145)	
CID 168 - Electrical System Voltage	
FMI 01	Data Valid but below normal operational range
CID 248 - CAT Data Link	
FMI 09	Abnormal update
FMI 14	Special Instruction
CID 650 - Harness Code	
FMI 02	Data erratic, intermittent, or incorrect
CID 1326 - ECM Location Code	
FMI 02	Data erratic, intermittent, or incorrect
CID 1960 - Ignition Key Reader	
FMI 09	Abnormal Update

Failure Mode Identifier

The codes for the Failure Mode Identifier are defined by the SAE standards. The following list contains a CAT version of definitions.

Table 16

Failure Mode Identifier and Message Center Displays	
FMI	**Description of Failure**
00	“Data valid but above normal operating range (Most severe - Level 3)”
01	“Data valid but below normal operating range (Most severe - Level 3)”
02	“Data erratic, intermittent or incorrect”
03	“Voltage above normal”
04	“Voltage below normal”
05	“Current below normal”

(continued)

(Table 16, contd)

Failure Mode Identifier and Message Center Displays	
FMI	**Description of Failure**
06	“Current above normal”
07	“Mechanical system not responding properly”
08	“Abnormal frequency, pulse width, or period”
09	“Abnormal update”
10	“Abnormal rate of change”
11	“Failure mode not identifiable”
12	“Bad device or component”
13	“Out of calibration”
14	“Special instruction”
15	Data valid but above normal operational range (Least severe - Level 1)
16	Data valid but above normal operational range (Least severe - Level 2)
17	Data valid but below normal operational range (Least severe - Level 1)
18	Data valid but below normal operational range (Least severe - Level 2)
19	Received network data in error

Detailed FMI Explanation

FMI 00 “Data Valid But Above Normal Operating Range (Most severe - Level 3)” – Every electronic control system sets a high limit for the expected operating range of the signal. The high limit includes over range signals. This limit could be a high temperature. A sensor that is still operating but sending a signal above the expected limit will cause an FMI 00 to be activated.

Some of the conditions that can cause the FMI 00 diagnostic code to be activated are:

- The medium or component that is being monitored is above the normal range.
- The signal is shorted to another voltage source.
- The sensor needs calibration
- An ECM has failed. This condition is unlikely.

FMI 01 “Data Valid But Below Normal Operating Range (Most severe - Level 3)” – Every electronic control system sets a low limit for the expected operating range of the signal. The limit includes signals that are under the lower limit. The low signal could be the oil pressure signal. The sensor is still working but sending a signal below the expected limit will cause an FMI 01 to be stored.

Some of the conditions that can cause the FMI 01 diagnostic code to be activated are:

- The medium or component that is being monitored is below the normal range.
- Poor connections in the circuit.
- The sensor has failed.
- An ECM has failed. This condition is unlikely.

FMI 02 "Data erratic, intermittent or incorrect" – The signal from a component is present. The control that reads the diagnostic information cannot read the signal properly. The signal appears to be gone, unstable, or invalid. The data can be correct or incorrect intermittently. Also, this condition relates to communication between controls. This condition is an example of communication between controls. When the monitoring system is looking for the engine speed from the Engine ECM over the CAT Data Link.

Some of the conditions that can cause the FMI 02 diagnostic code to be activated are:

- There is a poor connection in the circuit.
- The signal is intermittent or erratic.
- The software has been changed.
- The signal is receiving interference from another circuit.
- The signal is out of the range.
- An ECM has failed. This condition is unlikely.

FMI 03 "Voltage Above Normal" – The component or system voltage is higher than the limit. An FMI 03 most often relates to a signal circuit.

Some of the conditions that could cause an FMI 03 diagnostic code to be activated are listed below.

- Loss of power supply.
- An open circuit or a bad connection.
- A short to another voltage source.
- The sensor or the switch has failed.
- An ECM has failed. This condition is unlikely.

FMI 04 "Voltage Below Normal" – The component or system voltage is lower than the limit. An FMI 04 diagnostic code most often relates to a power supply circuit.

Conditions that could cause an FMI 04 diagnostic code are listed below.

- The circuit is shorted to a ground source.
- The circuit is open or has a poor connection.
- The ground circuit has failed.
- A component has failed.
- An ECM has failed. This condition is unlikely.

FMI 05 "Current Below Normal" – The current through the component or the system is lower than the limit. FMI 05 is most often related to a driver circuit.

Conditions that could cause an FMI 05 diagnostic code are listed below.

- There is an open circuit or a poor harness connection.
- The component has failed or has an open internally.
- An ECM has failed. This condition is unlikely.

FMI 06 "Current Above Normal" – The current through the component circuit is higher than the limit. FMI 06 is most often related to a driver circuit for a solenoid. This diagnostic code is like an FMI 04 diagnostic code.

Conditions that could cause an FMI 06 diagnostic code are listed below.

- The component has failed.
- There is a short circuit to a ground source in the machine harness.
- An ECM has failed. This condition is unlikely.

FMI 07 "Mechanical System Not Responding Properly" – The control detects a signal that is sent to a mechanical system and the response is not correct.

Conditions that could cause an FMI 07 diagnostic code are listed below.

- The component responds improperly.
- The component is mechanically stuck in a position.
- The mechanical component has failed.
- The engine is shut down.
- The machine is being used improperly.

FMI 08 "Abnormal Frequency, Pulse Width or Period" – This code occurs when the signal is not in the expected range. FMI 08 can also relate to a faulty sensor.

Conditions that could cause an FMI 08 diagnostic code are listed below.

- The harness connections are intermittent or poor.
- The signal is noisy due to nearby interference.
- There are loose mechanical devices.
- The component has failed.
- An ECM has failed. This condition is unlikely.

FMI 09 “Abnormal Update” – This code relates to communications on the data link. FMI 09 occurs when a control is not able to get information from another control.

Conditions that could cause an FMI 09 diagnostic code are listed below.

- The control module is not communicating on the data link correctly.
- The rate of data transmission is abnormal.
- The data link circuit has failed.
- There is a mismatch of software.
- An ECM has failed. This condition is unlikely.

FMI 10 “Abnormal Rate of Change” – This code relates to a signal that changes too fast or too slow. The rate of change is outside of the expected limit.

Conditions that could cause an FMI 10 diagnostic code are listed below.

- The component has failed
- Poor connections in the circuit.
- The medium or component that is being monitored has failed.
- An ECM has failed. This condition is unlikely.

FMI 11 “Failure Mode Not Identifiable” – The control identifies more than one FMI as being responsible for a single failure.

Conditions that could cause an FMI 11 diagnostic code are listed below.

- There is a mechanical failure.
- There is damage to multiple circuits.
- An ECM has failed. (ECM failure is unlikely)

FMI 12 “Bad Device or Component” – The electronic control sends a signal and the electronic control expects a response. The control receives no response or the response is incorrect.

Conditions that could cause an FMI 12 diagnostic code are listed below.

- The component has failed.
- There is a failure on the data link.
- There are one or more controls with mismatched software.
- An ECM has failed. (ECM failure is unlikely)

FMI 13 “Out of Calibration” – The electrical signal is not within limits for a specific mechanical condition.

Conditions that could cause an FMI 13 diagnostic code are listed below.

- Calibration is required.
- The component has failed.
- The data is out of the range.
- An ECM has failed. (ECM failure is unlikely)

FMI 14 “Parameter Failures” – This diagnostic code is set up for special circumstances for a particular component. The FMI 14 troubleshooting procedure for the component will list the possible conditions that can cause this code.

FMI 15 “Data valid but above Normal Operating Range (Least severe - Level 1)” – Every electronic control system sets a high limit for the expected operating range of the signal. The high limit includes over range signals. A sensor that is still operating but sending a signal above the expected limit will cause an FMI 15 to be activated.

Some of the conditions that can cause the FMI 15 diagnostic code to be activated are:

- The medium or component that is being monitored is above the normal range.
- The signal is shorted to another voltage source.
- The sensor needs calibration
- An ECM has failed. (ECM failure is unlikely)

FMI 16 “Data valid but above Normal Operating Range (Least severe - Level 2)” – Every electronic control system sets a high limit for the expected operating range of the signal. The high limit includes over range signals. A sensor that is still operating but sending a signal above the expected limit will cause an FMI 16 to be activated.

Some of the conditions that can cause the FMI 15 diagnostic code to be activated are:

- The medium or component that is being monitored is above the normal range.
- The signal is shorted to another voltage source.
- The sensor needs calibration
- An ECM has failed. (ECM failure is unlikely)

FMI 17 “Data valid but below Normal Operating Range (Least severe - Level 1)” – Every electronic control system sets a low limit for the expected operating range of the signal. The limit includes signals that are under the lower limit. The low signal could be the oil pressure signal. The sensor is still working but sending a signal below the expected limit will cause an FMI 17 to be stored.

Some of the conditions that can cause the FMI 17 diagnostic code to be activated are:

- The medium or component that is being monitored is below the normal range.
- Poor connections in the circuit.
- The sensor has failed.
- An ECM has failed. (ECM failure is unlikely)

FMI 18 “Data valid but below Normal Operating Range (Least severe - Level 2)” – Every electronic control system sets a low limit for the expected operating range of the signal. The limit includes signals that are under the lower limit. The low signal could be the oil pressure signal. The sensor is still working but sending a signal below the expected limit will cause an FMI 18 to be stored.

Some of the conditions that can cause the FMI 18 diagnostic code to be activated are:

- The medium or component that is being monitored is below the normal range.
- Poor connections in the circuit.
- The sensor has failed.
- An ECM has failed. (ECM failure is unlikely)

FMI 19 “Received Networkl Data in Error” – This type of failure is associated with network data received over the “J1939 Data Link” . The component used to measure the real world signal is wired directly to the module sourcing the data and not the module receiving the data via the network.

i05897588

Using Messenger to Determine Diagnostic Codes

SMCS Code: 7490; 7569

Active and logged diagnostic codes can be viewed and cleared using Messenger.

Perform the following steps to view the active and logged diagnostic codes:

Illustration 169 g02352535

Messenger Main Menu

1. From the Messenger Main Menu page, scroll to the “Service” menu and press the “OK” button.

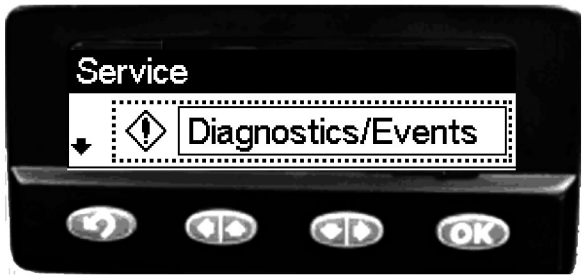


Illustration 170 g02352538

Messenger Service Menu

2. From the Messenger Service Menu page, the first option in the service menu will be “Diagnostics/ Events” . Press “OK” to view the list of Active codes and Logged codes.

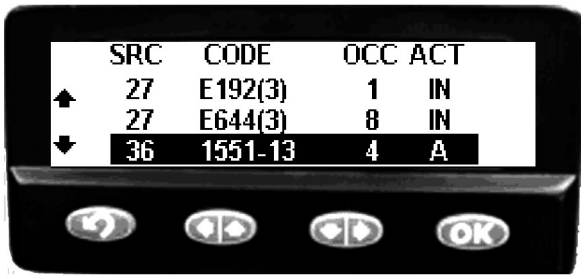


Illustration 171 g02352533

The Messenger Diagnostics/Events List screen

The Messenger Diagnostics/Events List screen shows the following:

SRC – Source

CODE – MID, CID, FMI, EID, and WCI

OCC – The number of occurrences of the codes.

ACT – The status of the code (“A” = active, “IN = previously logged”).

Pressing “OK” on any of these codes (when highlighted) will display the Diagnostic/Event screen.

Note: If the code is Active, there will be an “A” in the “ACT” column. There will be an “IN” if the code was previously logged.

Illustration 172 g02352539

The Messenger Diagnostic/Event Detail screen

The Messenger Diagnostic/Event Detail screen will display the following:

- Source of the failure
- Code: CID, FMI, EID, or WCI
- Text description of failed component
- Text description of the type of failure

i05897609

Using Caterpillar Electronic Technician to Determine Diagnostic Codes

SMCS Code: 0785-UE; 7569

Perform the following steps to use Cat ® Electronic Technician (Cat ET) Service Tool to determine diagnostic codes:

1. Connect Cat ET to the machine.

2. Turn the keyswitch on.

3. Start Cat ET.

Cat ET will initiate communication with the Electronic Control Modules (ECMs) on the machine. After communication has been established, Cat ET will list the ECMs.

4. Select the desired ECM.

5. After the diagnostic codes have been determined with Cat ET, see the test procedure for the desired diagnostic code.

Reference: Troubleshooting, “Service Tools”

Active Diagnostic Codes

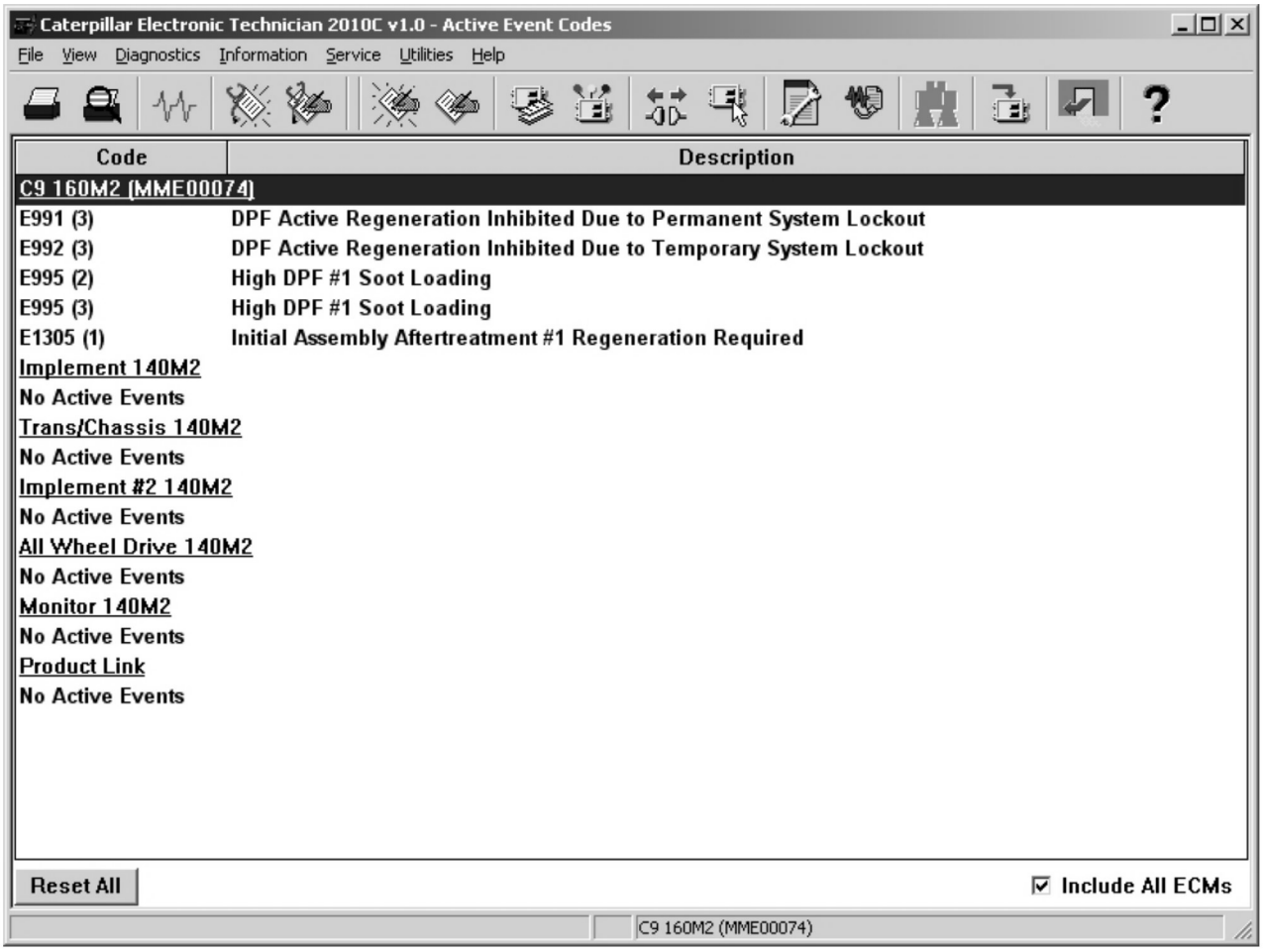


Illustration 173 g02355999

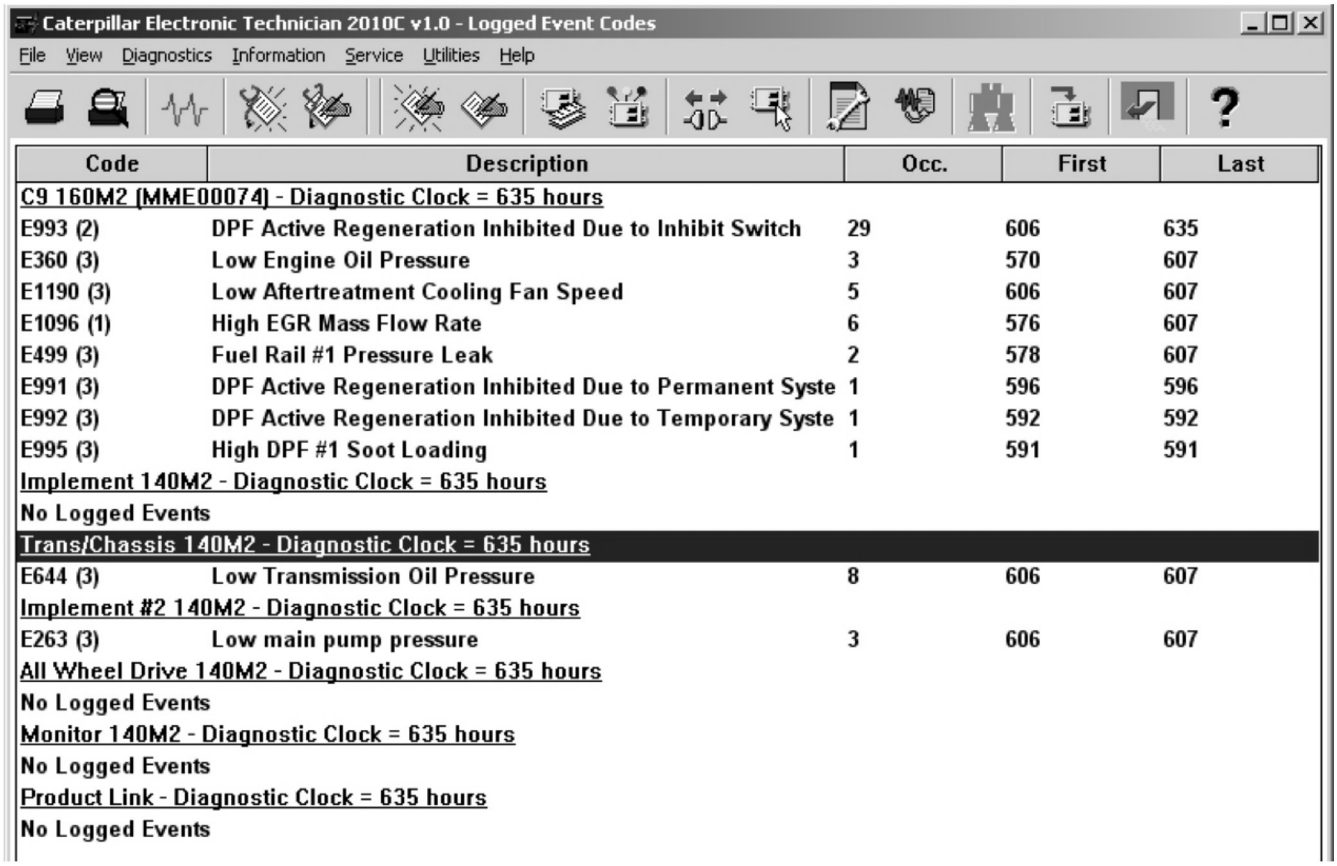
Typical Cat ® Electronic Technician (Cat ET) Service Tool screen for active diagnostic codes.

Cat ET has an active diagnostic code screen. The screen shows component identifier (CID), failure mode identifier (FMI) and text description of the problem.

The following procedures may cause new diagnostic codes to be logged. Therefore, before any procedures are performed, make a list of all the active diagnostic codes and perform the desired procedure. Clear any diagnostic codes caused by the procedure.

Note: Before performing a procedure, always check all the circuit breakers. Repair the cause of any circuit breaker that has been tripped.

Logged Diagnostic Codes



Code	Description	Occ.	First	Last
C9 160M2 (MME00074) - Diagnostic Clock = 635 hours				
E993 (2)	DPF Active Regeneration Inhibited Due to Inhibit Switch	29	606	635
E360 (3)	Low Engine Oil Pressure	3	570	607
E1190 (3)	Low Aftertreatment Cooling Fan Speed	5	606	607
E1096 (1)	High EGR Mass Flow Rate	6	576	607
E499 (3)	Fuel Rail #1 Pressure Leak	2	578	607
E991 (3)	DPF Active Regeneration Inhibited Due to Permanent Syste	1	596	596
E992 (3)	DPF Active Regeneration Inhibited Due to Temporary Syste	1	592	592
E995 (3)	High DPF #1 Soot Loading	1	591	591
Implement 140M2 - Diagnostic Clock = 635 hours				
No Logged Events				
Trans/Chassis 140M2 - Diagnostic Clock = 635 hours				
E644 (3)	Low Transmission Oil Pressure	8	606	607
Implement #2 140M2 - Diagnostic Clock = 635 hours				
E263 (3)	Low main pump pressure	3	606	607
All Wheel Drive 140M2 - Diagnostic Clock = 635 hours				
No Logged Events				
Monitor 140M2 - Diagnostic Clock = 635 hours				
No Logged Events				
Product Link - Diagnostic Clock = 635 hours				
No Logged Events				

Illustration 174 g02356001

Typical Cat ET screen for logged diagnostic codes.

Cat ET has a logged diagnostic code screen. Cat ET will log diagnostic codes that are intermittent. The logged diagnostic data includes component identifier (CID), failure mode identifier (FMI), and a text description of the problem. Also, the logged diagnostic data includes the number of occurrences of the problem and two time stamps. The time stamps display the first occurrence and the most recent occurrence of the problem.

Diagnostics are logged in non-volatile memory. On powerup, the ECM will clear any diagnostic codes that have not been detected or active within the last 1000 hours of machine operation.

i02857407

MID 082 - CID 0041 - FMI 03

SMCS Code: 1439-038

Conditions Which Generate This Code:

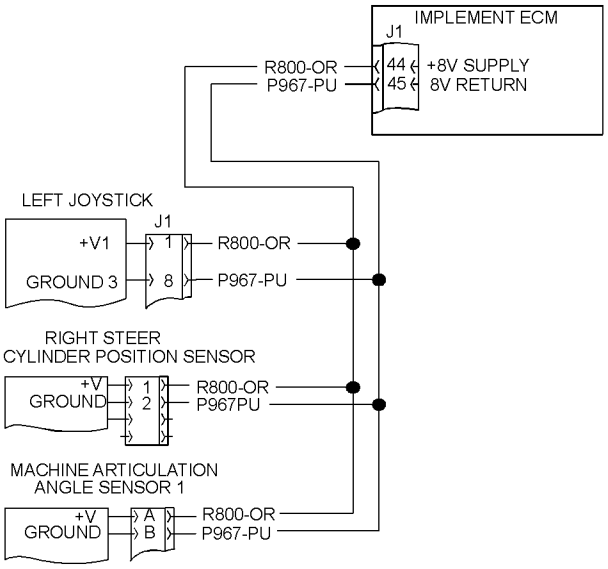


Illustration 175 g01273475

8 VDC Power Supply connections

This diagnostic code is associated with the ECM 8 volt power supply. The 8 volt power supply provides power for the left joystick, the right position sensor of the steering cylinder and the machine articulation angle sensor 1.

The Implement ECM 8 volt power supply is one of two power supplies that are used for the left hand joystick. The other power source for the left hand joystick is supplied by the Transmission/Chassis ECM.

The CID 0041 FMI 03 diagnostic code becomes active when the ECM detects that the voltage of the 8 volt power supply circuit is above normal.

The following conditions could cause this diagnostic code:

- The power supply circuit is shorted to a higher voltage source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE VOLTAGE AT A COMPONENT

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector from the position sensor of the right steering cylinder.

C. At the machine harness connector for the sensor, measure the voltage from contact 1 (wire R800-OR(Orange)) to contact 2 (wire P967-PU(Purple)).

Expected Result:

The voltage measurement is 8.0 ± 0.3 DCV.

Results:

- OK – The voltage measurement is 8.0 ± 0.3 DCV. The voltage is correct. Proceed to Test Step 4.
- NOT OK – The voltage measurement is greater than 8.0 ± 0.3 DCV. The measurement is not correct.Proceed to Test Step 2.

Test Step 2. CHECK THE POWER SUPPLY AT THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At Implement ECM connector J1, use a 151 - 6320 Removal Tool to remove the supply wire and the socket at contact J1-44 (wire R800-OR(Orange)) and the return wire and the socket at contact J1-45 (wire P967-PU(Purple)) from the connector. The machine harness connector J1 remains connected to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Use the multimeter probes in order to make contact on the pins of the ECM connector. Measure the voltage at the ECM pins between the contact of the power supply J1-44 and the contact of the return pins J1-45.

Expected Result:

The voltage measurement is 8.0 ± 0.3 DCV.

Results:

- OK – The voltage measurement is 8.0 ± 0.3 DCV. The voltage is correct. The ECM power supply is correct. Install the wires and sockets that were removed from the J1 connector back into the original locations.Proceed to Test Step 3.
- NOT OK – The voltage measurement is greater than 8.0 ± 0.3 DCV. The ECM power supply is not correct. The ECM has failed.

  Repair: Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK FOR A SHORT CIRCUIT IN THE MACHINE HARNESS

The machine harness connector remains disconnected from the position sensor of the right steering cylinder.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the machine harness connector from the connector of the left joystick J1 and disconnect the machine harness connector from the machine articulation sensor 1.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connector J1 for the Implement ECM, check the resistance from contact J1-44 (wire R800-OR(Orange)) to all of the other contacts that are used in connectors J1 and J2 for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The supply circuit is not shorted to another circuit in the machine harness. Proceed to Test Step 4.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The power supply circuit is shorted to a another circuit in the machine harness. Refer to the complete Electrical System Schematic of the machine. Examine the supply circuit in order to determine the location of the potential problem.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 0041 FMI 03 diagnostic code is active.

Expected Result:

The CID 0041 FMI 03 diagnostic code is active.

Results:

- YES – The CID 0041 FMI 03 diagnostic code is active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. A wiggle test can be used to detect conditions such as

momentary short circuits. A wiggle test can also be used to detect open locations in the machine wiring harness.

If the cause of the problem is not found, the ECM may be activating the diagnostic code incorrectly. The ECM may have failed.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 0041 FMI 03 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i04047335

MID 082 - CID 0041 - FMI 04

SMCS Code: 1439-038

Conditions Which Generate This Code:

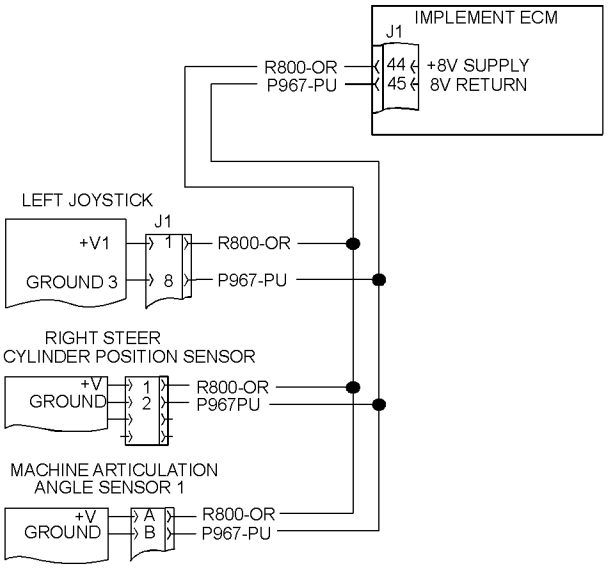


Illustration 176 g01273475

8 VDC Power Supply connections

This diagnostic code is associated with the 8 V power supply of the ECM. The 8 V power supply provides power for the left joystick, the position sensor of the right steering cylinder and the machine articulation angle sensor 1.

The CID 0041 FMI 04 diagnostic code is recorded when the ECM reads the voltage of the sensor supply circuit and the voltage is below normal.

The following conditions could cause this diagnostic code:

- A sensor has failed.
- The sensor supply circuit is shorted to a ground source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Clear these created diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSORS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. While observing the status of the diagnostic code as each component is disconnected, disconnect the connector of the left joystick J1, the machine articulation sensor 1 and the position sensor of the right steering cylinder from the machine harness.

Expected Result:

The CID 0041 FMI 04 diagnostic code is no longer active when one of the components in the supply circuit is disconnected.

Results:

- YES – The diagnostic code is not active when one of the components in the supply circuit is disconnected. The power supply circuit is correct. The sensor that was disconnected when the diagnostic code was cleared has failed.

Repair: Repeat this test step, in order to verify which component is causing the problem. Replace the component that is causing the problem.

STOP.

- NO – The diagnostic code is still active. Disconnecting the components in the circuit did not affect the status of the diagnostic code. Proceed to Test Step 2.

Test Step 2. CHECK THE POWER SUPPLY AT THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the Implement ECM connector J1, use a 151-6320 Removal Tool to remove the supply wire and the socket at contact J1-44 (wire R800-OR(Orange)) and the return wire and the socket at contact J1-45 (wire P967-PU(Purple)) from the connector. The machine harness connector J1 remains connected to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Use the multimeter probes in order to make contact on the connector pins of the ECM. Measure the voltage at the ECM pins between the contact of the power supply J1-44 and the return contact J1-45.

Expected Result:

The voltage measurement is 8.0 ± 0.3 VDC.

Results:

- OK – The voltage measurement is 8.0 ± 0.3 VDC. The voltage is correct. The ECM power supply is correct. Install the wires and the sockets that were removed from the J1 connector back into the original locations.Proceed to Test Step 3.

- NOT OK – The voltage measurement is less than 8.0 ± 0.3 VDC. The ECM power supply is not correct. The ECM has failed.

  Repair: Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK FOR A SHORT TO GROUND

The components that are powered by the 8 V power supply remain disconnected from the machine harness.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

C. At the harness connector for the ECM, measure the resistance between supply connection J1-44 (wire R800-OR(Orange)) and frame ground. Measure the resistance between supply connection J1-44 (wire R800-OR(Orange)) and all of the other contacts that are used in the J1 and J2 connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The harness circuit resistance is correct. Proceed to Test Step 4.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. The circuit is shorted in the machine harness.

  Repair: The power supply wire R800-OR(Orange) is shorted to ground in the machine harness. Refer to the complete Electrical System Schematic for your machine. Check all harness connectors that are in the power supply circuit. Ensure that the connectors are clean and secure. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 0041 FMI 04 diagnostic code is active.

Expected Result:

The CID 0041 FMI 04 diagnostic code is active.

Results:

- YES – The CID 0041 FMI 04 diagnostic code is active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0041 FMI 04 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i04032609

MID 082 - CID 0075 - FMI 03

SMCS Code: 1439-038-ZH; 430S-038-TA

Conditions Which Generate This Code:

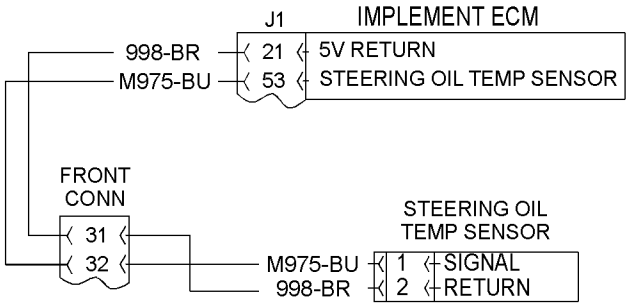


Illustration 177 g01964861

Schematic of the Temperature Sensor (Steering Oil)

This diagnostic code is associated with the Temperature Sensor (Steering Oil). The FMI 03 means that the ECM has determined that the voltage of the circuit for the sensor is above normal.

The possible causes of this diagnostic code are listed below:

- The signal circuit for the sensor is open.
- The signal circuit for the sensor is shorted to the +battery circuit.
- The sensor has failed.
- The power circuit or the ground circuit has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected. **Ensure that the diagnostic code of CID 0075 FMI 03 is active before performing this procedure.**

Note: Use the 146-4080 Digital Multimeter for the measurements in this procedure.

Table 17

Temperature	Resistance (Ohms)
−50° C (−58° F)	2724 Ohms
11° C (52° F)	167 Ohms
50° C (122° F)	44 Ohms

System Response:

The diagnostic code of CID 0075 FMI 03 will be logged in the internal memory of the ECM.

Test Step 1. CHECK FOR POWER AT THE SENSOR.

A. Do not disconnect the harness connector from the sensor.

B. Turn the key start switch and the disconnect switch to the ON position.

C. At the back of the harness connector for the sensor, insert a 7X-1710 Multimeter Probe along the voltage supply wire (contact 1).

D. Measure the voltage from contact 1 to frame ground.

Expected Result:

The voltage is 5 VDC.

Results:

- OK – The voltage is 5 VDC.Proceed to Test Step 2.
- NOT OK – The voltage is not 5 VDC. The +battery circuit in the machine harness has failed.

  Repair: Replace the machine harness or repair the machine harness.

  STOP.

Test Step 2. CHECK FOR PROPER GROUND AT THE SENSOR.

A. The machine harness remains connected to the sensor.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Remove the 7X-1710 Multimeter Probe from the voltage supply wire (contact 1).

D. At the back of the harness connector for the sensor, insert a 7X-1710 Multimeter Probe along the ground wire (contact 2).

E. Measure the resistance from contact 2 to frame ground.

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The ground circuit is correct.Proceed to Test Step 3.
- NOT OK – The resistance is greater than 5 ohms. The ground circuit in the machine harness has failed.

  Repair: Replace the machine harness or repair the machine harness.

  STOP.

Test Step 3. CHECK THE WIRING HARNESS OF THE SENSOR FOR AN OPEN CIRCUIT.

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness from the sensor.

C. At the harness connector for the sensor, connect a jumper wire between contact 2 and contact 1.

D. Disconnect the machine harness connectors from the ECM.

E. At the harness connector for the ECM, measure the resistance between contact J1-21 wire (998-BR(Brown)) and contact J1-53 wire (M975-BU(Blue)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The circuit is correct.Proceed to Test Step 4.
- NOT OK – The resistance is greater than 5 ohms. The circuit is not correct. There is an open circuit in the wiring harness.

  Repair: There is an open circuit in the wiring harness. Repair the wiring harness or replace the wiring harness.

  STOP.

Test Step 4. CHECK THE WIRING HARNESS OF THE SENSOR FOR A SHORT TO THE +BATTERY CIRCUIT.

A. The key start switch and the disconnect switch remain in the OFF position.

B. The machine harness remains disconnected from the sensor. Remove the jumper wire that was installed in the previous step.

C. The machine harness connectors remain disconnected from the ECM.

D. At the machine harness connector for the ECM, measure the resistance from the signal contact J1-21 wire (998-BR(Brown)) of the machine harness to all contacts that are used in the machine harness connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 5.
- NOT OK – One or more resistance measurements are not correct. There is a short in the machine harness.

  Repair: The short is between signal contact J1-21 wire (998-BR(Brown)) and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE OUTPUT OF THE SENSOR.

A. Reconnect the machine harness connectors to the ECM.

B. At the back of the harness connector for the sensor, insert a 7X-1710 Multimeter Probe along the signal wire (contact 1).

C. At the back of the harness connector for the sensor, insert a 7X-1710 Multimeter Probe along the ground wire (contact 2).

D. Measure the resistance of the sensor. The proper range for the sensor is described at the beginning of this procedure.

Expected Result:

The signal from the sensor is valid.

Results:

- OK – The signal from the sensor is valid.Proceed to Test Step 6.
- NOT OK – The signal from the sensor is not valid.

  Repair: The sensor has failed. Replace the sensor.

  STOP.

Test Step 6. CHECK IF THE DIAGNOSTIC CODE REMAINS.

A. Inspect the contacts of the harness connectors and clean the connectors.

B. Reconnect all harness connectors.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 0075 - FMI 03.

Expected Result:

The CID 0075 - FMI 03 is active.

Results:

- YES – The CID 0075 - FMI 03 is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Exit this procedure and perform the diagnostic code procedure again. If the problem persists, the ECM may have failed. Prior to replacing an ECM, always contact your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace” for more information.

  STOP.

- NO – The CID 0075 - FMI 03 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i04814820

MID 082 - CID 0168 - FMI 00

SMCS Code: 1406-038

Conditions Which Generate This Code:

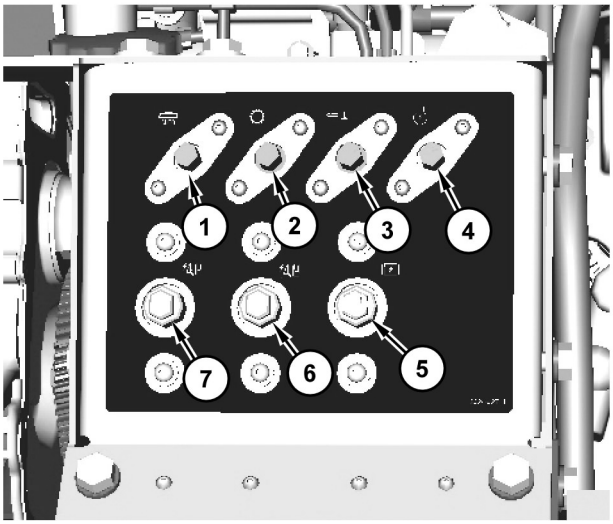


Illustration 178 g01323933

The Circuit Breaker Box is located on left side of machine behind the cab.

(1) Accugrade Breaker (20 Amp)
(2) Transmission Control Breaker (15 Amp)
(3) Key Switch Breaker (15 Amp)
(4) Engine Control Breaker (20 Amp)
(5) Alternator Breaker (150 Amp)
(6) Load Breaker (80 Amp)
(7) Main Breaker (80 Amp)

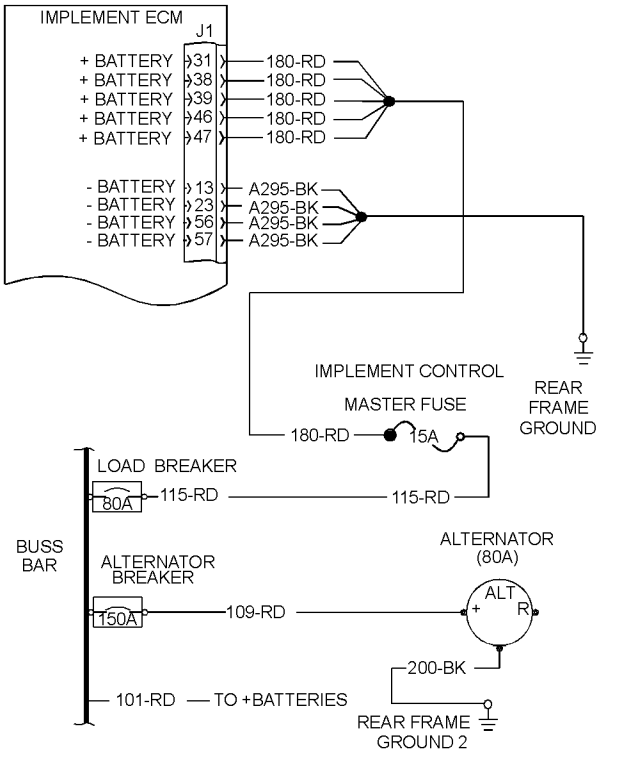


Illustration 179 g01284928

System Voltage connections

This diagnostic code is associated with the system voltage of the machine that is supplied to the ECM. The FMI 00 diagnostic code means that the ECM has detected that the system voltage is above normal. The ECM activates this diagnostic code when the system voltage is above 32.0 VDC.

The possible causes of this diagnostic code are listed below:

- A charging system component has failed.
- The harness wiring has failed.
- The ECM has failed, however ECM failure is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections in the circuit are secure and that all connections in the circuit are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE SYSTEM VOLTAGE OF THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the J1 harness connector for the Implement ECM, insert a7X-1710 Multimeter Probes along the supply connection for the J1-31 (wire 180-RD(Red)) (system voltage). Use the other multimeter probe to make contact to frame ground.

C. Turn the disconnect switch to the ON position.

D. Start the engine and run the engine at half throttle.

E. Measure the voltage between contact J1-31 (wire 180-RD(Red)) and frame ground.

F. At the J1 harness connector for the Implement ECM, insert the 7X-1710 Multimeter Probe that was used for the frame ground contact along the system power supply negative battery contact J1-13 (wire A295-BK(Black)).

G. Measure the voltage between contact J1-31 (wire 180-RD(Red)) and contact J1-13 (wire A295-BK(Black)).

Expected Result:

Both voltage measurements are approximately the same and both voltage measurements are in the range of 18.0 VDC to 32.0 VDC.

Results:

- OK – Each voltage measurement is approximately the same and each voltage measurement is in the range of 18.0 VDC to 32.0 VDC. The system voltage is correct.Proceed to Test Step 5.
- NOT OK – Each voltage measurement is approximately the same, however, the voltage measurements are greater than 32.0 VDC. The system voltage is above normal.Proceed to Test Step 3.
- NOT OK – The measurement from the positive battery contact to frame ground is in the range of 18.0 VDC to 32.0 VDC, however, the measurement between the ECM positive battery contact and the ECM negative battery contact is not in the correct range. The ground circuit may have failed.Proceed to Test Step 2.

Test Step 2. CHECK THE GROUND CIRCUITS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness J1 connector from the ECM.

C. At the J1 harness connector for the ECM, measure the resistance between each of the four negative battery contacts and frame ground. The contacts for the negative connections of the battery are illustrated in the connection diagram at the beginning of this procedure.

Expected Result:

Each resistance measurement is less than 5.0 ohms.

Results:

- OK – Each resistance measurement is less than 5.0 ohms. The ground circuit is correct. Reconnect the J1 machine harness connector to the ECM before proceeding to the next test step.Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is greater than 5.0 ohms. There is an open circuit or a poor connection in the ground circuit.

  Repair: The open or the possible poor connection is in the ground circuit wire of the ECM A295-BK(Black) in the machine harness. Refer to the complete Electrical System Schematic of the machine. Check the rear frame ground connection point where wire A295-BK(Black) is connected. Ensure that the ground connection is clean, that the ground connection is tight and that the ground connection is in good condition. Check all of the connectors and splice points that are in the ground circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OUTPUT CURRENT OF THE ALTERNATOR

A. Before performing this test step, partially discharge the batteries. Partially discharging the batteries can be done by cranking the engine for approximately 30 seconds without starting the engine. Partially discharging the batteries can also be done by turning on the lights without running the engine for about 10 minutes.

B. Turn the disconnect switch and the key start switch to the OFF position.

C. At the alternator, connect multimeter probes between the alternator “B” terminal (wire 109-RD(Red)) and the alternator case (frame ground).

D. Connect a 225-8266 Ammeter Tool Gp or an equivalent ammeter around the output wire 109-RD(Red).

E. Turn the disconnect switch to the ON position.

F. Start the engine.

G. Run the engine at approximately half throttle.

H. Immediately check the output current of the alternator.

Expected Result:

The output current of the alternator at half throttle is approximately 40 amps, half the alternator full current output rating (80 Amps).

Results:

- YES – The output current of the alternator at half throttle is approximately 40 amps. Proceed to Test Step 4.
- NO – The output current of the alternator at half throttle is not approximately 40 amps. The current output of the alternator is not correct.

  Repair: Refer to Service Manual, SENR4130 for brushless alternators for further testing and repair procedures for the alternator.

  STOP.

Test Step 4. CHECK THE VOLTAGE OUTPUT OF THE ALTERNATOR

The multimeter and the ammeter are still connected in the same manner as the last test step. The engine is running.

A. Run the engine for approximately 10 minutes at half throttle.

B. Check the voltage at the alternator output “B” terminal.

Expected Result:

The voltage measurement is 28.0 ± 1.0 VDC.

Results:

- YES – The voltage measurement is 28.0 ± 1.0 VDC. The voltage output of the alternator is correct. Proceed to Test Step 5.
- NO – The voltage is greater than 32.0 VDC.

  Repair: Refer to the complete Electrical System Schematic for your machine. Check all connections that are in the charging circuit.

  Ensure that all ground connections are clean, that all connections are tight and that all connections are in good condition.

  If a problem is not found in the machine harness or connection points, refer to Service Manual, SENR4130 for brushless alternators for further testing and repair procedures for the alternator.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Reconnect any harness connectors that were disconnected and checked.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 0168 FMI 00 diagnostic code is active.

Expected Result:

The CID CID 0168 FMI 00 diagnostic code is active.

Results:

- YES – The CID 0168 FMI 00 diagnostic code is active.

  Repair: Perform this procedure again. Verify that the measurements from the alternator are correct. Verify that the connections of the system voltage circuit are in good condition and that the connections are tight.

  If the problem remains and no cause can be found, the ECM may have failed.

  However, ECM failure is unlikely. Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0168 FMI 00 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i04853066

MID 082 - CID 0168 - FMI 01

SMCS Code: 1406-038

Conditions Which Generate This Code:

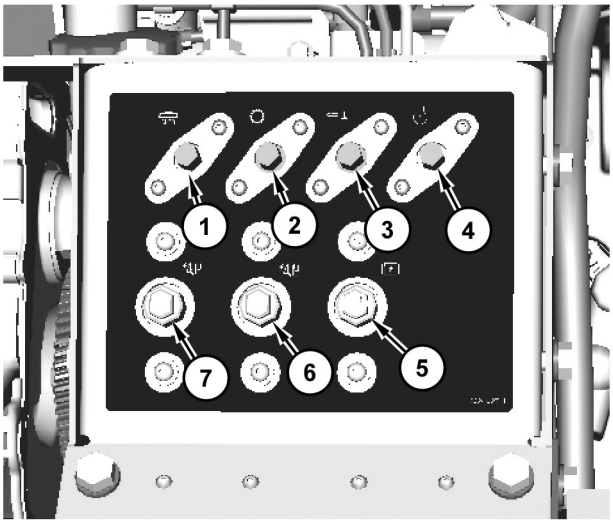


Illustration 180 g01323933

The circuit breaker box is located on left side of machine behind the cab.

(1) Accugrade breaker (20 Amp)
(2) Transmission control breaker (15 Amp)
(3) Key switch breaker (15 Amp)
(4) Engine control breaker (20 Amp)
(5) Alternator breaker (150 Amp)
(6) Load breaker (80 Amp)
(7) Main breaker (80 Amp)

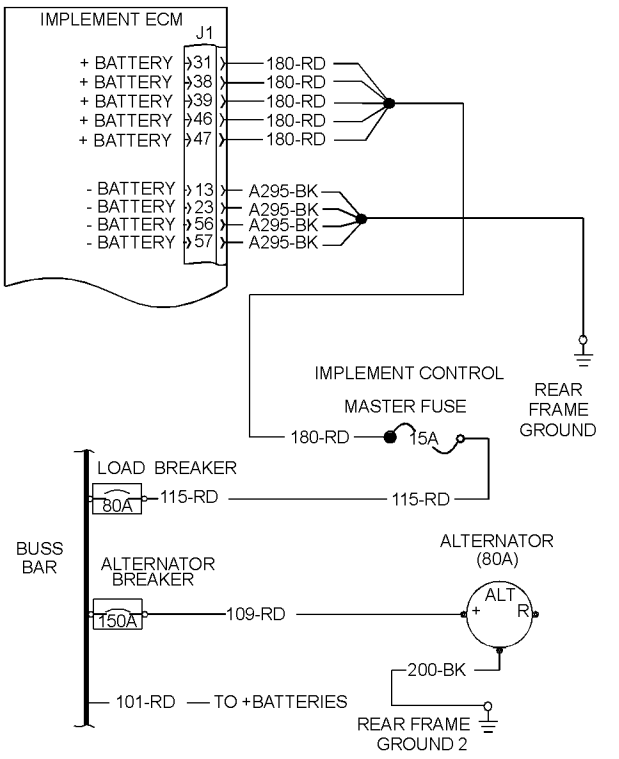


Illustration 181 g01284928

System voltage connections

This diagnostic code is associated with the system voltage of the machine that is supplied to the Implement ECM. The FMI 01 diagnostic code indicates that the ECM detects that the system voltage is below normal. The ECM activates this diagnostic code when the system voltage is below 19.0 VDC.

The possible causes of this diagnostic code are listed below:

- An open circuit connection or a poor system ground circuit connection
- An open circuit or a poor connection in the system voltage supply circuit
- A charging system component has failed
- The ECM has failed, however ECM failure is unlikely

Note: Before performing this procedure, verify that all circuit breakers and fuses in the charging circuit and the machine supply circuit of the ECM are closed. If a problem with a circuit breaker or a fuse is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE SYSTEM VOLTAGE OF THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the J1 harness connector for the Implement ECM, insert a7X-1710 Multimeter Probe along the contact of the system power J1-31 (wire 180-RD(Red)). Use the other multimeter probe to make contact to frame ground.

C. Turn the disconnect switch to the ON position.

D. Start the engine and run the engine at half throttle.

E. Measure the voltage between contact J1-31 (wire 180-RD(Red)) and frame ground.

F. At the J1 harness connector for the Implement ECM, insert the 7X-1710 Multimeter Probe that was used for the ground (frame) contact along the negative battery contact of the system power J1-15 (wire A295-BK(Black)).

G. Measure the voltage between contact J1-31 (wire 180-RD(Red)) and contact J1-15 (wire A295-BK(Black)).

Expected Result:

Both voltage measurements are approximately the same and both voltage measurements are in the range of 18.0 VDC to 32.0 VDC.

Results:

- OK – Each voltage measurement is approximately the same and each voltage measurement is in the range of 18.0 VDC to 32.0 VDC. The system voltage is correct.Proceed to Test Step 6.
- NOT OK – Each voltage measurement is approximately the same, however, the measurements are less than 18.0 VDC. The system voltage is below normal.Proceed to Test Step 4.
- NOT OK – The measurement from the positive battery contact to frame ground is in the range of 18.0 VDC to 32.0 VDC, however, the measurement between the ECM positive battery contact and the ECM negative battery contact is not in the correct range. The ground circuit may have failed.Proceed to Test Step 2.

Test Step 2. CHECK THE GROUND CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness J1 connector from the ECM.

C. At the J1 harness connector for the ECM, measure the resistance between each of the four negative battery contacts and frame ground. The contacts for the negative battery connections are illustrated in the connection diagram at the beginning of this procedure.

Expected Result:

Each resistance measurement is less than 5.0 ohms.

Results:

- OK – Each resistance measurement is less than 5.0 ohms. The ground circuit is correct.Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is greater than 5.0 ohms. There is an open circuit or a poor connection in the ground circuit.

  Repair: The open or the possible poor connection is in the ground circuit of the ECM (wire A295-BK(Black)) in the machine wiring harness. Refer to the complete Electrical System Schematic of the machine. Check the rear frame ground connection point where wire A295-BK(Black) is connected. Ensure that the ground connection is clean, that the ground connection is tight and that the ground connection is in good condition. Check all of the connectors and splice points that are in the ground circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SUPPLY CIRCUITS

The key start switch and the disconnect switch remain in the OFF position. The machine harness J1 connector remains disconnected from the ECM.

A. At the J1 harness connector for the ECM, using a length of spare wire, measure the resistance between the alternator “B” terminal (wire 109-RD(Red)) to each of the 5 V positive battery contacts that are connected to the J1 harness connector. The contacts for the 5 V positive battery connections are illustrated in the connection diagram at the beginning of this procedure.

Expected Result:

Each resistance measurement is less than 5.0 ohms.

Results:

- OK – Each resistance measurement is less than 5.0 ohms. The supply circuit is correct. Reconnect the J1 machine harness connector to the ECM before proceeding to the next test step.Proceed to Test Step 4.
- NOT OK – One or more of the resistance measurements is greater than 5.0 ohms. There is an open circuit or a poor connection in the supply circuit.

  Repair: The open or the possible poor connection is in the supply circuit for the ECM system voltage (wire 180-RD(Red) within the machine wiring harness. Verify that there are no open circuit breakers or fuses in the circuit.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors and splice points that are in the supply circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE CURRENT OUTPUT OF THE ALTERNATOR

A. Before performing this test step, partially discharge the batteries. Partially discharging the batteries can be done by cranking the engine for approximately 30 seconds without starting the engine. Partially discharging the batteries can also be done by turning on the lights for about 10 minutes without running the engine.

B. Turn the disconnect switch and the key start switch to the OFF position.

C. At the alternator, connect multimeter probes between the alternator “B” terminal (wire 109-RD(Red)) and the alternator case (frame ground).

D. Connect a clamp on 225-8266 Ammeter Tool Gp or an equivalent ammeter around the output wire 109-RD(Red).

E. Turn the disconnect switch to the ON position.

F. Start the engine.

G. Run the engine at approximately half throttle.

H. Immediately check the output current of the alternator.

Expected Result:

The output current of the alternator at half throttle is approximately 40 amps, half the alternator full current output rating (80 Amps).

Results:

- YES – The output current of the alternator at half throttle is approximately 40 amps. Proceed to Test Step 5.
- NO – The output current of the alternator at half throttle is not approximately 40 amps. The current output of the alternator is not correct.

  Repair: Refer to Service Manual, SENR4130 for brushless alternators for further testing and repair procedures for the alternator.

  STOP.

Test Step 5. CHECK THE OUTPUT VOLTAGE OF THE ALTERNATOR

The multimeter and the ammeter are still connected as in the prior test step. The engine is running.

A. Run the engine for approximately 10 minutes at half throttle.

B. Check the voltage at the alternator output, terminal “B” .

Expected Result:

The voltage measurement is 28.0 ± 1.0 VDC.

Results:

- YES – The voltage measurement is 28.0 ± 1.0 VDC. The voltage output of the alternator is correct. Proceed to Test Step 6.
- NO – The voltage is less than 18.0 VDC.

  Repair: Refer to the complete Electrical System Schematic for your machine. Check all connections that are in the charging circuit. Ensure that all ground connections are clean, that all connections are tight and that all connections are in good condition.

  If a problem is not found in the machine harness or connection points, refer to Service Manual, SENR4130 for brushless alternators for further testing and repair procedures for the alternator.

  STOP.

Test Step 6. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Reconnect any harness connectors that were disconnected.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 0168 FMI 01 diagnostic code is active.

Expected Result:

The CID CID 0168 FMI 01 diagnostic code is active.

Results:

- YES – The CID 0168 FMI 01 diagnostic code is active.

  Repair: Perform this procedure again. Confirm that the measurements of the alternator output are correct. Verify that the circuit connections for the system voltage are in good condition and that the connections are tight.

  If the problem remains and no cause can be found, the ECM may have failed.

  However, ECM failure is unlikely. Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0168 FMI 01 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i04814836

MID 082 - CID 0168 - FMI 02

SMCS Code: 1406-038

Conditions Which Generate This Code:

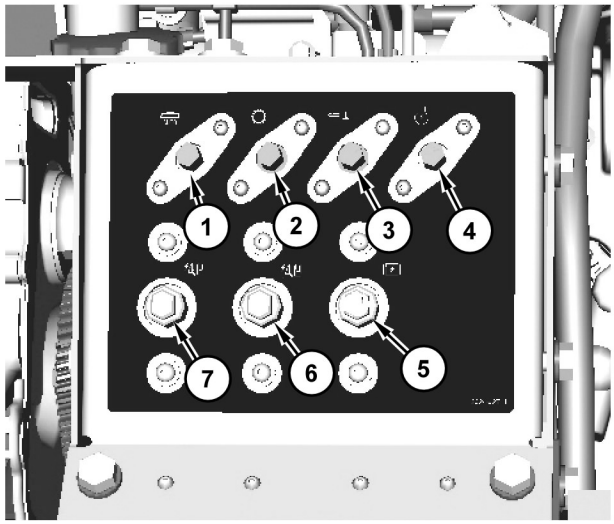


Illustration 182 g01323933

Circuit Breaker Box located on left side of machine behind the Cab

(1) Accugrade Breaker (20 Amp)
(2) Transmission Control Breaker (15 Amp)
(3) Key Switch Breaker (15 Amp)
(4) Engine Control Breaker (20 Amp)
(5) Alternator Breaker (150 Amp)
(6) Load Breaker (80 Amp)
(7) Main Breaker (80 Amp)

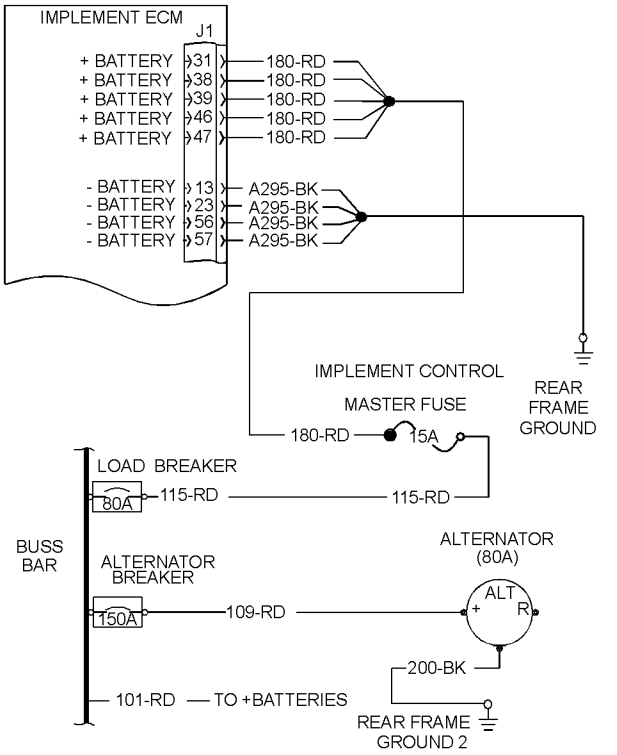


Illustration 183 g01284928

System Voltage connections

This diagnostic code is associated with the system voltage of the machine that is supplied to the ECM. The FMI 02 diagnostic code means that the ECM has detected that the system voltage is erratic. The ECM activates this diagnostic code when the system voltage is not in the range of 18.0 VDC to 32.0 VDC for more than a few seconds.

The possible causes of this diagnostic code are listed below:

- A poor system ground circuit connection.
- A poor system voltage supply circuit connection.
- A charging system component has failed.
- The ECM has failed, however ECM failure is unlikely.

Note: Before performing this procedure, verify that all circuit breakers and fuses in the charging circuit and the supply circuit of the ECM system are closed. If a problem with a circuit breaker or a fuse is found, correct the problem. Verify that this diagnostic code is active before performing this procedure.

Test Step 1. CHECK SYSTEM VOLTAGE AT THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the J1 harness connector for the Implement ECM, insert a 7X-1710 Multimeter Probe along the contact point for the system power J1-31 (wire 180-RD(Red)). Use the other multimeter probe to make contact to frame ground.

C. Turn the disconnect switch to the ON position.

D. Start the engine and run the engine at half throttle.

E. Measure the voltage between contact J1-31 (wire 180-RD(Red)) and frame ground.

F. While observing the multimeter resistance measurement, wiggle the machine harness connectors of the ECM. Gently pull on the wires and move the wires around.

G. At the J1 harness connector for the Implement ECM, insert the 7X-1710 Multimeter Probe that was used for the ground (frame) contact along the system power supply negative battery contact J1-13 (wire A295-BK(Black)).

H. Measure the voltage between contact J1-31 (wire 180-RD(Red)) and contact J1-13 (wire A295-BK(Black)).

I. While observing the multimeter resistance measurement, wiggle the machine harness connectors of the ECM. Gently pull on the wires and move the wires around.

Expected Result:

Both voltage measurements are approximately the same and are in the range of 18.0 VDC to 32.0 VDC at all times during the manipulation of the harness and the connectors.

Results:

- OK – Each voltage measurement is approximately the same and is in the range of 18.0 VDC to 32.0 VDC. The system voltage is correct at all times during the manipulation of the harness and connectors.Proceed to Test Step 6.
- NOT OK – Each voltage measurement is approximately the same, however, the voltage measurements are not stable. The voltage measurements are showing a large amount of variation. The manipulation of the machine harness and connectors does not affect the measurement.Proceed to Test Step 4.
- NOT OK – The measurement from the positive battery contact to frame ground is stable and is in the range of 18.0 VDC to 32.0 VDC. However, the measurement between the ECM positive battery

contact and the ECM negative battery contact is not stable or in the correct range at all times. Proceed to Test Step 2.

Test Step 2. CHECK THE GROUND CIRCUITS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness J1 connector from the ECM.

C. At the J1 harness connector for the ECM, measure the resistance between each of the four negative battery contacts and the frame ground. The contacts for the negative battery connections are illustrated in the connection diagram at the beginning of this procedure.

Expected Result:

Each resistance measurement is less than 5.0 ohms.

Results:

- OK – Each resistance measurement is less than 5.0 ohms. The ground circuit is correct. Reconnect the J1 machine harness connector to the ECM before proceeding to the next test step.Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is greater than 5.0 ohms. There is an open circuit or a poor connection in the ground circuit.

  Repair: The open or the possible poor connection is in the ECM ground circuit (wire A295-BK(Black)) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check the rear frame ground connection point where wire A295-BK(Black) is connected. Ensure that the ground connection is clean, that the ground connection is tight and that the ground connection is in good condition. Check all of the connectors and splice points that are in the ground circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SUPPLY CIRCUITS

The key start switch and the disconnect switch remain in the OFF position. The machine harness J1 connector remains disconnected from the ECM.

A. At the J1 harness connector for the ECM, using a length of spare wire, measure the resistance between the alternator “B” terminal (wire 109-RD(Red)) to each of the five positive battery contacts that are connected to the J1 harness connector. The contacts for the five positive battery connections are illustrated in the connection diagram at the beginning of this procedure.

Expected Result:

Each resistance measurement is less than 5.0 ohms.

Results:

- OK – Each resistance measurement is less than 5.0 ohms. The supply circuit is correct. Reconnect the J1 machine harness connector to the ECM before proceeding to the next test step.Proceed to Test Step 4.
- NOT OK – One or more of the resistance measurements is greater than 5.0 ohms. There is an open circuit or a poor connection in the supply circuit.

  Repair: The open or the possible poor connection is in the supply circuit for the system voltage of the ECM (wire 180-RD(Red)) in the machine harness. Verify that there are no open circuit breakers or fuses in the circuit.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors and splice points that are in the supply circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE CURRENT OUTPUT OF THE ALTERNATOR

A. Before performing this test step, partially discharge the batteries. Partially discharging the batteries can be done by cranking the engine for approximately 30 seconds without starting the engine. Partially discharging the batteries can also be done by turning on the lights for about 10 minutes without running the engine.

B. Turn the disconnect switch and the key start switch to the OFF position.

C. At the alternator, connect multimeter probes between the alternator “B” terminal (wire 109-RD(Red)) and the alternator case (frame ground).

D. Connect a clamp on 225 - 8266 Ammeter Tool Gp or an equivalent ammeter around the output wire 109-RD(Red).

E. Turn the disconnect switch to the ON position.

F. Start the engine.

G. Run the engine at approximately half throttle.

H. Immediately check the output current of the alternator.

Expected Result:

The output current of the alternator at half throttle is approximately 40 amps, half the alternator full current output rating (80 Amps). The current measurement is stable.

Results:

- YES – The output current of the alternator at half throttle is approximately 40 amps and is stable. Proceed to Test Step 5.
- NO – The output current of the alternator at half throttle is not stable. The measurement is showing a large variation of current values. The current output of the alternator is not correct.

  Repair: Refer to Service Manual, SENR4130 for brushless alternators for further testing and repair procedures for the alternator.

  STOP.

Test Step 5. CHECK THE VOLTAGE OUTPUT OF THE ALTERNATOR

The multimeter and the ammeter are still connected from the last test step. The engine is running.

A. Run the engine for approximately 10 minutes at half throttle.

B. Check the voltage at the alternator output, terminal “B” .

Expected Result:

The voltage measurement is 28.0 ± 1.0 VDC. There is little or no variation in the voltage measurement.

Results:

- YES – The voltage measurement is 28.0 ± 1.0 VDC. The voltage is stable. The voltage output of the alternator is correct. Proceed to Test Step 6.
- NO – The voltage is not stable. There is a large variation in the measured voltage. The voltage output is not correct.

  Repair: Refer to Service Manual, SENR4130 for brushless alternators for further testing and repair procedures for the alternator.

  STOP.

Test Step 6. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Reconnect any harness connectors that were disconnected.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 0168 FMI 02 diagnostic code is active.

Expected Result:

The CID 0168 FMI 02 diagnostic code is active.

Results:

- YES – The CID 0168 FMI 02 diagnostic code is active.

  Repair: Perform this procedure again. Verify that the measurement of the alternator output is correct and verify that the circuit connections of the system voltage are in good condition and that the connections are tight.

  If the problem remains and no cause can be found, the ECM may have failed.

  However, ECM failure is unlikely. Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0168 FMI 02 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i04831778

MID 082 - CID 0168 - FMI 03

SMCS Code: 1406-038

Conditions Which Generate This Code:

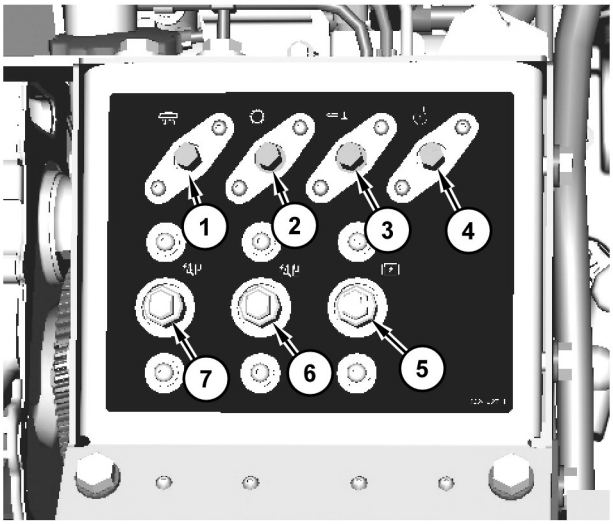


Illustration 184 g01323933

The circuit breaker box is located on left side of machine behind the cab.

(1) Accugrade breaker (20 Amp)
(2) Transmission control breaker (15 Amp)
(3) Key switch breaker (15 Amp)
(4) Engine control breaker (20 Amp)
(5) Alternator breaker (150 Amp)
(6) Load breaker (80 Amp)
(7) Main breaker (80 Amp)

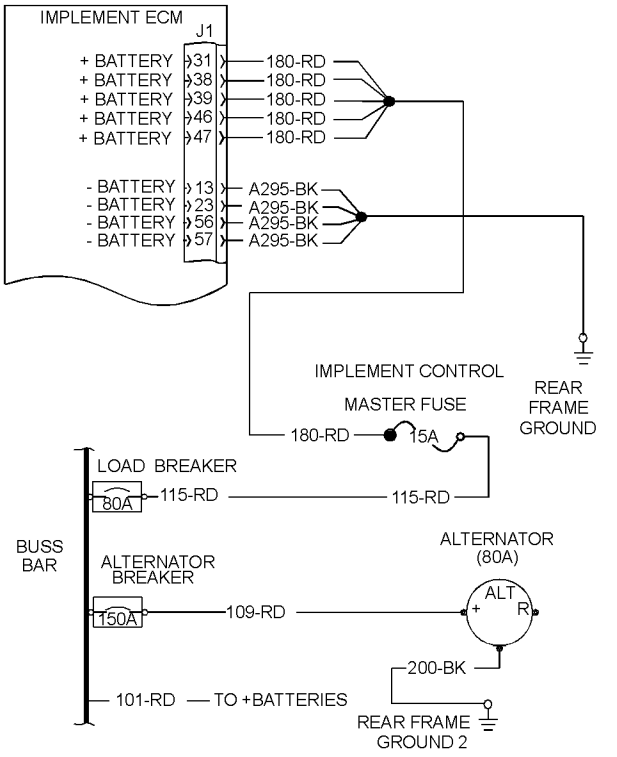


Illustration 185 g01284928

System voltage connections

This diagnostic code is associated with the system voltage of the machine that is supplied to the ECM. The FMI 03 diagnostic code means that the ECM has detected that the system voltage is above normal. The ECM activates this diagnostic code when the system voltage is above 32 VDC.

The possible causes of this diagnostic code are listed below:

- A charging system component has failed
- The harness wiring has failed
- The ECM has failed, however ECM failure is unlikely

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE VOLTAGE AT THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Perform the following with a multimeter:

a. Insert a 7X-1710 Multimeter Probe along the power contact of the J1 harness connector for the Implement ECM. The wire at the power contact is the J1-31 wire (180-RD(Red)).

b. Use the other multimeter probe to make contact to frame ground.

C. Turn the disconnect switch to the ON position.

D. Start the engine and run the engine at half throttle.

E. Measure the voltage between contact J1-31 wire (180-RD(Red)) and frame ground.

F. Insert the 7X-1710 Multimeter Probe along the negative battery contact at the J1 harness connector for the Implement ECM. The wire at the negative battery contact is J1-13 wire (A295-BK(Black)).

G. Measure the voltage between contact J1-31 wire (180-RD(Red)) and contact J1-13 wire (A295-BK(Black)).

Expected Result:

Both voltages are in the range of 18 VDC to 32 VDC.

Results:

- OK – Both voltages are in the range of 18 VDC to 32 VDC. The system voltage is correct.Proceed to Test Step 5.
- NOT OK – Each voltage is identical. However, the measurements are greater than 32 VDC. The system voltage is above normal.Proceed to Test Step 3.
- NOT OK – The measurement from the positive battery contact to frame ground is in the range of 18 VDC to 32 VDC. However, the measurement between the positive battery contact of the ECM and the negative battery contact of the ECM is not in the correct range. The ground circuit may have failed.Proceed to Test Step 2.

Test Step 2. CHECK THE GROUND CIRCUITS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness J1 connector from the ECM.

C. At the J1 harness connector for the ECM, measure the resistance between each of the four negative battery contacts and frame ground. The contacts for the negative battery connections are illustrated in the connection diagram at the beginning of this procedure.

Expected Result:

Each resistance measurement is less than 5 ohms.

Results:

- OK – Each resistance measurement is less than 5 ohms. The ground circuit is correct. Reconnect the J1 machine harness connector to the ECM before proceeding to the next test step.Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is greater than 5 ohms. There is an open circuit or a poor connection in the ground circuit.

  Repair: The open or the possible poor connection is in the ground wire of the ECM . The wire is (A295-BK(Black)) in the machine harness. Refer to the Electrical Schematic of the machine. Check the rear frame ground at wire (A295-BK(Black)). Verify the following:

  - The ground connection is clean
  - The ground connection is tight
  - The ground connection is in good condition

  Check all of the connectors and splice points that are in the ground circuit. Verify the following:

  - All connections are clean
  - All connections are secure
  - All connections are in good condition

  Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE CURRENT OUTPUT OF THE ALTERNATOR

A. Before performing this test step, partially discharge the batteries. Perform one of the following in order to discharge the batteries:

- Crank the engine for approximately 30 seconds without starting the engine

- Turn on the lights for 10 minutes with the engine off

B. Turn the disconnect switch and the key start switch to the OFF position.

C. Connect one multimeter probe to the “B” terminal of the alternator and connect one multimeter probe to the case of the alternator. Wire 109-RD(Red) is connected to the “B” terminal of the alternator and the case of the alternator is a frame ground.

D. Connect a clamp on 225-8266 Ammeter Tool Gp or an equivalent around the output wire (109-RD(Red)).

E. Turn the disconnect switch to the ON position.

F. Start the engine.

G. Run the engine at approximately half throttle.

H. Immediately check the output current of the alternator.

Expected Result:

The full current output rating of the alternator is 80 amp. The output current of the alternator at half throttle is approximately 40 amp.

Results:

- YES – The output current of the alternator at half throttle is approximately 40 amp. Proceed to Test Step 4.
- NO – The output current of the alternator at half throttle is not approximately 40 amp. The current output of the alternator is not correct.

  Repair: Refer to Service Manual, SENR4130 for brushless alternators for further testing and repair procedures for the alternator.

  STOP.

Test Step 4. CHECK THE VOLTAGE OUTPUT OF THE ALTERNATOR

The multimeter and the ammeter are still connected from the last test step. The engine is running.

A. Run the engine for approximately 10 minutes at half throttle.

B. Check the voltage at the “B” terminal of the alternator.

Expected Result:

The voltage measurement is 28 ± 1 VDC.

Results:

- YES – The voltage measurement is 28 ± 1 VDC. The voltage output of the alternator is correct. Proceed to Test Step 5.
- NO – The voltage is greater than 32 VDC.

  Repair: Refer to the Electrical Schematic for your machine. Check all connections that are in the charging circuit. Verify the following:

  - All ground connections are clean
  - All ground connections are tight
  - All ground connections are in good condition

  If a problem is not found, refer to Service Manual, SENR4130 for further testing and repair procedures for the alternator.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Reconnect any harness connectors that were disconnected and checked.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 0168 - FMI 03 diagnostic code is active.

Expected Result:

The CID CID 0168 - FMI 03 diagnostic code is active.

Results:

- YES – The CID 0168 - FMI 03 diagnostic code is active.

  Repair: Perform this procedure again. Verify the following:

  - The voltages of the alternator are correct
  - The circuit connections are in good condition
  - The circuit connections are tight

  If the problem remains and no cause can be found, the ECM may have failed.

An ECM failure is unlikely. Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 0168 - FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i04831782

MID 082 - CID 0168 - FMI 04

SMCS Code: 1406-038

Conditions Which Generate This Code:

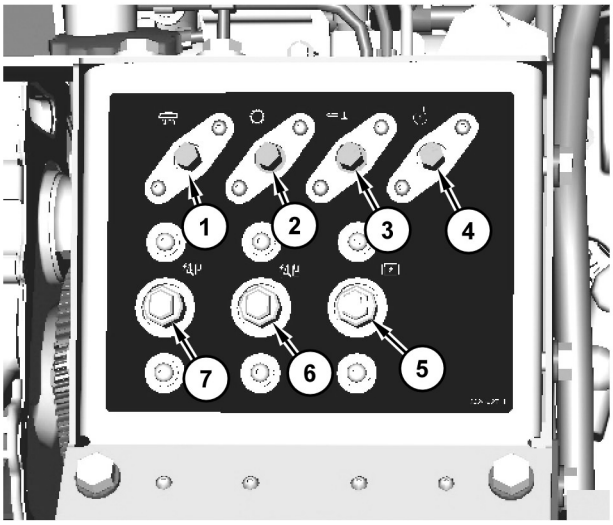


Illustration 186 g01323933

The circuit breaker box is located on left side of machine behind the cab.

(1) Accugrade breaker (20 Amp)
(2) Transmission control breaker (15 Amp)
(3) Key switch breaker (15 Amp)
(4) Engine control breaker (20 Amp)
(5) Alternator breaker (150 Amp)
(6) Load breaker (80 Amp)
(7) Main breaker (80 Amp)

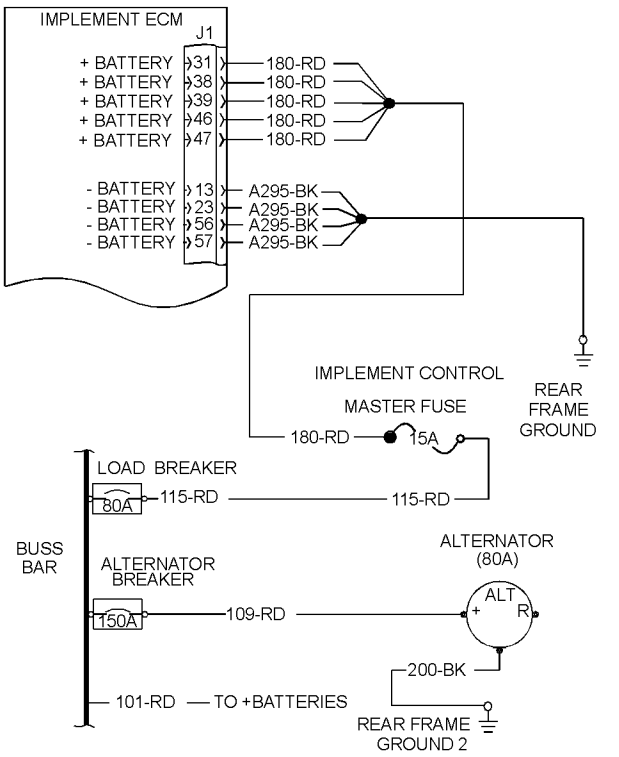


Illustration 187 g01284928

System voltage connections

This diagnostic code is associated with the system voltage of the machine that is supplied to the Implement ECM. The FMI 04 diagnostic code indicates that the ECM detects that the system voltage is below normal. The ECM activates this diagnostic code when the system voltage is below 19 VDC.

The possible causes of this diagnostic code are listed below:

- An open circuit connection or a poor system ground circuit connection
- An open circuit or a poor connection in the system voltage supply circuit
- A charging system component has failed
- The ECM has failed, however ECM failure is unlikely

Note: Before performing this procedure, verify that all circuit breakers and that all fuses in the charging circuit and the ECM system supply circuit are closed. If a problem with a circuit breaker or a fuse is found, correct the problem. Verify that this diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE SYSTEM VOLTAGE AT THE ECM

A. Turn the disconnect switch to the OFF position.

B. Turn the key start switch to the OFF position.

C. Perform the following with a multimeter:

a. Insert a 7X-1710 Multimeter Probe along the power contact of the J1 harness connector for the Implement ECM. The wire at the power contact is the J1-31 wire (180-RD(Red)).

b. Use the other multimeter probe to make contact to frame ground.

D. Turn the disconnect switch to the ON position.

E. Start the engine and run the engine at half throttle.

F. Measure the voltage between contact J1-31 wire (180-RD(Red)) and frame ground.

G. Insert the 7X-1710 Multimeter Probe along the negative battery contact at the J1 harness connector for the Implement ECM. The wire at the negative battery contact is J1-15 wire (A295-BK(Black)).

H. Measure the voltage between contact J1-31 wire (180-RD(Red)) and contact J1-15 wire (A295-BK(Black)).

Expected Result:

Both voltages are in the range of 19 VDC to 32 VDC.

Results:

- OK – Both voltages are in the range of 19 VDC to 32 VDC. The system voltage is correct.Proceed to Test Step 6.
- NOT OK – Each voltage is identical. However, the measurements are less than 19 VDC. The system voltage is below normal.Proceed to Test Step 4.
- NOT OK – The measurement from the positive contact of the battery to frame ground is in the range of 19 VDC to 32 VDC. However, the measurement between the positive battery contact of the ECM and the negative battery contact of the ECM is not in the correct range. The ground circuit may have failed.Proceed to Test Step 2.

Test Step 2. CHECK THE GROUND CIRCUIT

A. Turn the disconnect switch to the OFF position.

B. Turn the key start switch to the OFF position.

C. Disconnect the machine harness J1 connector from the ECM.

D. At the J1 harness connector for the ECM, measure the resistance between each of the four negative battery contacts and frame ground. The contacts for the negative battery connections are illustrated in the connection diagram at the beginning of this procedure.

Expected Result:

Each resistance measurement is less than 5 ohms.

Results:

- OK – Each resistance measurement is less than 5 ohms. The ground circuit is correct.Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is greater than 5.0 ohms. There is an open circuit or a poor connection in the ground circuit.

  Repair: The open or the possible poor connection is in the ground wire of the ECM. The wire is (A295-BK(Black)) in the machine harness. Refer to the Electrical Schematic of the machine. Check the rear frame ground at wire (A295-BK(Black)). Verify the following:

  - The ground connection is clean
  - The ground connection is tight
  - The ground connection is in good condition

  Check all of the connectors and splice points that are in the ground circuit. Verify the following:

  - All connections are clean
  - All connections are secure
  - All connections are in good condition

  Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SUPPLY CIRCUITS

A. Turn the disconnect switch to the OFF position.

B. Turn the key start switch to the OFF position.

C. Disconnect the machine harness J1 connector from the ECM.

D. At the J1 harness connector for the ECM, measure the resistance between the “B” terminal of the alternator wire (109-RD(Red)) with a length of spare wire to each of the five positive contacts of the battery that are connected to the J1 harness connector. The contacts for the five positive battery connections are illustrated in the connection diagram at the beginning of this procedure.

Expected Result:

Each resistance measurement is less than 5 ohms.

Results:

- OK – Each resistance measurement is less than 5 ohms. The supply circuit is correct. Reconnect the J1 machine harness connector to the ECM before proceeding to the next test step.Proceed to Test Step 4.
- NOT OK – One or more of the resistance measurements is greater than 5 ohms. There is an open circuit or a poor connection in the supply circuit.

  Repair: The open or the possible poor connection is in the system voltage circuit of the ECM. The wire is (180-RD(Red)) in the machine harness. Verify the following:

  - No open circuit breakers in the circuit
  - No fuses in the circuit

  Refer to the Electrical Schematic of the machine. Check all of the connectors and splice points that are in the supply circuit. Verify the following:

  - All connections are clean
  - All connections are secure
  - All connections are in good condition

  Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE CURRENT OUTPUT OF THE ALTERNATOR

A. Before performing this test step, partially discharge the batteries. Perform one of the following in order to discharge the batteries:

- Crank the engine for approximately 30 seconds without starting the engine
- Turn on the lights for 10 minutes with the engine off

B. Turn the disconnect switch to the OFF position.

C. Turn the key start switch to the OFF position.

D. Connect one multimeter probe to the “B” terminal of the alternator and connect one multimeter probe to the case of the alternator. Wire (109-RD(Red)) is connected to the “B” terminal of the alternator and the case of the alternator is a frame ground.

E. Connect a clamp on 225 - 8266 Ammeter Tool Gp or an equivalent around the output wire 109-RD(Red).

F. Turn the disconnect switch to the ON position.

G. Start the engine.

H. Run the engine at approximately half throttle.

I. Immediately check the output current of the alternator.

Expected Result:

The full current output rating of the alternator is 80 amp. The output current of the alternator at half throttle is approximately 40 amp.

Results:

- YES – The output current of the alternator at half throttle is approximately 40 amp.Proceed to Test Step 5.
- NO – The output current of the alternator at half throttle is not approximately 40 amp. The current output of the alternator is not correct.

  Repair: Refer to Service Manual, SENR4130 for brushless alternators for further testing and repair procedures for the alternator.

  STOP.

Test Step 5. CHECK THE VOLTAGE OUTPUT OF THE ALTERNATOR

The multimeter and the ammeter are still connected from the last test step. The engine is running.

A. Run the engine for approximately 10 minutes at half throttle.

B. Check the voltage at the “B” terminal of the alternator.

Expected Result:

The voltage measurement is 28 ± 1 VDC.

Results:

- YES – The voltage measurement is 28 ± 1 VDC. The voltage output of the alternator is correct. Proceed to Test Step 6.

- NO – The voltage is less than 19 VDC.

  Repair: Refer to the Electrical Schematic for your machine. Check all connections that are in the charging circuit. Verify the following:

  - All ground connections are clean
  - All ground connections are tight
  - All ground connections are in good condition

  If a problem is not found, refer to Service Manual, SENR4130 for further testing and repair procedures for the alternator.

  STOP.

Test Step 6. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch to the OFF position.

B. Turn the key start switch to the OFF position.

C. Reconnect any harness connectors that were disconnected and checked.

D. Turn the disconnect switch to the ON position.

E. Turn the key start switch to the ON position.

F. Operate the machine.

G. Determine if the CID 0168 - FMI 04 diagnostic code is active.

Expected Result:

The CID 0168 - FMI 04 diagnostic code is active.

Results:

- YES – The CID 0168 - FMI 04 diagnostic code is active.

  Repair: Perform this procedure again. Verify the following:

  - The voltages of the alternator are correct
  - The circuit connections are in good condition
  - The circuit connections are tight

  If the problem remains and no cause can be found, the ECM may have failed. However, ECM failure is unlikely. Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0168 - FMI 04 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i05325655

MID 082 - CID 0246 - FMI 09

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

Proprietary CAN Data Link - Abnormal Update Rate

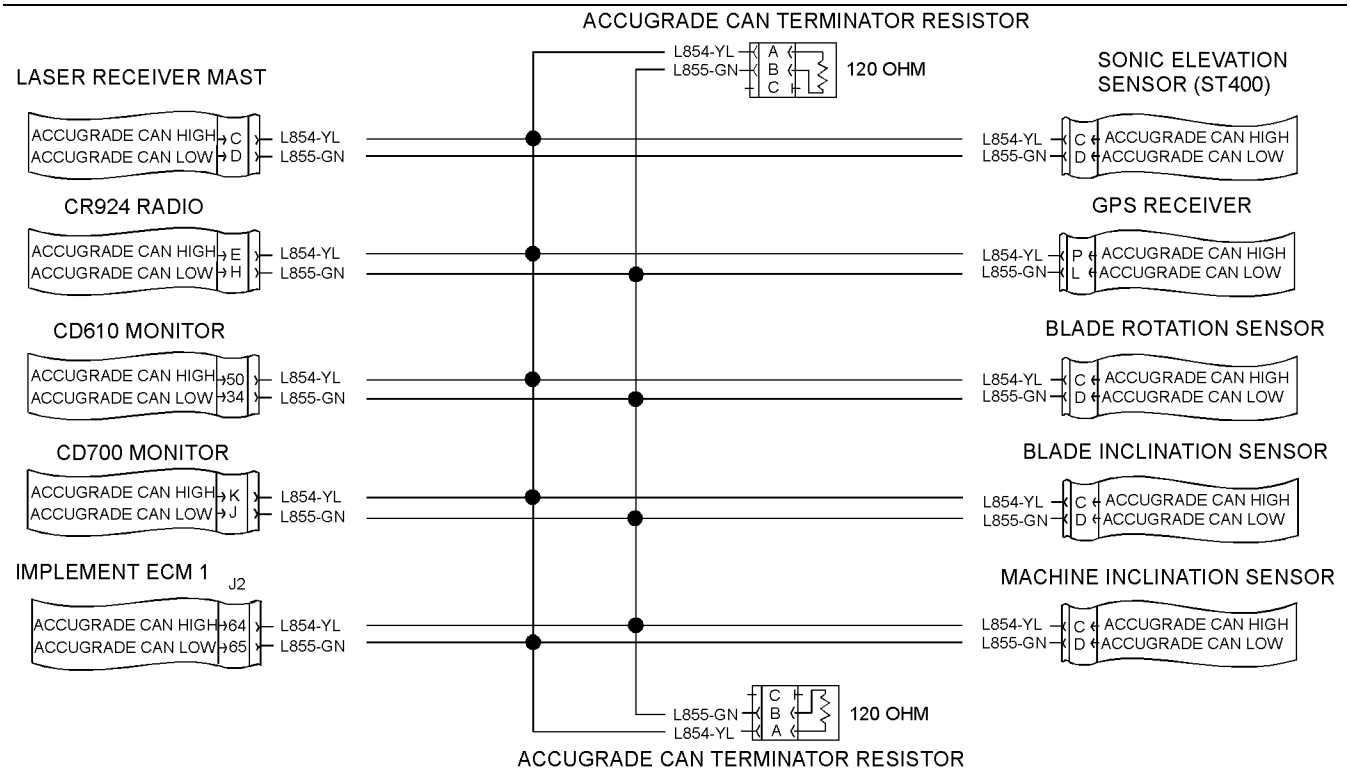


Illustration 188 g03365773

AccuGrade CAN Data Link

The CID 246 - FMI 9 diagnostic code is used by the Implement ECM to indicate that the proprietary CAN data link has an abnormal condition. This proprietary CAN data link is also referred to as the AccuGrade CAN data link.

The possible causes of this diagnostic code are:

- Poor electrical connection in the machine harness (likely between the three sensors and the Implement ECM)
- The CAN data link circuit in the machine harness is open.
- A terminal resister is faulty.
- A circuit in the AccuGrade CAN data link is shorted to ground.*
- The CAN data link circuit in the machine harness is shorted to the +battery circuit.*

Note: * This condition would most likely cause other CAN data link faults to be activated.

System Response:

Machine components that directly communicate on the AccuGrade CAN Data Link will be unavailable.

Troubleshooting:

Before troubleshooting, cycle the power to the system. Use the monitor display or Caterpillar Electronic Technician (Cat® ET) to see that all the required components are shown as “Connected” and that the 246-9 diagnostic code is still active. Perform the following procedure only when the 246-9 diagnostic code is active.

Note: Ensure that the correct software (ECM flash file) is being used.

Test Step 1. Inspect the harness connectors on the AccuGrade CAN Data Link

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Refer to the complete machine Electrical System Schematic for your machine. Inspect the connections that are involved in the CAN data link circuit. Concentrate on the AccuGrade sensor connectors.

C. Ensure that all connections are clean, secure and in good condition.

Note: Suspect the datalink connections from the Implement #1 ECM to the Blade Slope, Main Fall, and Rotation sensors first.

Note: Refer to Testing and Adjusting, “Electrical Connector - Inspect” in this manual.

Expected Result:

The machine harness connections are correct.

Results:

- OK – The machine harness connections are correct.Proceed to Test Step 3.
- NOT OK – One or more of the machine harness connections are not correct.

  Repair: Repair or replace any bad contacts, connectors, or wires that are not in good condition in the machine harness.

  STOP.

Test Step 2. Check for an Open AccuGrade CAN Harness

A. The key start switch and the disconnect switch remain in the OFF position.

B. All related control modules remain disconnected from the machine harness.

C. At the machine harness connector J2 for the Implement ECM, measure the resistance from all AccuGrade CAN data link Implement ECM contacts (high and low) to the corresponding connections at each of the AccuGrade components.

Expected Result:

The resistance measurements for each of the AccuGrade CAN circuits (high and low) are less than 5 ohms.

Results:

- OK – The resistance measurements for each of the CAN circuits (high and low) are less than 5 ohms.

  Repair: The CAN data link circuit in the machine harness is correct.
  Proceed to Test Step 8.
- NOT OK – The resistance measurements for one or more of the AccuGrade CAN circuits (high and low) are greater than 5000 ohms.

  Repair: The AccuGrade CAN circuit is open in the harness or the CAN wires have been interchanged in the circuit. Refer to the complete machine Electrical System Schematic. Examine all connections in the switch circuit. Repair or replace the machine harness.

  STOP.

Test Step 3. Check the Resistance of the AccuGrade CAN Data Link Circuit

A. Place the key start switch and the disconnect switch in the OFF position.

B. Take the following measurement at the connector of one the sensors that are on the AccuGrade CAN network. Measure the resistance between contact C wire (L854-YL(Yellow)) and contact D wire (L855-GN(Green)).

Expected Result:

The resistance measurement is 60 ± 6 ohms.

Results:

- OK – The resistance measurement is 60 ± 6 ohms.Proceed to Test Step 5.
- NOT OK – The resistance measurement is NOT 60 ± 6 ohms.Terminator resistors suspect, proceed to Test Step 4.

Test Step 4. Check the Terminator Resistors on the AccuGrade CAN Data Link

The key start switch and the disconnect switch remain in the OFF position.

A. Locate and disconnect the 3-pin connector for both of the terminator resistors.

Refer to the complete machine Electrical System Schematic for your machine for the location of the resistors.

B. Measure the resistance across contact A and contact B for one resistor. Measure the resistance across contact A and contact B for the other resistor. Note the resistance.

Expected Result:

The terminator resistance measurement is 120 ± 12 ohms.

Results:

- OK – The resistance measurements are 120 ± 12 ohms. Reconnect the resistors.Proceed to Test Step 5.
- NOT OK – One or both resistance measurements is NOT 120 ± 12 ohms.

  Repair: Replace the terminator resistor that did not measure 120 ± 12 ohms.

  STOP.

Test Step 5. Check the AccuGrade CAN Circuit for a Short to Ground

A. The key start switch and the disconnect switch remain in the OFF position.

B. Measure the resistance between contact C wire (L854-YL(Yellow)) and frame ground. Measure the resistance between contact D wire (L855-GN(Green)) and frame ground. Note the resistance.

Expected Result:

The resistance measurements are greater than 5000 ohms.

Results:

- OK – The resistance measurements are greater than 5000 ohms. Proceed to Test Step 6.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short to a ground source in the machine harness.

  Repair: The AccuGrade CAN circuit is shorted to frame ground. Refer to the complete Machine Electrical System Schematic for your machine. Examine all of the CAN data link circuit connections for the faulty circuit. Check for locations where the machine harness is contacting the machine frame. Repair or replace the machine harness.

  STOP.

Test Step 6. Check the AccuGrade CAN Circuit for a Short To + Battery

A. Turn the disconnect switch and the key start switch to the ON position.

B. Measure the voltage between contact C wire (L854-YL(Yellow)) and frame ground. Measure the voltage between contact D (L855-GN(Green)) and frame ground. Note the voltage.

Expected Result:

The voltage measurements are approximately 2.5 VDC.

Results:

- OK – The voltage measurements are approximately 2.5 VDC. Proceed to Test Step 7.
- NOT OK – One or both voltage measurements are greater than 5 V.

  Repair: The CAN circuit is shorted to “+” Battery. Repair the harness or replace the harness.

  STOP.

Test Step 7. Check the AccuGrade CAN Circuit for Failed Components

Note: Ensure that the diagnostic for the missing component is active prior to performing this step.

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the following components from the system one at a time. After each component has been disconnected, check the monitor display or Cat ET to verify that the correct components are connected.

Note: Suspect the Blade Slope, Main Fall, and Rotation sensors first.

- Blade Slope Sensor
- Main Fall Sensor
- Rotation Sensor
- Sonic Tracer (If Equipped)
- Electric Mast (If Equipped)
- Laser Receiver (If Equipped)
- GPS Receiver (If Equipped)
- AccuGrade Radio (If Equipped)
- Implement ECM

Expected Result:

Removing one of the system components will cause the “diagnostic” screen to show all connected components.

Results:

- Yes – removing one of the system components will cause the “diagnostic” screen to show all connected components.

  Repair: The last component that was removed from the system has failed. Replace the last component that was removed from the circuit.

  STOP.

- No – Removing one of the system components did not cause the “diagnostic” screen to show all connected components.Proceed to Test Step 2.

Test Step 8. Check the Status of the Diagnostic Code

A. Reconnect all disconnected harness connectors.

Before securing the connectors, inspect and clean the contacts of the machine harness connectors.

Note: Refer to Testing and Adjusting, “Electrical Connector - Inspect” in this manual.

B. Turn the disconnect switch and the key start switch to the ON position.

C. Operate the machine.

D. Check the status of the 246-9 diagnostic code.

Expected Result:

The 246-9 diagnostic code is not active.

Results:

- OK – The 246-9 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The 246-9 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the data link circuit again. Use Cat ® ET to perform a “Wiggle Test” on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause cannot be found, the ECM may have failed. Prior to replacing an ECM, contact your dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Machine ECM. Refer to Troubleshooting, “Electronic Control Module (ECM) - Replace” in this manual.

  STOP.

i05299638

MID 082 - CID 0246 - FMI 14

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

(Proprietary CAN Data Link - Special Instruction)

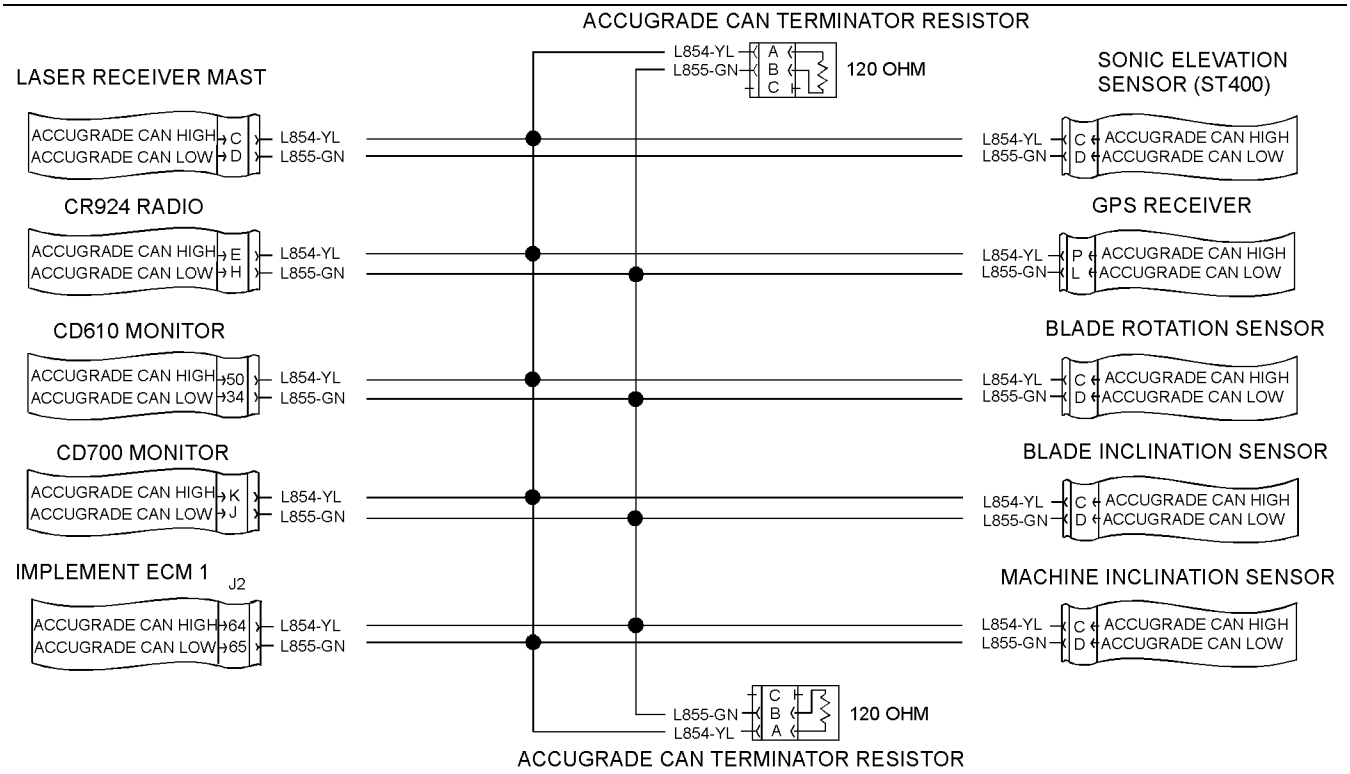


Illustration 189 g03365773

The 246-14 diagnostic code is used by the Implement ECM as a “companion code” that is activated simultaneously with a diagnostic code from another ECM to indicate that the Accugrade CAN Data Link has an abnormal condition.

The FMI 14 will match the FMI 14 that is activated for the diagnostic code from the control module. The FMI 14 means that the Implement ECM is communicating with the other control module. However, the Implement ECM is not receiving all of the expected information from the other control module.

The 246-14 diagnostic code will never be activated by the Implement ECM as a stand-alone diagnostic code. The Implement ECM will only activate the 246-14 diagnostic code along with one of the following module communication codes:

CID 296 FMI 14 – Transmission/Chassis ECM

CID 588 FMI 14 – Monitoring System

CID 590 FMI 14 – Engine ECM

For example, if the Implement ECM detects that some expected operating parameter information is not being received from the Transmission/Chassis ECM over the Accugrade CAN Data Link, the Implement ECM will simultaneously activate a 296-14 (Transmission/Chassis ECM) diagnostic code and a 246-14 (Accugrade CAN Data Link) diagnostic code.

If the Implement ECM did not activate the 246-14 code along with another ECM code, the technician would not know which data link is involved.

When the 246-14 code is activated by the Implement ECM, always look for one of the ECM diagnostic codes listed above and troubleshoot the problem.

Perform the following procedure when the CID 0246 FMI 14 diagnostic code is activated. Verify that the 246-14 diagnostic code is active before performing this procedure.

A. The 246-14 diagnostic code for the Accugrade CAN Data Link is active. Look for one of the diagnostic codes from the active control module that is listed at the beginning of this procedure.

Expected Result:

One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

Results:

- YES – One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

  Repair: Go to the troubleshooting procedure for the active control module diagnostic code.

Perform the troubleshooting procedure for the Accugrade CAN Data Link circuit that is detailed for the control module in order to isolate the problem.

STOP.

i05317579

MID 082 - CID 0247 - FMI 09

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

(SAE J1939 (CAN) Data Link - Abnormal Update Rate)

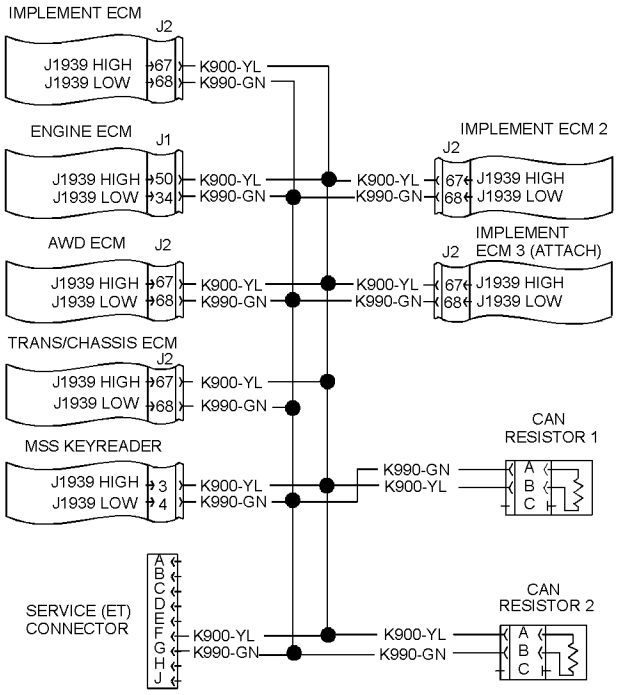


Illustration 190 g03370098

CAN Data Link Connections

The CID 247 - FMI 9 diagnostic code is used by the Implement ECM as a “companion code” . This 247-9 code is activated simultaneously with another ECM diagnostic code to indicate that the **SAE J1939 CAN Data Link** has an abnormal condition.

The FMI 9 will match the FMI 9 that is activated for the ECM diagnostic code. FMI 9 (Abnormal Update Rate) indicates that the Implement ECM has lost all communication with the other ECM.

The 247-9 diagnostic code will never be activated by the Implement ECM as a stand-alone diagnostic code. The Implement ECM will only activate the 247-9 diagnostic code along with one of the following module communication codes:

CID 296 - FMI 9 – Transmission/Chassis ECM

CID 590 - FMI 9 – Engine ECM

CID 1558 - FMI 9 – Implement ECM 2

CID 2143 - FMI 9 – Implement ECM 3

For example, if the Implement ECM detects that no communication is being received from the Transmission/Chassis ECM over the SAE J1939 CAN Data Link, the Implement ECM will simultaneously activate a 296-9 (Transmission/ Chassis ECM) diagnostic code and a 247-9 (SAE J1939 CAN Data Link) diagnostic code.

If the Implement ECM did not activate the companion code 247-9 along with the control module code, the technician would not know which data link circuit (Cat CAN Data Link or J1939 CAN Data Link) is involved.

When the 247-9 code is activated by the Implement ECM, always look for one of the ECM codes that are listed above and troubleshoot that problem.

Perform the following procedure when the 247-9 diagnostic code is activated. Verify that the 247-9 diagnostic code is active before performing this procedure.

A. The 247-9 diagnostic code for the SAE J1939 CAN Data Link is active. Look for one of the active diagnostic codes, associated with the control module, that are listed at the beginning of this procedure.

Expected Result:

One of the control module diagnostic codes that are listed at the beginning of this procedure is active.

Results:

- YES – One of the control module diagnostic codes that is listed at the beginning of this procedure is active.

  Repair: Go to the troubleshooting procedure for the active control module CID FMI diagnostic code. Perform the troubleshooting procedure for the SAE J1939 CAN Data Link circuit that is detailed for the control module in order to isolate the problem.

  STOP.

i05317417

MID 082 - CID 0247 - FMI 14

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

(SAE J1939 (CAN) Data Link - Special Instruction)

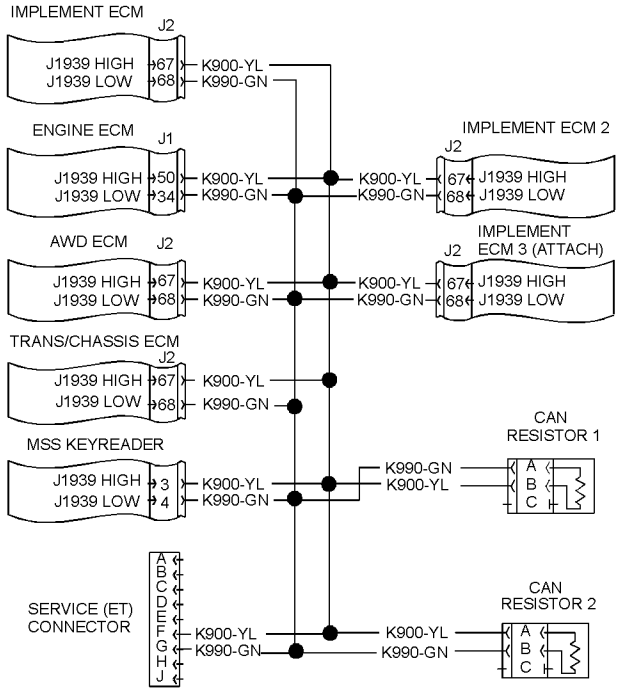


Illustration 191 g03370098

CAN Data Link Connections

The CID 247 FMI 14 diagnostic code is used by the Implement ECM as a “companion code” . This 247-14 code is activated simultaneously with another ECM code, indicating that the **SAE J1939 CAN Data Link** has an abnormal condition.

The FMI 14 will match the FMI 14 that is activated for the diagnostic code of the control module. FMI 14 (Special Instruction) means that the Implement ECM is not receiving expected information from another ECM.

The 247-14 diagnostic code will never be activated by the Implement ECM as a stand-alone diagnostic code. The Implement ECM will only activate the 247-14 diagnostic code along with one of the following module communication codes:

CID 0296 FMI 14 – Transmission/Chassis ECM

CID 0590 FMI 14 – Engine ECM

Example: If the Implement ECM detects that some expected operating parameter information is not being received from the Transmission/Chassis ECM over the SAE J1939 Data Link, the Implement ECM will simultaneously activate a 296-14 (Transmission/Chassis ECM) diagnostic code and a 247-14 (SAE J1939 CAN Data Link) diagnostic code.

If the Implement ECM did not activate the 247-14 code along with the ECM code, the technician would not know if the (Cat Data Link or J1939 CAN Data Link) is involved.

When the 247-14 code is activated by the Implement ECM, always look for one of the ECM codes that are listed above and troubleshoot that problem.

Perform the following procedure when the 247-14 diagnostic code is activated. Verify that the 247-14 diagnostic code is active before performing this procedure.

A. The 247-14 diagnostic code for the SAE J1939 CAN Data Link is active. Look for one of the diagnostic codes from the active control module that is listed at the beginning of this procedure.

Expected Result:

One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

Results:

- YES – One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

  Repair: Go to the troubleshooting procedure for the active control module CID FMI diagnostic code. Perform the troubleshooting procedure for the SAE J1939 CAN Data Link circuit that is detailed for the control module in order to isolate the problem.

  STOP.

i02857589

MID 082 - CID 0248 - FMI 09

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

CAT DATA LINK

The CID 0248 FMI 09 diagnostic code is used by the Implement ECM as a “companion code” that is activated simultaneously with another diagnostic code from a control module in order to indicate that the Cat Data Link has an abnormal condition.

The FMI 09 will match the FMI 09 that is activated for the diagnostic code from the control module. The FMI 09 means that the Implement ECM has lost all communication with the other control module.

The CID 0248 FMI 09 diagnostic code will never be activated by the Implement ECM as a stand-alone diagnostic code. The Implement ECM will only activate the CID 0248 FMI 09 diagnostic code along with one of the following module communication codes:

CID 0296 FMI 09 – Transmission/Chassis ECM

CID 0588 FMI 09 – Monitoring System

CID 0590 FMI 09 – Engine ECM

CID 1558 FMI 09 – Implement ECM 2

CID 2143 FMI 09 – Implement ECM 3

For example, if the Implement ECM detects that no communication is being received from the Transmission/Chassis ECM over the Cat Data Link, the Implement ECM will simultaneously activate a CID 0296 FMI 09 (Transmission/Chassis ECM) diagnostic code and a CID 0248 FMI 09 (Cat Data Link) diagnostic code.

If the Implement ECM did not activate the companion code CID 0248 FMI 09 along with the control module code, the technician would not know which data link circuit (Cat Data Link or J1939 Data Link) is involved.

When the CID 0248 FMI 09 diagnostic code is activated by the Implement ECM, always look for one of the diagnostic codes from the control module that are listed above in order to troubleshoot the problem.

Perform the following procedure when the CID 0248 FMI 09 diagnostic code is activated. Verify that the CID 0248 FMI 09 diagnostic code is active before performing this procedure.

A. The CID 0248 FMI 09 diagnostic code for the Cat Data Link is active. Look for one of the active diagnostic codes from the control module that is listed at the beginning of this procedure.

Expected Result:

One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

Results:

- YES – One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

  Repair: Go to the troubleshooting procedure for the active control module CID FMI diagnostic code. Perform the troubleshooting procedure for the Cat Data Link circuit that is detailed for the control module in order to isolate the problem.

  STOP.

i02954433

MID 082 - CID 0248 - FMI 14

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

CAT DATA LINK

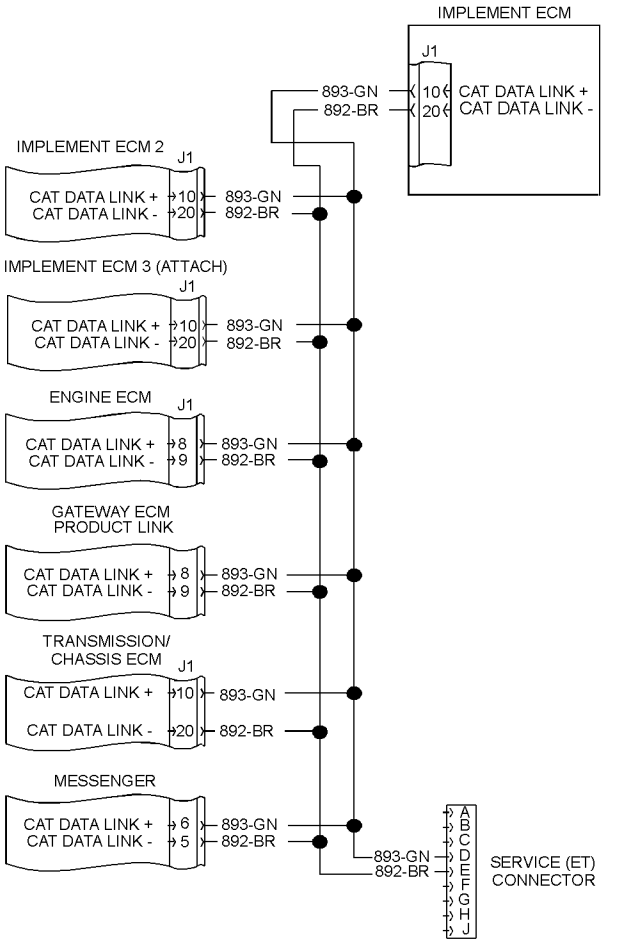


Illustration 192 g01243564

Cat Data Link connections

The CID 0248 FMI 14 diagnostic code is used by the Implement ECM as a “companion code” that is activated simultaneously with a diagnostic code from another control module in order to indicate that the Cat Data Link has an abnormal condition.

The FMI 14 will match the FMI 14 that is activated for the diagnostic code from the control module. The FMI 14 means that the Implement ECM is communicating with the other control module. However, the Implement ECM is not receiving all of the expected information from the other control module.

The CID 0248 FMI 14 diagnostic code will never be activated by the Implement ECM as a stand-alone diagnostic code. The Implement ECM will only activate the CID 0248 FMI 14 diagnostic code along with one of the following module communication codes:

CID 0296 FMI 14 – Transmission/Chassis ECM

CID 0588 FMI 14 – Monitoring System

CID 0590 FMI 14 – Engine ECM

For example, if the Implement ECM detects that some expected operating parameter information is not being received from the Transmission/Chassis ECM over the Cat Data Link, the Implement ECM will simultaneously activate a CID 0296 FMI 14 (Transmission/Chassis ECM) diagnostic code and a CID 0248 FMI 14 (Cat Data Link) diagnostic code.

If the Implement ECM did not activate the companion diagnostic code CID 0248 FMI 14 along with the control module code, the technician would not know which data link circuit (Cat Data Link or J1939 Data Link) is involved.

When the CID 0248 FMI 14 diagnostic code is activated by the Implement ECM, always look for one of the control module diagnostic codes that are listed above in order to troubleshoot the problem.

Perform the following procedure when the CID 0248 FMI 14 diagnostic code is activated. Verify that the CID 0248 FMI 14 diagnostic code is active before performing this procedure.

A. The CID 0248 FMI 14 diagnostic code for the Cat Data Link is active. Look for one of the diagnostic codes from the active control module that is listed at the beginning of this procedure.

Expected Result:

One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

Results:

- YES – One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

  Repair: Go to the troubleshooting procedure for the active control module CID FMI diagnostic code. Perform the troubleshooting procedure for the Cat Data Link circuit that is detailed for the control module in order to isolate the problem.

  STOP.

i02857788

MID 082 - CID 0262 - FMI 03

SMCS Code: 1439-038

Conditions Which Generate This Code:

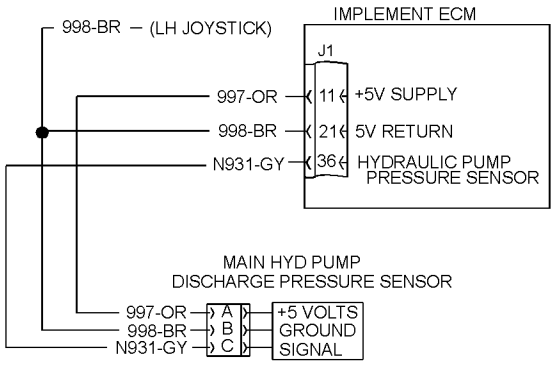


Illustration 193 g01254820

5 VDC Power Supply connections

This diagnostic code is associated the ECM 5 volt power supply. The 5 volt power supply provides power for the main hydraulic pump discharge pressure sensor.

The CID 0262 FMI 03 diagnostic code is activated when the ECM detects that the voltage of the 5 volt power supply circuit is higher than normal.

The following conditions could cause this diagnostic code:

- The power supply circuit is shorted to a higher voltage source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE VOLTAGE AT THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector from the main hydraulic pump discharge pressure sensor.

C. At the machine harness connector for the sensor, measure the voltage from contact A (wire 997-OR(Orange)) to contact B (wire 998-BR(Brown)).

Expected Result:

The voltage measurement is 5.0 ± 0.5 DCV.

Results:

- OK – The voltage measurement is 5.0 ± 0.5 DCV. The voltage is correct. Proceed to Test Step 4.
- NOT OK – The voltage measurement is greater than 5.0 ± 0.5 DCV. The measurement is not correct.Proceed to Test Step 2.

Test Step 2. CHECK THE POWER SUPPLY AT THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At ECM connector J1, use a 151-6320 Removal Tool to remove the supply wire and the socket at contact J1-11 (wire 997-OR(Orange)) and the return wire and socket at contact J1-21 (wire 998-BR(Brown)) from the connector. The machine harness connector J1 remains connected to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Use the multimeter probes in order to make contact on the connector pins of the ECM. Measure the voltage at the pins of the ECM between the power contact J1-11 and the return contact J1-21.

Expected Result:

The voltage measurement is 5.0 ± 0.5 DCV.

Results:

- OK – The voltage measurement is 5.0 ± 0.5 DCV. The voltage is correct. The ECM power supply is correct. Install the wires and sockets that were removed from the J1 connector back into the original locations.Proceed to Test Step 3.
- NOT OK – The voltage measurement is greater than 5.0 ± 0.5 DCV. The ECM power supply is not correct.

  Repair: Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK FOR A SHORT CIRCUIT IN THE MACHINE HARNESS

The machine harness connector remains disconnected from the sensor.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the harness connector J1, check the resistance from contact J1-11 (wire 997-OR(Orange)) to all of the other ECM positive battery (wire 180-RD(Red)) contacts that are connected to the ECM. The contacts are J1-31, J1-38, J1-39, J1-46 and J1-47.

D. At the harness connector J1, check the resistance from contact J1-11 (wire 997-OR(Orange)) to all of the other contacts that are used in connectors J1 and J2.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The supply circuit is not shorted to another circuit in the machine harness. Proceed to Test Step 4.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The power supply circuit is shorted to a another circuit in the machine harness. Refer to the complete Electrical System Schematic of the machine. Examine the supply circuit in order to determine the location of the problem.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replacethe machine harness.

STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 0262 FMI 03 diagnostic code is active.

Expected Result:

The CID 0262 FMI 03 diagnostic code is active.

Results:

- YES – The CID 0262 FMI 03 diagnostic code is active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, replace the pressure sensor. After the sensor is replaced, perform this test step again.

  If the problem is still present after the sensor has been replaced, the ECM may be faulty. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0262 FMI 03 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02857826

MID 082 - CID 0262 - FMI 04

SMCS Code: 1439-038

Conditions Which Generate This Code:

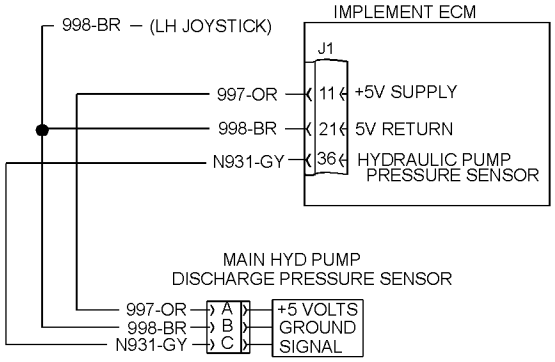


Illustration 194 g01254820

5 VDC Power Supply connections

This diagnostic code is associated the 5 volt power supply of the ECM. The 5 volt power supply provides power for the discharge pressure sensor of the main hydraulic pump .

The CID 0262 FMI 04 diagnostic code is recorded when the ECM reads the voltage of the sensor supply circuit and the voltage is below normal.

The following conditions could cause this diagnostic code:

- A sensor has failed.
- The sensor supply circuit is shorted to a ground source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the main hydraulic pump discharge pressure sensor from the machine harness.

C. After disconnecting the sensor, check the status of the CID 262 FMI 04 diagnostic code.

Expected Result:

The CID 262 FMI 04 diagnostic code is no longer active.

Results:

- OK – The diagnostic code is not active. The harness circuit is correct. The sensor that was just disconnected has failed.

  Repair: Replace the sensor. Verify that the new sensor corrected the problem before operating the machine.

  STOP.

- NOT OK – The diagnostic code is still active. The sensor is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE POWER SUPPLY AT THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At ECM connector J1, use a 151-6320 Removal Tool to remove the supply wire and the socket at contact J1-11 (wire 997-OR(Orange)) and the return wire and the socket at contact J1-21 (wire 998-BR(Brown)) from the connector. The machine harness connector J1 remains connected to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Use the multimeter probes in order to make contact on the connector pins of the ECM. Measure the voltage at the ECM pins between the contact J1-11 (power supply) and the contact J1-21 (return).

Expected Result:

The voltage measurement is 5.0 ± 0.5 DCV.

Results:

- OK – The voltage measurement is 5.0 ± 0.5 DCV. The voltage is correct. The ECM power supply is correct. Install the wires and sockets that were removed from the J1 connector back into the original locations.Proceed to Test Step 3.

- NOT OK – The voltage measurement is less than 5.0 ± 0.5 DCV. The ECM power supply is not correct.

  Repair: Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the harness connector for the ECM, measure the resistance between contact J1-11 (wire 997-OR(Orange)) and frame ground. Measure the resistance between contact J1-11 (supply) and all of the other contacts that are used in the J1 and J2 connectors of the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The harness circuit resistance is correct. Proceed to Test Step 4.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. The circuit is shorted in the machine harness.

  Repair: The power supply wire 997-OR(Orange) is shorted to ground in the machine harness. Refer to the complete Electrical System Schematic for your machine. Check all harness connectors that are in the power supply circuit. Ensure that the connectors are clean and secure.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 0262 FMI 04 diagnostic code is active.

Expected Result:

The CID 0262 FMI 04 diagnostic code is active.

Results:

- YES – The CID 0262 FMI 04 diagnostic code is active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may be activating the diagnostic code incorrectly. The ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0262 FMI 04 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02857844

MID 082 - CID 0296 - FMI 09

SMCS Code: 7610-038-DTN

Conditions Which Generate This Code:

This diagnostic code is associated with the communication between the Implement ECM and the Transmission/Chassis ECM that is conducted on the Cat Data Link circuit or the communication that is conducted over the SAE J1939 Data Link circuit.

The FMI 09 means that the Implement ECM is not receiving any communication from the Transmission/Chassis ECM on the involved data link circuit.

When this diagnostic code is activated by the Implement ECM, a “companion” diagnostic code will be activated in order to indicate which data link system is involved. The companion diagnostic code that has been activated will be either of the following diagnostic codes:

CID 0247 FMI 09 – SAE J1939 Data Link

CID 0248 FMI 09 – Cat Data Link

Determine which one of the companion diagnostic codes has been activated along with the CID 0296 FMI 09 diagnostic code to indicate which data link system is involved.

Note: When the CID 0296 FMI 09 diagnostic code is cleared, the data link companion code will also clear.

The possible causes of the CID 0296 FMI 09 diagnostic code are listed below:

- An open or a poor connection in the data link circuit
- The Transmission/Chassis ECM has failed. This is unlikely.

- The Implement ECM has failed. This is unlikely.

Note: A loss of system power to the Transmission/Chassis ECM can cause the Implement ECM to activate this diagnostic code. Ensure that the Transmission/Chassis ECM is powered up before proceeding with this procedure.

Note: Ensure that the CID 0296 FMI 09 diagnostic code is active before performing this procedure.

Test Step 1. DETERMINE WHICH DATA LINK COMPANION CODE IS ACTIVE

A. Check the list of active diagnostic codes in order to determine which of the following companion diagnostic codes is active: **CID 0247 FMI 09 - SAE J1939 Data Link CID 0248 FMI 09 - Cat Data Link**

Results:

- OK – The CID 0248 FMI 09 diagnostic code is active indicating that the problem is in the Cat Data Link.In order to perform the troubleshooting procedure for the Cat Data Link, proceed to Test Step 2.
- OK – The CID 0247 FMI 09 diagnostic code is active indicating that the problem is in the SAE J1939 Data Link.In order to perform the troubleshooting procedure for the SAE J1939 Data Link, proceed to Test Step 4.

Test Step 2. CHECK THE CAT DATA LINK CIRCUIT FOR AN OPEN

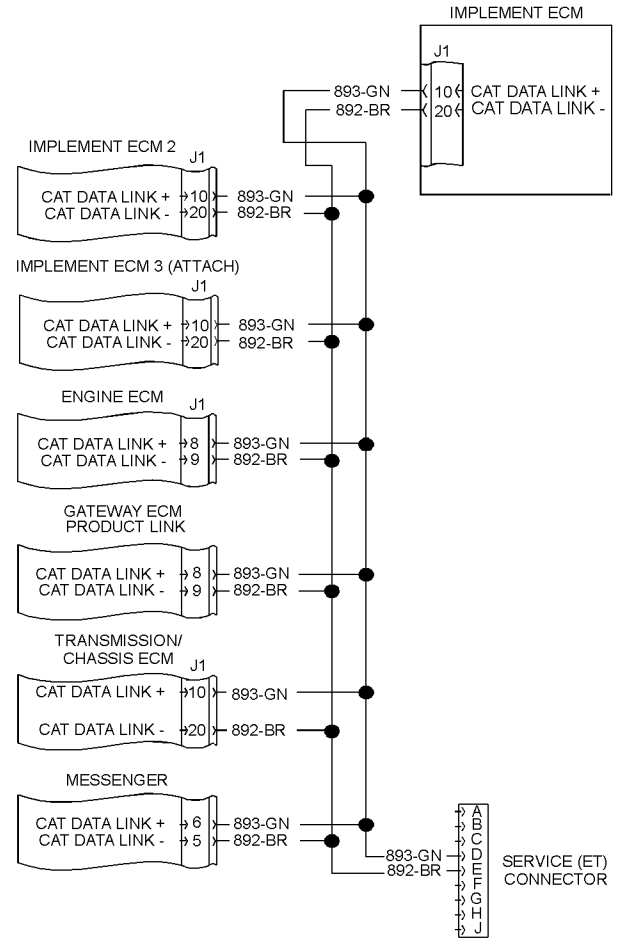


Illustration 195 g01243564

Cat Data Link connections

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM. Disconnect the machine harness connector J1 from the Transmission/ Chassis ECM.

C. Inspect the harness connectors. Clean all of the contacts of the harness connectors. Refer to the illustration above in order to check the Cat Data Link connection on each of the machine harness connectors. Ensure that the wires are secured in the connector, that the contacts are clean and that the contacts are in good condition.

D. At the disconnected harness connector J1 for the Transmission/Chassis ECM, connect a jumper wire between contact J1-10 (wire 893-GN(Green)) and contact J1-20 (wire 892-BR(Brown)).

E. At the disconnected harness connector J1 for the Implement ECM, measure the resistance between contact J1-10 (wire 893-GN(Green)) and contact J1-20 (wire 892-BR(Brown)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The Cat Data Link circuit in the machine harness is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the Cat Data Link circuit in the machine harness.

  Repair: A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the wires or one of the connection points in the circuit is not open but is not a good connection.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connections of the machine harness that are involved in the data link circuit. Check each wire section from connector to connector for an open or a bad connection. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the data link circuit.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 0296 FMI 09 diagnostic code.

Expected Result:

The CID 0296 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 0296 FMI 09 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 0296 FMI 09 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, one of the ECM modules may have failed. The ECM that activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE SAE J1939 DATA LINK CIRCUIT FOR AN OPEN

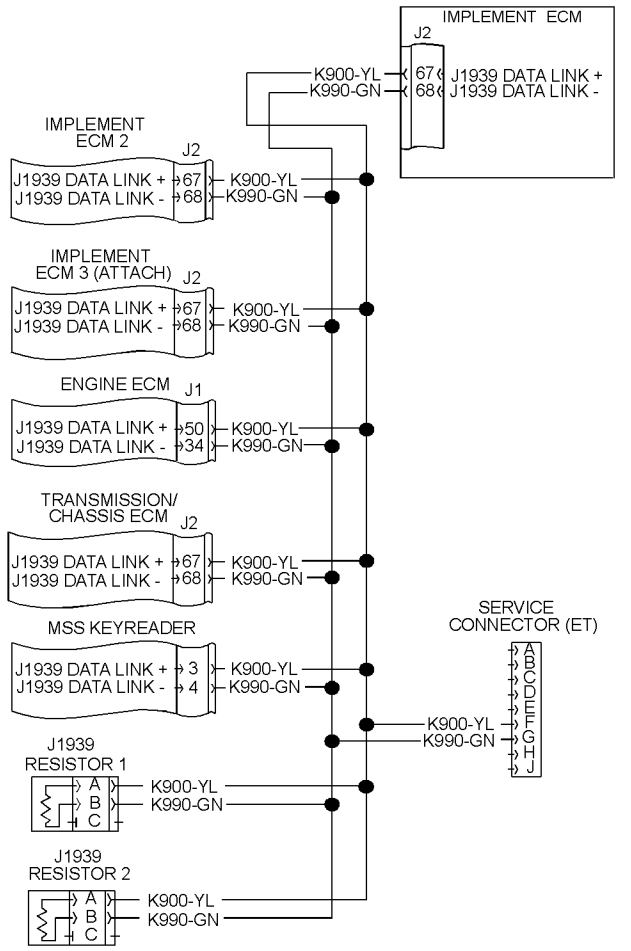


Illustration 196 g01319936

SAE J1939 Data Link Circuit connections

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J2 from the Implement ECM. Disconnect the machine harness connector J2 from the Transmission/ Chassis ECM.

C. Inspect the harness connectors. Clean all of the contacts of the harness connectors. Refer to the illustration above in order to check the SAE J1939 Data Link connection on each of the machine harness connectors. Ensure that the wires are secured in the connector, that the contacts are clean and that the contacts are in good condition.

D. At the disconnected harness connector J2 for the Transmission/Chassis ECM, connect a jumper wire between contact J2-67 (wire K900-YL(Yellow)) and contact J2-68 (wire K990-GN(Green)).

E. At the disconnected harness connector J2 for the Implement ECM, measure the resistance between contact J2-67 (wire K900-YL(Yellow)) and contact J2-68 (wire K990-GN(Green)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The SAE J1939 Data Link circuit in the machine harness is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the SAE J1939 Data Link circuit in the machine harness.

  Repair: Refer to the complete Electrical System Schematic of the machine. Examine all of the connections of the machine harness that are involved in the data link circuit. Check each wire section from connector to connector for an open or a bad connection. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the data link circuit.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 0296 FMI 09 diagnostic code.

Expected Result:

The CID 0296 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 0296 FMI 09 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably

caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

STOP.

- NOT OK – The CID 0296 FMI 09 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, one of the ECM modules may have failed. The ECM that activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02746251

MID 082 - CID 0296 - FMI 12

SMCS Code: 7610-038-DTN

Conditions Which Generate This Code:

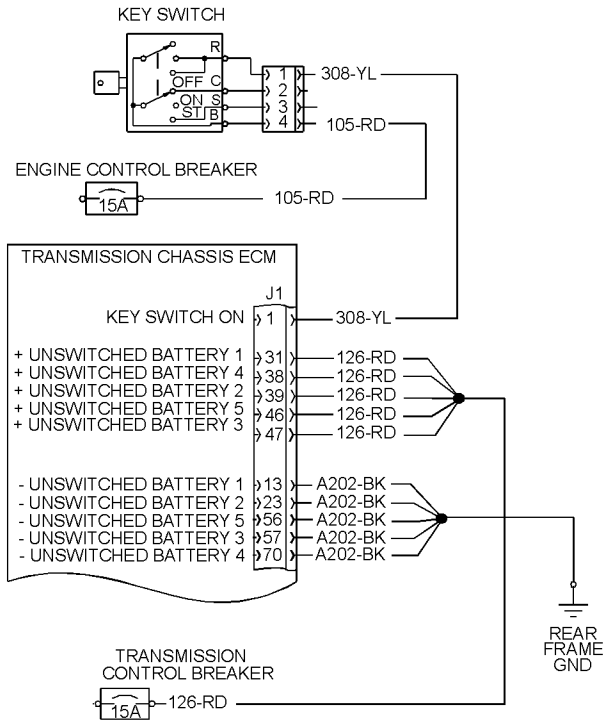


Illustration 197 g01375413

Key Switch “ON” and ECM Power connections

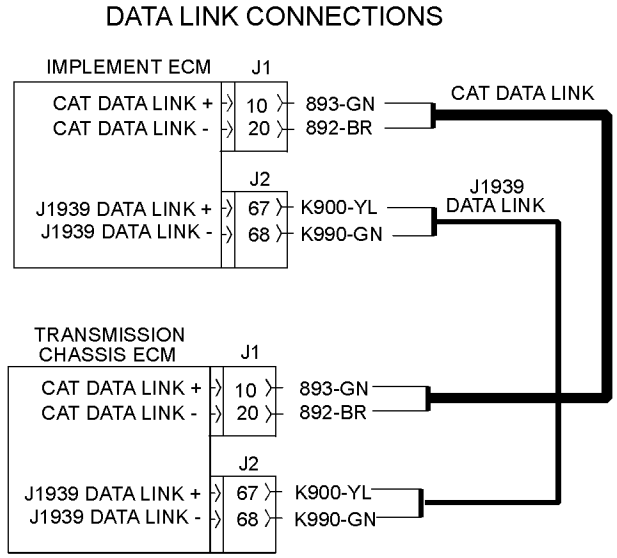


Illustration 198 g01375409

System Data Link connections

This diagnostic code is associated with the communication between the Implement ECM and the Transmission Chassis ECM that is conducted on the Cat Data Link circuit and the J1939 CAN Data Link circuit.

The FMI 12 means that the Implement ECM is not receiving expected communication from the Transmission Chassis ECM on the J1939 CAN data Link or on the CAT Data Link circuit, however, the Implement ECM is receiving expected data from the other control modules on the machine.

Specifically, the Implement ECM is NOT receiving BOTH of the following bits of information from the Transmission Chassis ECM.

- The steering lever to wheel angle alignment status information over the CAT Data Link
- The wheel based vehicle speed information from the Transmission Chassis ECM on the SAE J1939 Data Link.

The possible causes of the active CID 0296 FMI 12 diagnostic code are listed below:

- The Transmission Chassis ECM is not powered up.
- The key start switch “ON” input for the Transmission Chassis ECM is open or has a poor connection.
- An open or a poor connection in both of the data link circuits at the Transmission Chassis ECM.
- The Transmission Chassis ECM has failed.

Note: Ensure that the CID 0296 FMI 12 diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE KEY SWITCH INPUT AND ECM POWER SUPPLY

A. Turn the disconnect switch and the key switch to the ON position.

B. At the Transmission Chassis ECM connector J1, insert 7X-1710 Multimeter Probes along ground contact J1-13 (wire A202-BK(Black)) and along the key switch ON contact J1-1 (wire 308-YL(Yellow)). Measure the voltage.

C. At the Transmission Chassis ECM connector J1, remove the multimeter probe from the key switch “ON” contact J1-1 (wire 308-YL(Yellow)) and insert the probe along the +battery contact J1-31 (wire 126-RD(Red)). The other multimeter probe that is inserted along ground contact J1-13 (wire A202-BK(Black)) remains in place. Measure the voltage.

D. Repeat the last test step and measure the voltage between each of the +battery connections and the ground connections that are illustrated in the diagram at the beginning of this procedure.

Expected Result:

All of the voltage measurements are at the battery voltage level.

Results:

- OK – All of the voltage measurements are at the battery voltage level. The key switch “ON” input voltage and the ECM supply voltages are correct. Proceed to Test Step 2.
- NOT OK – One or more of the voltage measurements are NOT at the battery voltage level. There is a problem with either the key switch “ON” input voltage or the ECM supply voltage.

  Repair: If the key switch “ON” input voltage did not measure battery voltage level, there is an open or a poor connection in the input circuit between a connection point or a harness splice and the Transmission Chassis ECM.

  Turn the disconnect switch and the key switch to the OFF position.

  Refer to the complete Machine Electrical Schematic for your machine. Examine the circuit connections at each connector starting at the Transmission Chassis ECM J1 connector and working your way back through the harness connectors. Verify that each circuit connection in each connector is clean, secure and in good condition.

  While less likely than a harness connection, a splice point in the machine harness may have failed. If no other cause can be found, locate the splice points and examine them for failures. Fix the machine harness or replace the machine harness.

  A failure in one or two of the Transmission Chassis ECM supply circuits or ground circuits would most likely not cause the ECM to lose all power, however, the cause of a loss of power for any one of the supply circuits or the ground circuits must be investigated and the problem must be fixed in order for the ECM to operate correctly.

  If none of the ECM supply contacts measured battery voltage, check the Transmission Control Breaker for an open. Check the ground circuits for continuity to frame ground.

Refer to the complete Machine Electrical Schematic for your machine. Examine the +battery circuit connections and the ground at each connector starting at the Transmission Chassis ECM J1 connector and working your way back through the harness connectors. Verify that each circuit connection in each connector is clean, secure and in good condition. Fix the machine harness or replace the machine harness.

STOP.

Test Step 2. CHECK THE CAT DATA LINK CIRCUIT FOR AN OPEN

A. Turn the key switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Transmission Chassis ECM.

C. Inspect the harness connector and clean all of the contacts of the harness connector. Refer to the illustration above to check the Cat Data Link connections on the ECM harness connector. Ensure that the wires are secured in the connector, the contacts are clean and the contacts are in good condition.

D. At the disconnected harness connector J1 for the Transmission Chassis ECM, connect a jumper wire between contact J1-10 (wire 893-GN(Green)) and contact J1-20 (wire 892-BR(Brown)).

E. Disconnect the harness connector J1 from the Implement ECM. Measure the resistance between contact J1-10 (wire 893-GN(Green)) and contact J1-20 (wire 892-BR(Brown)) on the Implement ECM connector

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The Cat Data Link circuit between the Implement ECM and the Transmission Chassis ECM is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the Cat Data Link circuit in the machine harness between the Implement ECM and the Transmission Chassis ECM.

  Repair: A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the wires or one of the connection points in the circuit is not open but is not a good connection.

  Refer to the complete machine Electrical System Schematic. Starting at the Transmission Chassis ECM, locate and examine all of the machine harness connections that are involved in the data link circuit. Check each wire section from connector to connector for an open or a bad connection. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE J1939 CAN DATA LINK CIRCUIT FOR AN OPEN

The key switch and the disconnect switch remain in the OFF position.

A. Disconnect the Transmission Chassis ECM connector J2 from the machine harness.

B. At the Transmission Chassis ECM connector J2, clean all of the contacts of the harness connector. Refer to the illustration above to check the J1939 CAN Data Link connections on the ECM harness connector. Ensure that the wires are secured in the connector, the contacts are clean and the contacts are in good condition.

C. At the disconnected harness connector J2 for the Transmission Chassis ECM, connect a jumper wire between contact J2-67 (wire K900-YL(Yellow)) and contact J2-68 (wire K990-GN(Green)).

D. Disconnect the harness connector J2 from the Implement ECM. Measure the resistance between contact J2-67 (wire K900-YL(Yellow)) and contact J2-68 (wire K990-GN(Green)) on the Implement ECM connector

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The J1939 CAN Data Link circuit between the Implement ECM and the Transmission Chassis ECM is not open.Proceed to Test Step 4.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the J1939 CAN Data Link circuit in the machine harness between the Implement ECM and the Transmission Chassis ECM.

Repair: A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the wires or one of the connection points in the circuit is not open but is not a good connection.

Refer to the complete machine Electrical System Schematic. Starting at the Transmission Chassis ECM, locate and examine all of the machine harness connections that are involved in the data link circuit. Check each wire section from connector to connector for an open or a bad connection. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

B. Turn the disconnect switch and the key start switch to the ON position.

C. Check the status of the CID 0296 FMI 12 diagnostic code.

Expected Result:

The CID 0296 FMI 12 diagnostic code is not active.

Results:

- OK – The CID 0296 FMI 12 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 0296 FMI 12 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the data link circuits again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the Transmission Chassis ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Transmission Chassis ECM. Refer to Testing and Adjusting, RENR 9004, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02954438

MID 082 - CID 0296 - FMI 14

SMCS Code: 7610-038-DTN

Conditions Which Generate This Code:

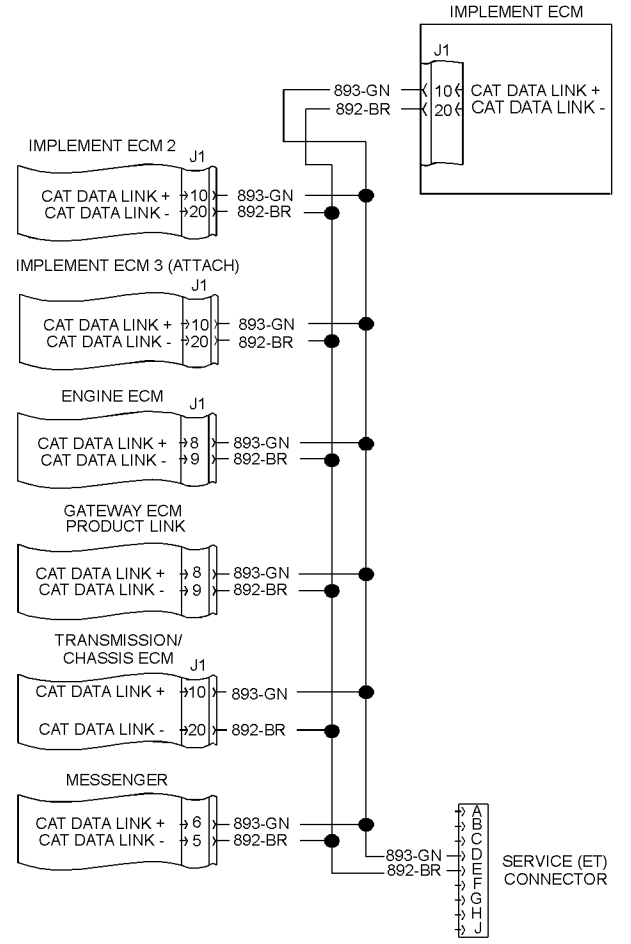


Illustration 199 g01243564

Cat Data Link Connections

This CID 0296 FMI 14 diagnostic code is associated with the communication between the Implement ECM and the Transmission/Chassis ECM that is conducted on the Cat Data Link circuit or the communication that is conducted over the SAE J1939 Data Link circuit.

The FMI 14 means that the Implement ECM is communicating with the Transmission/Chassis ECM on the involved data link circuit. However, the Implement ECM is not receiving expected operating parameter information.

When the CID 0296 FMI 14 diagnostic code is activated by the Implement ECM, a “companion” diagnostic code will be activated in order to indicate which data link system is involved. The companion diagnostic code that has been activated with this diagnostic code will be either of the following diagnostic codes:

CID 0247 FMI 14 – SAE J1939 Data Link

CID 0248 FMI 14 – Cat Data Link

Determine the companion diagnostic codes has been activated along with the CID 0296 FMI 14 diagnostic code to indicate the data link system that is involved.

Note: When the CID 0296 FMI 14 diagnostic code is cleared, the data link companion code will also cleared.

The possible causes of the CID 0296 FMI 14 diagnostic code are listed below:

- The software that is installed on the Transmission/ Chassis ECM is incorrect.
- The software that is installed on the Implement ECM is incorrect.
- A new ECM has been installed that is not the correct part.

Note: Ensure that the CID 0296 FMI 14 diagnostic code is active before performing this procedure.

Test Step 1. DETERMINE WHICH DATA LINK COMPANION DIAGNOSTIC CODE IS ACTIVE

Note: If incorrect software or an incorrect control module is causing the problem, both of the companion diagnostic codes of the data link may be active.

A. Check the list of active diagnostic codes in order to determine which of the following companion diagnostic codes is active: **CID 0247 FMI 14 - SAE J1939 Data Link CID 0248 FMI 14 - Cat Data Link**

Results:

- OK – The CID 0248 FMI 09 diagnostic code is active indicating that the problem is in the Cat Data Link system.In order to perform the troubleshooting procedure for the Cat Data Link, proceed to Test Step 2.
- OK – The CID 0247 FMI 09 diagnostic code is active indicating that the problem is in the SAE J1939 Data Link system.In order to perform the troubleshooting procedure for the SAE J1939 Data Link, proceed to Test Step 2.

Test Step 2. VERIFY THE HARDWARE AND THE SOFTWARE PART NUMBERS

A. Verify that the following information is correct:

- The part number of the installed software for the Implement ECM
- The part number of the installed software for the Transmission/Chassis ECM
- The part number of the Implement ECM
- The part number of the Transmission/Chassis ECM

Note: Contact your dealership's Technical Communicator for the correct part numbers of the hardware and the correct part numbers for the configuration software for your machine.

Expected Result:

All hardware and software part numbers are correct.

Results:

- OK – All hardware and software part numbers are correct.Proceed to Test Step 3.
- NOT OK – All hardware and software part numbers are NOT correct.

  Repair: Replace the hardware or software that is incorrect with the correct version. For flashing software, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Flash Program”. For replacing ECM modules, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and the key start switch to the ON position.

B. Operate the machine.

C. Check the status of the CID 0296 FMI 14 diagnostic code.

Expected Result:

The CID 0296 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 0296 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code could have been caused by a problem during start-up with one of the controls of the ECM. Resume normal operation.

  STOP.

- NOT OK – The CID 0296 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Repeat this procedure again and verify that the information is correct.

  If the cause of the problem is not found, the ECM that has activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02857911

MID 082 - CID 0358 - FMI 03

SMCS Code: 5479-038-PS

Conditions Which Generate This Code:

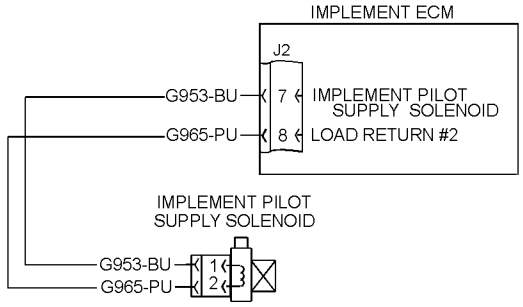


Illustration 200 g01371788

Implement Pilot Supply Solenoid connections

This diagnostic code is associated with the implement pilot supply solenoid. The FMI 03 means that the ECM has detected that the voltage of the solenoid circuit is above normal or that the ECM has detected voltage in the circuit when no voltage should be present.

Conditions that could cause this diagnostic code to become active are:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness connectors for the ECM, measure the resistance from contact J2-7 (wire G953-BU(Blue)) to all of the other contacts that are used in the J1 and J2 connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- YES – Each resistance measurement is greater than 5000 ohms. The resistance measurement does not indicate a short in the machine harness. Proceed to Test Step 2.
- NO – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness.

  Repair: The short is between wire G953-BU(Blue) and the circuit that has a low resistance measurement.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire G953-BU(Blue) and the socket at contact J2-7 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 0358 FMI 03 diagnostic code.

Expected Result:

The CID 0358 FMI 03 diagnostic code is no longer active. A CID 0358 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 0358 FMI 03 diagnostic code is no longer active. A CID 0358 FMI 05 diagnostic code has become active after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the energize wire of the solenoid into the correct space of the ECM connector. Proceed to the next test step. Proceed to Test Step 3.
- NO – The CID 0358 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the energize wire of the solenoid was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 0358 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 0358 FMI 03 diagnostic code is active.

Results:

- YES – The CID 0358 FMI 03 diagnostic code remains active.

Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the energize wire of the solenoid was disconnected.

Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 0358 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02983377

MID 082 - CID 0358 - FMI 05

SMCS Code: 5479-038-PS

Conditions Which Generate This Code:

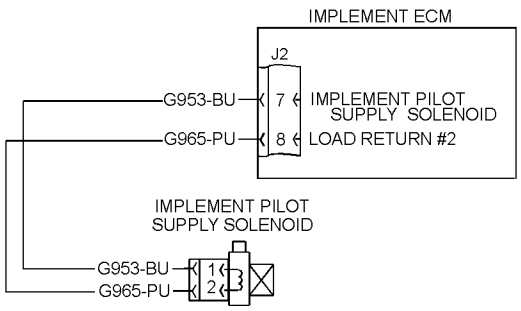


Illustration 201 g01371788

“Implement Pilot Supply” solenoid connections

This diagnostic code is associated with the implement pilot supply solenoid. The FMI 05 means that the ECM has detected that the current for the solenoid circuit is below normal.

Conditions that could causes this diagnostic code to be activated are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 27 ± 1.4 ohms at 20 °C (68.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire G953-BU(Blue)) to contact 2 (wire G965-PU(Purple)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 0358 FMI 05 diagnostic code.

Expected Result:

The CID 0358 FMI 05 diagnostic code is no longer active. A CID 0358 FMI 06 diagnostic code becomes active when the jumper wire is connected.

Results:

- YES – The CID 0358 FMI 05 diagnostic code is no longer active. A CID 0358 FMI 06 diagnostic code becomes active when the jumper wire is connected. The solenoid has failed.

Repair: Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

STOP.

- NO – The CID 0358 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the active diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

The jumper wire that was installed in the previous Test Step remains in place.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the ECM connector for the machine harness J2 from the ECM.

C. At the machine harness connector J2 for the ECM, measure the resistance from contact J2-7 (wire G953-BU(Blue)) to contact J2-8 (wire G965-PU(Purple)).

D. Observing the multimeter resistance measurement and wiggle the machine harness connectors for the ECM and wiggle the machine harness connector for the solenoid. Gently pull on the wires and wiggle the wires.

Expected Result:

The resistance measurement is less than 5.0 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – The resistance measurement is less than 5.0 ohms. The resistance measurement is not indicating an open or a bad connection in the circuit.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5.0 ohms. The resistance measurement is indicating an open circuit or a bad connection in the machine harness.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is not connected or that a wire is open. A resistance measurement that is greater than 5.0 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but is not a good connection.

  The open connection or the possible bad connection is in supply wire G953-BU(Blue) or in return wire G965-PU(Purple) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J2 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire G953-BU(Blue) and socket at contact J2-7 from the harness connector.

C. Reconnect the machine harness J2 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J2-7 through the empty space in the J2 connector.

F. Observe the status of the active CID 0358 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 0358 FMI 05 diagnostic code is no longer active. A CID 0358 FMI 06 diagnostic code becomes active when the ECM pin at J2-7 is grounded.

Results:

- YES – The CID 0358 FMI 05 diagnostic code is no longer active. A CID 0358 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is likely not the cause of the problem.Reinstall the disconnected solenoid energize wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 4.

- NO – The CID 0358 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 0358 FMI 05 diagnostic code.

Expected Result:

The CID 0358 FMI 05 diagnostic code is active.

Results:

- YES – The CID 0358 FMI 05 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0358 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02954372

MID 082 - CID 0358 - FMI 06

SMCS Code: 5479-038-PS

Conditions Which Generate This Code:

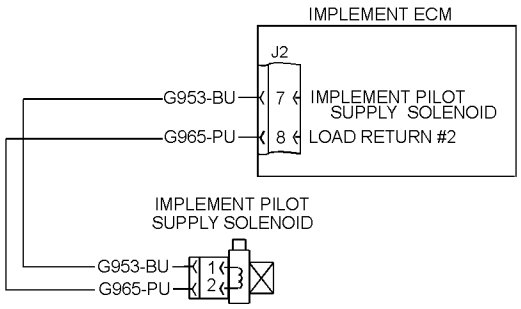


Illustration 202 g01371788

Connections of the Implement Pilot Supply Solenoid

This diagnostic code is associated with the implement pilot supply solenoid. The FMI 06 diagnostic code indicates that the ECM has detected that the current for the solenoid circuit is above normal.

Conditions that could cause this diagnostic code to be active are listed below:

- The energize circuit of the solenoid is shorted to a ground source.

- The solenoid has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 27 ± 1.4 ohms at 20 °C (68.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 0358 FMI 06 diagnostic code changes to a CID 0358 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 0358 FMI 06 diagnostic code changes to a CID 0358 FMI 05 diagnostic code when the solenoid is disconnected. The solenoid circuit in the machine harness is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 0358 FMI 06 diagnostic code remains active. Disconnecting the solenoid did not change the status of the active diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

The solenoid remains disconnected from the machine harness.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connectors of the ECM J1 and J2 from the ECM.

C. At the machine harness connectors of the ECM, measure the resistance from the signal contact J2-7 (wire G953-BU(Blue)) to frame ground. Measure the resistance from the signal contact J2-7 (wire G953-BU(Blue)) to all of the other contacts that are used in J1 and J2 ECM connectors.

D. While Observing the multimeter resistance measurements, wiggle the machine harness connectors for the ECM and the solenoid. Gently pull on the wires and wiggle the wires.

Expected Result:

Each resistance measurement is greater than 5000 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. The resistance measurement is indicating that a short is present in the machine harness. The short is between wire G953-BU(Blue) and the frame ground connection or the circuit with the low resistance measurement.

  Repair: For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 0358 FMI 06 diagnostic code.

Expected Result:

The CID 0358 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 0358 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause of the problem is not found, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0358 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02857970

MID 082 - CID 0490 - FMI 03

SMCS Code: 7332-038-HLK

Conditions Which Generate This Code:

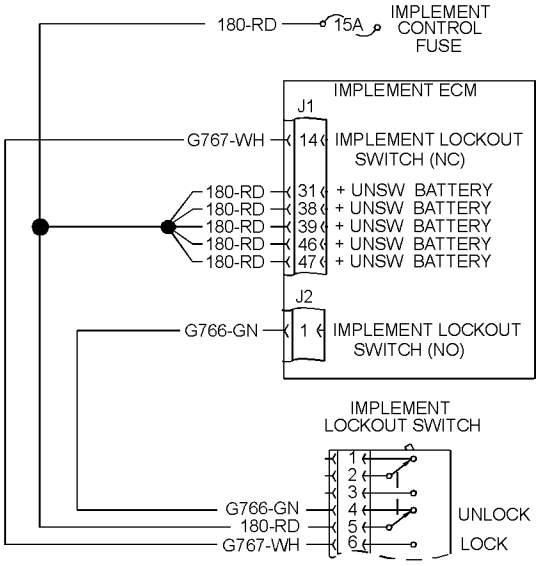


Illustration 203 g01256973

Connections of the Implement Lockout Switch

The implement lockout switch is a two-pole, double-throw switch. One pole is used to provide two switch-to-positive battery inputs to the ECM in order to indicate the status of the switch. During normal operation, one of the inputs is open. The other input is closed to the positive battery connection.

The FMI 03 diagnostic code is active when both switch inputs to the ECM are indicating a voltage present in the circuits at the same time.

The possible causes of this diagnostic code are listed below:

- The switch has failed.
- There is a short to a voltage source in one or both of the switch circuits.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: Contact 5 on the machine harness connector for the switch is connected to the positive battery connection. The disconnect switch must be OFF in order to interrupt power to this contact.

Table 18

Status of the Implement Lockout Switch		
Switch Position	N/O Contact (Wire G766-GN(Green) - J2-1	N/C Contact (Wire G767-WH(White) - J1-14
Locked	Open(1)	Closed (2)
Not Locked	Closed	Open

(1) Open to the positive battery wire 180-RD(Red) - Sw. contact 5.
(2) Closed to the positive battery wire 180-RD(Red) - Sw. contact 5.

Test Step 1. CHECK THE SWITCH

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the switch.

C. With the switch in the UNLOCKED position, measure the resistance between switch contact 4 and switch contact 5. Record this measurement.

D. With the switch in the UNLOCKED position, measure the resistance from switch contact 5 to switch contact 6. Record this measurement.

E. Move the switch to the LOCKED position and repeat Steps “C” and “D” .

Expected Result:

The contact status of the switch is correct according to the table at the beginning of this procedure with the switch in the LOCKED position and with the switch in the UNLOCKED position.

Results:

- OK – All of the resistance checks for the switch contacts are correct in both of the switch positions. The switch is working correctly.Proceed to Test Step 2.
- NOT OK – The contact states of the switch are not correct according to the table at the beginning of this procedure. The switch operation is not correct.

  Repair: Replace the implement lockout switch. After the switch is replaced, verify that the switch operation is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR A SHORT TO ANOTHER VOLTAGE SOURCE

The key start switch and the disconnect switch remain in the OFF position. The machine harness remains disconnected from the switch.

A. At the machine harness connector for the switch, place a jumper wire between contact 4 (wire G766-GN(Green)) and contact 6 (wire G767-WH(White)).

B. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness connector of the ECM J2, measure the resistance from input contact of the switch J2-1 (wire G766-GN(Green)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

D. While observing the resistance measurement, wiggle the wires and move the machine harness around at the ECM connectors and at the switch connectors.

E. At the machine harness connector of the ECM J2, measure the resistance from input contact of the switch J1-14 (wire G767-WH(White)) to all of the other J1 and J2 contacts that are used for the ECM.

F. While observing the resistance measurement, wiggle the wires and move the machine harness around at the ECM connectors and at the switch connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms at all times during the manipulation of the wires and connectors of the machine harness.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is not indicating a short.Proceed to Test Step 3.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between either the switch input circuit wire G766-GN(Green) or the switch input circuit wire G767-WH(White) and the circuit with the low resistance measurement.

  Repair: Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in the faulty circuit for points in the machine harness where a short could occur.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 0490 FMI 03 diagnostic code.

Expected Result:

The CID 0490 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 0490 FMI 03 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 0490 FMI 03 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the input circuits of the switch again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause can not be found, the ECM may have failed. Verify that all possible causes of the diagnostic code have been investigated before replacement of the ECM.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02858025

MID 082 - CID 0490 - FMI 04

SMCS Code: 7332-038-HLK

Conditions Which Generate This Code:

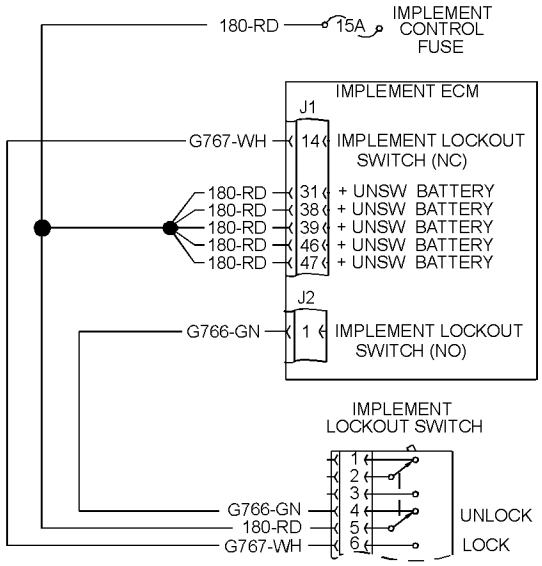


Illustration 204 g01256973

Connections of the Implement Lockout Switch

The implement lockout switch is a two-pole, double-throw switch. One pole is used to provide two, switch to the positive battery, inputs to the ECM in order to indicate the status of the switch. During normal operation, one of the inputs is open. The other input is closed to the positive battery.

The FMI 04 diagnostic code is active when neither of the two switch inputs to the ECM are indicating that a voltage is present.

Conditions which can cause this diagnostic code to be activated are listed below:

- The switch has failed.

- One or both of the switch inputs is open in the machine harness.
- The common positive battery switch circuit is open in the machine harness.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: Contact 5 on the machine harness connector for the switch is connected to the positive battery. The disconnect switch must be OFF in order to interrupt power to this contact.

Table 19

Status of the Implement Lockout Switch		
Switch Position	N/O Contact (Wire G766-GN(Green) - J2-1	N/C Contact (Wire G767-WH(White) - J1-14
Locked	Open(1)	Closed (2)
Not Locked	Closed	Open

(1) Open to the positive battery wire 180-RD(Red) - Sw. contact 5.
(2) Closed to the positive battery wire 180-RD(Red) - Sw. contact 5.

Test Step 1. CHECK THE SWITCH

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the switch.

C. With the switch in the UNLOCKED position, measure the resistance between the switch contact 4 and the switch contact 5. Record this measurement.

D. With the switch in the UNLOCKED position, measure the resistance from switch contact 5 to switch contact 6. Record this measurement.

E. Move the switch to the LOCKED position and repeat Steps “C” and “D” .

Expected Result:

The status of the switch is correct according to the table at the beginning of this procedure with the switch in the LOCKED position and with the switch in the UNLOCKED position.

Results:

- OK – All of the resistance checks for the switch contacts are correct in both of the switch positions. The switch is working correctly.Proceed to Test Step 2.
- NOT OK – The states of contact of the switch are not correct according to the table at the beginning of this procedure. The switch operation is not correct.

  Repair: Replace the implement lockout switch. After the switch is replaced, verify that the switch operation is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE INPUT CIRCUITS OF THE SWITCH FOR AN OPEN

The key start switch and the disconnect switch remain in the OFF position. The implement lockout switch remains disconnected from the machine harness.

A. At the machine harness connector for the switch, place a jumper wire between contact 4 (wire G766-GN(Green)) and contact 6 (wire G767-WH(White)).

B. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness connectors for the ECM, measure the resistance between contact J2-1 (wire G766-GN(Green)) and contact J1-14 (wire G767-WH(White)).

Expected Result:

The resistance measurement is less than 5.0 ohms.

Results:

- OK – The resistance measurement is less than 5.0 ohms. The signal wires of the switch in the machine harness are not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5.0 ohms. There is an open or a bad connection in the machine harness.

  Repair: A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but is not a good connection.

The open connection or the possible bad connection is in wire G766-GN(Green) or in wire G767-WH(White) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the switch circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK FOR VOLTAGE AT THE SWITCH COMMON +BATTERY CIRCUIT

A. Reconnect the machine harness connectors to the switch and to the ECM.

B. Turn the disconnect switch and the key start switch to the ON position.

C. At the machine harness connector for the switch, insert the positive 7X-1710 Multimeter Probe along the common contact of the switch 5 (wire 180-RD(Red)). Use the other multimeter probe to make contact with a good ground point on the machine frame.

D. Measure the DC voltage.

Expected Result:

The positive voltage measurement of the battery is approximately 24.0 VDC.

Results:

- OK – The positive voltage measurement of the battery is approximately 24.0 VDC. The common positive battery circuit is correct.Proceed to Test Step 4.
- NOT OK – The voltage measurement is not indicating positive battery voltage. Verify that the multimeter probes are making contact with the switch contact 5 and a good ground contact on the machine frame.

  Repair: If positive battery voltage is not present at the measurement, there is an open, a bad connection, or a bad splice in the positive common switch connection of the battery circuit (wire 180-RD(Red)).

  It is unlikely that the control fuse is open or the Implement ECM would not be operating.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the common circuit of the switch. Ensure that the connections are clean, that the connections are secure and that the connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 0490 FMI 04 diagnostic code.

Expected Result:

The CID 0490 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 0490 FMI 04 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 0490 FMI 04 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the input circuits of the switch again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary shorts or open connections in the machine wiring harness.

If the cause can not be found, the ECM may have failed. Verify that all possible causes of the diagnostic code have been investigated before replacement of the ECM.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02858129

MID 082 - CID 0588 - FMI 09

SMCS Code: 7490-038

Conditions Which Generate This Code:

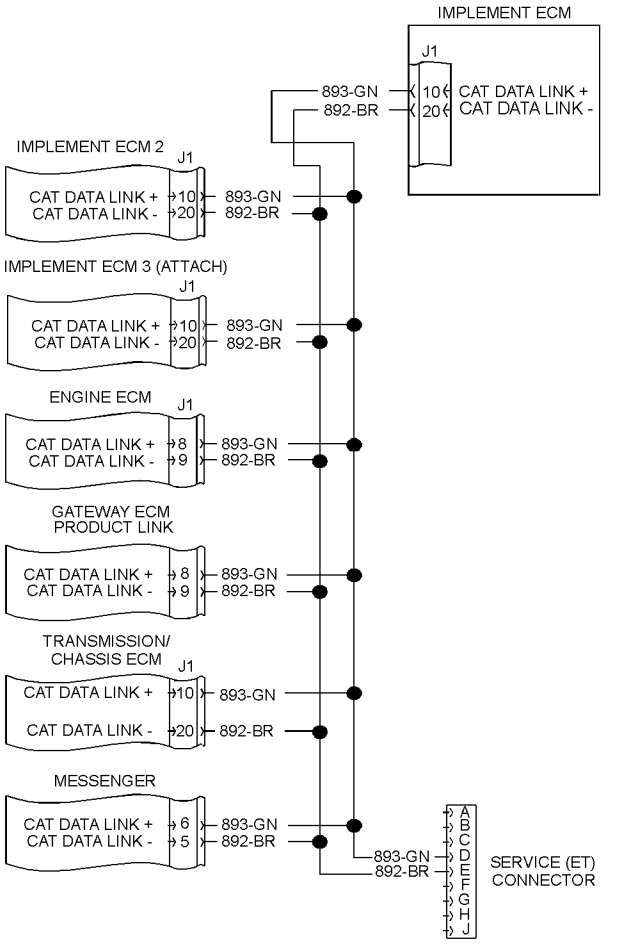


Illustration 205 g01243564

Cat Data Link connections

The CID 0588 FMI 09 diagnostic code is associated with the communication between the Implement ECM and the Monitoring System (Messenger) that is conducted on the Cat Data Link circuit.

The FMI 09 means that the Implement ECM is not receiving any communication from the Monitoring System over the Cat Data Link circuit.

The possible causes of the CID 0588 FMI 09 diagnostic code are listed below:

- An open connection or a poor connection in the Cat Data Link circuit
- The Messenger Module has failed, this is unlikely
- The Implement ECM has failed. This is unlikely.

Note: A loss of system power to the Monitoring System can cause the Implement ECM to activate this diagnostic code. Ensure that the Monitoring System is powered up before proceeding with this procedure.

Note: Ensure that the CID 0588 FMI 09 diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE CAT DATA LINK CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM. Disconnect the machine harness connector from the Messenger.

C. Inspect the harness connectors and clean all of the contacts of the harness connectors. Refer to the illustration above in order to check the Cat Data Link connection on each of the machine harness connectors. Ensure that the wires are secured in the connector, that the contacts are clean and that the contacts are in good condition.

D. At the disconnected harness connector for the Monitoring System, connect a jumper wire between contact 6 (wire 893-GN(Green)) and contact 5 (wire 892-BR(Brown)).

E. At the disconnected harness connector J1 for the Implement ECM, measure the resistance between contact J1-10 (wire 893-GN(Green)) and contact J1-20 (wire 892-BR(Brown)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The Cat Data Link circuit in the machine harness is not open.Proceed to Test Step 2.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the Cat Data Link circuit in the machine harness.

  Repair: A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the wires or one of the connection points in the circuit is not open but is not a good connection.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connections of the machine harness that are involved in the data link circuit. Check each wire section from connector to connector for an open or a bad connection. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the data link circuit.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 0588 FMI 09 diagnostic code.

Expected Result:

The CID 0588 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 0588 FMI 09 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 0588 FMI 09 diagnostic code is active. The diagnostic code has not been corrected.

Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the problem is not found, one of the ECM modules may have failed. The ECM that activated the diagnostic code may have failed.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02858307

MID 082 - CID 0588 - FMI 14

SMCS Code: 7490-038

Conditions Which Generate This Code:

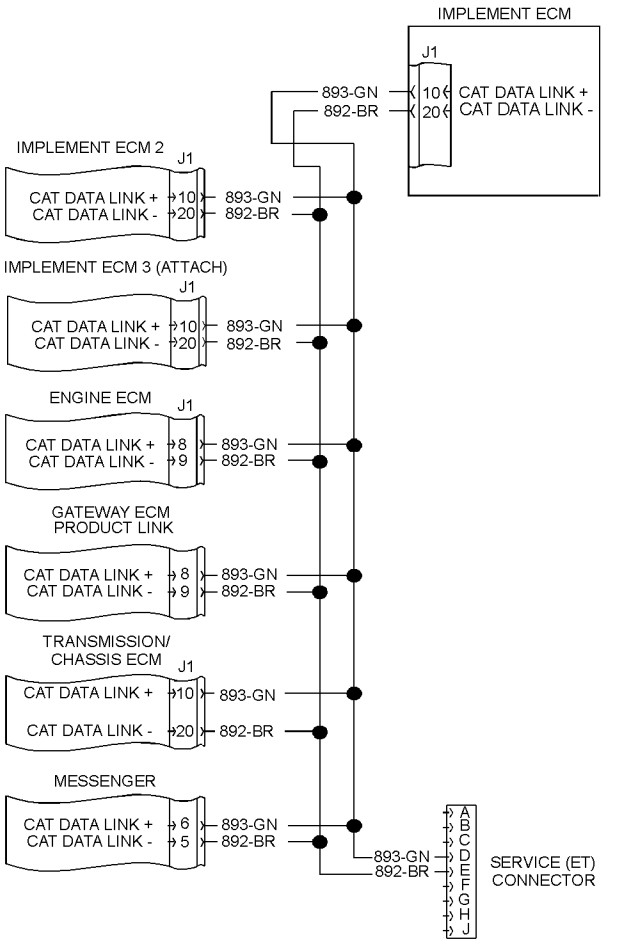


Illustration 206 g01243564

Cat Data Link connections

This CID 0588 FMI 14 diagnostic code is associated with the communication between the Implement ECM and the Monitoring System (Messenger) that is conducted on the Cat Data Link circuit.

The FMI 14 diagnostic code means that the Implement ECM is communicating with the Messenger on the Cat Data Link circuit. However, the Implement ECM is not receiving expected operating parameter information from the Messenger.

The possible causes of the CID 0588 FMI 14 diagnostic code are listed below:

- The software that is installed on the Messenger is incorrect.
- The software that is installed on the Implement ECM is incorrect.
- A new ECM has been installed but the ECM is not the correct part.

Note: Ensure that the CID 0588 FMI 14 diagnostic code is active before performing this procedure.

Test Step 1. VERIFY THE HARDWARE AND THE SOFTWARE PART NUMBERS

A. Verify that the following information is correct:

- The part number of the installed software for the Implement ECM
- The part number of the installed software for the Messenger
- The part number of the Implement ECM
- The part number of the Messenger

Note: Contact your dealership's Technical Communicator for the correct part numbers of the hardware and the correct part numbers for the configuration software for your machine.

Expected Result:

All hardware and software part numbers are correct.

Results:

- OK – All hardware and software part numbers are correct.Proceed to Test Step 2.
- NOT OK – All hardware and software part numbers are NOT correct.

  Repair: Replace the hardware or software that is incorrect with the correct version. For flashing software, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Flash Program”. For replacing ECM modules, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”

  STOP.

Test Step 2. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and the key start switch to the ON position.

B. Operate the machine.

C. Check the status of the CID 0588 FMI 14 diagnostic code.

Expected Result:

The CID 0588 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 0588 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code could have been caused by a problem during start-up with one of the controls of the ECM. Resume normal operation.

  STOP.

- NOT OK – The CID 0588 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Repeat this procedure again and verify that the information is correct.

  If the cause of the problem is not found, the ECM that has activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02858313

MID 082 - CID 0590 - FMI 09

SMCS Code: 1901-038

Conditions Which Generate This Code:

The CID 0590 FMI 09 diagnostic code is associated with the communication between the Implement ECM and the Engine ECM that is conducted on the Cat Data Link circuit or the communication that is conducted over the SAE J1939 Data Link circuit.

The FMI 09 means that the Implement ECM is not receiving any communication from the Engine ECM on the involved data link circuit.

When the Implement ECM activates this diagnostic code, a “companion” diagnostic code will become active in order to indicate which data link system is involved. The “companion” diagnostic code that has been activated will be either of the following:

CID 0247 FMI 09 – SAE J1939 Data Link

CID 0248 FMI 09 – Cat Data Link

Determine which one of the “companion” diagnostic codes has become active along with the CID 0590 FMI 09 diagnostic code to indicate which data link system is involved.

When the CID 0590 FMI 09 diagnostic code is cleared, the Data Link “companion” code will also clear.

The possible causes of the CID 0590 FMI 09 diagnostic code are listed below:

- An open or a poor connection in the data link circuit
- The Engine ECM has failed. This is unlikely.
- The Implement ECM has failed. This is unlikely.

Note: A loss of power to the Engine ECM can cause the Implement ECM to activate this diagnostic code. Ensure that the Engine ECM is powered up before proceeding with this procedure.

Note: Ensure that the CID 0590 FMI 09 diagnostic code is active before performing this procedure.

Test Step 1. DETERMINE WHICH DATA LINK “COMPANION” CODE IS ACTIVE

A. Check the list of active diagnostic codes in order to determine which of the following “companion” diagnostic codes are active: **CID 0247 FMI 09 - SAE J1939 Data Link CID 0248 FMI 09 - Cat Data Link**

Results:

- OK – The CID 0248 FMI 09 diagnostic code is active indicating that the problem is in the Cat Data Link system.In order to perform the troubleshooting procedure for the Cat Data Link, proceed to Test Step 2.
- OK – The CID 0247 FMI 09 diagnostic code is active indicating that the problem is in the SAE J1939 Cat Data Link system.In order to perform the troubleshooting procedure for the SAE J1939 Data Link, proceed to Test Step 4.

Test Step 2. CHECK THE CAT DATA LINK CIRCUIT FOR AN OPEN

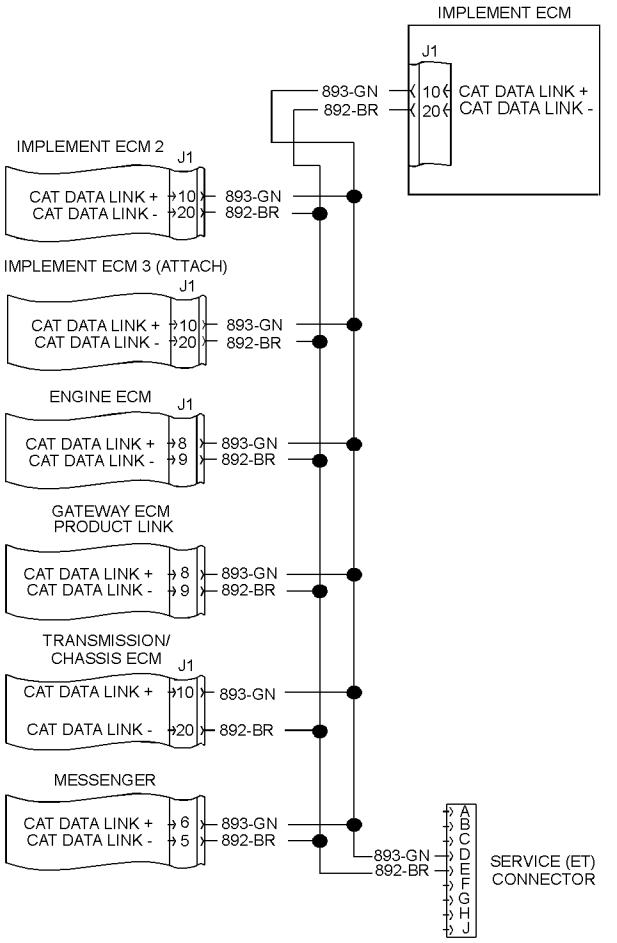


Illustration 207 g01243564

Cat Data Link connections

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM. Disconnect the machine harness connector J1 from the Engine ECM.

C. Inspect the harness connectors. Clean all of the contacts of the harness connectors. Refer to the illustration above in order to check the connection to the Cat Data Link on each of the machine harness connectors. Ensure that the wires are secured in the connector, that the contacts are clean and that the contacts are in good condition.

D. At the disconnected harness connector J1 for the Engine ECM, connect a jumper wire between contact J1-8 (wire 893-GN(Green)) and contact J1-9 (wire 892-BR(Brown)).

E. At the disconnected harness connector J1 for the Implement ECM, measure the resistance between contact J1-10 (wire 893-GN(Green)) and contact J1-20 (wire 892-BR(Brown)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The Cat Data Link circuit in the machine harness is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the Cat Data Link circuit in the machine harness.

  Repair: A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the wires or one of the connection points in the circuit is not open but is not a good connection.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connections of the machine harness that are involved in the data link circuit. Check each wire section from one connector to the other connector for an open or a bad connection. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the data link circuit.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 0590 FMI 09 diagnostic code.

Expected Result:

The CID 0590 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 0590 FMI 09 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

STOP.

- NOT OK – The CID 0590 FMI 09 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, one of the ECM modules may have failed. The ECM that activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE SAE J1939 DATA LINK CIRCUIT FOR AN OPEN

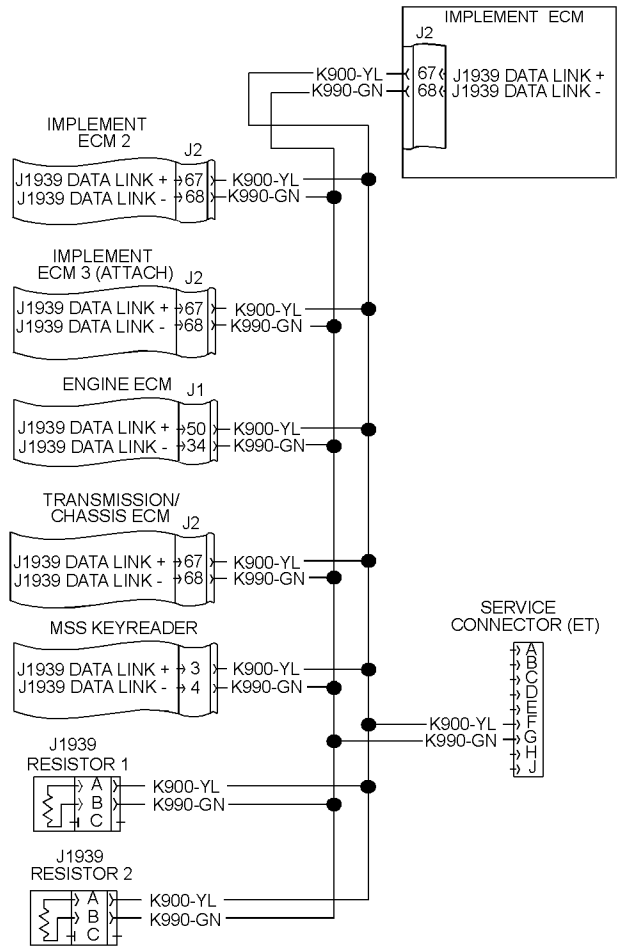


Illustration 208 g01319936

SAE J1939 Data Link Circuit connections

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J2 from the Implement ECM. Disconnect the machine harness connector J1 from the Engine ECM.

C. Inspect the harness connectors. Clean all of the contacts of the harness connectors. Refer to the illustration above in order to check the SAE J1939 Data Link connection on each of the machine harness connectors. Ensure that the wires are secured in the connector, that the contacts are clean and that the contacts are in good condition.

D. At the disconnected harness connector J1 for the Engine ECM, connect a jumper wire between contact J1-50 (wire K900-YL(Yellow)) and contact J1-34 (wire K990-GN(Green)).

E. At the disconnected harness connector J2 for the Implement ECM, measure the resistance between contact J2-67 (wire K900-YL(Yellow)) and contact J2-68 (wire K990-GN(Green)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The SAE J1939 Data Link circuit in the machine harness is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the SAE J1939 Data Link circuit in the machine harness.

  Repair: Refer to the complete Electrical System Schematic of the machine. Examine all of the connections of the machine harness that are involved in the data link circuit. Check each wire section from one connector to the other connector for an open or a bad connection. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the data link circuit.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 0590 FMI 09 diagnostic code.

Expected Result:

The CID 0590 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 0590 FMI 09 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.
- NOT OK – The CID 0590 FMI 09 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect intermittent short circuit connections or open connections in the machine wiring harness.

  If the cause of the problem is not found, one of the ECM modules may have failed. The ECM that activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02954442

MID 082 - CID 0590 - FMI 14

SMCS Code: 1901-038

Conditions Which Generate This Code:

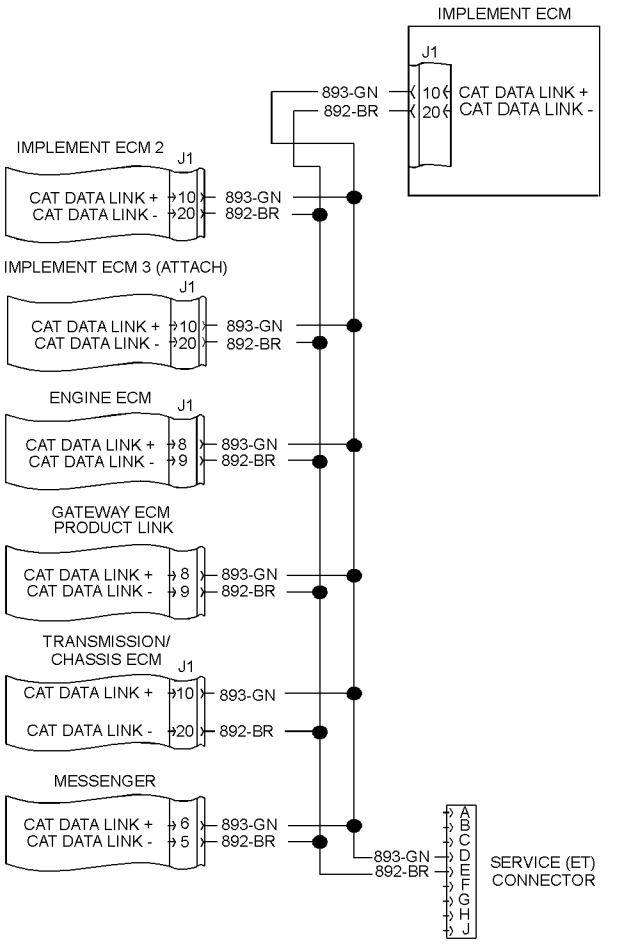


Illustration 209 g01243564

Cat Data Link connections

This CID 0590 FMI 14 diagnostic code is associated with the communication between the Implement ECM and the Engine ECM that is conducted on the Cat Data Link circuit or the communication that is conducted over the SAE J1939 Data Link circuit.

The FMI 14 means that the Implement ECM is communicating with the Engine ECM on the involved data link circuit. However, the Implement ECM is not receiving expected operating parameter information.

When the Implement ECM activates diagnostic code CID 0590 FMI 14, a “companion” diagnostic code will become active. The combination of the two codes will indicate the data link system that is involved. The “companion” diagnostic code that has been activated will be either of the following diagnostic codes:

CID 0247 FMI 14 – SAE J1939 Data Link

CID 0248 FMI 14 – Cat Data Link

Determine the “companion” diagnostic code that is active at the same time as the CID 0590 FMI 14 diagnostic code. This information will indicate the data link system that is involved.

Note: Clear the CID 0590 FMI 14 diagnostic code. Note that this will also clear the companion diagnostic code from the data link.

The possible causes of the CID 0590 FMI 14 diagnostic code are listed below:

- The software that is installed on the Engine ECM is incorrect.
- The software that is installed on the Implement ECM is incorrect.
- An incorrect part has been installed in order to replace the old ECM.

Note: Ensure that the CID 0590 FMI 14 diagnostic code is active before performing this procedure.

Test Step 1. PROCESS FOR DETERMINING THE DATA LINK “COMPANION” CODE THAT IS ACTIVE

Note: If incorrect software or an incorrect control module is causing the problem, both of the data link “companion” codes may be active.

A. Check the following list of active diagnostic codes in order to determine the “companion” diagnostic code that is active: **CID 0247 FMI 14 - SAE J1939 Data Link CID 0248 FMI 14 - Cat Data Link**

Results:

- OK – The CID 0248 FMI 09 diagnostic code is active indicating that the problem is in the Cat Data Link system.In order to perform the troubleshooting procedure for the Cat Data Link, proceed to Test Step 2.
- OK – The CID 0247 FMI 09 diagnostic code is active indicating that the problem is in the SAE J1939 Cat Data Link system.In order to perform the troubleshooting procedure for the SAE J1939 Data Link, proceed to Test Step 2.

Test Step 2. VERIFY THE HARDWARE AND THE SOFTWARE PART NUMBERS

A. Verify that the following information is correct:

- The part number of the installed software for the Implement ECM

- The part number of the installed software for the Engine ECM
- The part number of the Implement ECM
- The part number of the Engine ECM

Note: Contact your dealership's Technical Communicator for the correct part numbers of the hardware and the correct part numbers for the configuration software for your machine.

Expected Result:

All hardware and software part numbers are correct.

Results:

- OK – All hardware and software part numbers are correct.Proceed to Test Step 3.
- NOT OK – All hardware and software part numbers are NOT correct.

  Repair: Replace the hardware or software that is incorrect with the correct version. For flashing software, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Flash Program”. For replacing ECM modules, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and the key start switch to the ON position.

B. Operate the machine.

C. Check the status of the CID 0590 FMI 14 diagnostic code.

Expected Result:

The CID 0590 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 0590 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code could have been caused by a problem during start-up with one of the controls of the ECM. Resume normal operation.

  STOP.

- NOT OK – The CID 0590 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Repeat this procedure again and verify that the information is correct.

  If the cause of the problem is not found, the ECM that has activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02954471

MID 082 - CID 0597 - FMI 03

SMCS Code: 1439-038-NP

Conditions Which Generate This Code:

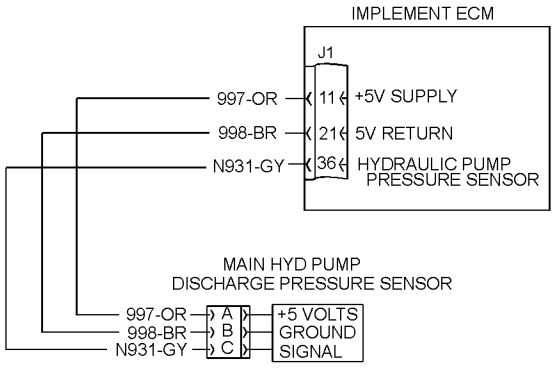


Illustration 210 g01255117

Connections of the Main Hydraulic Pump Discharge Pressure Sensor

This diagnostic code is associated with the main hydraulic pump discharge pressure sensor. The FMI 03 diagnostic code means that the ECM has determined that the voltage of the sensor signal circuit is above normal.

The pressure sensor sends a variable voltage input to the ECM that will indicate the main hydraulic pump discharge pressure. The output voltage of the sensor will be around 0.5 VDC, when no pressure is applied. The output voltage of the pressure sensor will be around 4.5 VDC at 34500 kPa (5004 psi) of pressure.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- The signal circuit for the sensor is shorted to another voltage source.

- An open circuit connection to the power, the ground or the signal wires
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE POWER SUPPLY AT THE SENSOR

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Do not disconnect the machine harness connector from the sensor.

C. At the back of the machine harness connector for the main hydraulic pump discharge pressure sensor, insert 7X-1710 Multimeter Probes along contact A (wire 997-OR(Orange)) (supply) and along contact B (wire 998-BR(Brown)) (return).

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the voltage from contact A to contact B.

Expected Result:

The voltage measurement is 5.0 ± 0.5 VDC.

Results:

- OK – The voltage measurement is 5.0 ± 0.5 VDC. The voltage is correct.Proceed to Test Step 2.
- NOT OK – The voltage measurement is less than 5.0 ± 0.5 VDC. The power supply voltage is not correct.

  Repair: There is a problem with the power supply for the sensor. Refer to the CID 0262 diagnostic code procedures in this manual for information on troubleshooting the 5 volt power supply circuit of the ECM. Repair the power supply circuit. After the power supply circuit is repaired, check the status of this diagnostic code. Operate the machine in order to confirm the repair.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the machine harness connector of the Implement ECM J1, use a 151-6320 Removal Tool to remove the signal wire N931-GY(Grey) and the socket at contact J1-36 from the J1 connector. The machine harness connector J1 remains connected to the Implement ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-36 through the empty space in the J1 connector.

E. Observe the status of the active CID 0597 FMI 03 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to a location on the machine frame.

Expected Result:

The active CID 0597 FMI 03 diagnostic code is no longer active. A CID 0597 FMI 04 diagnostic code becomes active when the ECM pin at J1-36 is grounded.

Results:

- YES – The CID 0597 FMI 03 diagnostic code is no longer active. A CID 0597 FMI 04 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the circuit. It is likely that the ECM is not causing the problem. Reconnect the signal wire and the socket in the machine harness connector J1 for the ECM before proceeding to the next test step.Proceed to Test Step 3.
- NO – The CID 0597 FMI 03 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: Reconnect the signal wire and the socket in the machine harness connector J1 for the ECM. Repeat this test step in order to verify that the ECM is the cause of the problem.

Place the pin of the ECM for the solenoid in contact with ground. If the CID 0597 FMI 03 diagnostic code is still active, the Implement ECM has failed.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

Test Step 3. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the pressure sensor. At the machine harness connector for the pressure sensor, place a jumper wire between the return contact B (wire 998-BR(Brown)) and the signal contact C (wire N931-GY(Grey)) .

C. Disconnect machine harness connectors J1 from the Implement ECM.

D. At the harness connector for the Implement ECM, measure the resistance from return contact J1-21 (wire 998-BR(Brown)) to signal contact J2-36 (wire N931-GY(Grey)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 4.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 0597 FMI 03 diagnostic code is active.

Expected Result:

The CID 0597 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 0597 FMI 03 diagnostic code is not active. The problem has been corrected.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 0597 FMI 03 diagnostic code is still active. The problem has not been corrected.

  Repair: Perform this test step again. If the problem persists, proceed with the following procedure. Use a Caterpillar Electronic Technician service tool and perform a wiggle test on the circuit of the sensor for the wiring harness of the machine. The wiggle test can be used in order to detect momentary short circuit connections. The wiggle test can also be used to detect open connections in the machine wiring harness.

  If a problem is not found in the machine harness, replace the pressure sensor. Verify that the operation of the new pressure sensor is correct before operating the machine.

  If the diagnostic code is active after the replacement of the pressure sensor, the ECM may have failed.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02954456

MID 082 - CID 0597 - FMI 04

SMCS Code: 1439-038-NP

Conditions Which Generate This Code:

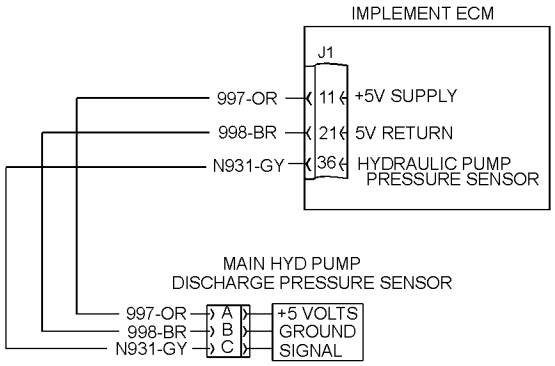


Illustration 211 g01255117

Connections of the Main Hydraulic Pump Discharge Pressure Sensor

This diagnostic code is associated with the main hydraulic pump discharge pressure sensor. The FMI 04 indicates that the ECM has detected the sensor signal voltage as being below normal.

The pressure sensor sends a variable voltage input to the ECM that will indicate the main hydraulic pump discharge pressure. The sensor output voltage of the sensor will be around 0.5 VDC, when no pressure is applied. The output voltage of the pressure sensor will be around 4.5 VDC at 34500 kPa (5004 psi) of pressure.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- The power supply connection for the sensor is shorted to ground.
- The signal circuit for the sensor is shorted to ground.
- The ECM has failed. This is unlikely.

Note: Check that the diagnostic code CID 0262 does not exist before performing this procedure. If an active CID 0262 diagnostic code is present, correct the problem and clear the diagnostic code before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: This procedure can cause new diagnostic codes to be recorded. Ignore these created diagnostic codes. When the problem has been corrected, clear the created diagnostic codes.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the harness connector of the machine from the main hydraulic pump discharge pressure sensor. Observe the status of the diagnostic code at the same time.

Expected Result:

The FMI 04 diagnostic code will remain active if the sensor is not the cause of the problem. If the FMI 04 diagnostic code changes to an active FMI 03 diagnostic code after disconnecting the sensor from the machine harness, then the sensor is shorted internally.

Results:

- OK – The FMI 04 diagnostic code remains active. The sensor has not failed. Proceed to Test Step 2.
- NOT OK – The FMI 04 diagnostic code changes to an FMI 03 diagnostic code when the sensor is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The main hydraulic pump discharge pressure sensor has failed. Replace the sensor. After replacement of the sensor, verify that the operation of the new sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE POWER SUPPLY AT THE SENSOR

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Do not disconnect the machine harness connector from the sensor.

C. At the back of the machine harness connector for the main hydraulic pump discharge pressure sensor, insert 7X-1710 Multimeter Probes along contact A (wire 997-OR(Orange)) (supply) and along contact B (wire 998-BR(Brown)) (return).

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the voltage from contact A to contact B.

Expected Result:

The voltage measurement is 5.0 ± .5 VDC.

Results:

- OK – The voltage measurement is 5.0 ± .5 VDC. The voltage is correct.Proceed to Test Step 4.
- NOT OK – The voltage measurement is less than 5.0 ± .5 VDC. The power supply voltage is not correct.Proceed to Test Step 3.

Test Step 3. CHECK THE POWER SUPPLY AT THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the connector for the Implement ECM J1, use a 151-6320 Removal Tool to remove the supply wire and the socket at contact J1-11 (wire 997-OR(Orange)) and remove the return wire and the socket (wire 998-BR(Brown)) at contact J1-21. The harness connector remains connected to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Use the multimeter probes to make contact on the connector pins of the ECM. Measure the voltage at the ECM pins between the contact J1-11 (power supply) and the contact J1-21 (return).

Expected Result:

The voltage measurement is 5.0 ± .5 VDC.

Results:

- OK – The voltage measurement is 5.0 ± .5 VDC. The voltage is correct. the ECM power supply is correct. There is a problem in the machine harness.

  Repair: The Power supply circuit is not connected or the circuit has a bad connection in the machine harness. Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the power supply circuit. Verify that the connections are clean, that the connections are secure and that the connections are in good condition.

  Refer to the CID 0262 diagnostic code procedures in this manual for information on troubleshooting the 5 volt power supply circuit of the ECM. Repair the power supply circuit. After the power supply circuit is repaired, check the status of this diagnostic code before operating the machine.

  STOP.

- NOT OK – The voltage measurement is less than 5.0 ± .5 VDC. The voltage reading of ECM power supply is not correct.

  Repair: Repeat this test step in order to verify that the ECM power supply is not correct.

  If the ECM power supply has failed, contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE SIGNAL CIRCUIT OF THE SENSOR FOR A SHORT

The machine harness connector remains disconnected from the sensor.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the machine harness connector from the sensor.

C. Disconnect the machine harness connector J1 and J2 from the Implement ECM and from the Implement ECM 2.

D. At the harness connector J1 for the Implement ECM, measure the resistance from contact J1-36 (wire N931-GY(Grey)) (signal) to all of the other contacts that are used for the J1 and J2 connectors of the Implement ECM and the Implement ECM 2.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted to another circuit in the machine harness.Proceed to Test Step 5.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The circuit connection of the sensor N931-GY(Grey) is shorted to the circuit with the low resistance measurement in the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in circuits for indications of damage that indicate a possible short circuit in the machine harness.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE SENSOR CIRCUIT FOR A SHORT

The pressure sensor remains disconnected from the machine harness.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 and J2 from the Implement ECM and from the Implement ECM 2.

C. At the machine harness connector J1 for the Implement ECM, measure the resistance from the signal contact J1-36 (wire N931-GY(Grey)) to frame ground. Measure the resistance from the signal contact J1-36 (wire N931-GY(Grey)) to all of the contacts that are used in the machine harness connectors for the Implement ECM and the Implement ECM 2.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 6.
- NOT OK – One or more resistance measurements is not correct. There is a short in the machine harness.

  Repair: The short is between the signal wire N931-GY(Grey) and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in circuits. Examine all of the locations in the circuit for indications of damage that indicate a possible short circuit in the machine wiring harness. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 6. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 0597 FMI 04 diagnostic code.

Expected Result:

The CID 0597 FMI 04 diagnostic code is active.

Results:

- YES – The CID 0597 FMI 04 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Perform this procedure again. If the problem persists, proceed with the following process. Use a Caterpillar Electronic Technician service tool and perform a wiggle test on the circuit of the sensor for the wiring harness of the machine. The wiggle test can be used to detect momentary short circuit connections. The wiggle test can also be used to detect open connections in the machine wiring harness.

If the cause of the problem is not found, the ECM may have failed.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 0597 FMI 04 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02973803

MID 082 - CID 0597 - FMI 14

SMCS Code: 1439-038-NP

Conditions Which Generate This Code:

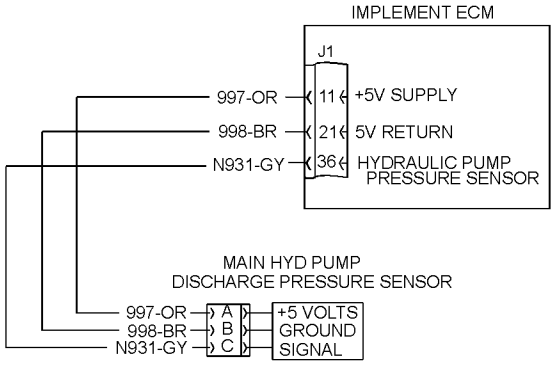


Illustration 212 g01255117

Connections of the Main Hydraulic Pump Discharge Pressure Sensor

This diagnostic code is associated with the main hydraulic pump discharge pressure sensor.

The Implement ECM will activate an FMI 14 for this sensor when the reading of the standby pressure transducer at the discharge side of the hydraulic pump is above 7500 kPa (1089 psi). The output of the pressure sensor is checked by the Implement ECM when the following conditions occur during machine operation:

- Immediately after the engine has been started and the engine low idle speed has been stabilized
- Immediately after the switch for the Secondary Steer Test has been moved to the TEST position

The Implement ECM checks the status of the sensor when a secondary steering test is requested. The ECM checks the status of the sensor in order to determine if the sensor is indicating the correct pressure for the secondary steering pump pressure.

The pressure sensor sends a variable voltage input to the ECM that will indicate the main hydraulic pump discharge pressure. The output voltage of the sensor will be around 0.5 VDC when no pressure is applied. The output voltage of the pressure sensor will be around 4.5 VDC at 34500 kPa (5004 psi) of pressure .

The possible conditions that can cause this diagnostic code are listed below:

- A hydraulic problem is causing above normal hydraulic pump pressure.
- The sensor has failed.
- The signal circuit for the sensor is shorted to a voltage source.
- The ECM has failed. This is unlikely.

Check that the diagnostic code CID 0262 is not active before performing this procedure. If an active CID 0262 diagnostic code is present, correct the problem and clear the diagnostic code before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE HYDRAULIC PUMP DISCHARGE PRESSURE

Note: This test step requires the installation of a pressure gauge at the tap for the outlet pressure for the main hydraulic pump. Confirm that the pressure gauge is properly installed and that the pressure gauge will display the expected pressure range before the key start switch is turned to the ON position.

A. After a pressure gauge is installed at the main hydraulic pump pressure tap, start the engine and run the engine at low idle.

B. Ensure that all the following conditions are in place before proceeding to the next step:

- Disable the steering system by not aligning the joystick to the angle of the front wheels.
- Disable the steering system by not having the operator in the operator seat.
- Move the implement lockout switch to the LOCK position.

C. Use the Caterpillar Electronic Technician (Cat ET) diagnostic tool in order to check the status of the main hydraulic pump pressure.

D. Observe the display of the pressure reading that is on the Cat ET status screen. Note the reading on the pressure gauge from the pump outlet. Compare the two sets of readings.

Expected Result:

The pressure this is observed on the Cat ET status screen and the pressure that is observed on the pressure gauge are approximately the same. However, the pressure reading is above the 7500 kPa (1089 psi) standby pressure limit.

Results:

- YES – The pressure observed on the status screen and the value displayed on the pressure gauge are approximately the same. However, the pressure is above the 7500 kPa (1089 psi) standby pressure limit. There is a problem with the operation of the main hydraulic pump.

  Repair: The standby pressure of the main hydraulic pump is above normal.

  Repeat this test step in order to ensure that all of the listed conditions for testing are correct.

  If the main hydraulic pump standby pressure is still above normal, refer to the Testing and Adjusting, RENR8482 service manual for more information for troubleshooting the hydraulic pump.

  STOP.

- NO – The pressure value displayed on the Cat ET status screen and the value displayed on the pressure gauge are not approximately the same. The Cat ET status screen is indicating a higher value than the pressure indicated on the gauge.

  There is a problem with the pressure sensor or in the circuit of the pressure sensor.Proceed to Test Step 2.

Test Step 2. CHECK THE SENSOR

A. Turn the key start switch to the OFF position.

B. Disconnect the machine harness connector from the pressure sensor.

C. Turn the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the sensor.

Expected Result:

The active CID 0597 FMI 14 diagnostic code changed to an active CID 0597 FMI 03 diagnostic code after disconnecting the sensor from the machine harness.

Results:

- YES – The active CID 0597 FMI 14 diagnostic code changed to an active CID 0597 FMI 03 diagnostic code after disconnecting the sensor from the machine harness. The sensor is causing the problem.

  Repair: Replace the main hydraulic pump discharge pressure sensor. After the sensor is replaced, verify that the problem has been corrected before operating the machine.

  STOP.

- NO – The status of the active CID 0597 FMI 14 diagnostic code did not change when the sensor was disconnected from the machine harness. The sensor is not causing the problem.Proceed to Test Step 3.

Test Step 3. CHECK THE SENSOR CIRCUIT AT THE ECM

The key start switch remains in the ON position. The engine is not running.

A. Reconnect the machine harness connector to the pressure sensor. Verify that the CID 0597 FMI 14 diagnostic code is active.

B. At the machine harness connector for the Implement ECM J1, use a 151-6320 Removal Tool to remove the signal wire N931-GY(Grey) and the socket at contact J1-36 from the J1 connector. The machine harness connector J1 remains connected to the Implement ECM.

C. Observe the status of the CID 0597 FMI 14 diagnostic code after the signal wire is removed from the J1 connector.

Expected Result:

The active CID 0597 FMI 14 diagnostic code changed to an active CID 0597 FMI 03 diagnostic code after removing the signal wire of the sensor from the J1 connector.

Results:

- YES – The active CID 0597 FMI 14 diagnostic code changed to an active CID 0597 FMI 03 diagnostic code after removing the signal wire of the sensor from the J1 connector. The ECM is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector J1 for the ECM before proceeding to the next test step.Proceed to Test Step 4.

- NO – The status of the active CID 0597 FMI 14 diagnostic code did not change when the sensor signal wire was removed from the machine harness J1 connector for the ECM. The ECM may have failed.

  Repair: Reconnect the signal wire and the socket in the machine harness connector J1 for the ECM. Repeat this test step in order to verify that the ECM is the cause of the problem.

  If the ECM is still activating the CID 0597 FMI 14 diagnostic code after removing the signal wire of the pressure sensor from the J1 connector, the Implement ECM has failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE SIGNAL CIRCUIT OF THE SENSOR FOR A SHORT

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the machine harness connector from the sensor.

C. Disconnect the machine harness connector J1 and J2 from the Implement ECM and from the Implement ECM 2.

D. At the harness connector J1 for the Implement ECM, measure the resistance from signal contact J1-36 (wire N931-GY(Grey)) to all of the other contacts that are used for the J1 and J2 connectors on the Implement ECM and the Implement ECM 2.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted to another circuit in the machine harness.Proceed to Test Step 5.

- NOT OK – One or more resistance of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The signal wire of the sensor N931-GY(Grey) is shorted to the circuit with the low resistance measurement in the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in the circuits for potential shorted locations in the machine harness. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 0597 FMI 14 diagnostic code is active.

Expected Result:

The CID 0597 FMI 14 diagnostic code is not active.

Results:

- YES – The CID 0597 FMI 14 diagnostic code is not active. The problem has been corrected.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NO – The CID 0597 FMI 14 diagnostic code is still active. The problem has not been corrected.

  Repair: Perform this test step again. If the problem has not been corrected, proceed with the following process. Use a Caterpillar Electronic Technician service tool and perform a wiggle test on the sensor circuit for the machine wiring harness of the machine. The wiggle test can be used to detect momentary short circuit connections. The wiggle test can also be used to detect open connections in the machine wiring harness.

  If a problem is not found in the machine harness, replace the pressure sensor. If the problem is still present after replacement of the sensor, the Implement ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02954760

MID 082 - CID 0600 - FMI 03

SMCS Code: 509T-038

Conditions Which Generate This Code:

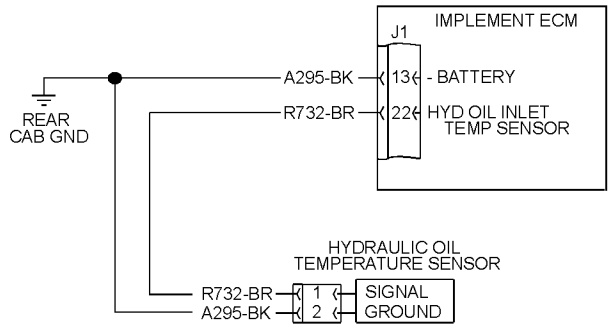


Illustration 213 g01267914

Connections of the Hydraulic Oil Temperature Sensor

This diagnostic code is associated with the hydraulic oil temperature sensor. The FMI 03 means that the Implement ECM has determined that the voltage of the sensor circuit is above normal.

The temperature sensor provides a resistive voltage input signal to the ECM. The ECM will calculate the temperature of the hydraulic oil according to the value of the input signal. The operating range of the sensor is from 4.9 VDC at −40 °C (−40.0 °F) to 0.18 VDC at 150 °C (302.0 °F). The Implement ECM will activate the FMI 03 diagnostic code if the input signal from the sensor is 5.0 VDC or greater.

The possible causes of this diagnostic code are listed below:

- There is an open in the sensor circuit.
- The signal circuit for the sensor is shorted to another voltage source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SENSOR CIRCUIT FOR AN OPEN CIRCUIT

The machine harness remains disconnected from the sensor.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the machine harness connector for the sensor, connect a jumper wire from the signal contact 1 (wire R732-BR(Brown)) to the return contact 2 (wire A295-BK(Black)).

C. Disconnect the machine harness connector J1 from the ECM.

D. At the machine harness connector J1 for the ECM, measure the resistance from return contact J1-13 (wire A295-BK(Black)) to signal contact J1-22 (wire R732-BR(Brown)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The harness is correct.Proceed to Test Step 2.
- NOT OK – The resistance is greater than 5 ohms. There is an open or a bad connection in the sensor circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit and the return circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE SENSOR CIRCUIT FOR A SHORT

The machine harness connector remains disconnected from the sensor. The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire that was installed in the previous step.

B. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness connector for the ECM, measure the resistance from the signal contact J1-22 (wire R732-BR(Brown)) to all of the other contacts that are used in the machine harness connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more resistance measurements is not correct. There is a short in the machine harness.

  Repair: The short is between the signal circuit R732-BR(Brown) and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK OPERATION OF THE ECM

The machine harness connector remains disconnected from the sensor. The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors remain disconnected from the ECM.

A. At the disconnected machine harness connector of the Implement ECM J1, use a 151-6320 Removal Tool to remove the signal wire R732-BR(Brown) and the socket at contact J1-22 from the J1 connector.

B. Reconnect the machine harness connectors J1 and J2 to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-22 through the empty space in the J1 connector.

E. Observe the status of the active CID 0600 FMI 03 diagnostic code. Ground the other end of the 7X-1710 Multimeter Probe to ground location on the frame of the machine.

Expected Result:

The active CID 0600 FMI 03 diagnostic code is no longer active. A CID 0600 FMI 04 diagnostic code becomes active when the ECM pin at J1-22 is grounded.

Results:

- YES – The CID 0600 FMI 03 diagnostic code is no longer active. A CID 0600 FMI 04 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the sensor circuit. It is likely that the problem is not being caused by the ECM. Reconnect the signal wire and the socket in the machine harness connector J1 for the ECM before proceeding to the next test step.Proceed to Test Step 4.

- NO – The CID 0600 FMI 03 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the sensor is grounded.

  Repair: Reconnect the signal wire and the socket in the machine harness connector J1 for the ECM. Repeat this test step in order to verify that the ECM is the cause of the problem.

  If the CID 0600 FMI 03 diagnostic code is still active, the Implement ECM has failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 0600 FMI 03 diagnostic code.

Expected Result:

The CID 0600 FMI 03 diagnostic code is active.

Results:

- YES – The CID 0600 FMI 03 diagnostic code is active. The problem has not been corrected.

  Repair: If the problem has not been corrected, use the Caterpillar Electronic Technician service tool in order to perform a wiggle test on the sensor circuit of the machine wiring harness. The wiggle test can be used in order to detect momentary short circuit connections. The wiggle test can also be used to detect open connections in the machine wiring harness.

  If the cause of the problem is not found, replace the temperature sensor. After the sensor is replaced, perform this test step again. If the problem is still present after replacement of the sensor, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. See the Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0600 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02859915

MID 082 - CID 0600 - FMI 04

SMCS Code: 509T-038

Conditions Which Generate This Code:

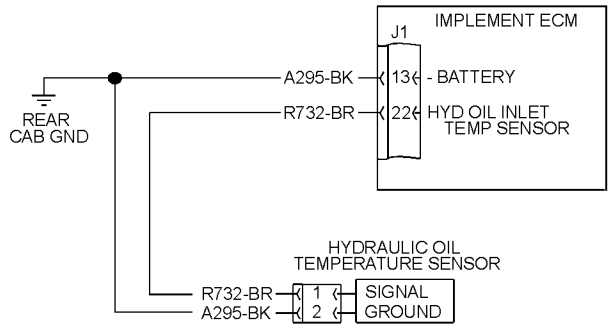


Illustration 214 g01267914

Connections of the Hydraulic Oil Temperature Sensor

This diagnostic code is associated with the hydraulic oil temperature sensor. The FMI 04 means that the Implement ECM has determined that the voltage of the sensor signal circuit is below normal.

The temperature sensor provides a resistive voltage input signal to the ECM. The ECM will calculate the temperature of the hydraulic oil according to the value of the input signal. The voltage input from the sensor will be around 4.9 VDC at −40 °C (−40.0 °F). The voltage input from the sensor will be around 0.18 VDC at 150 °C (302.0 °F). The ECM will activate the FMI 04 diagnostic code when the input signal from the sensor is 0.0 VDC.

The possible causes of this diagnostic code are listed below:

- The signal circuit for the sensor is shorted to ground.
- The sensor has failed.
- The machine ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Ensure that the diagnostic code is active.

C. Observe the status of the diagnostic code. Disconnect the sensor from the machine harness.

Expected Result:

The CID 0600 FMI 04 diagnostic code changes to an CID 0600 FMI 03 diagnostic code when the sensor is disconnected from the machine harness.

Results:

- YES – The CID 0600 FMI 04 diagnostic code changes to an CID 0600 FMI 03 diagnostic code when the sensor is disconnected from the machine harness. The sensor has failed.

  Repair: The sensor is causing the problem. Replace the temperature sensor.

  STOP.

- NO – Disconnecting the sensor from the machine harness did not change the status for the active diagnostic code. The CID 0600 FMI 04 diagnostic code is still active. The sensor is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE SENSOR CIRCUIT FOR A SHORT

The sensor remains disconnected from the machine harness.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 and J2 from the Implement ECM.

C. At the machine harness connector for the ECM, measure the resistance from the signal contact J1-22 (wire R732-BR(Brown)) to frame ground. Measure the resistance from the signal contact J1-22 (wire R732-BR(Brown)) to all of the contacts that are used in the machine harness connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The short is between signal wire R732-BR(Brown) and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The key start switch and the disconnect switch remain in the OFF position. The machine harness connector for the sensor and the ECM connectors remain disconnected.

A. At the machine harness connector of the ECM J1, use a 151-6320 Removal Tool to remove the energize wire of the solenoid R732-BR(Brown) and the socket at contact J1-22 from the harness connector.

B. Reconnect the machine harness connectors J1 and J2 to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Observe the status of the CID 0600 FMI 04 diagnostic code.

Expected Result:

The CID 0600 FMI 04 diagnostic code is no longer active. A CID 0600 FMI 03 diagnostic code becomes active when the wire R732-BR(Brown) at J1-22 is disconnected from the ECM connector.

Results:

- YES – The CID 0600 FMI 04 diagnostic code is no longer active. A CID 0600 FMI 03 diagnostic code becomes active when the wire R732-BR(Brown) at J1-22 is disconnected from the ECM connector. The ECM has responded correctly to the open circuit condition in the sensor circuit. Most likely cause of the problem is not the ECM.Reinstall the disconnected sensor signal wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 4.
- NO – The CID 0600 FMI 04 diagnostic code remains active. The status of the active diagnostic code does not change when the sensor wire is disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the sensor circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 0600 FMI 04 diagnostic code.

Expected Result:

The CID 0600 FMI 04 diagnostic code is active.

Results:

- YES – The CID 0600 FMI 04 diagnostic code is active. The problem has not been corrected.

  Repair: If the problem has not been corrected, use the Caterpillar Electronic Technician service tool in order to perform a wiggle test on the sensor circuit in the machine wiring harness. The wiggle test can detect intermittent short circuits. The wiggle test can also detect open connections in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. See the Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 0600 FMI 04 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i05761849

MID 082 - CID 0615 - FMI 02

SMCS Code: 4806-038

Conditions Which Generate This Code:

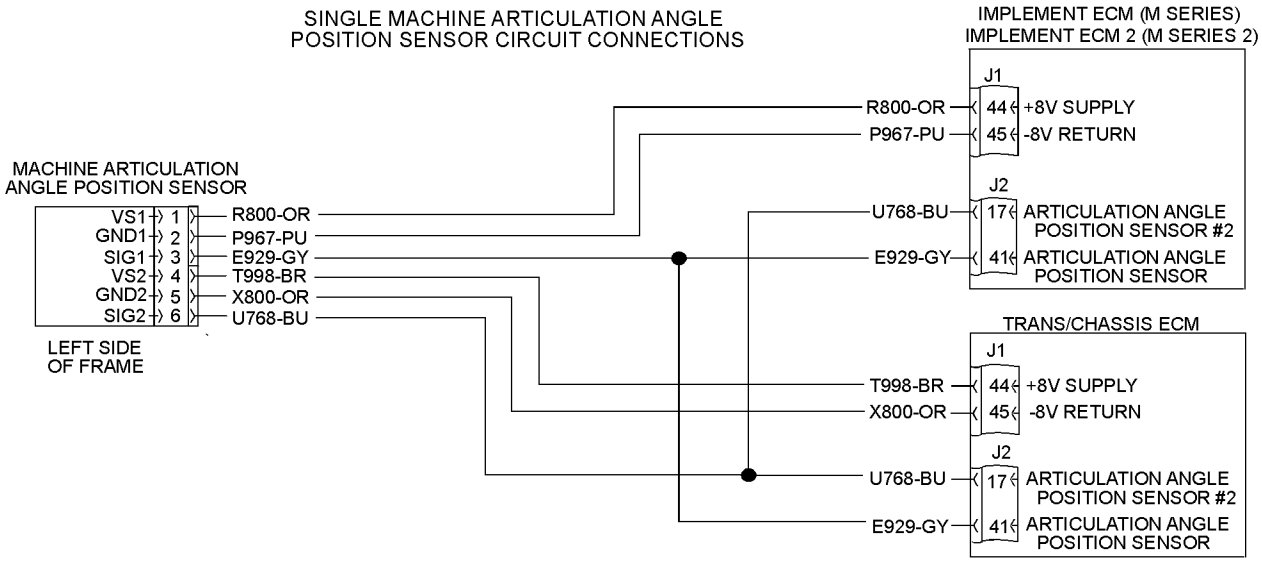


Illustration 215 g03656401

Connections for the Single Machine Articulation Angle Position Sensor 1 with two outputs

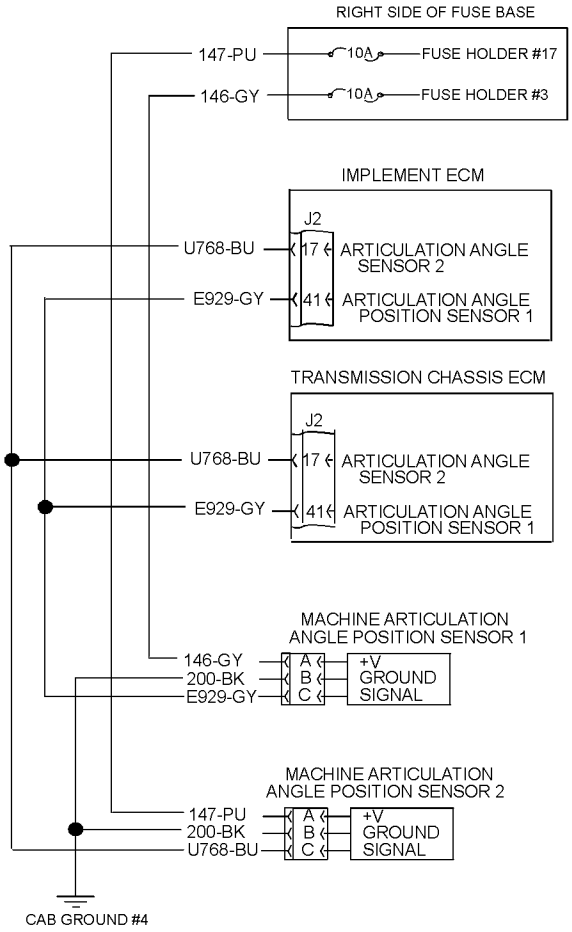


Illustration 216 g03665278

Connections of the number one sensor and number two sensor for the Angle of Machine Articulation

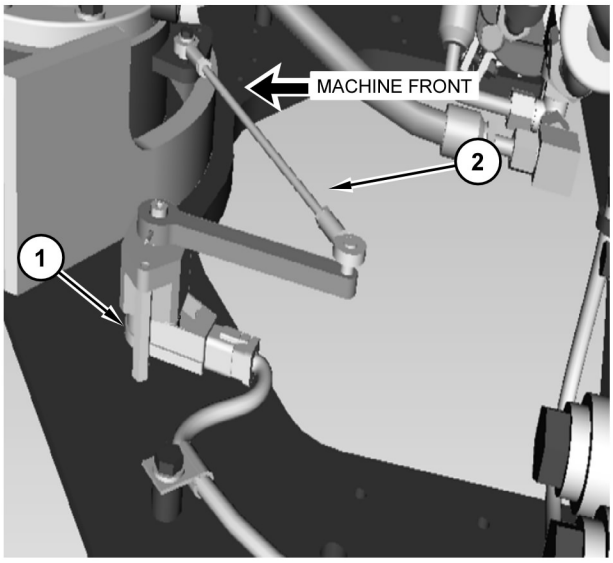


Illustration 217 g03236020

"Machine Articulation Angle Position" Sensor location (View from the left side of the machine at the articulation hitch)

(1) Articulation angle sensor
(2) Mechanical linkage

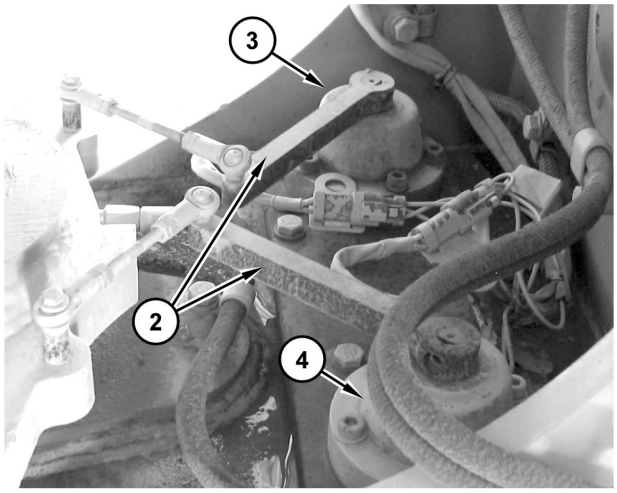


Illustration 218 g03665280

Location of the position sensor for the angle of the machine articulation

The view is from the left side of machine and the covers are removed.

(1) Articulation angle sensor 1
(2) Articulation angle sensor 2
(3) Mechanical linkage

Two articulation angle signals are required for the correct operation of the articulation of the machine. Either the two separate sensors or the dual output sensor will provide a PWM input to the Transmission/ Chassis ECM and the Implement ECM.

This diagnostic code is associated with the “machine articulation angle sensor signal 1” connected to each ECM at J2-41. The FMI 02 means that the ECM has determined that the input data from the sensor is erratic, intermittent, or incorrect. Either the Implement ECM or the Transmission/Chassis ECM or both ECM modules can activate this diagnostic code.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the input of the duty cycle from the sensor to the ECM is approximately 51% for the model 16M, approximately 54% for the model 14M and approximately 55% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models.

The possible causes of this diagnostic code are listed below:

- Mechanical devices are loose or mechanical devices are not adjusted correctly.
- There is an Intermittent connection or a poor connection in the circuit.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “articulation sensor 1” . Both ECM modules can activate a CID 0615 FMI 02 diagnostic code when an erratic signal or an intermittent signal is detected. If one ECM has activated a CID 0615 FMI 02 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor or a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL LINKAGE

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight and that all components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and adjustment components for the articulation sensor(s) are in good condition and that no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensor is correct. Proceed to Test Step 2.

- NOT OK – All mechanical linkage and adjustment for the articulation sensor is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensor(s). After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK FOR POWER AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Do not disconnect the harness connector from the sensor.

C. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along supply contact 1 (wire R800-OR(Orange)) and along return contact 2 (wire P967-PU(Purple)).

D. Turn the key start switch and the disconnect switch to the ON position.

E. Measure the voltage from contact 1 to contact 2.

Expected Result:

The voltage measurement is 8 ± 0.5 VDC.

Results:

- OK – The voltage measurement is 8 ± 0.5 VDC. The power supply circuit is correct.Proceed to Test Step 3.

- NOT OK – The voltage measurement is not 8 ± 0.5 VDC. The power supply circuit is not correct.

  Repair: There is a problem between the sensor circuit and the 8 VDC power supply circuit of the Implement ECM. Refer to the complete Electrical System Schematic of the machine. Check all of the connections that are in the power supply circuit and the return circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL OF THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the back of the harness connector for the sensor, remove the multimeter probe from contact 1 (wire R800-OR(Orange)) and insert the probe along the signal contact 3 (wire E929-GY(Grey)).

C. The multimeter probe along return contact 2 (wire P967-PU(Purple)) remains in place.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Monitor the signal of the sensor with a digital multimeter. When possible monitor the signal from the cab of the machine in order to maintain a safe distance from the articulation point of the machine.

Note: The steering frame lock must be disconnected in order to articulate the machine. Ensure that all technicians at work in the immediate area are aware that the machine will be articulated during the check of the sensor.

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

F. Without disconnecting the sensor or the hardware that is associated with the sensor from the machine, take the sensor through the full operating range of the sensor.

G. Connect the steering frame lock link between the front and rear frames of the machine.

Expected Result:

The sensors signal responds in the manner that is described at the beginning of this procedure.

Results:

- OK – The sensors signal responds correctly. The sensor is operating correctly. Proceed to Test Step 4.

- NOT OK – The sensors signal does not respond correctly. The sensor is not operating correctly.

  Repair: Replace the “articulation angle 1” sensor. After the replacement of the sensor, the

sensor must be calibrated. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

STOP.

Test Step 4. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

The key start switch and the disconnect switch remain in the OFF position.

A. Disconnect the machine harness connector from the sensor.

B. At the machine harness connector for the sensor, place the jumper wire between return contact 2 (wire P967-PU(Purple)) and signal contact 3 (wire E929-GY(Grey)).

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

D. At the machine harness connectors of the Implement ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-41 (wire E929-GY(Grey)).

E. While observing the resistance measurement, wiggle the connector of the ECM and the connector of the sensor. Gently pull on the wires and move the wires around for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness.

Results:

- OK – The resistance measurement is less than 5 ohms. The resistance measurement is not indicating an open in the circuit.Proceed to Test Step 6.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: If both of the ECM modules have activated this diagnostic code, there is most likely an open or a bad connection on the sensor side of the machine harness splice connection for the signal wire.

  If only the Implement ECM activates this diagnostic code, there is most likely an open or a bad connection on the ECM side of the machine harness splice connection for the signal wire.

  In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspect section of the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE OPERATION OF THE ECM

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors for the sensor and both the Implement ECM and the Transmission/Chassis ECM remain disconnected.

Note: This check should be performed on the ECM that has activated the diagnostic code. If both of the ECM modules have activated the diagnostic code, perform this check on both of the ECM modules.

A. At the machine harness connector J2 for the ECM, use a 151 - 6320 Removal Tool to remove the sensor signal wire E929-GY(Grey) and the socket at contact J2-41 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Observe the status of the active CID 0615 FMI 02 diagnostic code.

Expected Result:

The CID 0615 FMI 02 diagnostic code is no longer active. A CID 0615 FMI 03 diagnostic code is now active.

Results:

- YES – The CID 0615 FMI 02 diagnostic code is no longer active. A CID 0615 FMI 03 diagnostic code is active after the sensor signal wire is disconnected. The ECM has responded correctly to the open circuit condition in the sensor circuit. Reinstall the sensor signal wire into the correct spot of the ECM connector. Proceed to the next test step. Proceed to Test Step 6.
- NO – The CID 0615 FMI 03 diagnostic code remains active. The status of the active diagnostic code does not change when the sensor signal wire is disconnected from the ECM.

Repair: The ECM has not responded correctly to the open condition in the sensor circuit. The operation of the ECM is not correct.

Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

Test Step 6. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) Pull Test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 0615 FMI 02 diagnostic code.

Expected Result:

The CID 0615 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 0615 FMI 02 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Remove “steering frame lock link” and resume normal operation.

  STOP.

- NOT OK – The CID 0615 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, replace the sensor. After the replacement of the sensor, the sensor must be calibrated. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  If the problem is still present after the replacement of the sensor, the ECM may have failed. This is unlikely as the ECM responded correctly to the condition change in the previous test step.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM that activated the diagnostic code.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05761777

MID 082 - CID 0615 - FMI 03

SMCS Code: 4806-038

Conditions Which Generate This Code:

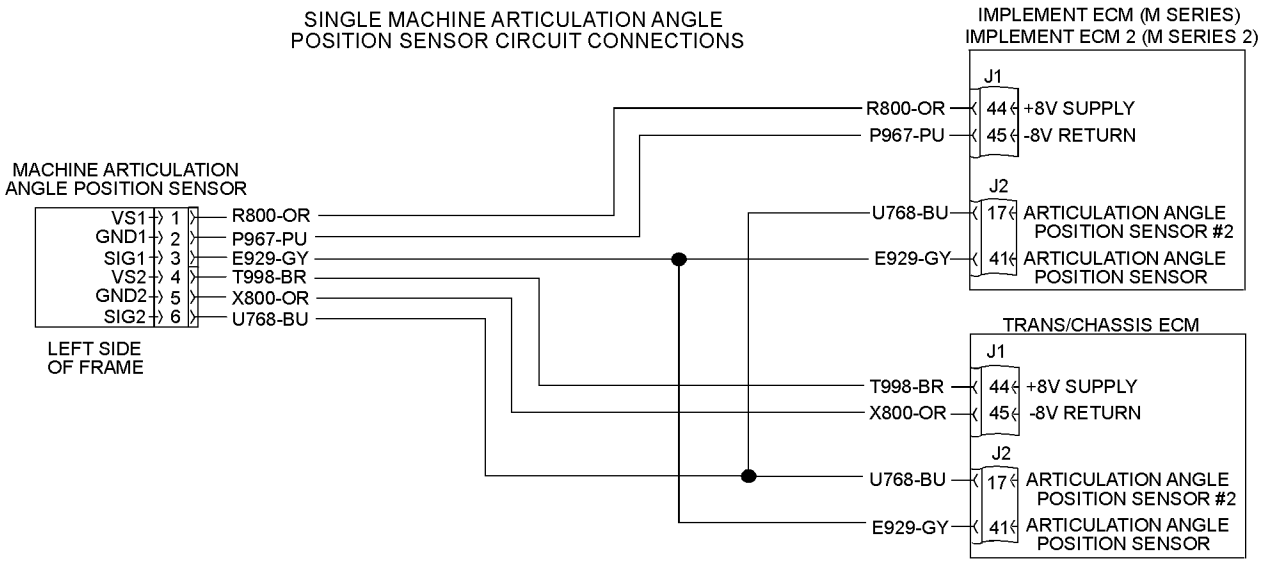


Illustration 219 g03656371

Connections for the Single Machine Articulation Angle Position Sensor 1 with two outputs

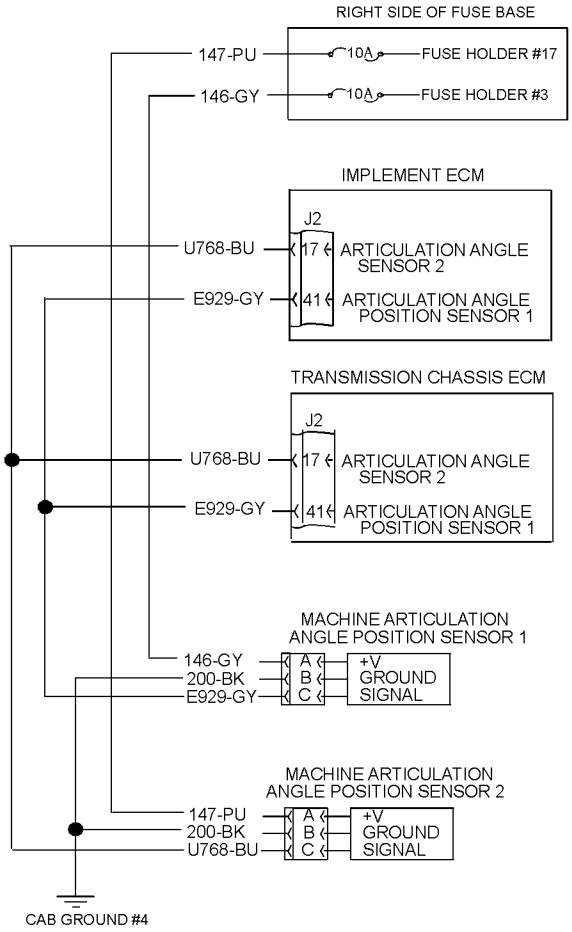


Illustration 220 g03665281

Connections of the number one sensor and number two sensor for the Angle of Machine Articulation

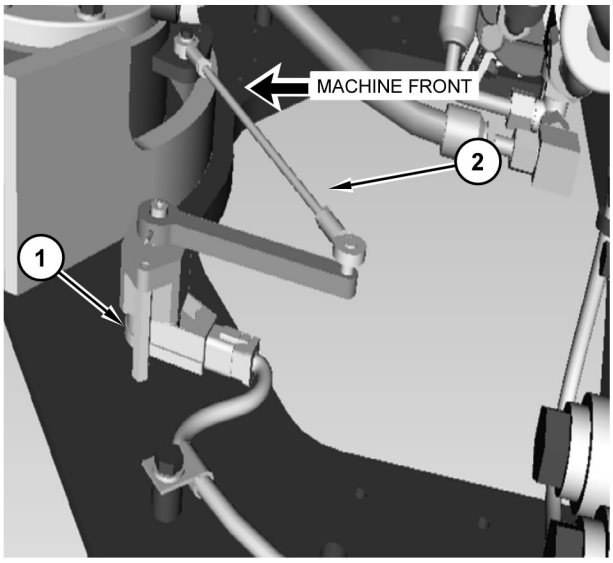


Illustration 221 g03236020

"Machine Articulation Angle Position" Sensor location (View from the left side of the machine at the articulation hitch)

(1) Articulation angle sensor
(2) Mechanical linkage

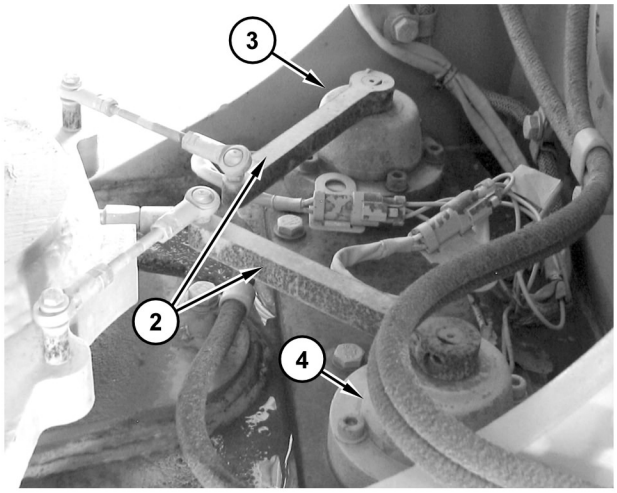


Illustration 222 g03665282

Location of the position sensor for the angle of the machine articulation

The view is from the left side of machine and the covers are removed.

(1) Articulation angle sensor 1
(2) Articulation angle sensor 2
(3) Mechanical linkage

Two articulation angle signals are required for the correct operation of the articulation of the machine . Either the two separate sensors or the dual output sensor will provide a PWM input to the Implement ECM and the Transmission/Chassis ECM.

The FMI 03 diagnostic code is active when the ECM reads the input signal from the machine “articulation angle sensor signal 1” connected to each ECM at J2-41 and the voltage of the signal is above normal. Either the Implement ECM or the Transmission/Chassis ECM or both ECM modules can activate this diagnostic code.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the duty cycle of the sensor is approximately 51% for the model 16M, approximately 54% for the model 14M and approximately 55% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models.

The possible causes of this diagnostic code are listed below:

- The power supply circuit of the sensor is open.
- The return circuit is open.
- The signal circuit is open or the sensor is disconnected.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the 8 VDC sensor power supply of the Implement ECM. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “articulation sensor signal 1” . Both ECM modules can activate a CID 0615 FMI 03 diagnostic code when an above normal voltage signal is detected. If one ECM has activated a CID 0615 FMI 03 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor or a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL LINKAGE

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight and that all mechanical components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and adjustable components for the articulation sensor(s) are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensor is correct. Proceed to Test Step 2.
- NOT OK – All mechanical linkage and adjustment for the articulation sensors is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensor(s). After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SUPPLY VOLTAGE AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Do not disconnect the harness connector from the sensor.

C. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along contact 1 (wire R800-OR(Orange)) (supply). Insert a multimeter probe along return contact 2 (wire P967-PU(Purple)).

D. Turn the key start switch and the disconnect switch to the ON position.

E. Measure the voltage from contact 1 to contact 2.

Expected Result:

The voltage measurement is 8.0 ± 0.5 VDC.

Results:

- OK – The voltage measurement is 8.0 ± 0.5 VDC. The power supply circuit is correct.Proceed to Test Step 3.
- NOT OK – The voltage measurement is not 8.0 ± 0.5 VDC. The power supply circuit is not correct.

  Repair: There is a problem between the sensor and the 8 VDC power supply of the Implement ECM. Refer to the complete Electrical System Schematic of the machine. Check all of the connections that are in the power supply circuit and the return circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

The key start switch and the disconnect switch remain in the OFF position.

A. Disconnect the machine harness connector from the sensor.

B. At the machine harness connector for the sensor, connect a jumper wire between return contact 2 (wire P967-PU(Purple)) and signal contact 3 (wire E929-GY(Grey)).

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

D. At the machine harness connectors of the Implement ECM, measure the resistance from contact J1-45 (wire P967-PU(Purple)) (return) to contact J2-41 (wire E929-GY(Grey)) (signal).

E. Simultaneously observe the resistance measurement and wiggle the ECM connector and the sensor connector. Gently pull on the wires and move the wires around for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness.

Results:

- OK – The resistance measurement is less than 5 ohms. The resistance measurement is not indicating an open in the circuit.Proceed to Test Step 4.
- NOT OK – One or both of the resistance measurements is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: If both of the ECM modules have activated this diagnostic code, there is most likely an open or a bad connection on the sensor side of the machine harness splice connection for the signal wire.

If only the Implement ECM has activated this diagnostic code, there is most likely an open or a bad connection on the ECM side of the machine harness splice connection for the signal wire.

In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspect section of the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The harness connectors of the Implement ECM remain disconnected from the machine harness.

A. Remove the jumper wire that was installed in the last step.

B. Disconnect the machine harness connectors J1 and J2 from the Transmission/Chassis ECM.

C. At the J1 and J2 machine harness connectors for the Implement ECM, measure the resistance from the sensor signal contact J2-41 (wire E929-GY(Grey)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

D. At the J1 and J2 machine harness connectors for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-41 (wire E929-GY(Grey)) to all of the other J1 and J2 contacts that are used for the Transmission/Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted. Proceed to Test Step 5.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE SIGNAL OF THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Reconnect the harness connectors J1 and J2 to the connectors of the Implement ECM and to the connectors of the Transmission/Chassis ECM.

B. Reconnect the harness connector to the sensor.

C. At the back of the harness connector for the sensor, insert the multimeter probe along contact 2 (wire P967-GY(Grey)) and insert the probe along the signal contact 3 (wire E929-GY(Grey)).

D. Turn the disconnect switch and the key start switch to the ON position.

E. Monitor the signal of the sensor with a digital multimeter. When possible monitor the signal from the cab of the machine in order to maintain a safe distance from the articulation point of the machine.

Note: The steering frame lock must be disconnected in order to articulate the machine. Ensure that all technicians at work in the immediate area are aware that the machine will be articulated during the check of the sensor.

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

F. Without disconnecting the sensor or the hardware that is associated with the sensor from the machine, take the sensor through the full operating range of the sensor.

G. Connect the steering frame lock link between the front and rear frames of the machine.

Expected Result:

The sensors signal responds in the manner that is described at the beginning of this procedure.

Results:

- OK – The sensors signal responds correctly. The sensor is operating correctly. Proceed to Test Step 6.
- NOT OK – The sensors signal does not respond correctly. The sensor is NOT operating correctly.

  Repair: Replace the “articulation angle 1” sensor. After replacement of the sensor, the sensor must be calibrated. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  STOP.

Test Step 6. CHECK THE OPERATION OF THE ECM

Note: This check should be performed on the ECM that has activated the diagnostic code. If both of the ECM modules have activated the diagnostic code, perform this check on both of the ECM modules.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the sensor signal wire E929-GY(Grey) and the socket at contact J2-41 from the harness connector. The J2 connector remains connected to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J2-41 through the empty space in the J2 connector.

E. Observe the status of the active CID 0615 FMI 03 diagnostic code and simultaneously ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 0615 FMI 03 diagnostic code is no longer active. A CID 0615 FMI 04 diagnostic code becomes active when the ECM pin at J2-41 is grounded.

Results:

- YES – The CID 0615 FMI 03 diagnostic code is no longer active. A CID 0615 FMI 04 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. Most likely the cause of the problem is not the ECM. Most likely the ECM is not the cause of the problem. Reinstall the disconnected sensor signal wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 7.
- NO – The CID 0615 FMI 03 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the sensor signal is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the sensor circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 7. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) Pull Test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 0615 FMI 03 diagnostic code is active.

Expected Result:

The CID 0615 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 0615 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 0615 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician service tool in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect intermittent short circuits. The wiggle test can also be used to detect open connections in the machine wiring harness.

  If the cause of the active diagnostic code is not found, replace the sensor. After replacement of the sensor, the sensor must be calibrated. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  If the problem is still present after the replacement of the sensor, the ECM may have failed. A failure of the ECM is unlikely as the ECM responded correctly to the condition change in the previous test step.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05761772

MID 082 - CID 0615 - FMI 04

SMCS Code: 4806-038

Conditions Which Generate This Code:

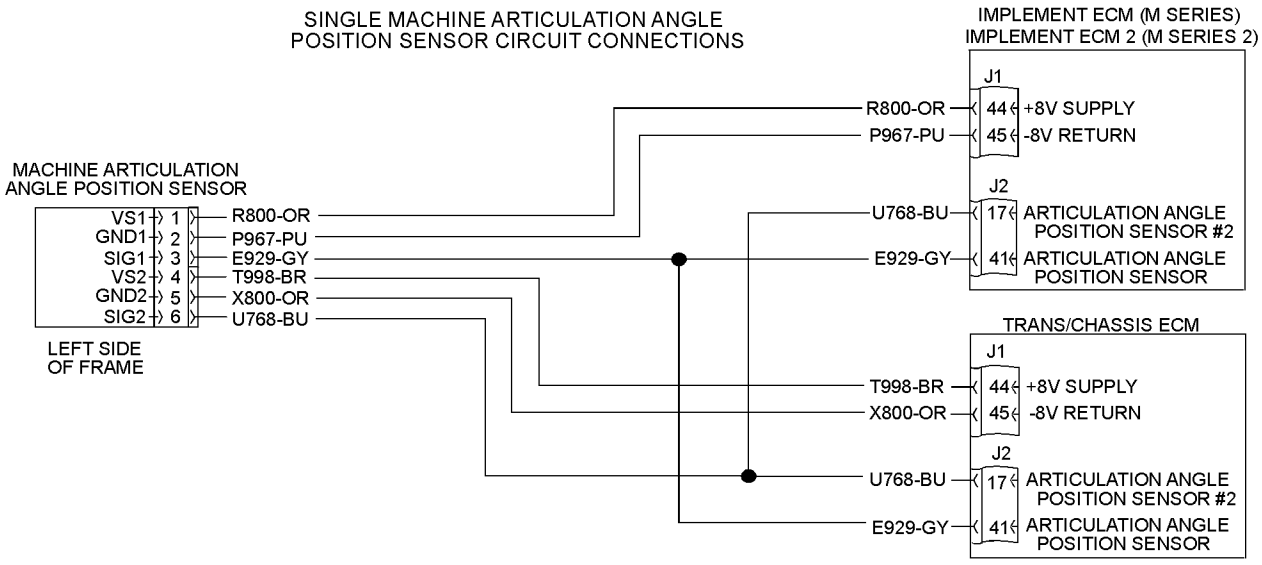


Illustration 223 g03656369

Connections for the Single Machine Articulation Angle Position Sensor 1 with two outputs

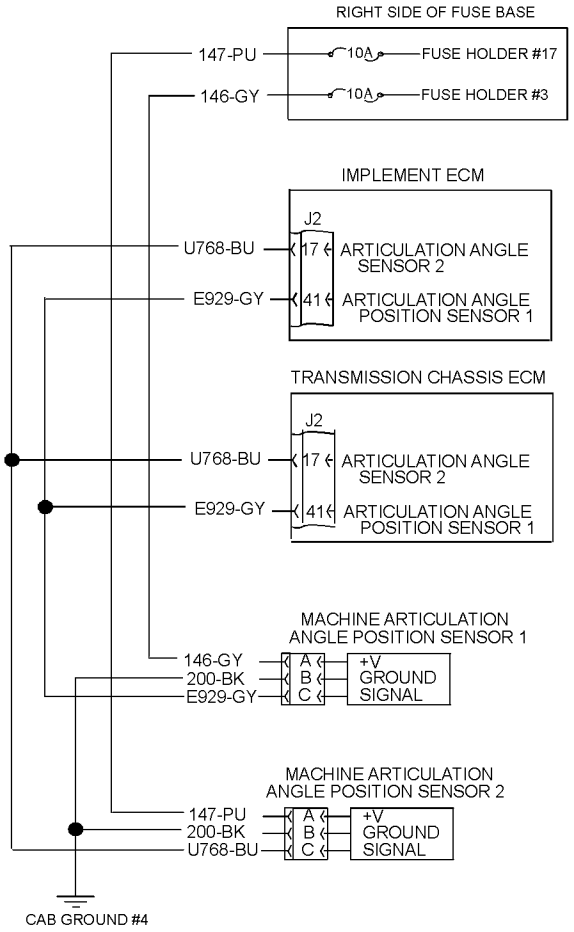


Illustration 224 g03665283

Connections of the number one sensor and number two sensor for the Angle of Machine Articulation

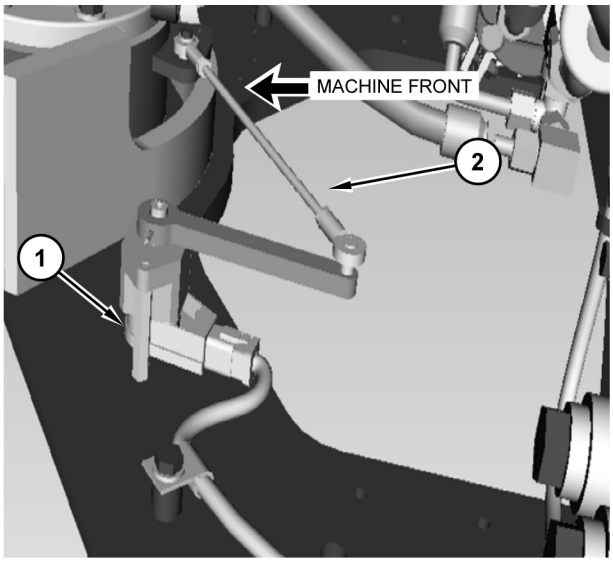


Illustration 225 g03656370

"Machine Articulation Angle Position" Sensor location (View from the left side of the machine at the articulation hitch)

(1) Articulation angle sensor
(2) Mechanical linkage

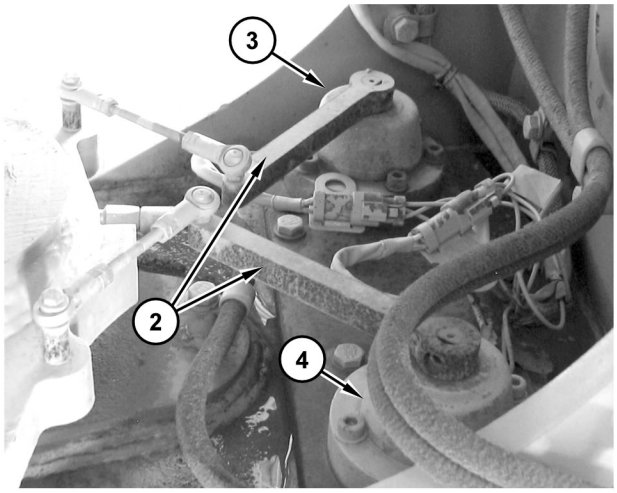


Illustration 226 g03665304

Location of the position sensor for the angle of the machine articulation

The view is from the left side of machine and the covers are removed.

(3) Articulation angle sensor 1
(4) Articulation angle sensor 2
(2) Mechanical linkage

Two articulation angle signals are required for correct operation of the articulation of the machine. Either the two separate sensors or the dual output sensor will provide a PWM input to the Implement ECM and the Transmission/Chassis ECM.

This diagnostic code is associated with the machine “articulation angle sensor signal 1” connected to each ECM at J2-41. The FMI 04 diagnostic code means that the ECM has detected that the voltage (signal) of the sensor is below normal. The Implement ECM or the Transmission Chassis ECM or both ECM modules can activate this diagnostic code.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the duty cycle input from the sensor to the ECM is approximately 51% for the model 16M, approximately 54% for the model 14M and approximately 55% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the articulation sensor signal 1. Both ECM modules can activate a CID 0615 FMI 04 diagnostic code when a below normal voltage signal is detected. If one ECM has an active CID 0615 FMI 04 diagnostic code and the other ECM does not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL LINKAGE

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight and that all mechanical components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and adjustable components for the articulation sensor(s) are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensor is correct. Proceed to Test Step 2.
- NOT OK – All mechanical linkage and adjustment for the articulation sensors is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensor(s). After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP. STOP

Test Step 2. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Ensure that the diagnostic code is active.

C. Observe the status of the diagnostic code and simultaneously disconnect the sensor from the machine harness.

Expected Result:

The CID 0615 FMI 04 diagnostic code is no longer active. A CID 0615 FMI 03 diagnostic code is now active.

Results:

- YES – The CID 0615 FMI 04 diagnostic code is no longer active. A CID 0615 FMI 03 diagnostic code is now active. The ECM and the circuit are correct. The position sensor is causing the problem.

  Repair: The sensor has failed. Replace the “articulation angle 1” sensor. After replacement of the sensor, the sensor must be calibrated. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  STOP.

- NO – The CID 0615 FMI 04 diagnostic code remains active. Disconnecting the sensor did not affect the status of the active diagnostic code. The position sensor is not causing the problem. Proceed to Test Step 3.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The sensor remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM and the Transmission/Chassis ECM.

D. At machine harness connector J2 for the Implement ECM, measure the resistance from contact J2-41 (wire E929-GY(Grey)) to frame ground. Measure the resistance from contact J2-41 (wire E929-GY(Grey)) all of the other contacts that are used in the machine harness connectors for the Implement ECM.

E. At machine harness connector J2 for the Transmission/Chassis ECM, measure the resistance from contact J2-41 (wire E929-GY(Grey)) to frame ground. Measure the resistance from contact J2-41 (wire E929-GY(Grey)) to all of the other contacts that are used in the machine harness connectors for the Transmission/Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 4.

- NOT OK – One or more of the resistance measurements is NOT correct. The machine harness has failed.

  Repair: There is a short in the machine harness between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE OPERATION OF THE ECM

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors for the sensor and both the Implement ECM and the Transmission/Chassis ECM remain disconnected.

Note: This check should be performed on the ECM that has activated the diagnostic code. If both of the ECM modules have activated the diagnostic code, perform this check on both of the ECM modules.

A. At the machine harness connector J2 for the ECM, use a 151 - 6320 Removal Tool to remove the sensor signal wire E929-GY(Grey) and the socket at contact J2-41 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Observe the status of the active CID 0615 FMI 04 diagnostic code.

Expected Result:

The CID 0615 FMI 04 diagnostic code is no longer active. A CID 0615 FMI 03 diagnostic code is now active.

Results:

- YES – The CID 0615 FMI 04 diagnostic code is no longer active. A CID 0615 FMI 03 diagnostic code is active after the sensor signal wire is disconnected. The ECM has responded correctly to the open circuit condition in the sensor circuit. Reinstall the disconnected sensor signal wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 5.

- NO – The CID 0615 FMI 04 diagnostic code remains active. The status of the active diagnostic code does not change when the sensor signal wire is disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the sensor circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) Pull Test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 0615 FMI 04 diagnostic code is active.

Expected Result:

The CID 0615 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 0615 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP. STOP

- NOT OK – The CID 0615 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician service tool in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect intermittent short circuits. The wiggle test can also detect open connections in the machine wiring harness.

  If the problem is still present the ECM may have failed. This is unlikely as the ECM responded correctly to the condition change in the previous test step.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05761853

MID 082 - CID 0615 - FMI 08

SMCS Code: 4806-038

Conditions Which Generate This Code:

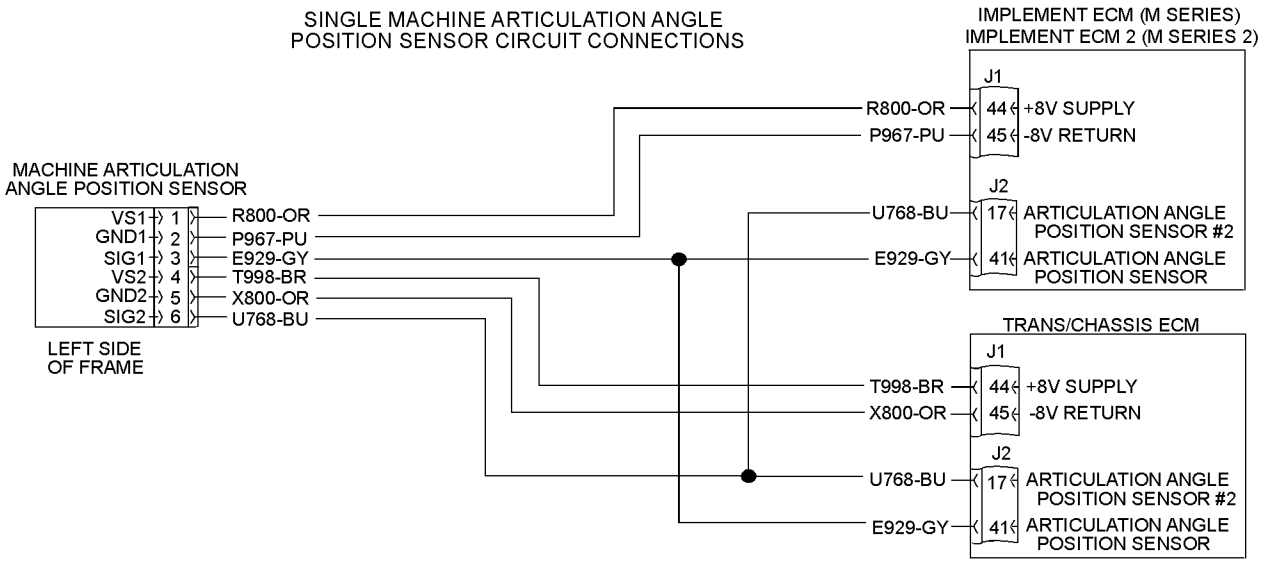


Illustration 227 g03656403

Connections for the Single Machine Articulation Angle Position Sensor 1 with two outputs

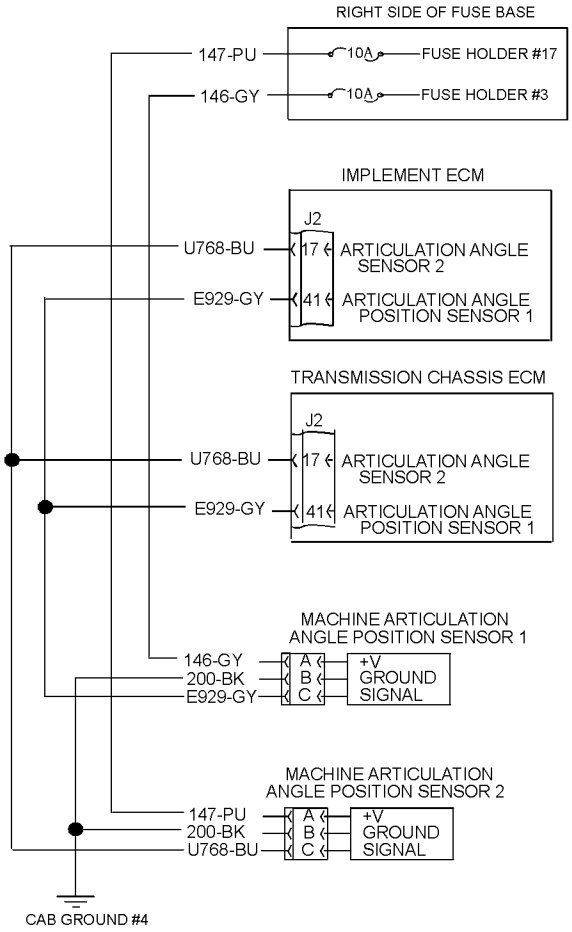


Illustration 228 g03665276

Connections of the number one sensor and number two sensor for the Angle of Machine Articulation

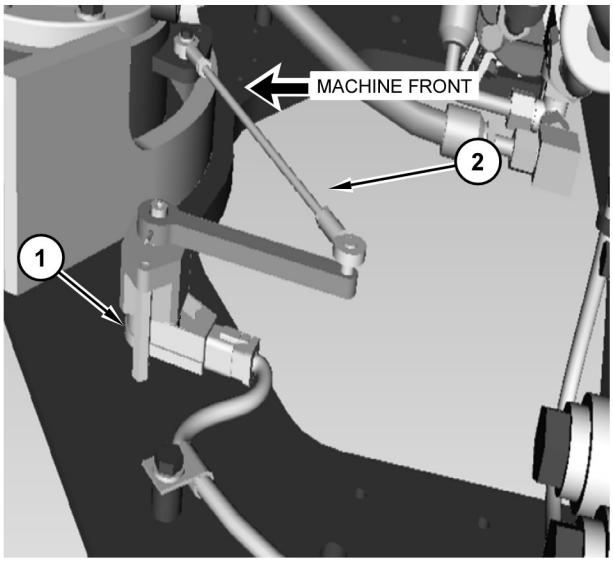


Illustration 229 g03661437

"Machine Articulation Angle Position" Sensor location (View from the left side of the machine at the articulation hitch)

(1) Articulation angle sensor
(2) Mechanical linkage

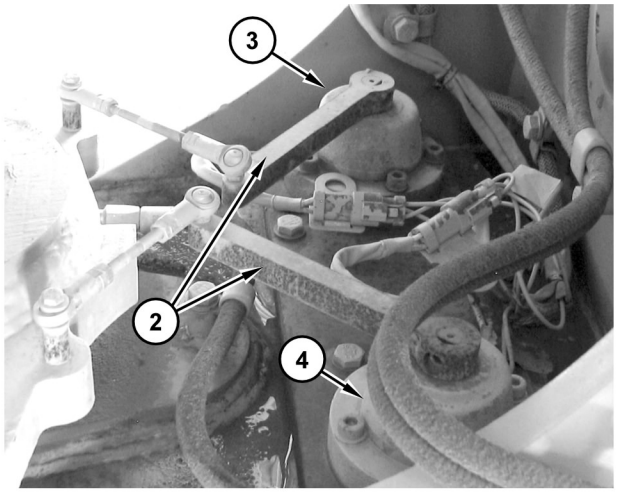


Illustration 230 g03665277

Location of the position sensor for the angle of the machine articulation

The view is from the left side of machine and the covers are removed.

(3) Articulation angle sensor 1
(4) Articulation angle sensor 2
(2) Mechanical linkage

Two articulation angle signals are required for the correct operation of the articulation of the machine. Either the two separate sensors or the dual output sensor will provide a PWM input to the Implement ECM and to the Transmission/Chassis ECM.

This diagnostic code is associated with the “machine articulation angle sensor signal 1” connected to each ECM at J2-41. The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range. Either the Implement ECM or the Transmission Chassis ECM or both ECM modules can activate this diagnostic code.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the duty cycle input from the sensor to the ECM is approximately 51% for the model 16M, approximately 54% for the model 14M and approximately 55% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models..

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- Mechanical devices are loose.
- The ECM has failed. An ECM failure is unlikely.

Before performing this procedure, check for an active CID 0041 diagnostic code for the 8 VDC sensor power supply of the Implement ECM. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the articulation sensor signal 1. Both ECM modules can activate a CID 0615 FMI 08 diagnostic code when the signal frequency or the signal pulse width is not within the expected range. If one ECM has an active CID 0615 FMI 08 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL LINKAGE

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight and that all mechanical components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and adjustable components for the articulation sensor(s) are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensor is correct. Proceed to Test Step 2.

- NOT OK – All mechanical linkage and adjustment for the articulation sensors is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensor(s). After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SIGNAL OF THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along return contact 2 (wire P967-PU(Purple)) and insert a probe along the signal contact 3 (wire E929-GY(Grey)).

C. Turn the disconnect switch and the key start switch to the ON position.

D. Monitor the signal of the sensor with a digital multimeter. When possible, monitor the signal from the cab of the machine in order to maintain a safe distance from the articulation point of the machine.

Note: The steering frame lock must be disconnected in order to articulate the machine. Ensure that all technicians at work in the immediate area are aware that the machine will be articulated during the check of the sensor.

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

E. Without disconnecting the sensor or the hardware that is associated with the sensor from the machine, take the sensor through the full operating range of the sensor.

F. Connect the steering frame lock link between the front and rear frames of the machine.

Expected Result:

The sensors signal responds in the manner that is described at the beginning of this procedure.

Results:

- OK – The signal of the sensor responds correctly. The sensor is operating correctly. Proceed to Test Step 3.

- NOT OK – The signal of the sensor does not respond correctly. The sensor is not operating correctly.

  Repair: Replace the “articulation angle 1” sensor. After the replacement of the sensor, the sensor must be calibrated. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  STOP.

Test Step 3. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

The key start switch and the disconnect switch remain in the OFF position.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the sensor.

C. At the machine harness connector for the sensor, connect a jumper wire between return contact 2 (wire P967-PU(Purple)) and signal contact 3 (wire E929-GY(Grey)).

D. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

E. At the machine harness connectors of the Implement ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-41 (wire E929-GY(Grey)).

F. Observe the resistance measurement and simultaneously wiggle the ECM connector and the sensor connector. Gently pull on the wires for both connectors. Wiggle the wires for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness.

Results:

- OK – The resistance measurement is less than 5 ohms. The resistance measurement is not indicating an open in the circuit.Proceed to Test Step 4.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: If both of the ECM modules have activated this diagnostic code, there is most likely an open or a bad connection on the sensor side of the machine harness splice connection for the signal wire.

  If only the Implement ECM has an active diagnostic code, there is most likely an open or a bad connection on the ECM side of the splice connections of the machine harness for the signal wire.

  In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspected section of the sensor signal circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE OPERATION OF THE ECM

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors for the sensor and the Implement ECM remain disconnected.

Note: This check should be performed on the ECM that has activated the diagnostic code. If both of the ECM modules have activated the diagnostic code, perform this check on both of the ECM modules.

A. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the sensor signal wire E929-GY(Grey) and the socket at contact J2-41 from the harness connector.

B. Reconnect the disconnected machine harness connectors to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Observe the status of the active CID 0615 FMI 08 diagnostic code.

Expected Result:

The CID 0615 FMI 08 diagnostic code is no longer active. A CID 0615 FMI 03 diagnostic code is now active.

Results:

- YES – The CID 0615 FMI 08 diagnostic code is no longer active. A CID 0615 FMI 03 diagnostic code is active after the sensor signal wire is disconnected. The ECM has responded correctly to the open circuit condition in the sensor circuit. Reinstall the disconnected sensor signal wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 5.
- NO – The CID 0615 FMI 08 diagnostic code remains active. The status of the active diagnostic code does not change when the sensor signal wire is disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the sensor circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors and make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 0615 FMI 08.

Expected Result:

The CID 0615 FMI 08 is not active.

Results:

- OK – The CID 0615 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a

poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

STOP.

- NOT OK – The CID 0615 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician service tool in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect intermittent short circuits. The wiggle test can also be used to detect open connections in the machine wiring harness.

  If the cause of the active diagnostic code is not found, replace the sensor. After the replacement of the sensor, verify that the new sensor corrected the problem. If the problem is still present after the replacement of the sensor, the ECM may have failed. This is unlikely as the ECM responded correctly to the condition change in the previous test step.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05039410

MID 082 - CID 0615 - FMI 13

SMCS Code: 4806-038

Conditions Which Generate This Code:

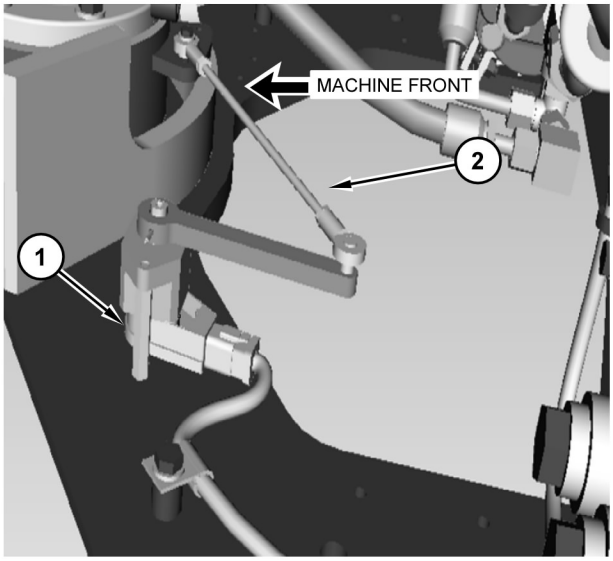


Illustration 231 g03236020

Location of the Position Sensor that control the Articulation Angle of the machine (View from the left side of the machine at the articulation hitch)

(1) Articulation angle sensor
(2) Mechanical linkage

Two articulation angle sensors are required for the correct operation of the articulation of the machine. Each sensor will provide a PWM signal to the ECM.

When the Implement ECM has detected that the signal from the “articulation angle sensor 1” is out of calibration, the FMI 13 diagnostic code is recorded. The Implement ECM and the Transmission/Chassis ECM can activate this diagnostic code.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the input of the duty cycle from the sensor to the ECM is approximately 51% for the model 16M, approximately 54% for the model 14M and approximately 55% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models.

Note: The power supply of the Implement ECM provides power to the sensor. The sensor does not connect directly to the frame ground. The sensor connects to the return circuit of the ECM. The ECM internally connects the return wire to frame ground. In order to correct this diagnostic code, calibrate the sensor.

Note: Verify that no other CID 0615 diagnostic codes are active. Any other active CID 0615 diagnostic codes must be investigated and the code must be cleared before performing this procedure. Prior to attempting the calibration of the articulation angle sensors a check of the mechanical linkage is highly recommended.

Test Step 1. CHECK THE MECHANICAL LINKAGE

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight and that all mechanical components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and adjustable components for the articulation sensors are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensors is correct. Proceed to Test Step 2.
- NOT OK – All mechanical linkage and adjustment for the articulation sensors is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensors. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CALIBRATION

A. Perform the calibration procedure for the sensor. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the sensor.

  If the second calibration procedure is not successful, replace the position sensor. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new sensor, the ECM may be faulty.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05761863

MID 082 - CID 0615 - FMI 14

SMCS Code: 4806-038

Conditions Which Generate This Code:

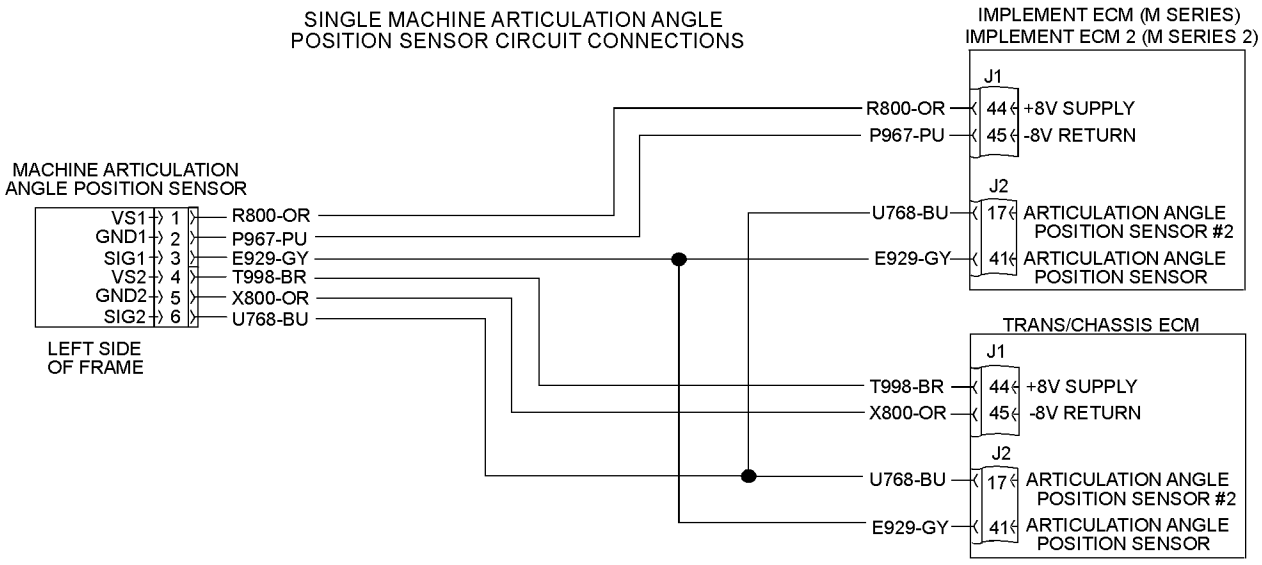


Illustration 232 g03656422

Connections for the Single Machine Articulation Angle Position Sensor 1 with two outputs

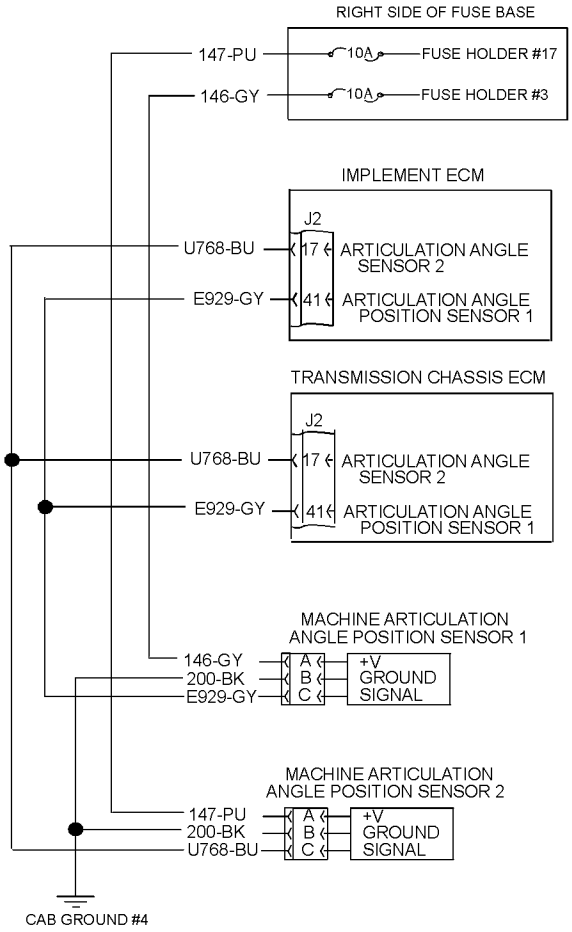


Illustration 233 g03665274

Connections of the number one sensor and number two sensor for the Angle of Machine Articulation

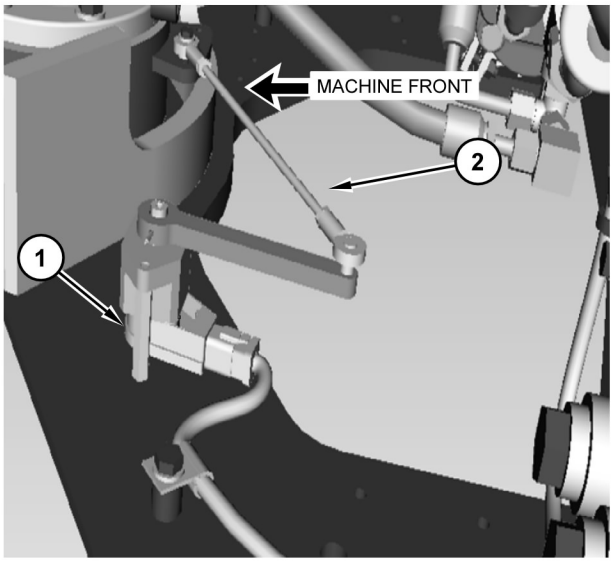


Illustration 234 g03236020

Machine “Articulation Angle Position” Sensor location (View from the left side of the machine at the articulation hitch).

(1) Articulation angle sensor
(2) Mechanical linkage

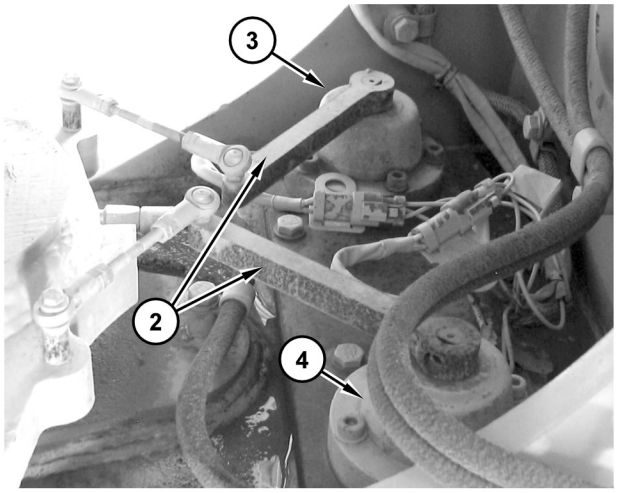


Illustration 235 g03665275

Location of the position sensor for the angle of the machine articulation

The view is from the left side of machine and the covers are removed.

(3) Articulation angle sensor 1
(4) Articulation angle sensor 2
(2) Mechanical linkage

Two articulation angle signals are required for correct operation of the articulation of the machine. Either the two separate sensors or the dual output sensor will provide a PWM input signal to the Implement ECM and the Transmission/Chassis ECM.

This diagnostic code is associated with the machine “articulation angle sensor signal 1” connected to each ECM at J2-41. The FMI 14 diagnostic code is recorded when the ECM determines that the signal from the sensor does not match the signal from machine “articulation angle sensor 2” .

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the duty cycle input from the sensor to the ECM is approximately 51% for the model 16M, approximately 54% for the model 14M and approximately 55% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models.

The possible causes of this diagnostic code are listed below:

- The mechanical linkage for the position sensor is not functioning correctly.
- The sensor calibrated.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, ensure that there are no active CID 0041 diagnostic codes relating to the 8 VDC power supply of the sensor. Ensure that the power supply for the angular sensor is correct.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL LINKAGE

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight and that all mechanical components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and adjustable components for the articulation sensor(s) are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensor is correct. Proceed to Test Step 2.
- NOT OK – All mechanical linkage and adjustment for the articulation sensors is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensor(s). After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CALIBRATE THE POSITION SENSOR

A. After the linkage for the sensor is verified to be correct, use the Caterpillar Electronic Technician service tool to perform the calibration procedure for the articulation angle sensor 1. Refer to Testing and Adjusting, “Calibrations” for information on access to the articulation sensor calibration procedure.

Expected Result:

The calibration procedure has been performed for the machine “articulation sensor 1” and the FMI 14 diagnostic code is no longer active.

Results:

- OK – The calibration procedure has been performed for the machine “articulation sensor 1” and the FMI 14 diagnostic code is no longer active. NOTE: If the position sensor has been calibrated recently and the FMI 14 diagnostic code becomes active again after a short time, the linkage for the articulation position sensor is the most likely cause of the problem. Repair the linkage for the sensor or replace the linkage for the sensor.

  STOP.

- NOT OK – The calibration procedure has been performed for the machine “articulation sensor 1” , however, the FMI 14 diagnostic code is still active. The problem has not been corrected.Proceed to Test Step 3.

Test Step 3. CHECK THE SIGNAL CIRCUIT OF THE SENSOR

A. The key start switch and the disconnect switch remain in the OFF position.

B. Do not disconnect the harness connector from the sensor.

C. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along return contact B (wire P967-PU(Purple)) and insert a multimeter probe along the signal wire C (wire E929-GY(Grey)).

D. Turn the disconnect switch and the key start switch to the ON position.

E. Monitor the signal of the sensor with a digital multimeter. When possible monitor the signal from the cab of the machine in order to maintain a safe distance from the articulation point of the machine.

Note: The steering frame lock must be disconnected in order to articulate the machine. Ensure that all technicians at work in the immediate area are aware that the machine will be articulated during the check of the sensor.

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

F. Without disconnecting the sensor or the hardware that is associated with the sensor from the machine, articulate the machine through the full range of operation.

G. Connect the steering frame lock link between the front and rear frames of the machine.

Expected Result:

The sensors signal responds in the manner that is described at the beginning of this procedure.

Results:

- OK – The sensors signal responds correctly. The sensor is operating correctly. Proceed to Test Step 4.

- NOT OK – The sensors signal does not respond correctly. The sensor is NOT operating correctly.

  Repair: Replace the “articulation angle 1” sensor. After the replacement of the sensor, the sensor must be calibrated. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and the key start switch to the ON position.

B. Operate the machine.

C. Check the status of the CID 0615 FMI 14 diagnostic code.

Expected Result:

The CID 0615 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 0615 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 0615 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM that activated the diagnostic code. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05819465

MID 082 - CID 0908 - FMI 09

SMCS Code: 1439-038-BG; 6060-038-PSN

Conditions Which Generate This Code:

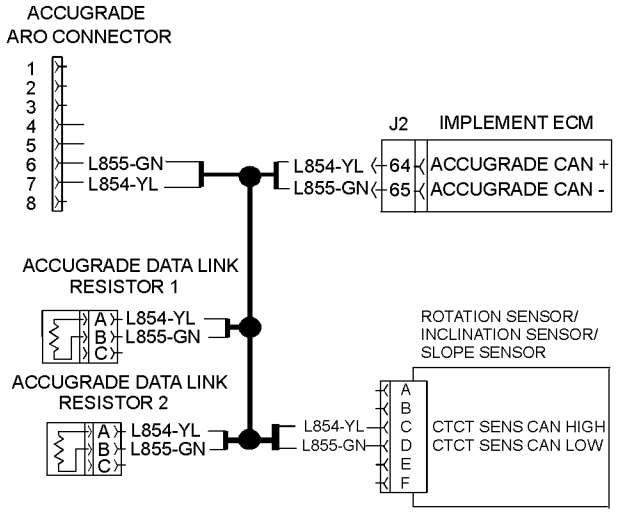


Illustration 236 g02727850

Accugrade Data Link

This diagnostic code is recorded when the Implement ECM cannot receive data off the Accugrade data link from the blade rotation sensor. The Implement ECM should receive information from the Accugrade data link at a specific rate.

Possible causes of this diagnostic code are listed:

- The blade rotation sensor is not functioning.
- The termination resistor on the Accugrade data link is disconnected.
- The ECM has failed. This condition is unlikely.

Test Step 1. CHECK THE INPUT VOLTAGE OF THE SENSOR.

A. Turn the key start switch to the ON position. Do NOT start the tractor.

B. Remove the floorplate.

Note: Ensure that the tractor has cooled. Avoid contact with the manifold.

C. Disconnect the machine harness connector for the blade rotation sensor.

D. Measure the voltage across contact A (wire L872-BU(Blue)) and contact E (wire T744-WH(White)).

Expected Result:

The voltage that is measured is between 18 VDC and 32 VDC.

Results:

- YES – The voltage that is measured is between 18 VDC and 32 VDC. The sensor is receiving the correct voltage. Proceed to test step 2.
- NO – The sensor is NOT receiving input voltage. Verify that the connector for the sensor and the harness are correct.Proceed to test step 2.

Test Step 2. CHECK THE TERMINATION RESISTOR.

A. De-energize the system.

B. The machine harness connector for the sensor remains disconnected.

C. Measure the resistance across contact C (wire L854-YL(Yellow)) and contact D (wire L855-GN(Green)).

Expected Result:

The resistance that is measured is 60 ± 10 ohms.

Results:

- YES – The resistance that is measured is 60 ± 10 ohms. Repeat this test step. If the same results occur, an internal component to the sensor has failed.

  Repair: Replace the sensor.

  STOP.

- NO – The resistance that is measured is NOT 60 ± 10 ohms.

  Repair: Replace the termination resistor.

  STOP.

Test Step 3. CHECK THE BATTERY VOLTAGE.

A. The engine should not be running.

B. At the battery, measure the voltage of the battery.

Expected Result:

The voltage that is measured is less than 18 VDC.

Results:

- YES – The voltage that is measured is less than 18 VDC. The voltage is NOT correct.

  Repair: Check the charging system. See Special Instruction, REHS0354.

  STOP.

- NO – The voltage that is measured is between 18 and 32.5 VDC. There is an open in the circuit between the battery and the sensor.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

i05819477

MID 082 - CID 0908 - FMI 13

SMCS Code: 1439-038-BG; 6060-038-PSN

Conditions Which Generate This Code:

This diagnostic code is associated with the Blade Rotation Position Sensor . The position sensor provides an Analog input signal to the Implement ECM. The FMI 13 diagnostic code is activated when the ECM detects a sensor that needs calibration.

CALIBRATION

A. Perform the calibration procedure for the sensor. Refer to the Testing and Adjusting, “Calibration” Story in this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- OK – The calibration procedure was performed successfully. Resume normal machine operation

  STOP.

- NOT OK – The calibration was not successful.

  Repair: Repeat the calibration procedure for the sensor.

  If the second calibration procedure is not successful, replace the implement control lever assembly.

  After sensor replacement, refer to the Testing and Adjusting, “Calibration” Story in this manual for the correct procedure. If the problem is still present after replacement and calibration of the new sensor, the ECM may have failed.

  Prior to replacing an ECM, always contact the Technical Communicator at your dealership for possible consultation with Caterpillar. This consultation may effect repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to the Testing and Adjusting, “Electronic Control Module (ECM) - Replace” Story in this manual for additional information.

  STOP.

i02860837

MID 082 - CID 0967 - FMI 02

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

This diagnostic code is associated with the communication between the Implement ECM and the Messenger that is conducted over the Cat Data Link. The machine serial number is programmed into the Messenger. The serial number is communicated to the Implement ECM and to the other ECM modules on the machine. The Implement ECM will activate the CID 0967 FMI 02 diagnostic code when the machine serial number that is received from the Messenger is incorrect or the serial number has been changed.

Note: Ensure that the CID 0967 FMI 02 diagnostic code is active before performing this procedure.

Test Step 1. Check The Serial Number That Is Programmed

A. Connect the Caterpillar Electronic Technician service tool to the machine service connector.

B. Turn the key start switch and the disconnect switch to the ON position.

C. Check the machine serial number that is programmed for the Messenger.

Expected Result:

The machine serial number is not correct for this machine.

Results:

- YES – The programmed machine serial number is not the correct serial number for this machine.

  Repair: Use the Electronic Technician service tool to program the complete machine serial number for this machine into the Messenger. After the correct serial number has been programmed, turn the key start switch to the OFF position. After a minute, turn the key start switch to the ON position. Verify that the diagnostic code has been cleared.

  STOP.

- NO – The machine serial number is correct for this machine. The complete serial number for this machine is programmed correctly for the Messenger.Proceed to Test Step 2.

Test Step 2. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. The disconnect switch and the key start switch remain in the ON position.

B. Operate the machine.

C. Determine if the CID 0967 FMI 02 diagnostic code is active.

Expected Result:

The CID 0967 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 0967 FMI 02 diagnostic code is not active. The diagnostic code does not exist at this time. Resume normal operation.

  STOP.

- NOT OK – The CID 0967 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause is not found, contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code can not be found, replace the ECM. Refer to Troubleshooting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02860851

MID 082 - CID 0967 - FMI 09

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

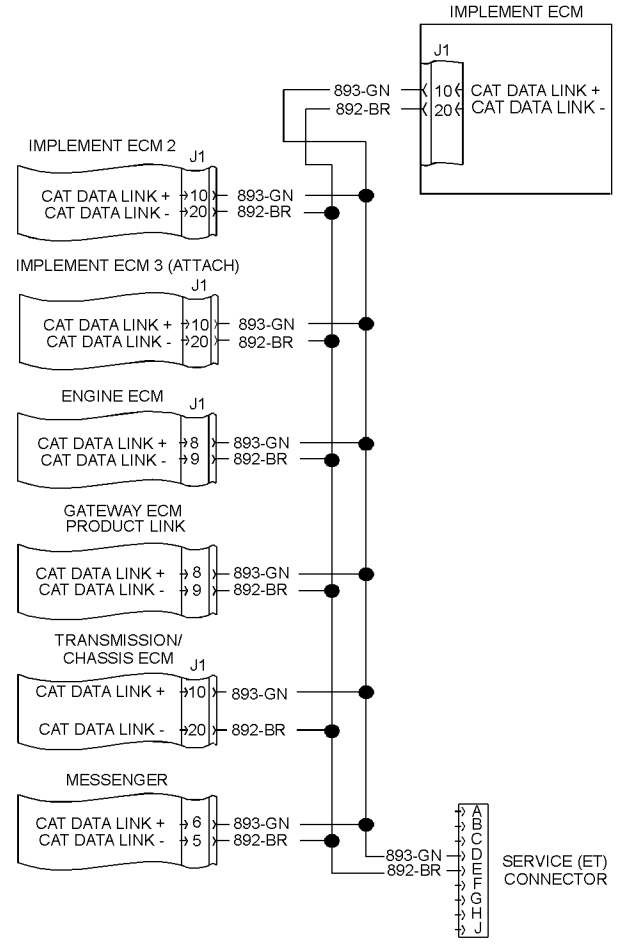


Illustration 237 g01243564

Connections of the Cat Data Link

This diagnostic code is associated with the communication between the Implement ECM and the Messenger that is conducted over the Cat Data Link. The FMI 09 means that the Implement ECM has lost communication with the Messenger.

The possible causes of this diagnostic code are listed below:

- An open or a faulty connection in the Cat Data Link circuit
- The Messenger has failed. This is unlikely.
- The ECM has failed. This is unlikely.

Note: If the Messenger is not operating correctly, refer to Testing and Adjusting, RENR9034 for information on troubleshooting the Messenger. Ensure that CID 0967 FMI 09 diagnostic code is active before performing this procedure. Check the Messenger for correct operation before performing this procedure.

Test Step 1. CHECK THE DATA LINK CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM. Disconnect the machine harness connector from the Messenger.

C. Inspect the harness connectors. Clean all of the contacts of the harness connectors. Refer to the illustration above in order to check the Cat Data Link connection on each of the machine harness connectors. Ensure that the wires are secure in the connector and that the wires are in good condition.

D. At the harness connectors, measure the resistance from the contact of the ECM connector J1-10 (wire 893-GN(Green)) to the contact of the Messenger 6 (wire 893-GN(Green)).

E. At the disconnected harness connectors, measure the resistance from the contact of the ECM connector J1-20 (wire 892-BR(Brown)) to the contact of the Messenger 5 (wire 892-BR(Brown)).

Expected Result:

Both of the resistance measurements are less than 5 ohms.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The Cat Data Link circuit in the machine harness is not open.Proceed to Test Step 2.
- NOT OK – At least one of the resistance measurements is more than 5 ohms.

  Repair: There is an open or a bad connection in the Cat Data Link circuit in the machine harness. Refer to the complete Electrical System Schematic of the machine. Examine all of the harness connections of the machine that are involved in the data link circuit. Check each wire section from each end of the connectors (connector to connector) for an open or a bad connection. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the data link circuit.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 0967 FMI 09 diagnostic code.

Expected Result:

The CID 0967 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 0967 FMI 09 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 0967 FMI 09 diagnostic code is active. The diagnostic code has not been corrected.

Repair: Check the circuit again. Use the Caterpillar Electronic Technician service tool in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect intermittent short circuits. The wiggle test can also be used to detect open connections in the machine wiring harness.

It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. See the Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02911134

MID 082 - CID 1326 - FMI 02

SMCS Code: 1408-038

Conditions Which Generate This Code:

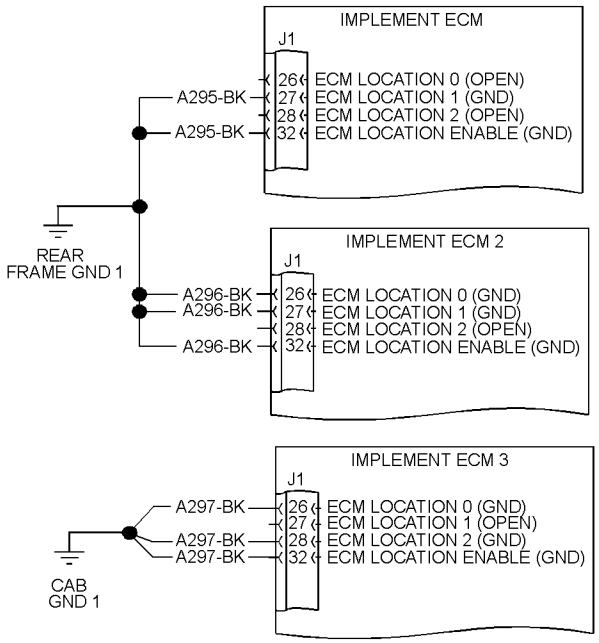


Illustration 238 g01301801

Location Code connections

This diagnostic code is recorded when the software location code for the Implement ECM does not match the hard wired location codes.

The probable cause of this diagnostic code is software. The wrong software has been flashed into the ECM. A short to a ground source in one of the location code circuits in the machine harness could also cause this diagnostic code to activate.

Note: Do not change the hard wired location code if you have flashed the incorrect software into the control.

Note: For help with verification of correct location codes, in the Cat ET status screen, the “actual” location code and the “desired” location code for each ECM on the machine can be displayed.

Test Step 1. VERIFY HARDWARE AND SOFTWARE PART NUMBERS

A. Verify whether the part number of the software for the ECM is correct.

Expected Result:

Contact the Business Unit that is producing the product for the correct configuration for the machine.

Results:

- OK – All part numbers are correct for the ECM. Proceed to Test Step 2.
- NOT OK – All part numbers are NOT correct. The installed ECM has the wrong part number or incorrect configuration software is installed.

  Repair: Replace the ECM with a module that has the correct part number or flash the correct configuration software. See Troubleshooting, “Electronic Control Module - Flash Program”.

  STOP.

Test Step 2. VERIFY WHETHER THE LOCATION CODE MATCHES THE ET STATUS SCREEN

A. Check the ET status screen in order to verify the location code . The codes are listed below:

Implement ECM 2
Implement ECM 2 3
Implement ECM 3 5

Expected Result:

The location codes in the ET are correct.

Results:

- OK – The location codes in the ET are correct. Proceed to Test Step 3.
- NOT OK – The location codes are NOT correct.

Repair: Repeat this test step in order to verify that the software and hardware part numbers are correct.

Proceed to Test Step 3 if the part numbers are correct.

Test Step 3. INSPECT HARNESS CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Inspect the harness connections that are related to the location codes. Make sure that the connectors are clean. Make sure that the connectors are tight.

C. Check for the proper mating of the connector.

D. Check all wires at the connector.

E. Check each wire for nicks. Check each wire for signs of abrasion in the insulation.

F. Check for moisture at the connector.

G. Check for dirty contacts or corroded contacts.

H. Check each pin and check each socket.

Expected Result:

The machine harness connectors are tight and the machine harness connectors are free of corrosion.

Results:

- OK – The machine harness connectors are tight and the machine harness connectors are free from corrosion.Proceed to Test Step 4.
- NOT OK – One or more of the machine harness connectors are in need of repair.

  Repair: Repair the connector and verify that all connections are correct before reconnecting to the mating connector. After the connector is repaired, verify that the problem has been corrected before operating the machine.

  STOP.

Test Step 4. CHECK FOR A SHORT TO GROUND

A. The disconnect switch and the key start switch remain in the OFF position.

B. Disconnect the machine harness connector from the ECM.

C. At the machine harness for the ECM, measure the resistance between the frame ground and the J1 location code contacts.

Expected Result:

The resistance that is measured is greater than 5 ohms at contacts J1-26 and J1-28. The resistance measures less than 5 ohms at contacts J1-27 and J1-32.

Results:

- OK – The resistance measurements are correct. The harness circuit is correct.Proceed to Test Step 5.
- NOT OK – One or more of the resistance measurements is NOT correct. The machine harness has failed.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK FOR AN OPEN HARNESS

A. The disconnect switch and the key start switch remain in the OFF position. The ECM remains disconnected from the machine harness.

B. At the machine harness for the ECM, measure the resistance between the frame ground and J1-27.

C. At the machine harness for the ECM, measure the resistance between the frame ground and J1-32.

Expected Result:

The resistance measurements are less than 5 ohms.

Results:

- OK – The resistance measurements are less than 5 ohms. The location code circuit is correct. The ECM may have failed.

  Repair: Check the location code circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem can not be found, The ECM may have failed. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Troubleshooting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NOT OK – The resistance is greater than 5 ohms. The machine harness has failed.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

i04991134

MID 082 - CID 1471 - FMI 02

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

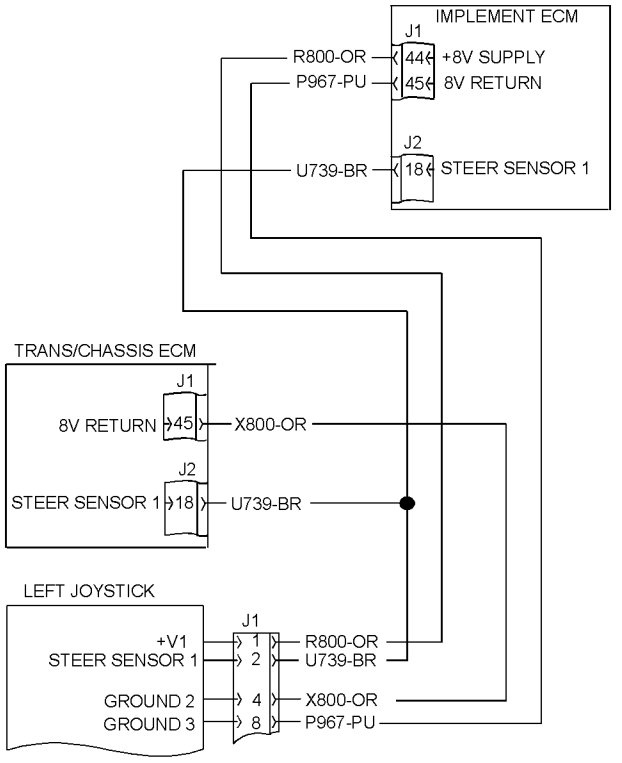


Illustration 239 g03170476

Connections of “Steer Sensor 1”

Three “steer position sensors” are required for correct operation of the steering control. The “steer position sensors” are located in the assembly of the left joystick . Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. This diagnostic code is activated when the ECM reads the input signal from the “steer position sensor 1” and the signal is erratic or intermittent.

The “steer position sensor 1” receives power from the 8 V power supply of the Implement ECM. “Steer position sensor 1” is internally connected to the ground that is supplied by the 8 V sensor return of the Transmission/Chassis ECM (ground of ECM) and to the ground that is supplied by the 8 V sensor return of the Implement ECM (ground of ECM). The “steer sensor” must lose both grounds in order to lose a ground connection. The illustration above indicates the power and ground connections for the “steer sensor 1” .

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the full left position of the joystick to approximately 90 ± 5% at the full right position of the joystick. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections exist in the sensor circuit.
- The signal circuit is shorted to another circuit in the machine harness.
- The ECM has failed. This is unlikely.

Consider the following points when this code is active:

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate the problem and fix the problem before proceeding with this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “steer sensor 1” . Both ECM modules can activate a CID 1471 FMI 02 diagnostic code when the signal is erratic or intermittent. If one ECM has activated a CID 1471 FMI 02 diagnostic code and the other ECM has not activated a CID 1471 FMI 02, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE POWER SUPPLY CIRCUIT OF THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left joystick, insert 7X-1710 Multimeter Probes along the contact of the power supply J1-1 (wire R800-OR(Orange)) and along ground 3 contact J1-8 (wire P967-PU(Purple)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage.

D. At the harness connectors for the left joystick, remove the multimeter probe that is inserted along the ground 3 contact J1-8 and insert the probe along ground 2 contact J1-4 (wire X800-OR(Orange)). The other probe remains inserted along the contact of the power supply J1-1 (wire R800-OR(Orange)).

E. Measure the DC voltage.

Expected Result:

Both of the voltage measurements are approximately 8.0 ± 0.4 VDC.

Results:

- OK – Both of the voltage measurements are approximately 8.0 ± 0.4 VDC. The power and ground circuits for the sensor are correct.Proceed to Test Step 2.

- NOT OK – Both of the voltage measurements are less than 8.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: If both of the voltage measurements are not correct, the problem is most likely in the wire of the power circuit. This condition will cause multiple diagnostic codes to activate.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the power and ground circuits. Ensure that the connections are clean, that the connectors are secure and that the connectors are in good condition.

  For troubleshooting the ECM power supply that is providing power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Implement ECM.

  STOP.

- NOT OK – One of the voltage measurements is not correct.

  Repair: If one of the voltage measurements is correct and the other voltage measurement is not correct, there is a problem in the ground circuit that registered the bad measurement. This condition will not cause this diagnostic code to activate. There is another problem that is causing this active diagnostic code. However, the ground circuit must be repaired before proceeding with this procedure.

  Do not operate the machine with only one ground connection for the left joystick.

  Repair the faulty ground circuit or the faulty circuit of the power supply before proceeding with this procedure.

  After repairing the faulty ground circuit, proceed to Test Step 2.

Test Step 2. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire U739-BR(Brown) and the socket at contact J1-2 from the harness connector. The machine harness connector J1 remains connected to the connector of the left joystick.

B. At the back of the connector for the joystick J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-2 and the ground contact at J1-4.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Measure the duty cycle of the sensor at the connector contacts of the joystick J1-2 and J1-4. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “steer sensor 1” is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reinstall the signal wire U739-BR(Brown) and the socket back to the original location at contact J1-2 in the machine harness connector for the joystick. Verify that all of the wires for the joystick are in the correct locations. Verify that all of the wires for the joystick are secure in the connector before proceeding to the next step. Proceed to Test Step 3.
- NOT OK – The duty cycle of the “steer sensor 1” is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the “steer sensor 1” signal is not correct according to the description at the beginning of this procedure, replace the assembly of the left joystick . After replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 3. CHECK THE SIGNAL AT BOTH OF THE ECM MODULES

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the machine harness connector J1 for the Transmission/Chassis ECM, insert a multimeter probe along return contact J1-45 (wire X800-OR(Orange)). At the machine harness connector J2 for the Transmission/Chassis ECM, insert a multimeter probe along signal contact J2-18 (wire U739-BR(Brown)). The machine harness connectors remain connected to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Measure the duty cycle of the sensor at the connector contacts of the ECM J1-45 and J2-18. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

E. At the machine harness connector J1 for the Implement ECM, insert a multimeter probe along return contact J1-45 (wire P967-PU(Purple)). At the machine harness connector J2 for the Implement ECM, insert a multimeter probe along signal contact J2-18 (wire U739-BR(Brown)). The machine harness connectors remain connected to the ECM.

F. Measure the duty cycle of the sensor at the connector contacts of the ECM J1-45 and J2-18. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “steer sensor 1” is correct according to the description at the beginning of this procedure at both of the ECM modules.

Results:

- OK – The duty cycle of the sensor is correct at both of the ECM modules. The machine harness does not appear to be the cause of the problem. An intermittent open or short circuit could still be the cause of the problem.Proceed to Test Step 4.
- NOT OK – The duty cycle of the “steer sensor 1” is NOT correct at one of the ECM modules according to the description at the beginning of this procedure. There is a problem in the machine harness.

  Repair: If the sensor signal at one ECM is correct and the sensor signal at the other ECM is not correct, a poor connection in the circuit would be suspected.

  The “steer sensor 1” signal at one of the ECM modules is not correct.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the section of the sensor signal circuit that connects to the ECM that is not receiving a good signal. Verify that the connections are clean, that the connections are secure and that the connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

- NOT OK – The duty cycle of the “steer sensor 1” is NOT correct at either of the ECM modules according to the description at the beginning of this procedure. A problem in the machine harness is the most likely cause.Proceed to Test Step 4.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

Turn the key start switch and the disconnect switch to the OFF position.

A. Disconnect the J1 connector and the J2 connector from the Implement ECM.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-18 (wire U739-BR(Brown)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

C. If any of the resistance measurements in the last test step are less than 5000 ohms, skip the next test step and proceed to the “Expected Result” step. If all of the resistance measurements in the last test step are above 5000 ohms, perform the next test step.

D. Disconnect the J1 connector and the J2 connector from the Transmission/Chassis ECM.

E. At the J2 machine harness connector for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-18 (wire U739-BR(Brown)) to all of the other J1 and J2 contacts that are used for the Transmission/Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance checks of the signal circuit do not indicate a short in the machine harness.Proceed to Test Step 5.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1471 FMI 02 diagnostic code is active.

Expected Result:

The CID 1471 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 1471 FMI 02 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1471 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Perform a “wiggle” test on the machine wiring harness. It is recommended that the Caterpillar “Electronic Technician (ET) service tool” be used in order to perform the wiggle test. The wiggle test can detect momentary shorts or intermittent shorts. The wiggle test can also be used to detect open connections in the wiring harness of the machine.

  If the cause of the active diagnostic code is not found, an ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is unlikely that either ECM is causing the problem.

Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i04991871

MID 082 - CID 1471 - FMI 03

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

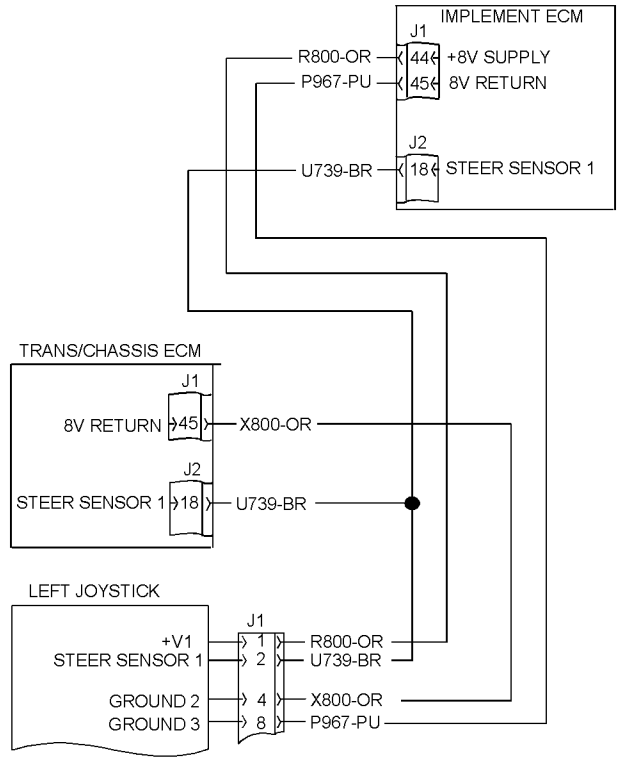


Illustration 240 g03170476

Steer Position Sensor one connections

Three steer position sensors are required for correct control of the steering system. The steer position sensors are located in the left joystick assembly.

Each sensor provides an input signal to the Implement ECM and to the Transmission Chassis ECM. This diagnostic code is activated when the Implement ECM detects that the input signal from the steer position sensor 1 is above normal.

The steer position sensor 1 receives power from the Implement ECM 8 V power supply. Steer position sensor 1 is internally connected to the ground that is supplied by the Transmission Chassis ECM 8 V sensor return (ECM ground) and to the ground that is supplied by the Implement ECM 8 V sensor return (ECM ground). The steer sensor would have to lose both grounds in order to lose a ground connection. The illustration above indicates the power and ground connections for the steer sensor 1.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 80 Hz. The duty cycle of the signal will vary from approximately 10 ± 5% at the joystick full left position to approximately 90 ± 5% at the joystick full right position. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible conditions that can cause the ECM to activate this condition code are listed:

- The sensor power supply circuit is open.
- The signal circuit is open.
- The signal circuit is shorted to another voltage source.
- Both of the sensor return circuits are open.
- The sensor has failed.
- The ECM has failed.

Points to consider before troubleshooting this active diagnostic code:

- If there is any indication of a problem with the Implement ECM 8 V power supply (CID 0041) investigate and fix the problem before proceeding with this procedure.
- Components that are also powered by the Implement ECM 8 V power supply are the Right Steer Cylinder Position Sensor and the Machine Articulation Angle Sensor 1. If diagnostic codes are also active for these components, there is most likely a problem with the power supply circuits.

- The correct operating temperature range for the steering sensors is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a steering sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the steer sensors operating in the acceptable temperature range. After temperature normalization, verify that the CID 1471 FMI 03 diagnostic code is active before performing this procedure.
- The Transmission Chassis ECM (MID 027) and the Implement ECM (MID 082) both receive an input signal from the steer sensor 1. Both ECM's can activate a CID 1471 FMI 03 diagnostic code when the signal voltage is above normal.
- If one ECM has activated a CID 1471 FMI 03 diagnostic code and the other ECM has not activated the code, the sensor is most likely operating correctly. When this occurs, an open or a poor connection in the machine harness would be suspected between a splice and the ECM that has activated the code.
- When both ECM's have activated the diagnostic code, any of the possible listed conditions could be causing the problem. If both ECM's have activated the diagnostic code, it is unlikely that either ECM is causing the problem.
- When making voltage or resistance measurements, wiggle the involved connectors and wiring harness. Intermittent problems may only be observed during movement of the harness.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes. The codes will clear when the problem has been corrected.

Test Step 1. TROUBLESHOOTING PROCEDURE

Table 20

Test Step	Value	Results
1. Check the power supply for the steer sensor 1: A. Key switch OFF, disconnect switch OFF B. Disconnect the J1 harness connector from the left joystick. C. Disconnect switch ON, key switch ON D. Measure the supply voltage between positive contact 1 and return contact 8. E. Measure the supply voltage between positive contact 1 and return contact 4.	The voltage for both measurements is in the range of 8 ± 0.4 VDC	**YES:** Proceed to Step 2. **NO:** Either the power circuit, a ground circuit or both ground circuits have failed. A failure of one ground circuit will not cause this diagnostic code to be activated. Both ground circuits are required for correct operation. Investigate and repair the power supply circuit problem or the ground circuit problem. STOP.
2. Check the signal circuit for a short circuit: A. Joystick connector J1 remains disconnected from the machine harness. B. Disconnect switch ON, key switch ON C. At the disconnected joystick connector, measure for DC voltage between signal contact 2 and return contact 8.	The DC voltage is less than 1 VDC.	**YES:** A short circuit is not indicated. Proceed to Step 3. **NO:**The level of voltage measured could indicate whether the signal circuit is shorted to an ECM power supply circuit or to a system power circuit. For more information on locating short circuits, refer to Troubleshooting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness. STOP.
3. Check the sensor duty cycle and signal frequency at the sensor: A. Key switch OFF, disconnect switch OFF B. At the disconnected J1 harness connector for the joystick, remove wire (U739-BR(Brown)) and the socket at contact 2 from the connector. C. Reconnect the harness connector to the joystick connector. D. At the rear of the joystick connector, use insertion type probes to insert the positive multimeter probe along the signal circuit at contact 2. Ensure good contact with the conductor. E. At either side of the joystick connector, insert the negative multimeter probe along the return circuit at contact 8. Ensure good contact with the conductor. F. Disconnect switch ON, key switch ON G. Lever is stationary. Measure the frequency. H. While measuring the duty cycle. Sweep the lever through the steering axis range.	The signal frequency is in the range of 500 ± 80 Hz. The duty cycle of the signal is in the range of 5% to 95%.	**YES:** Install the wire and the socket back in the joystick harness connector. Proceed to Step 4. **NO:** Verify the measurements a second time. Ensure good contact with the multimeter probes. The sensor has failed. The joystick is not serviceable. Replace the left joystick. STOP.

(continued)

(Table 20, contd)

Test Step	Value	Results
4. Check for an open in the signal circuit: A. Key switch OFF, disconnect switch OFF B. Disconnect the J1 connector from the left joystick. C. At the harness connector, connect a jumper wire between signal contact 2 and return contact 8. D. At the Implement ECM, disconnect the J1 and J2 harness connectors. E. At the Implement ECM harness connectors, measure the resistance between signal contact J2-18 and return contact J1-45. Note the resistance. D. At the Transmission Chassis ECM, disconnect the J1 and J2 harness connectors. C. At the harness connector for the joystick, connect the jumper wire between signal contact 2 and return contact 4. E. At the Transmission Chassis ECM harness connectors, measure the resistance between signal contact J2-18 and return contact J1-45.	Both of the resistance measurements are less than 5 ohms.	**YES:** An open circuit or poor connection is not indicated. Proceed to Step 5. **NO:** One resistance measurement is less than 5 ohms and the other measurement is greater than 5 ohms. There is an open or a poor connection between the harness splice and the ECM connector that measured the high resistance. **NO:** Both resistance measurements are greater than 5 ohms. There is an open or a poor connection between the harness splice and joystick connector. Repair the machine harness or replace the machine harness. For more information on locating open circuits or poor connections, refer to Troubleshooting, “Wiring Harness (Open Circuit) - Test”. STOP.
5. Check the diagnostic code status: A. Inspect harness connectors. B. Reconnect harness connectors. C. Disconnect switch ON, key switch ON Is the diagnostic code active?		**YES:** The diagnostic code is still active. If only the Implement ECM has activated this diagnostic code and no cause can be found, flash the latest version of software to the Implement ECM. Determine if the diagnostic code is reactivated. If the same diagnostic code is reactivated, the ECM could be causing the problem. Call DSN to report this issue. If the ECM must be replaced, refer to Troubleshooting, “Electronic Control Module (ECM) - Replace”. **NO:** This diagnostic code is no longer active. Resume machine operation.

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left joystick, insert 7X-1710 Multimeter Probes along the power contact J1-1 (wire R800-OR(Orange)) and along ground 3 contact J1-8 (wire P967-PU(Purple)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage.

D. At the harness connectors for the left joystick, remove the multimeter probe that is inserted along the ground 3 contact J1-8 and insert the probe along ground 2 contact J1-4 (wire X800-OR(Orange)). The other probe remains inserted along the power contactJ1-1 (wire R800-OR(Orange)).

E. Measure the DC voltage.

Expected Result:

Both of the voltage measurements are approximately 8.0 ± 0.4 VDC.

Results:

- OK – Both of the voltage measurements are approximately 8.0 ± 0.4 VDC. The power and ground circuits for the sensor are correct.Proceed to Test Step 2.
- NOT OK – Both of the voltage measurements are less than 8.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: If both of the voltage measurements are not correct, the problem is most likely in the power circuit wire.

Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the power and ground circuits. Ensure that the connections are clean, that the connections are secure and that the connections are in good condition.

For troubleshooting the ECM power supply that is providing power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the Implement ECM.

STOP.

- NOT OK – One of the voltage measurements is not correct.

  Repair: If one of the voltage measurements is correct and the other voltage measurement is not correct, there is a problem in the ground circuit that registered the bad measurement. This condition will not cause this diagnostic code to activate. There is another problem that is causing this active diagnostic code. However, the ground circuit must be repaired before proceeding with this procedure.

  Do not operate the machine with only one ground connection for the sensor.

  Repair the failed ground circuit before proceeding with this procedure.

  After repairing the faulty circuit, proceed to Test Step 2.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUITS OF BOTH ECM MODULES

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the left joystick. At harness connector J1 for the joystick, place a jumper wire between the ground 2 contact J1-4 (wire X800-OR(Orange)) and the signal contact J1-2 (wire U739-BR(Brown)).

C. Disconnect machine harness connectors J1 and J2 from the Transmission/Chassis ECM.

D. At the harness connector for the Transmission/ Chassis ECM, measure the resistance from ground 2 return contact J1-45 (wire X800-OR(Orange)) to signal contact J2-18 (wire U739-BR(Brown)).

E. Observe the resistance measurement. Wiggle the ECM connectors and the sensor connector. Gently pull on the wires and wiggle the wires of both connectors.

F. At harness connector J1 for the joystick, move the jumper wire to the ground 3 contact J1-8 (wire P967-PU(Purple)) and the signal contact J1-2 (wire U739-BR(Brown)) .

G. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

H. At the harness connectors for the Implement ECM, measure the resistance from ground 3 return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-18 (wire U739-BR(Brown)).

I. Observe the resistance measurement. Wiggle the ECM connectors and the sensor connector. Gently pull on the wires and wiggle the wires of both connectors.

Expected Result:

Both resistance measurements are less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The sensor circuit is not open in either input circuit of the ECM.Proceed to Test Step 3.

- NOT OK – The resistance measurement at one or both of the ECM modules is greater than 5 ohms. There is an open or a bad connection in one or both of the signal circuits.

  Repair: If both of the resistance measurements are not correct, there is an open connection or a bad connection on the sensor side of the splice of the machine harness for the signal wire U739-BR(Brown).

  If one of the measurements is correct and the other measurement is not correct, there is an open or a bad connection on the ECM side of the splice of the machine harness for the signal wire U739-BR(Brown).

  In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspected section of the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors remain disconnected from the Implement ECM and the Transmission/Chassis ECM.

A. Remove the jumper wire that was installed in the last step at the connector of the joystick.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-18 (wire U739-BR(Brown)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

C. If any of the resistance measurements in the last test step are less than 5000 ohms, skip the next test step and proceed to the “Expected Result” step. If all of the resistance measurements in the last test step are above 5000 ohms, perform the next test step.

D. At the J2 machine harness connector for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-18 (wire U739-BR(Brown)) to all of the other J1 and J2 contacts that are used for the Transmission/Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance checks of the signal circuit do not indicate a short in the machine harness.Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Reconnect the machine harness connectors J1 and J2 to both ECM modules.

B. Reconnect the connectors of the machine harness that are disconnected to the left joystick.

C. At the machine harness connector J1 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire U739-BR(Brown) and the socket at contact J1-2 from the harness connector. The machine harness connector J1 remains connected to the joystick connector.

D. At the back of the connector for the joystick J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-2 and the ground 2 contact at J1-4.

E. Turn the disconnect switch and the key start switch to the ON position.

F. Measure the duty cycle of the sensor signal. Move the joystick through the full steering axis range.

Expected Result:

The duty cycle of the “steer sensor 1” is in the range of 5 percent to 95 percent at all times while the joystick is moved.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not causing the problem. Reinstall the signal wire U739-BR(Brown) and the socket back to the original location at contact J1-2 in the machine harness connector for the joystick. Verify that all of the wires of the joystick are in the correct locations. Verify that all of the wires of the joystick are secure in the connector before proceeding to the next step. Proceed to Test Step 5.

- NOT OK – The duty cycle of the “steer sensor 1” is NOT in the range of 5 percent to 95 percent at all times while the joystick is moved. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  Replace the left joystick assembly. After replacement of the joystick, verify that the joystick operation is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are securely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1471 FMI 03 diagnostic code is active.

Expected Result:

The CID 1471 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 1471 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1471 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary shorts or intermittent shorts. The wiggle test can also detect open connections in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with company personnel. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04991291

MID 082 - CID 1471 - FMI 04

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

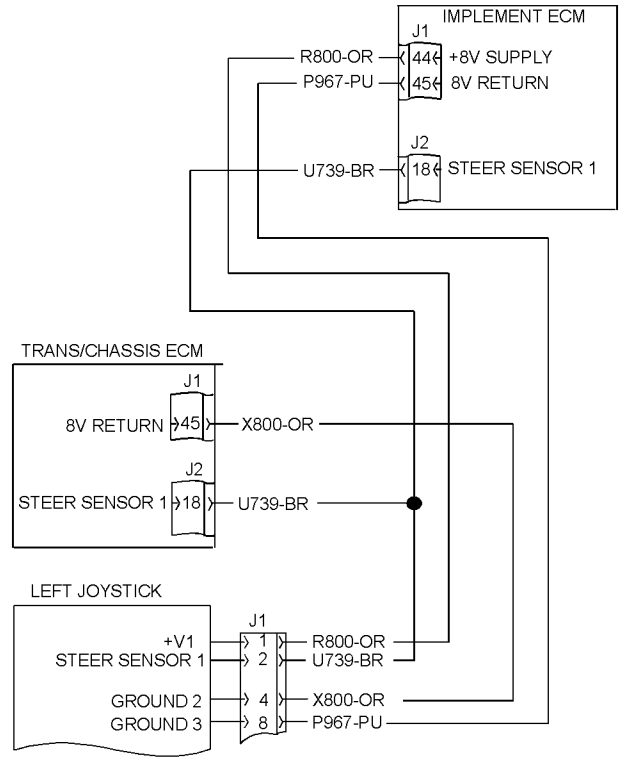


Illustration 241 g03170476

Connectors of “Steer Position Sensor 1”

Three “steer position sensors” are required for correct operation of the steering control lever. The “steer position sensors” are located in the assembly of the left joystick . Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. This diagnostic code is activated when the ECM detects that the signal voltage from the “steer position sensor 1” is below normal.

The “steer position sensor 1” receives power from the 8 V power supply of the Implement ECM. “Steer position sensor 1” is internally connected to the ground that is supplied by the 8 V sensor return of the Transmission/Chassis ECM (ECM ground) and to the ground that is supplied by the 8 V sensor return of the Implement ECM (ECM ground). The “steer sensor” must lose both grounds in order to lose a ground connection. The illustration above indicates the power and ground connections for the “steer sensor 1” .

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the joystick full left position to approximately 90 ± 5% at the joystick full right position. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The signal circuit is shorted to a ground source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “steer sensor 1” . Both ECM modules can activate a CID 1471 FMI 04 diagnostic code when the signal voltage is below normal. If one ECM has activated a CID 1471 FMI 04 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the left joystick. Observe the status of the active CID 1471 FMI 04 diagnostic code.

Expected Result:

The status of the CID 1471 FMI 04 diagnostic code did not change when the connector of the joystick was disconnected. A CID 1471 FMI 03 diagnostic code has NOT been activated by either the Implement ECM or the Transmission/Chassis ECM. The CID 1471 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected.

Results:

- YES – The CID 1471 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected. The sensor is not causing the problem. Proceed to Test Step 2.
- NO – The CID 1471 FMI 04 diagnostic code is no longer active when the connector of the joystick is disconnected. A CID 1471 FMI 03 diagnostic code has been activated by both of the ECM modules when the connector of the joystick is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The “steer sensor 1” is causing the problem. There is an internal short to ground in the left joystick. Replace the assembly of the left joystick . After replacement of the assembly of the joystick , verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the joystick J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. Disconnect the J1 and the J2 connectors from the Transmission/Chassis ECM.

E. At machine harness connector J2 for the Implement ECM, measure the resistance from contact J2-18 (wire U739-BR(Brown)) to frame ground. Measure the resistance from contact J2-18 (wire U739-BR(Brown)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

F. At the J2 machine harness connector for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-18 (wire U739-BR(Brown)) to all of the other J1 and J2 contacts that are used for the Transmission/Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance checks of the signal circuit do not indicate a short in the machine harness.Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and either the frame ground or the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1471 FMI 04 diagnostic code is active.

Expected Result:

The CID 1471 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 1471 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1471 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is very unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04991309

MID 082 - CID 1471 - FMI 08

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

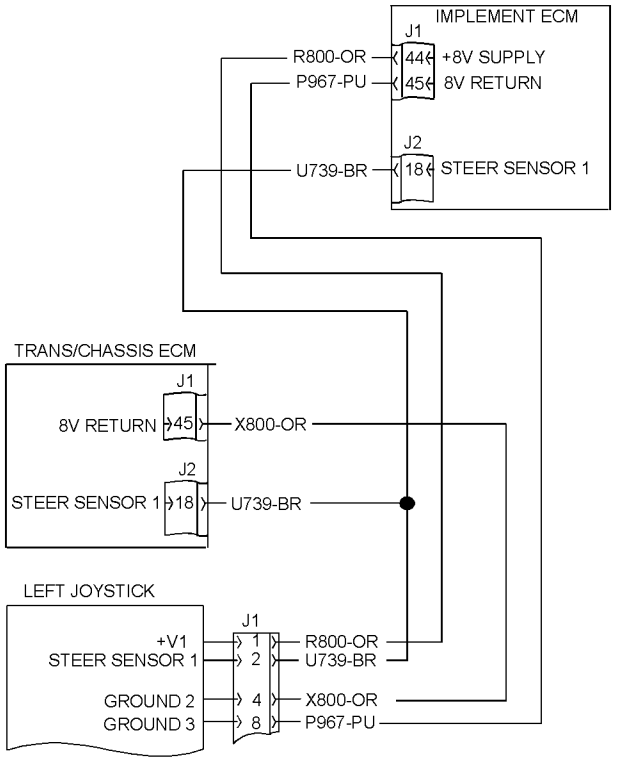


Illustration 242 g03170476

Connections of “Steer Position Sensor 1”

Three “steer position sensors” are required for correct operation of the steering control. The “steer position sensors” are located in the assembly of the left joystick. Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. This diagnostic code is associated with the left hand “steering lever position sensor 1” . The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range.

The “steer position sensor 1” receives power from the 8 V power supply of the Implement ECM. “Steer position sensor 1” is internally connected to the ground that is supplied by the 8 V sensor return of the Transmission/Chassis ECM (ground of ECM) and to the ground that is supplied by the 8 V sensor return of the Implement ECM (ground of ECM). The “steer sensor” must lose both grounds in order to lose a ground connection. The illustration above indicates the power and ground connections for “steer position sensor 1” .

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the full left position of the joystick to approximately 90 ± 5% at the full right position of the joystick. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections in the sensor circuit
- The ECM has failed. This is unlikely.

Consider the following points when this code is active:

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate the problem and fix the problem before proceeding with this procedure.

Note: The correct operating temperature range for the steering sensors is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a steering sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the steer sensors operating in the acceptable temperature range. After temperature normalization, verify that the CID 1471 FMI 08 diagnostic code is active before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “steer sensor 1” . Both ECM modules can activate a CID 1471 FMI 08 diagnostic code when the signal frequency or the signal pulse width is not within the expected range. If one ECM has activated a CID 1471 FMI 08 diagnostic code and the other ECM has not activated a CID 1471 FMI 08, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire (wire U739-BR(Brown)) and the socket at contact J1-2. The machine harness connector J1 remains connected to the connector of the left joystick.

B. At the back of the connector of the joystick J1, insert 7X-1710 Multimeter Probes along the contact of the sensor signal J1-2 and the ground 2 contact at J1-4.

C. Turn the disconnect switch and the key start switch to the ON position.

D. With the joystick in a stationary position, measure the frequency of the signal from the sensor.

E. Observe the measurement and wiggle the connector of the joystick. Gently pull on the wires and wiggle the wires.

F. Measure the duty cycle of the sensor at the connector contacts of the joystick J1-2 and J1-4. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

G. Observe the measurement and wiggle the connector of the joystick. Gently pull on the wires and wiggle the wires.

Expected Result:

The frequency of the “steer sensor 1” signal is 500 ± 100 Hz. The duty cycle of the “steer sensor 1” is correct according to the description at the beginning of this procedure. The frequency and the duty cycle are stable during the manipulation of the harness connector and the wiring.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The signal frequency and the duty cycle did not change when the harness was manipulated. The sensor is not causing the problem. Reconnect the signal wire and the socket in the connector of the machine harness for the joystick. Verify that all wires of the joystick are secure in the connector before proceeding to the next step.Proceed to Test Step 2.
- NOT OK – The signal frequency and the duty cycle of the “steer sensor 1” is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the “steer sensor 1” signal is not correct according to the description at the beginning of this procedure, replace the assembly of the left joystick. After replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT AT BOTH OF THE ECM MODULES

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the left joystick. At harness connector J1 for the joystick, place a jumper wire between the contact for ground 2 J1-4 (wire X800-OR(Orange)) and the signal contact J1-2 (wire U739-BR(Brown)) .

C. Disconnect machine harness connectors J1 and J2 from the Transmission/Chassis ECM.

D. At the harness connector for the Transmission/Chassis ECM, measure the resistance from the return contact for ground 2 J1-45 (wire X800-OR(Orange)) to signal contact J2-18 (wire U739-BR(Brown)).

E. Observe the resistance measurement and wiggle the connector of the ECM and the connector of the sensor. Gently pull on the wires and wiggle the wires of both connectors.

F. At harness connector J1 for the joystick, move the jumper wire to the ground 3 contact J1-8 (wire P967-PU(Purple)) and the signal contact J1-2 (wire U739-BR(Brown)).

G. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

H. At the harness connectors for the Implement ECM, measure the resistance from ground 3 return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-18 (wire U739-BR(Brown)).

I. Observe the resistance measurement and wiggle the connector of the ECM and the connector of the sensor. Gently pull on the wires and wiggle the wires of both connectors.

Expected Result:

Both resistance measurements are less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The sensor circuit is not open in either input circuit of the ECM.Proceed to Test Step 3.
- NOT OK – The resistance measurement at one or both of the ECM modules is greater than 5 ohms. There is an open or a bad connection in one or both of the signal circuits.

  Repair: If both of the resistance measurements are not correct, there is an open or a bad connection on the sensor side of the machine harness of the splice for the signal wire U739-BR(Brown).

  If one of the measurements is correct and the other measurement is not correct, there is an open or a bad connection on the ECM side of the machine harness at the splice for the signal wire U739-BR(Brown).

  In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspected section of the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 1471 FMI 08.

Expected Result:

The CID 1471 FMI 08 is not active.

Results:

- OK – The CID 1471 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1471 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary shorts or intermittent shorts. The wiggle test can also detect open connections in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04991492

MID 082 - CID 1471 - FMI 14

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

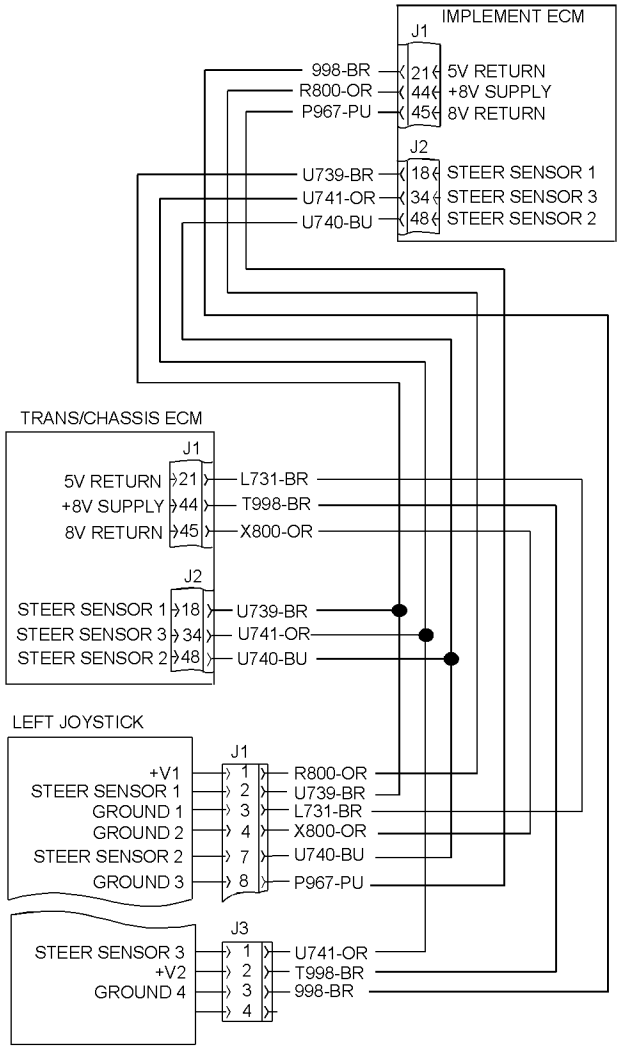


Illustration 243 g03170678

Connections of the left joystick steer sensors.

Three steer position sensors are required for correct operation of the steering control. The steer position sensors are located in the assembly of the left joystick. Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. The ECM expects the input signals from all three steer position sensors to closely match. The FMI 14 diagnostic code is activated when the following occurs:

- ECM determines that the PWM input signal from the number one “steer position sensor” does not match the PWM input signal from the other steer position sensors.

The number one “steer position sensor” receives power from the 8 V power supply of the Implement ECM. The number one “steer position sensor” is internally connected to ground. Ground is supplied by the Transmission/Chassis ECM and the Implement ECM. The steer position sensors must lose both grounds in order to lose a ground connection. The illustration above indicates the power and ground connections for the number one “steer position sensor” .

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The steer position sensors are PWM sensors. The steer position sensors operate at a frequency of 500 ± 100 Hz. The steer position sensors send a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. Following is the variation in the duty cycle of the signal:

- When the lever is in the FULL LEFT position, the duty cycle will be approximately 10%.
- When the lever is in the FULL RIGHT position, the duty cycle will be approximately 90%.
- When the lever is in the CENTER position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), correct the problem before proceeding with this procedure.

Note: The correct operating temperature range for the steer position sensors is −40 °C (−40.0 °F) to 75 °C (167.0 °F). Return the temperature in the cab to a normal temperature when the temperature in the cab is extreme and a diagnostic code becomes active. Returning the temperature in the cab to a normal temperature will keep the steer position sensors operating in the acceptable temperature range. After returning the temperature to normal, verify that the CID 1471 FMI 14 diagnostic code is active before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the number one “steer position sensor” . Both electronic control modules can activate a CID 1471 FMI 14 diagnostic code when the following occurs: The signal from the number one “steer position sensor” does not match the signal from either of the other two steer position sensors. If one of the electronic control modules has activated a CID 1471 FMI 14 diagnostic code and the other ECM has not activated a CID 1471 FMI 14 diagnostic code, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both electronic control modules have activated the diagnostic code, either the sensor or a harness problem could be the cause. If both electronic control modules have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are in good condition. The connections must be clean and the connections must be secure. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Note: The next two test steps will measure the duty cycle of each “steer position sensor” in order to determine if one signal is not closely matching with both of the other sensor signals. Record the duty cycle of each of the three steer position sensors for comparison.

Test Step 1. CHECK THE SIGNAL AT THE NUMBER ONE “STEER POSITION SENSOR”

A. Turn the key start switch to the OFF position.

B. Turn the disconnect switch to the OFF position.

C. Do not disconnect the harness connector from the sensor.

D. Perform the following on the back of the joystick at connector J1. Insert 7X-1710 Multimeter Probes along each sensor signal contact and the return contact at J1-4.

E. Turn the disconnect switch and the key start switch to the ON position.

F. Move the joystick to the position that activates the code.

G. Hold the joystick in the position that activates the code.

H. Monitor the signal of the sensor with a digital multimeter.

I. Record the duty cycle of all the steer position sensors.

J. Compare the duty cycles of all three steer position sensors at the same specific position of the joystick.

Expected Result:

Each duty cycle is within 5% or less of the signals from the other sensors.

Results:

- OK – There is 5% or less deviation in the duty cycle between the three steer position sensors with the joystick in the same position. Proceed to Test Step 2.

- NOT OK – With the joystick in the same position, one or more of the duty cycles deviates more than 5% from the other duty cycles. There is a problem with a “steer position sensor” .

  Repair: One of the steer position sensors is not operating correctly. Replace the assembly of the left joystick. After replacement of the assembly, verify that the new assembly is working correctly before operating the machine.

  STOP.

Test Step 2. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Perform the following:

- Clean the contacts of the harness connectors.

- Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.

- The clips for each connector are completely fastened.

D. Operate the machine.

E. Check the status of the CID 1471 FMI 14 diagnostic code.

Expected Result:

The CID 1471 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 1471 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Clear logged codes. Verify that the assembly is working correctly. Resume normal operation.

  STOP.

- NOT OK – The CID 1471 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04991589

MID 082 - CID 1472 - FMI 02

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

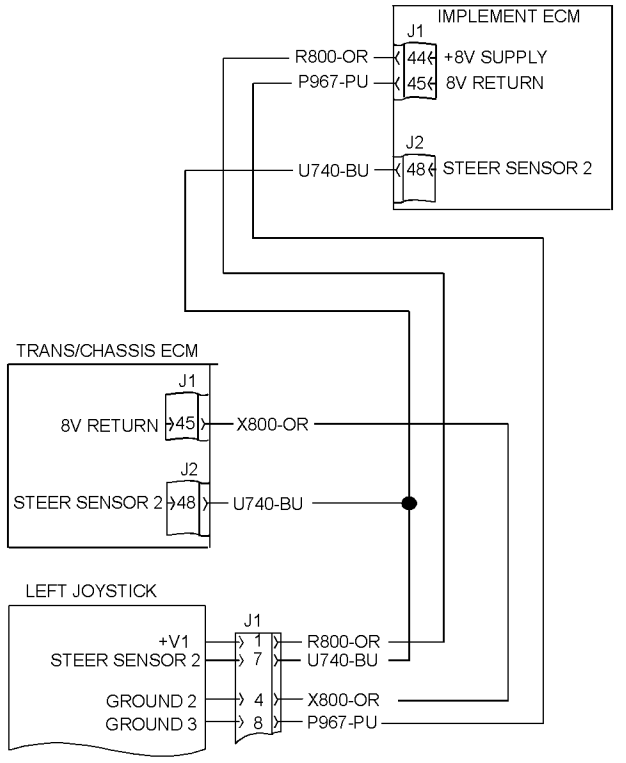


Illustration 244 g03170776

Connections of “Steer Sensor 2”

Three “steer position sensors” are required for correct operation of the steering control. The “steer position sensors” are located in the assembly of the left joystick. Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. The CID 1472 FMI 02 diagnostic code is recorded when the ECM detects that the input signal from the “steer position sensor 2” is erratic or that the input signal from the “ steer position sensor 2” is intermittent.

The “steer position sensor 2” receives power from the 8 V power supply of the Implement ECM. “Steer position sensor 2” is internally connected to ground at the 8 V sensor return of the Transmission/Chassis ECM (ground of ECM) and the 8 V sensor return of the Implement ECM (ground of ECM). The “steer sensor” must lose the 8 V power supply or both grounds in order to lose power. The illustration above indicates the power and ground connections for “steer position sensor 2” .

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the full left position of the joystick to approximately 90 ± 5% at the full right position of the joystick. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The sensor has failed.
- Intermittent connections or poor connections exist in the sensor circuit.
- The signal circuit is shorted to another circuit in the machine harness.
- The ECM has failed. This is unlikely.

Consider the following points when this code is active:

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the 8 V sensor power supply of the Implement ECM (MID 082). Correct any problem with the 8 V power supply before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “steer sensor 2” . Both ECM modules can activate a CID 1472 FMI 02 diagnostic code when the signal is erratic or intermittent. If one ECM has activated a CID 1472 FMI 02 diagnostic code and the other ECM has not activated a CID 1472 FMI 02, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor or a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left joystick, insert 7X-1710 Multimeter Probes along the contact of the power supply J1-1 (wire R800-OR(Orange)) and along ground 3 contact J1-8 (wire P967-PU(Purple)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

D. Reposition the multimeter probe that is along the contact for ground 3 J1-8 (wire P967-PU(Purple)) to along the contact for ground 2 J1-4 (wire P967-PU(Purple)). The other multimeter probe remains positioned along contact of the power supply J1-1 (wire R800-OR(Orange)).

E. Measure the DC voltage of the sensor power supply.

Expected Result:

Both of the voltage measurements are approximately 8.0 ± 0.4 VDC.

Results:

- OK – Both of the voltage measurements are approximately 8.0 ± 0.4 VDC. The power supply for the sensor is correct. Proceed to Test Step 2.
- NOT OK – The voltage measurements are less than 8.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: Either both of the wires of the ground circuit for the sensor are faulty or the sensor supply circuit is faulty.

  NOTE: If one of the voltage measurements is correct and the other measurement is not correct, one of the ground circuits is faulty. This condition will not cause this code to activate. However, the faulty ground circuit must be repaired before proceeding with this procedure.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the circuits. Ensure that the connections are clean, that the connections are secure and that the connections are in good condition.

For troubleshooting the power supply of the Implement ECM, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Implement ECM.

Repair the faulty power supply circuit before proceeding with this procedure.

STOP.

Test Step 2. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire U740-BU(Blue) and the socket at contact J1-7 from the harness connector. The machine harness connector J1 remains connected to the connector of the left joystick.

B. At the back of the connector of the joystick J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-7 and the ground 3 contact at J1-8.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Measure the duty cycle of the sensor at the connector contacts of the joystick J1-7 and J1-8. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “steer sensor 2” is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reinstall the signal wire U740-BU(Blue) and the socket back to the original location at contact J1-7 in the machine harness connector for the joystick. Verify that all of the wires for the joystick are in the correct locations. Verify that all of the wires for the joystick are secure in the connector before proceeding to the next step. Proceed to Test Step 3.

- NOT OK – The duty cycle of the “steer sensor 2” is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the “steer sensor 2” signal is not correct according to the description at the beginning of this procedure, replace the assembly of the left joystick. After replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 3. CHECK THE SIGNAL AT BOTH OF THE ECM MODULES

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the machine harness connector J1 for the Transmission/Chassis ECM, insert a multimeter probe along return contact J1-45 (wire X800-OR(Orange)). At the machine harness connector J2 for the Transmission/Chassis ECM, insert a multimeter probe along signal contact J2-48 (wire U740-BU(Blue)). The machine harness connectors remain connected to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Measure the duty cycle of the sensor at the connector contacts of the ECM J1-45 and J2-48. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

E. At the machine harness connector J1 for the Implement ECM, insert a multimeter probe along return contact J1-45 (wire P967-PU(Purple)). At the machine harness connector J2 for the Implement ECM, insert a multimeter probe along signal contact J2-48 (wire U740-BU(Blue)). The connectors of the machine harness remain connected to the ECM.

F. Measure the duty cycle of the sensor at the connector contacts of the ECM J1-45 and J2-48. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “steer sensor 2” is correct according to the description at the beginning of this procedure at both of the ECM modules.

Results:

- OK – The duty cycle of the sensor is correct at both of the ECM modules. The machine harness

does not appear to be the cause of the problem. An intermittent open or short circuit could still be causing the problem.Proceed to Test Step 4.

- NOT OK – The duty cycle of the “steer sensor 2” is NOT correct at one of the ECM modules according to the description at the beginning of this procedure. There is a problem in the machine harness.

  Repair: If the sensor signal at one ECM is correct and the sensor signal at the other ECM is not correct, a poor connection in the circuit would be suspected.

  The “steer sensor 2” signal at one of the ECM modules is not correct.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the section of the sensor signal circuit that connects to the ECM that is not receiving a good signal. Verify that the connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

- NOT OK – The duty cycle of the “steer sensor 2” is NOT correct at either of the ECM modules according to the description at the beginning of this procedure. A problem in the machine harness is the most likely cause.Proceed to Test Step 4.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

Turn the key start switch and the disconnect switch to the OFF position.

A. Disconnect the J1 connector and the J2 connector from the Implement ECM.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-48 (wire U740-BU(Blue)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

C. If any of the resistance measurements in the last test step are less than 5000 ohms, skip the next test step and proceed to the “Expected Result” step. If all of the resistance measurements in the last test step are above 5000 ohms, perform the next test step.

D. Disconnect the J1 connector and the J2 connector from the Transmission/Chassis ECM.

E. At the J2 machine harness connector for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-48 (wire U740-BU(Blue)) to all of the other J1 and J2 contacts that are used for the Transmission/ Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance checks of the signal circuit do not indicate a short in the machine harness.Proceed to Test Step 5.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1472 FMI 02 diagnostic code is active.

Expected Result:

The CID 1472 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 1472 FMI 02 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1472 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary shorts or intermittent shorts. The wiggle test can also be used to detect open connections in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated the diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is very unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04991971

MID 082 - CID 1472 - FMI 03

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

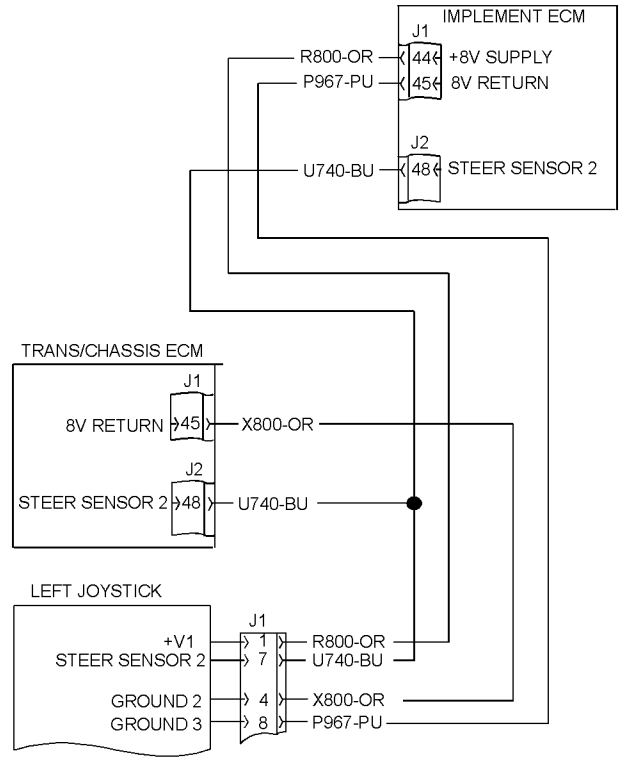


Illustration 245 g03170776

Connections “Steer Sensor 2”

Three steer position sensors are required for correct operation of the steering control. The “steer position” sensors are located in the assembly of the left joystick. Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. This diagnostic code is recorded when the ECM reads the input signal from the “steer position sensor 2” and the voltage of the signal is above normal.

The “steer position sensor 2” receives power from the 8 V power supply of the Implement ECM. “Steer position sensor 2” is internally connected to ground at the 8 V sensor return of the Transmission/Chassis ECM(ground of ECM) and the 8 V sensor return of the Implement ECM (ground of ECM). The “steer” sensor must lose the 8 V power supply or both grounds in order to lose power. The illustration above indicates the power and ground connections for “steer position sensor 2” .

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the full left position of the joystick to approximately 90 ± 5% at the full right position of the joystick. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The circuit of the sensor power supply is open.
- The circuit of the sensor return is open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Consider the following points when this code is active:

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the 8 V sensor power supply of the Implement ECM (MID 082). Correct any problem with the 8 V power supply before performing this procedure.

Note: The correct operating temperature range for the steering sensors is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a steering sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the steer sensors operating in the acceptable temperature range. After temperature normalization, verify that the CID 1472 FMI 03 diagnostic code is active before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “steer sensor 2” . Both ECM modules can activate a CID 1472 FMI 03 diagnostic code when the signal voltage is above normal. If one ECM has activated a CID 1472 FMI 03 diagnostic code and the other ECM has not activated a CID 1472 FMI 03, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left joystick, insert 7X-1710 Multimeter Probes along the contact of the power supply J1-1 (wire R800-OR(Orange)) and along ground 3 contact J1-8 (wire P967-PU(Purple)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

D. Reposition the multimeter probe that is along the contact of ground 3 J1-8 (wire P967-PU(Purple)) to along the contact of ground 2 J1-4 (wire P967-PU(Purple)). The other multimeter probe remains positioned along the contact of the power supply J1-1 (wire R800-OR(Orange)).

Expected Result:

Both of the voltage measurements are approximately 8.0 ± 0.4 VDC.

Results:

- OK – Both of the voltage measurements are approximately 8.0 ± 0.4 VDC. The power supply for the sensor is correct. Proceed to Test Step 2.
- NOT OK – One or both of the voltage measurements is less than 8.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: Either both of the ground circuit wires for the sensor or the sensor supply circuit for the sensor is faulty.

NOTE: If one of the voltage measurements is correct and the other measurement is not correct, one of the ground circuits is faulty. This condition will not cause this code to activate. However, the faulty ground circuit must be repaired before proceeding with this procedure.

Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the circuits. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition.

For troubleshooting the power supply of the Implement ECM , refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Implement ECM.

Repair the faulty power supply circuit before proceeding with this procedure.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT AT BOTH OF THE ECM MODULES

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the left joystick. At harness connector J1 for the joystick, connect a jumper wire between ground 2 contact J1-4 (wire X800-OR(Orange)) and the signal contact J1-7 (wire U740-BU(Blue)).

C. Disconnect machine harness connectors J1 and J2 from the Transmission/Chassis ECM.

D. At the harness connector for the Transmission/ Chassis ECM, measure the resistance from return contact J1-45 (wire X800-OR(Orange)) to signal contact J2-48 (wire U740-BU(Blue)).

E. Observe the resistance measurement and wiggle the connector for the ECM and the connector for the sensor. Gently pull on the wires and wiggle the wires for both of the connectors.

F. At harness connector J1 for the joystick, move the jumper wire to the ground 3 contact J1-8 (wire P967-PU(Purple)) and the signal contact J1-7 (wire U740-BU(Blue)).

G. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

H. At the harness connectors for the Implement ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-48 (wire U740-BU(Blue)).

I. Observe the resistance measurement and wiggle the connector for the ECM and the connector for the sensor. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

Both resistance measurements are less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The sensor circuit is not open in either input circuit of the ECM.Proceed to Test Step 3.
- NOT OK – The resistance measurement at one or both of the ECM modules is greater than 5 ohms. There is an open connection or a bad connection in one or both of the signal circuits.

  Repair: If both of the resistance measurements are not correct, there is an open connection or a bad connection on the sensor side of the splice of the machine harness for the signal wire U740-BU(Blue).

  If one of the measurements is correct and the other measurement is not correct, there is an open connection or a bad connection on the ECM side of the splice of the machine harness for the signal wire U740-BU(Blue).

  In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspected section of the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors remain disconnected from the Implement ECM and the Transmission/Chassis ECM.

A. Remove the jumper wire that was installed in the last step at the connector of the joystick.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-48 (wire U740-BU(Blue)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

C. At the J2 machine harness connector for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-48 (wire U740-BU(Blue)) to all of the other J1 and J2 contacts that are used for the Transmission/ Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance checks of the signal circuit do not indicate a short in the machine harness.Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Reconnect the machine harness connectors J1 and J2 to both ECM modules.

B. Reconnect the machine harness connectors that are disconnected to the left joystick.

C. At the machine harness connector J1 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire U740-BU(Blue) and the socket at contact J1-7 from the harness connector. The machine harness connector J1 remains connected to the connector of the left joystick.

D. At the back of the connector of the joystick J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-7 and the ground contact at J1-8.

E. Turn the disconnect switch and the key start switch to the ON position.

F. Measure the duty cycle of the sensor at the connector contacts of the joystick J1-7 and J1-8. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “steer sensor 2” is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick. Reinstall the signal wire U740-BU(Blue) and the socket back to the original location at contact J1-7 in the machine harness connector for the joystick. Verify that all of the wires of the joystick are in the correct locations. Verify that all of the wires of the joystick are secure in the connector before proceeding to the next step. Proceed to Test Step 5.
- NOT OK – The duty cycle of the “steer sensor 2” is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the “steer sensor 2” signal is not correct according to the description at the beginning of this procedure, replace the assembly of the left joystick. After replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1472 FMI 03 diagnostic code is active.

Expected Result:

The CID 1472 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 1472 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1472 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary shorts or intermittent shorts. The wiggle test can also be used to detect open connections in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is very unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04991709

MID 082 - CID 1472 - FMI 04

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

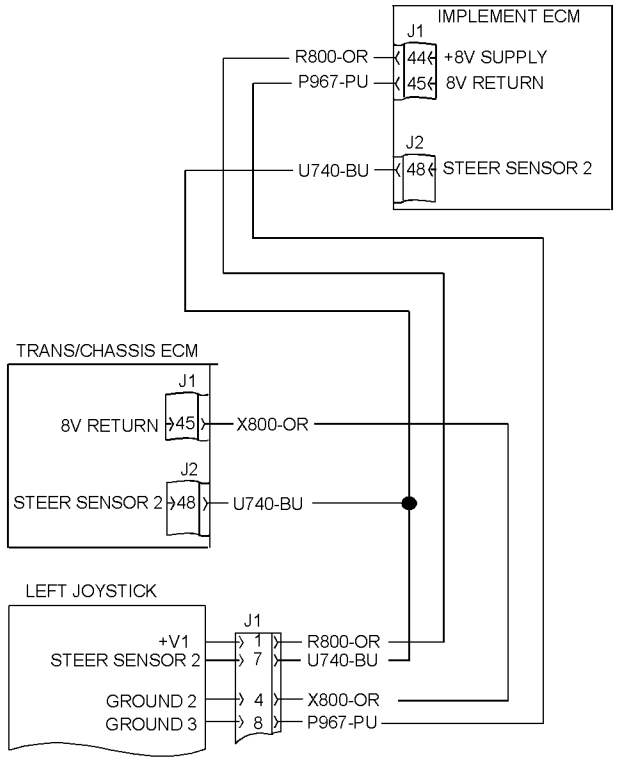


Illustration 246 g03170776

Steer Sensor 2 connections

Three steer position sensors are required for correct operation of the steering control lever. The steer position sensors are located in the assembly of the left joystick. Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. This diagnostic code is recorded when the ECM reads the signal from the steer position sensor 2 and the voltage of the signal is below normal.

The steer position sensor 2 receives power from the Implement ECM 8 V power supply. Steer position sensor 2 is internally connected to ground at the Transmission/Chassis ECM 8 V sensor return (ECM ground) and the Implement ECM 8 V sensor return (ECM ground). The steer sensor must lose the 8 V power supply or both grounds in order to lose power. The illustration above indicates the power and ground connections for steer position sensor 2.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the joystick full left position to approximately 90 ± 5% at the joystick full right position. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the Implement ECM (MID 082) 8 V sensor power supply. Correct any problem with the 8 V power supply before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the steer sensor 2. Both ECM modules can activate a CID 1472 FMI 04 diagnostic code when the signal voltage is below normal. If one ECM has activated a CID 1472 FMI 04 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the left joystick. Observe the status of the active CID 1472 FMI 04 diagnostic code.

Expected Result:

The status of the CID 1472 FMI 04 diagnostic code did not change when the connector of the joystick was disconnected. A CID 1472 FMI 03 diagnostic code has NOT been activated by either the Implement ECM or the Transmission/Chassis ECM. The CID 1472 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected.

Results:

- YES – The CID 1472 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected. The sensor is not causing the problem.Proceed to Test Step 2.
- NO – The CID 1472 FMI 04 diagnostic code is no longer active when the connector of the joystick is disconnected. A CID 1472 FMI 03 diagnostic code has been activated by both of the ECM modules when the connector of the joystick is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The steer sensor 2 is causing the problem. There is an internal short to ground in the left joystick. Replace the assembly of the left joystick. After replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the joystick J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. Disconnect the J1 and the J2 connectors from the Transmission/Chassis ECM.

E. At machine harness connector J2 for the Implement ECM, measure the resistance from contact J2-48 (wire U740-BU(Blue)) to frame ground. Measure the resistance from contact J2-48 (wire U740-BU(Blue)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

F. At the J2 machine harness connector for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-48 (wire U740-BU(Blue)) to frame ground and measure the resistance to all of the other J1 and J2 contacts that are used for the Transmission/ Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance checks of the signal circuit do not indicate a short in the machine harness.Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and either the frame ground or the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1472 FMI 04 diagnostic code is active.

Expected Result:

The CID 1472 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 1472 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1472 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04991749

MID 082 - CID 1472 - FMI 08

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

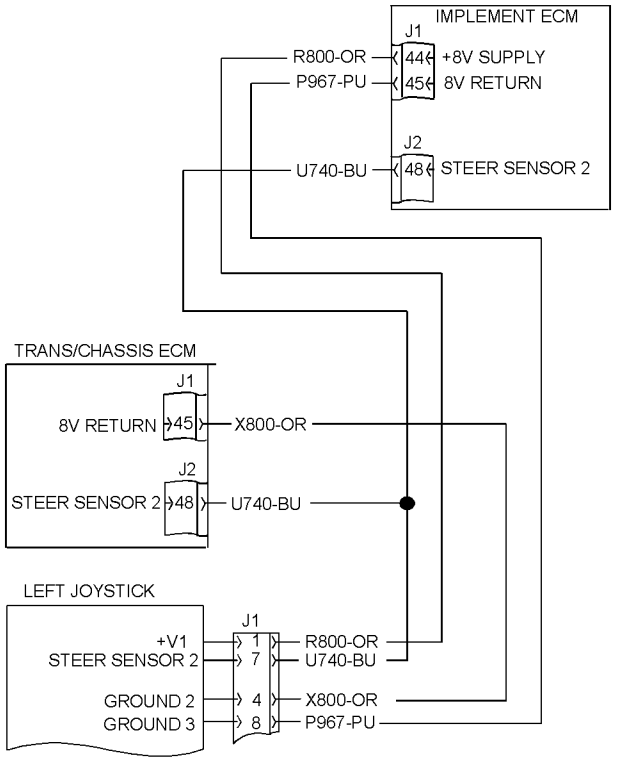


Illustration 247 g03170776

Connections of “Steer Sensor 2”

Three “steer position” sensors are required for correct operation of the steering control. The “steer position” sensors are located in the assembly of the left joystick. Each sensor provides an input signal to the ECM. This diagnostic code is associated with the left hand “steering lever position sensor 2” . The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range.

The “steer position sensor 2” receives power from the 8 V power supply of the Implement ECM. “Steer position sensor 2” is internally connected to ground at the 8 V sensor return of the Transmission/Chassis ECM (ground of ECM) and the 8 V sensor return of the Implement ECM (ground of ECM). The “steer” sensor must lose the 8 V power supply or both grounds in order to lose power. The illustration above indicates the power and ground connections for “steer position sensor 2” .

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the full left position of the joystick to approximately 90 ± 5% at the full right position of the joystick. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Consider the following points when this code is active:

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the 8 V sensor power supply of the ECM . Correct any problem with the 8 V power supply before performing this procedure.

Note: The correct operating temperature range for the steering sensors is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a steering sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the steer sensors operating in the acceptable temperature range. After temperature normalization, verify that the CID 1472 FMI 08 diagnostic code is active before performing this procedure.

Note: The Transmission/Chassis ECM also receives an input from the “steer sensor 2” signal. The Transmission/Chassis ECM (MID 027) will activate a CID 1472 FMI 08 diagnostic code when an abnormal signal frequency or pulse width is detected. If one ECM has activated a CID 1472 FMI 08 diagnostic code and the other ECM has not activated a CID 1472 FMI 08 diagnostic code, it is likely that the sensor is operating correctly. When this occurs, an intermittent open in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor or a harness problem could be the cause. For either condition, proceed with this procedure in order to verify the cause of the problem.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that the connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire (wire U740-BU(Blue)) and the socket at contact J1-7. The machine harness connector J1 remains connected to the connector of the left joystick.

B. At the back of the connector of the joystick J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-7 and the ground contact at J1-4.

C. Turn the disconnect switch and the key start switch to the ON position.

D. With the joystick in a stationary position, measure the frequency of the signal from the sensor.

E. Observe the measurement and wiggle the connector of the joystick. Gently pull on the wires and wiggle the wires.

F. Measure the duty cycle of the sensor at the connector contacts of the joystick J1-7 and J1-4. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

G. Observe the measurement and wiggle the connector of the joystick. Gently pull on the wires and wiggle the wires.

Expected Result:

The frequency of the “steer sensor 2” signal is 500 ± 100 Hz. The duty cycle of the “steer sensor 2” is correct according to the description at the beginning of this procedure. The frequency and the duty cycle are stable during the manipulation of the harness connector and the wiring.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The signal frequency and the duty cycle of the sensor did not change when the harness was manipulated. The sensor is not causing the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick. Verify that all wires of the joystick are secure in the connector before proceeding to the next step.Proceed to Test Step 2.

- NOT OK – The signal frequency and the duty cycle of the “steer sensor 2” is not correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the “steer sensor 3” signal is not correct according to the description at the beginning of this procedure, replace the assembly of the left joystick . After replacement of the assembly of the joystick , verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT AT BOTH OF THE ECM MODULES

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the left joystick. At the sensor connector of the machine harness J1, place a jumper wire between the ground 3 contact J1-8 (wire P967-PU(Purple)) and the signal contact J1-7 (wire L740-BU(Blue)) .

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connector for the Implement ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-48 (wire U740-BU(Blue)).

E. Observe the resistance measurement and wiggle the connector of the ECM and the connector of the sensor. Gently pull on the wires and wiggle the wires for both connectors.

F. At the harness connectors for the joystick, move the jumper from the ground 3 contact and connect the jumper to the ground 2 contact J1-4 (wire X800-OR(Orange)). The other end of the jumper wire remains connected to the signal contact J1-7 (wire L740-BU(Blue)).

G. Disconnect machine harness connectors J1 and J2 from the Transmission/Chassis ECM.

H. At the harness connector for the Transmission/ Chassis ECM, measure the resistance from return contact J1-45 (wire X800-OR(Orange)) to signal contact J2-48 (wire U740-BU(Blue)).

I. Observe the resistance measurement and wiggle the connector for the ECM and the connector for the sensor. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

Both resistance measurements are less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The sensor circuit is not open in either input circuit of the ECM.Proceed to Test Step 3.
- NOT OK – The resistance measurement at one or both of the ECM modules is greater than 5 ohms. There is an open or a bad connection in one or both of the signal circuits.

  Repair: If both of the resistance measurements are not correct, there is an open connection or a bad connection on the sensor side of the machine harness at the splice of the signal wire U740-BU(Blue).

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  If one of the measurements is correct and the other measurement is not correct, there is an open connection or a bad connection on the ECM side of the machine harness at the splice for the signal wire U740-BU(Blue).

  In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspected section of the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 1472 FMI 08.

Expected Result:

The CID 1472 FMI 08 is not active.

Results:

- OK – The CID 1472 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1472 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary shorts or intermittent shorts. The wiggle test can detect open connections in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is very unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i04991809

MID 082 - CID 1472 - FMI 14

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

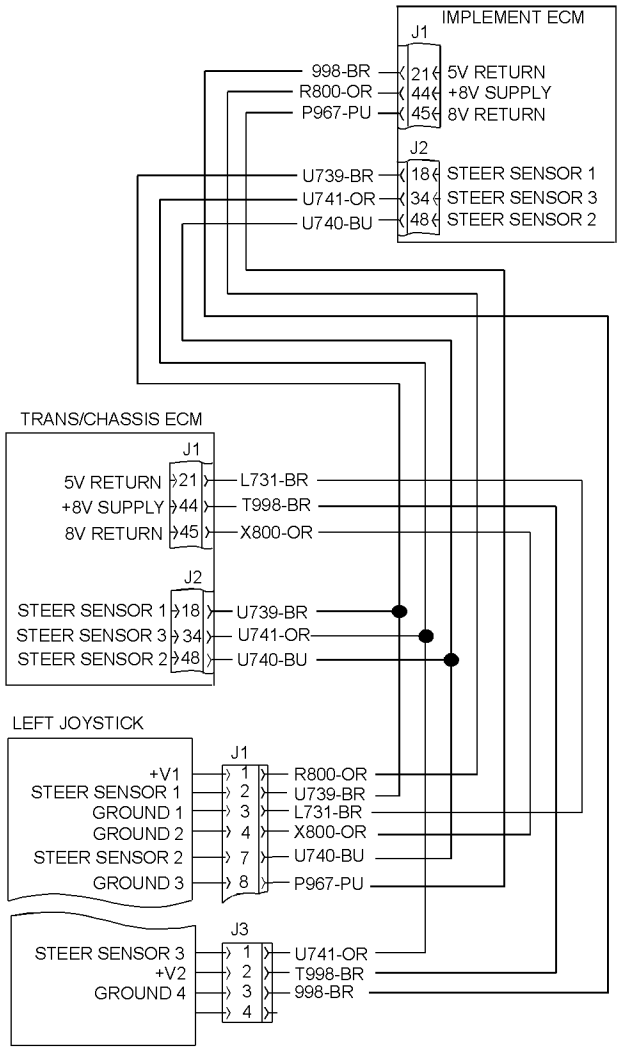


Illustration 248 g03170678

Connections of the left joystick steer sensors.

Three steer position sensors are required for correct operation of the steering control. The steer position sensors are located in the assembly of the left joystick. Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. The ECM expects the input signals from all three steer position sensors to closely match. The FMI 14 diagnostic code is activated when the following occurs:

- ECM determines that the PWM input signal from the number two steer position sensor does not match the PWM input signal from the other steer position sensors.
- The signal from the first steer position sensor matches the signal from the third steer position sensor.

The number two steer position sensor receives power from the 8 V power supply of the Implement ECM. The number two steer position sensor is internally connected to ground. Ground is supplied by the Transmission/Chassis ECM and the Implement ECM. The steer position sensors must lose both grounds in order to lose a ground connection. The illustration above indicates the power and ground connections for the number two steer position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The steer position sensors are PWM sensors. The steer position sensors operate at a frequency of 500 ± 100 Hz. The steer position sensors send a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. Following is the variation in the duty cycle of the signal:

- When the lever is in the FULL LEFT position, the duty cycle will be approximately 10%.
- When the lever is in the FULL RIGHT position, the duty cycle will be approximately 90%.
- When the lever is in the CENTER position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: If a MID 027 CID 0041 diagnostic code for the 8 V power supply has been activated by the Transmission/Chassis ECM (MID 027), correct the problem before proceeding with this procedure.

Note: The correct operating temperature range for the steer position sensors is −40 °C (−40.0 °F) to 75 °C (167.0 °F). Return the temperature in the cab to a normal temperature when the temperature in the cab is extreme and a diagnostic code becomes active. Returning the temperature in the cab to a normal temperature will keep the steer position sensors operating in the acceptable temperature range. After returning the temperature to normal, verify that the CID 1472 FMI 14 diagnostic code is active before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the number one steer position sensor. Both electronic control modules can activate a CID 1472 FMI 14 diagnostic code when the following occurs: The signal from the number two steer position sensor does not match the signal from the other steer position sensors. If one of the electronic control modules has activated a CID 1472 FMI 14 diagnostic code and the other ECM has not activated a CID 1472 FMI 14 diagnostic code, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both electronic control modules have activated the diagnostic code, either the sensor or a harness problem could be the cause. If both electronic control modules have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are in good condition. The connections must be clean and the connections must be secure. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Note: The next two test steps will measure the duty cycle of each steer position sensor in order to determine if one signal is not closely matching with both of the other sensor signals. Record the duty cycle of each of the three steer position sensors for comparison.

Test Step 1. CHECK THE SIGNAL AT THE NUMBER ONE STEER POSITION SENSOR

A. Turn the key start switch to the OFF position.

B. Turn the disconnect switch to the OFF position.

C. Do not disconnect the harness connector from the sensor.

D. Perform the following on the back of the joystick at connector J1. Insert 7X-1710 Multimeter Probes along each sensor signal contact and the return contact at J1-4.

E. Turn the disconnect switch and the key start switch to the ON position.

F. Move the joystick to the position that activates the code.

G. Hold the joystick in the position that activates the code.

H. Monitor the signal of the sensor with a digital multimeter.

I. Record the duty cycle of all the steer position sensors.

J. Compare the duty cycles of all three steer position sensors at the same specific position of the joystick.

Expected Result:

Each duty cycle is within 5% or less of the signals from the other sensors.

Results:

- OK – There is 5% or less deviation in the duty cycle between the three steer position sensors with the joystick in the same position. Proceed to Test Step 2.
- NOT OK – With the joystick in the same position, one or more of the duty cycles deviates more than 5% from the other duty cycles. There is a problem with a steer position sensor.

  Repair: One of the steer position sensors is not operating correctly. Replace the assembly of the left joystick. After replacement of the assembly, verify that the new assembly is working correctly before operating the machine.

  STOP.

Test Step 2. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Perform the following:

- Clean the contacts of the harness connectors.
- Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.

- The clips for each connector are completely fastened.

D. Operate the machine.

E. Check the status of the CID 1472 FMI 14 diagnostic code.

Expected Result:

The CID 1472 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 1472 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Clear logged codes. Verify that the assembly is working correctly. Resume normal operation.

  STOP.

- NOT OK – The CID 1472 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04991993

MID 082 - CID 1473 - FMI 02

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

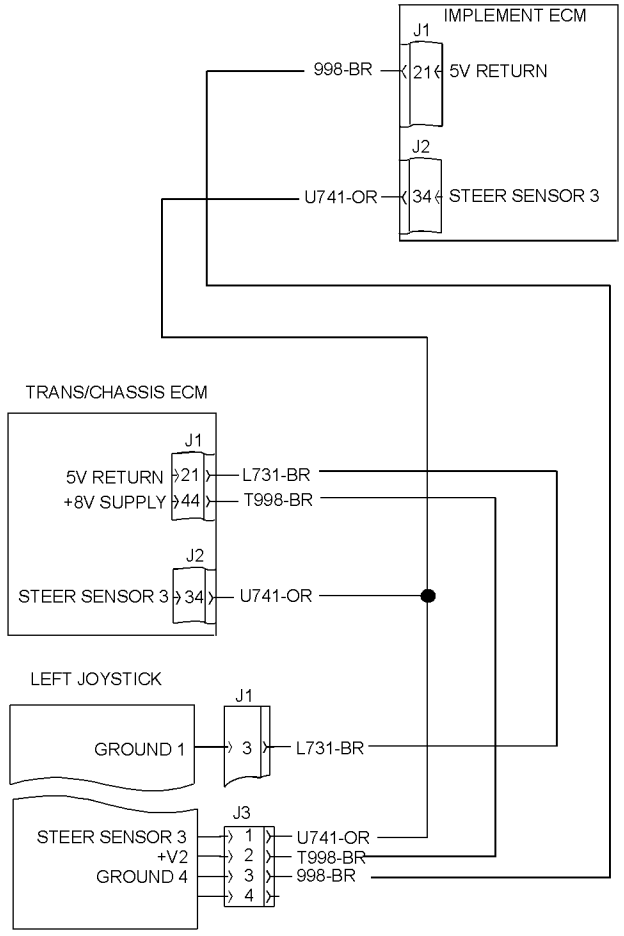


Illustration 249 g03171003

Connections of “Steer Sensor 3”

Three “steer position sensors” are required for correct operation of the steering control. The “steer position sensors” are located in the assembly of the left joystick . Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. This diagnostic code is recorded when the ECM reads the input signal from the “steer position sensor 3” and the signal is erratic or intermittent.

The “steer position sensor 3” receives power from the 8 V power supply of the Transmission/Chassis ECM. The “steer sensor 3” is internally connected to the ground from the 5 V sensor return of the Transmission/Chassis ECM (ground of ECM) and to the ground from the 5 V sensor return of the Implement ECM (ground of ECM). The “steer sensor” must lose the 8 V power supply or both grounds in order to lose power. The illustration above indicates the power and ground connections for “steer position sensor 3” .

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the full left position of the joystick to approximately 90 ± 5% at the full right position of the joystick. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections exist in the sensor circuit.
- The signal circuit is shorted to another circuit in the machine harness.
- The ECM has failed. This is unlikely.

Consider the following points when this code is active:

Note: Before performing this procedure, check for an active MID 027 CID 0041 diagnostic code for the 8 V sensor power supply of the Transmission/Chassis ECM. Correct any problem with the 8 V power supply before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “steer sensor 3” . Both ECM modules can activate a CID 1473 FMI 02 diagnostic code when the signal is erratic or intermittent. If one ECM has activated a CID 1473 FMI 02 diagnostic code and the other ECM has not activated a CID 1472 FMI 02, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that the connections are secure and that the connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the machine harness connectors for the left joystick, insert 7X-1710 Multimeter Probes along the contact for the power supply J3-2 (wire T998-BR(Brown)) and along ground 1 contact J1-3 (wire L731-BR(Brown)). Do not disconnect the machine harness from the connectors of the joystick.

C. Measure the DC voltage of the sensor power supply.

D. Reposition the multimeter probe that is along the contact for ground 1 J1-3 (wire L731-BR(Brown)) to along the contact for ground 4 J3-3 (wire 998-BR(Brown)). The other multimeter probe remains positioned along the contact for the power supply J3-2 (wire T998-BR(Brown)).

E. Measure the DC voltage of the sensor power supply.

Expected Result:

Both of the voltage measurements are approximately 8.0 ± 0.4 VDC.

Results:

- OK – Both of the voltage measurements are approximately 8.0 ± 0.4 VDC. The power supply of the Transmission/Chassis ECM for the sensor is correct. Proceed to Test Step 2.
- NOT OK – One or both of the voltage measurements is not 8.0 ± 0.4 VDC. The power supply for the Transmission/Chassis ECM for the sensor is not correct.

  Repair: Either both of the wires of the ground circuit for the sensor are faulty or the sensor supply circuit is faulty.

  NOTE: If one of the voltage measurements is correct and the other measurement is not correct, one of the ground circuits is faulty. This condition will not cause this code to be active. However, the faulty ground circuit must be repaired before proceeding with this procedure.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the circuits. Ensure that the connections are clean, that the connectors are secure and that the connectors are in good condition.

  For troubleshooting the power supply of the Transmission/Chassis ECM , refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Transmission/Chassis ECM.

  Repair the faulty power supply circuit before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J3 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire U741-OR(Orange) and the socket at contact J3-1 from the harness connector. The machine harness connector J3 remains connected to the connector of the left joystick.

B. At the back of the connectors of the joystick J3 and J1, insert 7X-1710 Multimeter Probes along the contact of the sensor signal J3-1 and the contact for ground 4 at J3-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Measure the duty cycle of the sensor at the connector contacts of the joystick J3-1 and J3-3. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “steer sensor 3” is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reinstall the signal wire U741-OR(Orange) and the socket back to the original location at contact J3-1 in the machine harness connector for the joystick. Verify that all of the wires of the joystick are in the correct locations. Verify that all the wires of the joystick are secure in the connector before proceeding to the next step. Proceed to Test Step 3.
- NOT OK – The duty cycle of the “steer sensor 3” is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the “steer sensor 3” signal is not correct according to the description at the beginning of this procedure, replace the assembly of the left joystick. After replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 3. CHECK THE SIGNAL AT BOTH OF THE ECM MODULES

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the machine harness connector J1 for the Implement ECM, insert a multimeter probe along return contact J1-21 (998-BR(Brown)). At the machine harness connector J2 for the Implement ECM, insert a multimeter probe along signal contact J2-34 (wire U741-OR(Orange)). The machine harness connectors remain connected to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Measure the duty cycle of the sensor at the connector contacts of the ECM J1-21 and J2-34. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

E. At the machine harness connector J1 for the Transmission/Chassis ECM, insert a multimeter probe along return contact J1-21 (L731-BR(Brown)). At the machine harness connector J2 for the Implement ECM, insert a multimeter probe along signal contact J2-34 (wire U741-OR(Orange)). The machine harness connectors remain connected to the ECM.

F. Measure the duty cycle of the sensor at the connector contacts of the ECM J1-21 and J2-34. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “steer sensor 3” is correct according to the description at the beginning of this procedure at both of the ECM modules.

Results:

- OK – The duty cycle of the sensor is correct at both of the ECM modules. The machine harness does not appear to be the cause of the problem. An intermittent open or a short circuit could still be causing the problem.Proceed to Test Step 4.

- NOT OK – The duty cycle of the “steer sensor 3” is NOT correct at one or both of the ECM modules according to the description at the beginning of this procedure. There is a problem in the machine harness.

  Repair: If the sensor signal at one ECM is correct and the sensor signal at the other ECM is not correct, a poor connection in the circuit would be suspected.

  The “steer sensor 3” signal at one of the ECM modules is not correct.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the section of the sensor signal circuit that connects to the ECM that is not receiving a good signal. Verify that the connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

- NOT OK – The duty cycle of the “steer sensor 3” is NOT correct at either of the ECM modules according to the description at the beginning of this procedure. A problem in the machine harness is the most likely cause.Proceed to Test Step 4.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

Turn the key start switch and the disconnect switch to the OFF position.

A. Disconnect the J1 connector and the J2 connector from the Implement ECM.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-34 (wire U741-OR(Orange)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

C. If any of the resistance measurements in the last test step are less than 5000 ohms, skip the next test step and proceed to the “expected result” step. If all of the resistance measurements in the last test step are above 5000 ohms, perform the next test step.

D. Disconnect the J1 connector and the J2 connector from the Transmission/Chassis ECM.

E. At the J2 machine harness connector for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-34 (wire U741-OR(Orange)) to all of the other J1 and J2 contacts that are used for the Transmission/ Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance checks of the signal circuit do not indicate a short in the machine harness.Proceed to Test Step 5.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1473 FMI 02 diagnostic code is active.

Expected Result:

The CID 1473 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 1473 FMI 02 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1473 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary shorts or intermittent shorts. The wiggle test can also be used to detect open connections in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated the diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is very unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04994289

MID 082 - CID 1473 - FMI 03

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

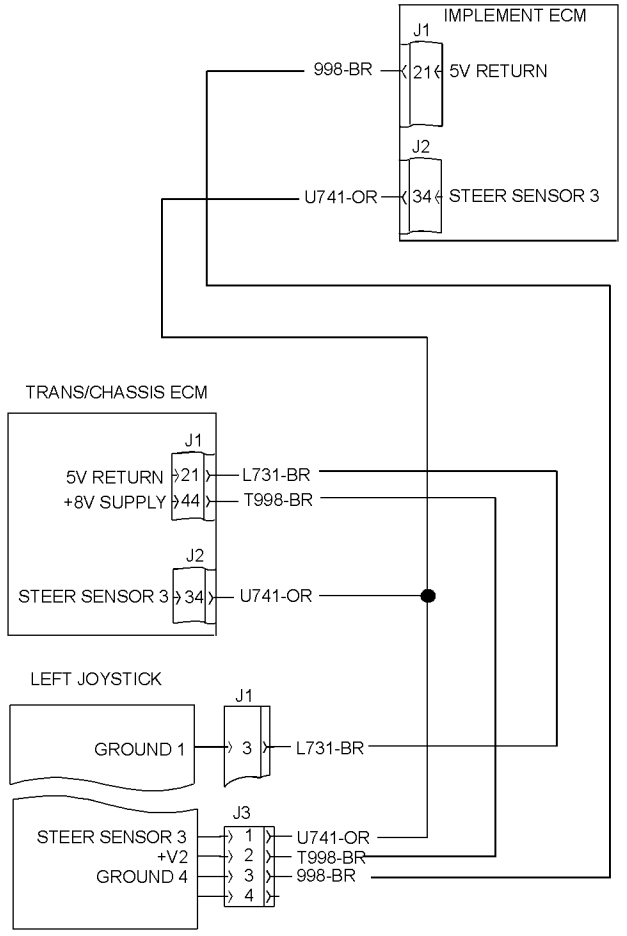


Illustration 250 g03171003

Connections of “Steer Sensor 3”

Three “steer sensors” are required for correct operation of the steering control. The “steer sensors” are located in the assembly of the left joystick. Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. This diagnostic code is recorded when the ECM reads the input signal from the “steer position sensor 3” and the voltage of the signal is above normal.

The “steer position sensor 3” receives power from the 8 V power supply of the Transmission/Chassis ECM. The “steer sensor 3” is internally connected to the ground from the 5 V sensor return of the Transmission/Chassis ECM (ground of ECM) and to the ground from the 5 V sensor return of the Implement ECM (ground of ECM). The “steer sensor” must lose the 8 V power supply or both grounds in order to lose power. The illustration above indicates the power and ground connections for steer position sensor 3.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the full left position of the joystick to approximately 90 ± 5% at the full right position of the joystick. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The power supply circuit of the sensor is faulty.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to a voltage source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Consider the following points when this code is active:

Before performing this procedure, check for an active MID 027 CID 0041 diagnostic code for the 8 V sensor power supply of the Transmission/Chassis ECM. Correct any problem with the 8 V power supply before performing this procedure.

Note: The correct operating temperature range for the steering sensors is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a steering sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the “steer sensors” operating in the acceptable temperature range. After temperature normalization, verify that the CID 1473 FMI 03 diagnostic code is active before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “steer sensor 3” . Both ECM modules can activate a CID 1473 FMI 03 diagnostic code when the signal is erratic or intermittent. If one ECM has activated a CID 1473 FMI 03 diagnostic code and the other ECM has not activated a CID 1473 FMI 03, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the J3 and J1 harness connectors for the left joystick, insert 7X-1710 Multimeter Probes along the contact for the power supply J3-2 (wire T998-BR(Brown)) and along the contact of ground 2 J1-4 (wire X800-OR(Orange)). Do not disconnect the machine harness from the connectors of the joystick.

C. Measure the DC voltage of the sensor power supply.

D. Reposition the multimeter probe that is along the contact of ground 1 J1-3 (wire L731-BR(Brown)) to along the contact of ground 4 J3-3 (wire 998-BR(Brown)). The other multimeter probe remains positioned along the contact of the power supply J3-2 (wire T998-BR(Brown)).

E. Measure the DC voltage of the sensor power supply.

Expected Result:

Both of the voltage measurements are approximately 8.0 ± 0.4 VDC.

Results:

- OK – Both of the voltage measurements are approximately 8.0 ± 0.4 VDC. The power supply for the Transmission/Chassis ECM for the sensor is correct. Proceed to Test Step 2.
- NOT OK – One or both of the voltage measurements is not 8.0 ± 0.4 VDC. The power supply of the Transmission/Chassis ECM for the sensor is not correct.

  Repair: Either both of the wires for the ground circuit for the sensor are faulty or the sensor supply circuit is faulty.

  NOTE: If one of the voltage measurements is correct and the other measurement is not correct, one of the ground circuits is faulty. This condition will not cause this code to be active. However, the faulty ground circuit must be repaired before proceeding with this procedure.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the circuits. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition.

  For troubleshooting the power supply of the Transmission/Chassis ECM , refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Transmission/Chassis ECM.

  Repair the faulty power supply circuit before proceeding with this procedure.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT AT BOTH OF THE ECM MODULES

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connectors J3 and J1 from the left joystick. At the harness connectors for the joystick, place a jumper wire between the signal contact J3-1 (wire U741-OR(Orange)) and the ground 1 contact J1-3 (wire L731-BR(Brown)) .

C. Disconnect machine harness connectors J1 and J2 from the Transmission/Chassis ECM.

D. At the harness connector for the Transmission/Chassis ECM, measure the resistance from return contact J1-21 (wire L731-BR(Brown)) to signal contact J2-34 (wire U741-OR(Orange)).

E. Observe the resistance measurement and wiggle the connector of the ECM and the connector of the sensor. Gently pull on the wires and wiggle the wires for both connectors.

F. At the harness connectors for the joystick, move the jumper from the ground 1 contact and connect the jumper to ground 4 contact J3-3 (wire 998-BR(Brown)). The other end of the jumper wire remains connected to the signal contact J3-1 (wire U741-OR(Orange)).

G. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

H. At the harness connector for the Implement ECM, measure the resistance from return contact J1-21 (wire 998-BR(Brown)) to signal contact J2-34 (wire U741-OR(Orange)).

I. Observe the resistance measurement and wiggle the connector of the ECM and the connector of the sensor. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

Both resistance measurements are less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The sensor circuit is not open in either input circuit of the ECM.Proceed to Test Step 3.
- NOT OK – The resistance measurement at one or both of the ECM modules is greater than 5 ohms. There is an open or a bad connection in one or both of the signal circuits.

  Repair: If both of the resistance measurements are not correct, there is an open connection or a

bad connection on the sensor side of the machine harness at the splice for the signal wire U741-OR(Orange).

Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

If one of the measurements is correct and the other measurement is not correct, there is an open connection or a bad connection on the ECM side of the machine harness at the splice for the signal wire U741-OR(Orange).

In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspected section of the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors remain disconnected from the Implement ECM and the Transmission/Chassis ECM.

A. Remove the jumper wire that was installed in the last step at the connector of the joystick.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-34 (wire U741-OR(Orange)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

C. At the J2 machine harness connector for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-34 (wire U741-OR(Orange)) to all of the other J1 and J2 contacts that are used for the Transmission/Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance checks of the signal circuit do not indicate a short in the machine harness.Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Reconnect the machine harness connectors J1 and J2 to both ECM modules.

B. Reconnect the machine harness connectors that are disconnected to the left joystick.

C. At the machine harness connector J3 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire U741-OR(Orange) and the socket at contact J3-1 from the harness connector. The machine harness connector J3 remains connected to the connector of the left joystick.

D. At the back of the connectors of the joystick J3 and J1, insert 7X-1710 Multimeter Probes along the signal contact of the sensor J3-1 and the ground 1 contact at J1-3.

E. Turn the disconnect switch and the key start switch to the ON position.

F. Measure the duty cycle of the sensor at the connector contacts of the joystick J3-1 and J1-3. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “steer sensor 3” is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reinstall the signal wire U741-OR(Orange) and the socket back to the original location at contact J3-1 in the machine harness connector for the joystick. Verify that all of the wires of the joystick are in the correct locations. Verify that the wires of the joystick are secure in the connector before proceeding to the next step. Proceed to Test Step 5.

- NOT OK – The duty cycle of the “steer sensor 3” is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the “steer sensor 3” signal is not correct according to the description at the beginning of this procedure, replace the assembly of the left joystick. After replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1473 FMI 03 diagnostic code is active.

Expected Result:

The CID 1473 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 1473 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1472 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary shorts or intermittent shorts. The wiggle test can also be used to detect open connections in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is very unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04994292

MID 082 - CID 1473 - FMI 04

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

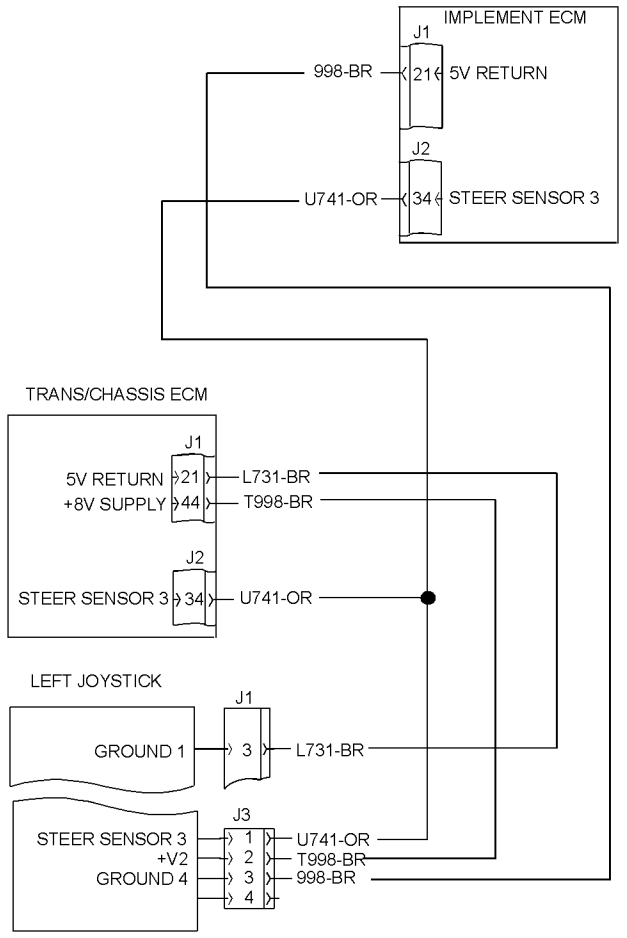


Illustration 251 g03171003

“Steer Sensor 3” connections

Three “steer position sensors” are required for correct operation of the steering control lever. The “steer position sensors” are located in the assembly of the left joystick . Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. This diagnostic code is recorded when the ECM reads the signal from the “steer position sensor 3” and the voltage of the signal is below normal.

The “steer position sensor 3” receives power from the 8 V power supply of the Transmission/Chassis ECM. The “steer sensor 3” is internally connected to the ground from the 5 V sensor return of the Transmission/Chassis ECM (ECM ground) and to the ground from the 5 V sensor return of the Implement ECM (ECM ground). The “steer sensor” must lose the 8 V power supply or both grounds in order to lose power. The illustration above indicates the power and ground connections for “steer position sensor 3” .

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The “steer sensor 3” receives power from the 8 V power supply of the Transmission/Chassis ECM. The “steer sensor 3” is connected to ground at the 5 V sensor return of the Transmission/Chassis ECM (ECM ground) and the 8 V sensor return of the Transmission/Chassis ECM(ECM ground). The “steer sensor” must lose the 8 V power supply or both grounds in order to lose power. The illustration above indicates the power and ground connections for the “steer sensor 3” .

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the full left position of the joystick to approximately 90 ± 5% at the full right position of the joystick. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The signal circuit is shorted to a ground source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, check for an active MID 027 CID 0041 diagnostic code for the 8 V sensor power supply of the Transmission/Chassis ECM. Correct any problem with the 8 V power supply before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “steer sensor 3” . Both ECM modules can activate a CID 1473 FMI 04 diagnostic code when the signal voltage is below normal. If one ECM has activated a CID 1473 FMI 04 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J3 from the left joystick. Observe the status of the active CID 1473 FMI 04 diagnostic code.

Expected Result:

The status of the CID 1473 FMI 04 diagnostic code did not change when the connector of the joystick was disconnected. A CID 1473 FMI 03 diagnostic code has NOT been activated by either the Implement ECM or the Transmission/Chassis ECM. The CID 1473 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected.

Results:

- YES – The CID 1473 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected. The sensor is not causing the problem.Proceed to Test Step 2.
- NOT OK – The CID 1473 FMI 04 diagnostic code is no longer active when the connector of the joystick is disconnected. A CID 1473 FMI 03 diagnostic code has been activated by both of the ECM modules when the connector of the joystick is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The “steer sensor 3” is causing the problem. There is an internal short to ground in the left joystick. Replace the assembly of the left joystick. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the joystick J3 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. Disconnect the J1 and the J2 connectors from the Transmission/Chassis ECM.

E. At machine harness connector J2 for the Implement ECM, measure the resistance from contact J2-34 (wire U741-OR(Orange)) to frame ground. Measure the resistance from contact J2-34 (wire U741-OR(Orange)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

F. At the J2 machine harness connector for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-34 (wire U741-OR(Orange)) to frame ground and measure the resistance to all of the other J1 and J2 contacts that are used for the Transmission/Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance checks of the signal circuit do not indicate a short in the machine harness.Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms.

Repair: There is a short in the machine harness. The short is between the signal circuit and either the frame ground or the circuit with the low resistance measurement.

Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1473 FMI 04 diagnostic code is active.

Expected Result:

The CID 1473 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 1473 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1473 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is very unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04994295

MID 082 - CID 1473 - FMI 08

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

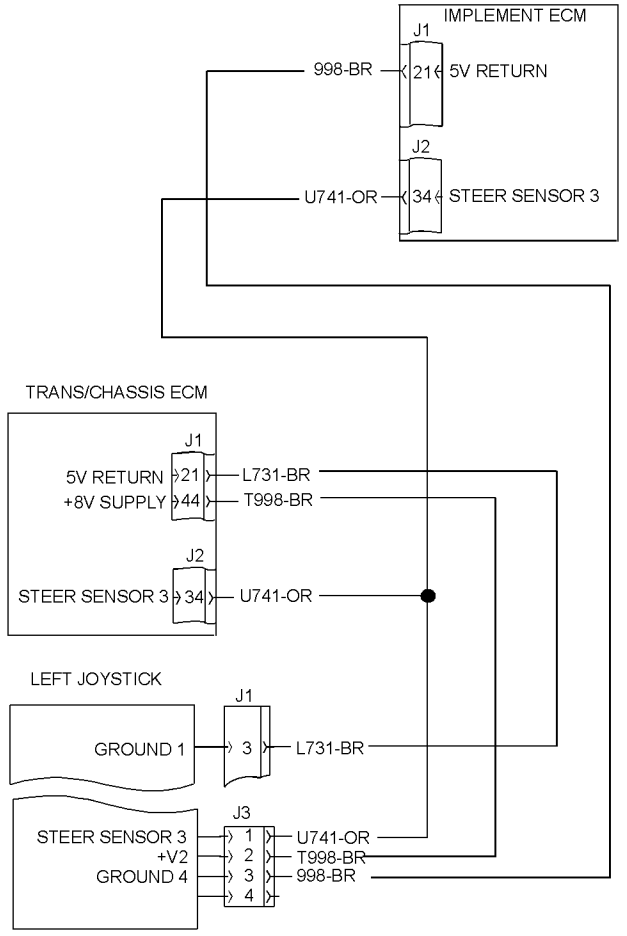


Illustration 252 g03171003

Connections of “Steer Sensor 3”

Three “steer position sensors” are required for correct operation of the steering control. The “steer position sensors” are located in the assembly of the left joystick. Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. This diagnostic code is associated with the steering position sensor 3. The FMI 08 means that the ECM has detected that the signal frequency or the signal pulse width is not within the expected range.

The “steer position sensor 3” receives power from the 8 v power supply of the Transmission/Chassis ECM. The “steer sensor 3” is internally connected to the ground from the 5 v sensor return of the Transmission/Chassis ECM (ground of ECM) and to the ground from the 5 v sensor return of the Implement ECM (ground of ECM). The “steer sensor” must lose the 8 v power supply or both grounds in order to lose power. The illustration above indicates the power and ground connections for steer position sensor 3.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the full left position of the joystick to approximately 90 ± 5% at the full right position of the joystick. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections in the sensor circuit or poor connections in the sensor circuit
- The ECM has failed. This is unlikely.

Consider the following points when this code is active:

Note: Before performing this procedure, check for an active MID 027 CID 0041 diagnostic code for the 8 v sensor power supply of the Transmission/Chassis ECM. Correct any problem with the 8 v power supply before performing this procedure.

Note: The correct operating temperature range for the steering sensors is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a steering sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the steer sensors operating in the acceptable temperature range. After temperature normalization, verify that the CID 1473 FMI 08 diagnostic code is active before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “steer sensor 3” . Both ECM modules can activate a CID 1473 FMI 08 diagnostic code when the ECM has detected that the signal frequency or the signal pulse width is not within the expected range. If one ECM has activated a CID 1473 FMI 08 diagnostic code and the other ECM has not activated a CID 1473 FMI 08, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor or a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J3 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire (wire U741-OR(Orange)) and the socket at contact J3-1. The machine harness connector J3 remains connected to the connector of the left joystick.

B. At the back of the connectors of the joystick J3 and J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J3-1 and the ground 4 contact at J3-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. With the joystick in a stationary position, measure the frequency of the signal from the sensor.

E. Observe the measurement and wiggle the connector of the joystick. Gently pull on the wires and wiggle the wires.

F. Measure the duty cycle of the sensor at the connector contacts of the joystick J3-1 and J3-3. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

G. Observe the measurement and wiggle the connector of the joystick. Gently pull on the wires and wiggle the wires.

Expected Result:

The frequency of the “steer sensor 3” signal is 500 ± 100 Hz. The duty cycle of the “steer sensor 3” is correct according to the description at the beginning of this procedure. The frequency and the duty cycle are stable during the manipulation of the harness connector and the wiring.

Results:

- OK – The signal frequency of the sensor and the duty cycle of the sensor are correct. The signal frequency and the duty cycle do not change when the harness is manipulated. The sensor is not causing the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick. Verify that all of the wires of the joystick are secure in the connector before proceeding to the next step.Proceed to Test Step 2.

- NOT OK – The signal frequency and the duty cycle of the “steer sensor 3” is not correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the “steer sensor 3” signal is not correct according to the description at the beginning of this procedure, replace the assembly of the left joystick. After replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT AT BOTH OF THE ECM MODULES

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connectors J3 and J1 from the left joystick. At the harness connectors for the joystick, place a jumper wire between the signal contact J3-1 (wire U741-OR(Orange)) and the ground 1 contact J1-3 (wire L731-BR(Brown)) .

C. Disconnect machine harness connectors J1 and J2 from the Transmission/Chassis ECM.

D. At the harness connector for the Transmission/ Chassis ECM, measure the resistance from return contact J1-21 (wire L731-BR(Brown)) to signal contact J2-34 (wire U741-OR(Orange)).

E. Observe the resistance measurement and wiggle the connector of the ECM and the connector of the sensor. Gently pull on the wires and wiggle the wires for both connectors.

F. At the harness connectors for the joystick, move the jumper from the ground 1 contact and connect the jumper to ground 4 contact J3-3 (wire 998-BR(Brown)). The other end of the jumper wire remains connected to the signal contact J3-1 (wire U741-OR(Orange)).

G. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

H. At the harness connectors for the Implement ECM, measure the resistance from return contact J1-21 (wire 998-BR(Brown)) to signal contact J2-34 (wire U741-OR(Orange)).

I. Observe the resistance measurement and wiggle the connector of the ECM and the connector of the sensor. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

Both resistance measurements are less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The sensor circuit is not open in either input circuit of the ECM.Proceed to Test Step 3.

- NOT OK – The resistance measurement at one or both of the ECM modules is greater than 5 ohms. There is an open or a bad connection in one or both of the signal circuits.

  Repair: If both of the resistance measurements are not correct, there is an open connection or a bad connection on the sensor side of the splice of the machine harness for the signal wire U741-OR(Orange).

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  If one of the measurements is correct and the other measurement is not correct, there is an open connection or a bad connection on the ECM side of the splice of the machine harness for the signal wire U741-OR(Orange).

  In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspected section of the circuit for the sensor signal. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 1473 FMI 08.

Expected Result:

The CID 1473 FMI 08 is not active.

Results:

- OK – The CID 1473 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1473 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary shorts or intermittent shorts. The wiggle test can also be used to detect open connections in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04994309

MID 082 - CID 1473 - FMI 14

SMCS Code: 5737-038-ZH

Conditions Which Generate This Code:

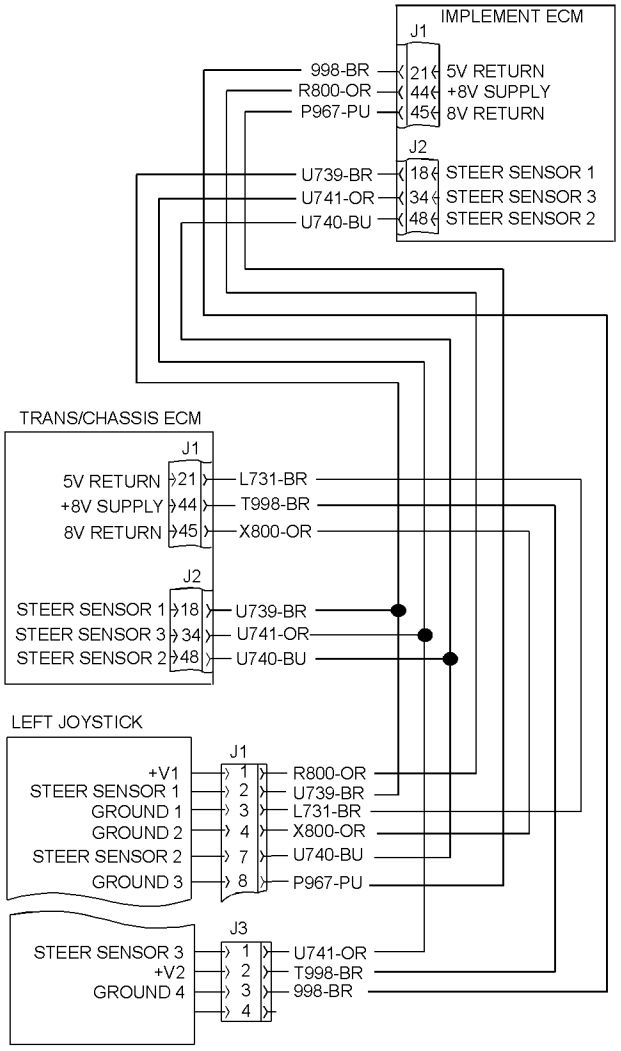


Illustration 253 g03170678

Connections of the left joystick steer sensors.

Three steer position sensors are required for correct operation of the steering control. The steer position sensors are located in the assembly of the left joystick. Each sensor provides an input signal to the Implement ECM and to the Transmission/Chassis ECM. The ECM expects the input signals from all three steer position sensors to closely match. The FMI 14 diagnostic code is activated when the following occurs:

- ECM determines that the PWM input signal from the number three steer position sensor does not match the PWM input signal from the other steer position sensors.

The number three steer position sensor receives power from the 8 V power supply of the Implement ECM. The number three steer position sensor is internally connected to ground. Ground is supplied by the Transmission/Chassis ECM and the Implement ECM. The steer position sensors must lose both grounds in order to lose a ground connection. The illustration above indicates the power and ground connections for the number three steer position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The steer position sensors are PWM sensors. The steer position sensors operate at a frequency of 500 ± 100 Hz. The steer position sensors send a PWM input signal to the Implement ECM and to the Transmission/Chassis ECM. Following is the variation in the duty cycle of the signal:

- When the lever is in the FULL LEFT position, the duty cycle will be approximately 10%.
- When the lever is in the FULL RIGHT position, the duty cycle will be approximately 90%.
- When the lever is in the CENTER position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: If a MID 027 CID 0041 diagnostic code for the 8 V power supply has been activated by the Transmission/Chassis ECM (MID 027), correct the problem before proceeding with this procedure.

Note: The correct operating temperature range for the steer position sensors is −40 °C (−40.0 °F) to 75 °C (167.0 °F). Return the temperature in the cab to a normal temperature when the temperature in the cab is extreme and a diagnostic code becomes active. Returning the temperature in the cab to a normal temperature will keep the steer position sensors operating in the acceptable temperature range. After returning the temperature to normal, verify that the CID 1473 FMI 14 diagnostic code is active before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the number three steer position sensor. Both electronic control modules can activate a CID 1473 FMI 14 diagnostic code when the following occurs: The signal from the number three steer position sensor does not match the signal from the other steer position sensors. If one of the electronic control modules has activated a CID 1473 FMI 14 diagnostic code and the other ECM has not activated a CID 1473 FMI 14 diagnostic code, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both electronic control modules have activated the diagnostic code, either the sensor or a harness problem could be the cause. If both electronic control modules have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are in good condition. The connections must be clean and the connections must be secure. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Note: The next two test steps will measure the duty cycle of each steer position sensor in order to determine if one signal is not closely matching with both of the other sensor signals. Record the duty cycle of each of the three steer position sensors for comparison.

Test Step 1. CHECK THE SIGNAL AT THE NUMBER ONE STEER POSITION SENSOR

A. Turn the key start switch to the OFF position.

B. Turn the disconnect switch to the OFF position.

C. Do not disconnect the harness connector from the sensor.

D. Perform the following on the back of the joystick at connector J1. Insert 7X-1710 Multimeter Probes along each sensor signal contact and the return contact at J1-4.

E. Turn the disconnect switch and the key start switch to the ON position.

F. Move the joystick to the position that activates the code.

G. Hold the joystick in the position that activates the code.

H. Monitor the signal of the sensor with a digital multimeter.

I. Record the duty cycle of all the steer position sensors.

J. Compare the duty cycles of all three steer position sensors at the same specific position of the joystick.

Expected Result:

Each duty cycle is within 5% or less of the signals from the other sensors.

Results:

- OK – There is 5% or less deviation in the duty cycle between the three steer position sensors with the joystick in the same position. Proceed to Test Step 2.
- NOT OK – With the joystick in the same position, one or more of the duty cycles deviates more than 5% from the other duty cycles. There is a problem with a steer position sensor.

  Repair: One of the steer position sensors is not operating correctly. Replace the assembly of the left joystick. After replacement of the assembly, verify that the new assembly is working correctly before operating the machine.

  STOP.

Test Step 2. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Perform the following:

- Clean the contacts of the harness connectors.
- Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are completely fastened.

D. Operate the machine.

E. Check the status of the CID 1473 FMI 14 diagnostic code.

Expected Result:

The CID 1473 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 1473 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Clear logged codes. Verify that the assembly is working correctly. Resume normal operation.

  STOP.

- NOT OK – The CID 1473 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  If both the Transmission/Chassis ECM and the Implement ECM have activated this diagnostic code, it is unlikely that either ECM is causing the problem.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02533991

MID 082 - CID 1482 - FMI 03

SMCS Code: 1439-038

Conditions Which Generate This Code:

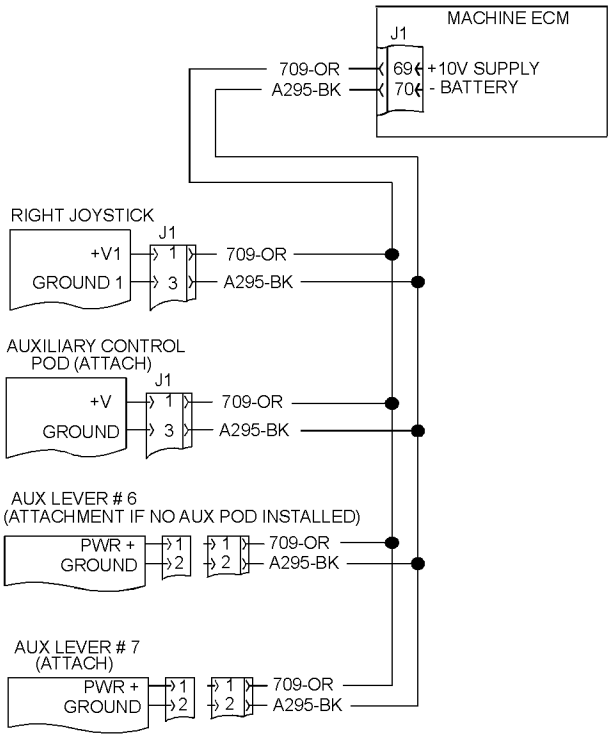


Illustration 254 g01267511

Implement ECM 10 VDC Power Supply connections

This diagnostic code is associated with the Implement ECM 10 volt sensor power supply. The 10 volt sensor power supply provides power for the right hand joystick and the auxiliary attachment control components.

Note: The Implement ECM 10 volt sensor power supply is one of two power supplies that are used for the right hand joystick. The other power source for the right hand joystick is supplied by the Transmission Chassis ECM.

The CID 1482 FMI 03 diagnostic code is activated when the Implement ECM detects that the voltage of the 10 volt power supply circuit is above normal.

The following conditions could cause this diagnostic code:

- The power supply circuit is shorted to a higher voltage source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE VOLTAGE AT THE COMPONENT

A. Turn the disconnect switch and the key switch to the ON position.

B. At the right hand joystick connector J1, insert a 7X-1710 Multimeter Probe along the supply wire 709-OR(Orange) at contact J1-1. Insert a 7X-1710 Multimeter Probe along the return wire A295-BK(Black) at contact J1-3.

C. Measure the voltage between the supply contact J1-1 and the return contact J1-3.

Expected Result:

The voltage measurement is 10.0 ± 0.4 VDC.

Results:

- OK – The voltage measurement is 10.0 ± 0.4 VDC. The voltage is correct. Proceed to Test Step 4.
- NOT OK – The voltage measurement is greater than 10.0 ± 0.4 VDC. The voltage measurement is not correct.Proceed to Test Step 2.

Test Step 2. CHECK THE POWER SUPPLY AT THE ECM

A. Turn the disconnect switch and the key switch to the OFF position.

B. At the Implement ECM connector J1, use a 151-6320 Removal Tool or a similar tool to remove the power supply wire and socket at contact J1-69 (wire 709-OR(Orange)) from the connector. The machine harness connector J1 remains connected to the ECM.

C. At the Implement ECM connector J1, insert a 7X-1710 Multimeter Probe along the return wire A295-BK(Black) and socket at contact J1-70.

D. Turn the disconnect switch and the key switch to the ON position.

E. Use a multimeter probe in order to make contact on the ECM connector pin at contact J1-69. Measure the voltage at the ECM between the power supply contact J1-69 and the return contact J1-70.

Expected Result:

The voltage measurement is 10.0 ± 0.4 VDC.

Results:

- OK – The voltage measurement is 10.0 ± 0.4 VDC. The voltage is correct. The ECM power supply is correct. Install the wire and socket that were removed from the J1 connector back into their original locations.Proceed to Test Step 3.
- NOT OK – The voltage measurement is greater than 10.0 ± 0.4 VDC. The ECM power supply is not correct.

  Repair: Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK FOR A SHORT CIRCUIT IN THE MACHINE HARNESS

The machine harness connector J1 remains disconnected from the right joystick.

A. Disconnect the machine harness connectors from any other components that are recieving power from the 10 volt power supply.

B. Turn the disconnect switch and the key switch to the OFF position.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

D. At the ECM harness connector J1, measure the resistance from contact J1-69 (wire 709-OR(Orange)) to all of the other contacts that are used in connectors J1 and J2 for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The supply circuit is not shorted to another circuit in the machine harness. Proceed to Test Step 4.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The power supply circuit is shorted to a another circuit in the machine harness. Refer to the complete machine Electrical System Schematic. Examine the supply circuit in order to determine where the problem could be.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1482 FMI 03 diagnostic code is active.

Expected Result:

The CID 1482 FMI 03 diagnostic code is active.

Results:

- YES – The CID 1482 FMI 03 diagnostic code is active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the problem is not found, the ECM may be activating the diagnostic code incorrectly. The ECM may have failed.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 1482 FMI 03 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02533996

MID 082 - CID 1482 - FMI 04

SMCS Code: 1439-038

Conditions Which Generate This Code:

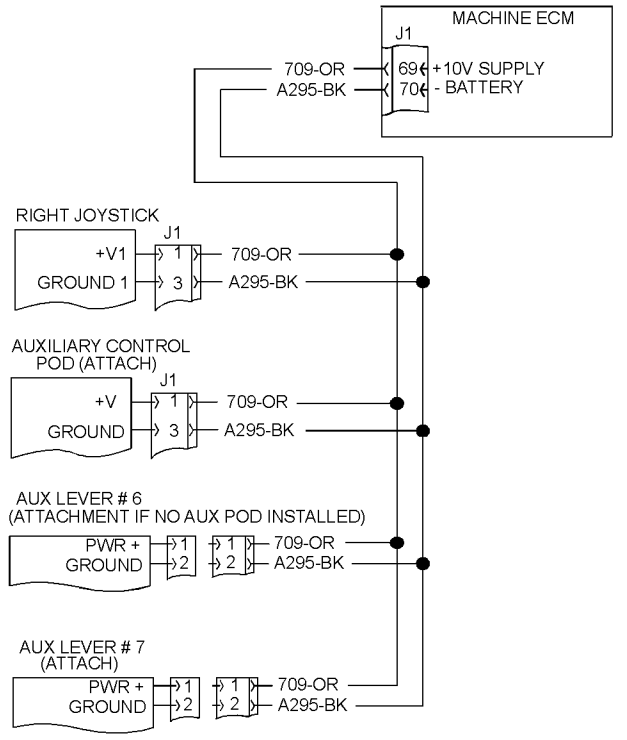


Illustration 255 g01267511

Implement ECM 10 VDC Power Supply connections

This diagnostic code is associated with the Implement ECM 10 volt sensor power supply. The 10 volt sensor power supply provides power for the right hand joystick and the auxiliary attachment control components.

The CID 1482 FMI 04 diagnostic code is activated when the Implement ECM detects that the voltage of the 10 volt power supply circuit is lower than normal.

The following conditions could cause this diagnostic code:

- A component that is powered by the power supply has failed.
- The power supply circuit is shorted to a ground source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE COMPONENTS

A. Turn the key switch and the disconnect switch to the ON position.

B. One at a time, disconnect a component that uses the 10 VDC power supply from the machine harness. As each component is disconnected, check the status of the CID 1482 FMI 04 diagnostic code.

C. Continue disconnecting the components from the machine harness one at a time until the status of the CID 1482 FMI 04 diagnostic code changes or until all of the components that are connected to the 10 volt power supply are disconnected.

Expected Result:

When one of the components is disconnected from the machine harness, the CID 1482 FMI 04 diagnostic code is no longer active.

Results:

- OK – The CID 1482 FMI 04 diagnostic code is not active when one of the components is disconnected. The power supply circuit is correct.

The component that was disconnected when the status of the CID 1482 FMI 04 diagnostic code changed has failed. Repeat this test step in order to verify which component is causing the problem.

Repair: Once the problem component is determined, replace the component. After the component is replaced, verify that the problem has been corrected before operating the machine.

STOP.

- NOT OK – The CID 1482 FMI 04 diagnostic code is still active. Disconnecting all of the components that are using the 10 VDC power supply did not change the status of the diagnostic code. Proceed to Test Step 2.

Test Step 2. CHECK THE POWER SUPPLY AT THE ECM

All components that are connected to the 10 VDC power supply remain disconnected from the machine harness.

A. Turn the disconnect switch and the key switch to the OFF position.

B. At the Implement ECM connector J1, use a 151-6320 Removal Tool or a similar tool to remove the power supply wire and socket at contact J1-69 (wire 709-OR(Orange)) from the connector. The machine harness connector J1 remains connected to the ECM.

C. At the Implement ECM connector J1, insert a 7X-1710 Multimeter Probe along the return wire A295-BK(Black) and socket at contact J1-70.

D. Turn the disconnect switch and the key switch to the ON position.

E. Use a multimeter probe in order to make contact on the ECM connector pin at contact J1-69. Measure the voltage at the ECM between the power supply contact J1-69 and the return contact J1-70.

Expected Result:

The voltage measurement is 10.0 ± 0.4 DCV.

Results:

- OK – The voltage measurement is 10.0 ± 0.4 DCV. The voltage is correct. The ECM power supply is correct. Install the wire and socket that were removed from the J1 connector back into their original locations.Proceed to Test Step 3.

- NOT OK – The voltage measurement is greater than 10.0 ± 0.4 DCV. The ECM power supply is not correct.

  Repair: Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK FOR A SHORT TO GROUND

All components that are connected to the 10 VDC power supply remain disconnected from the machine harness.

A. Turn the key switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

C. At the harness connector for the ECM, measure the resistance between supply contact J1-69 (wire 709-OR(Orange)) and frame ground. Measure the resistance between supply contact J1-69 (wire 709-OR(Orange)) and all of the other contacts that are used in the J1 and J2 connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The circuit in the machine harness is correct. Proceed to Test Step 4.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. The circuit is shorted in the machine harness.

  Repair: The power supply wire 709-OR(Orange) is shorted in the machine harness to the circuit with the low resistance measurement. Refer to the complete Electrical System Schematic for your machine. Check all harness connectors that are in the power supply circuit. Ensure that the connectors are clean and secure.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key switch to the ON position.

E. Operate the machine.

F. Determine if the CID 1482 FMI 04 diagnostic code is active.

Expected Result:

The CID 1482 FMI 04 diagnostic code is active.

Results:

- YES – The CID 1482 FMI 04 diagnostic code is active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may be activating the diagnostic code incorrectly. The ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 1482 FMI 04 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02508918

MID 082 - CID 1558 - FMI 09

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

The CID 1558 FMI 09 diagnostic code is associated with the communication between the Implement ECM and the Implement ECM 2 that is conducted on the Cat Data Link circuit or the communication that is conducted over the SAE J1939 Data Link circuit.

The FMI 09 means that the Implement ECM is not receiving any communication from the Implement ECM 2 on the involved data link circuit.

When this diagnostic code is activated by the Implement ECM, a “companion” diagnostic code will be activated in order to indicate which data link system is involved. The companion diagnostic code that has been activated will be either of the following:

CID 0247 FMI 09 – SAE J1939 Data Link

CID 0248 FMI 09 – Cat Data Link

Determine which one of the companion diagnostic codes has been activated along with the CID 1558 FMI 09 diagnostic code to indicate which data link system is involved.

When the CID 1558 FMI 09 diagnostic code is cleared, the data link companion code will also clear.

The possible causes of the CID 1558 FMI 09 diagnostic code are listed below:

- An open or a poor connection in the data link circuit.
- The Implement ECM 2 has failed. This is unlikely
- The Implement ECM has failed. This is unlikely.

Note: A loss of system power to the Implement ECM 2 can cause the Implement ECM to activate this diagnostic code. Ensure that the Implement ECM 2 is powered up before proceeding with this procedure.

Note: Ensure that the CID 1558 FMI 09 diagnostic code is active before performing this procedure.

Test Step 1. DETERMINE WHICH DATA LINK COMPANION CODE IS ACTIVE

A. Check the list of active diagnostic codes in order to determine which of the following companion diagnostic codes is active: **CID 0247 FMI 09 - SAE J1939 Data Link CID 0248 FMI 09 - Cat Data Link**

Results:

- OK – The CID 0248 FMI 09 diagnostic code is active indicating that the problem is in the Cat Data Link system.In order to perform the troubleshooting procedure for the Cat Data Link, proceed to Test Step 2.
- OK – The CID 0247 FMI 09 diagnostic code is active indicating that the problem is in the SAE J1939 Data Link system.In order to perform the troubleshooting procedure for the SAE J1939 Data Link, proceed to Test Step 4.

Test Step 2. CHECK THE CAT DATA LINK CIRCUIT FOR AN OPEN

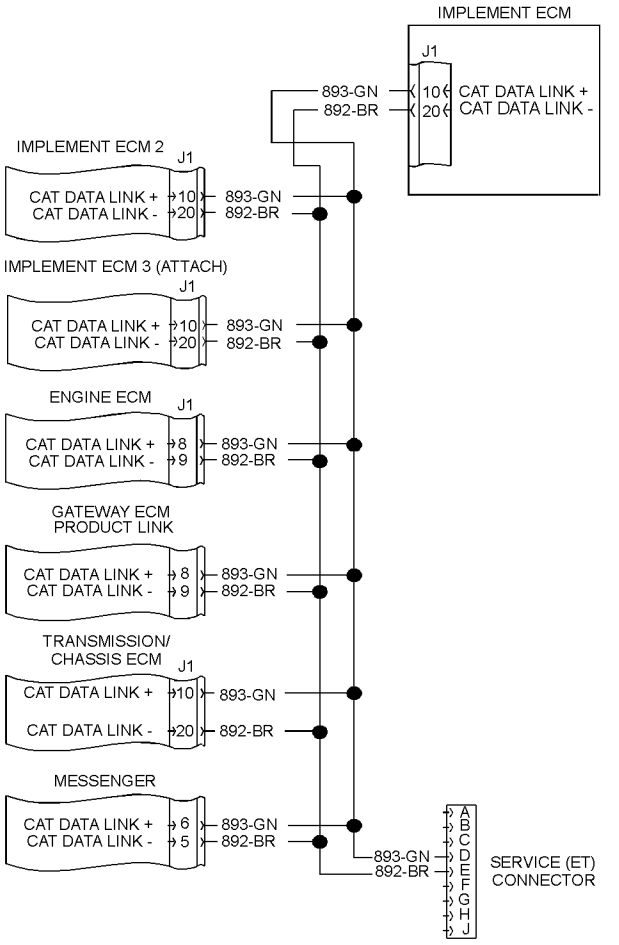


Illustration 256 g01243564

Cat Data Link connections

A. Turn the key switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM. Disconnect the machine harness connector J1 from the Implement ECM 2.

C. Inspect the harness connectors and clean all of the contacts of the harness connectors. Refer to the illustration above to check the Cat Data Link connection on each of the machine harness connectors. Ensure that the wires are secured in the connector, the contacts are clean and the contacts are in good condition.

D. At the disconnected harness connector J1 for the Implement ECM 2, connect a jumper wire between contact J1-10 (wire 893-GN(Green)) and contact J1-20 (wire 892-BR(Brown)).

E. At the disconnected harness connector J1 for the Implement ECM, measure the resistance between contact J1-10 (wire 893-GN(Green)) and contact J1-20 (wire 892-BR(Brown)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The Cat Data Link circuit in the machine harness is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the Cat Data Link circuit in the machine harness.

  Repair: A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the wires or one of the connection points in the circuit is not open but is not a good connection.

  Refer to the complete machine Electrical System Schematic. Locate and examine all of the machine harness connections that are involved in the data link circuit. Check each wire section from connector to connector for an open or a bad connection. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the data link circuit.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 1558 FMI 09 diagnostic code.

Expected Result:

The CID 1558 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 1558 FMI 09 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1558 FMI 09 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, one of the ECM modules may have failed. The ECM that activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE SAE J1939 DATA LINK CIRCUIT FOR AN OPEN

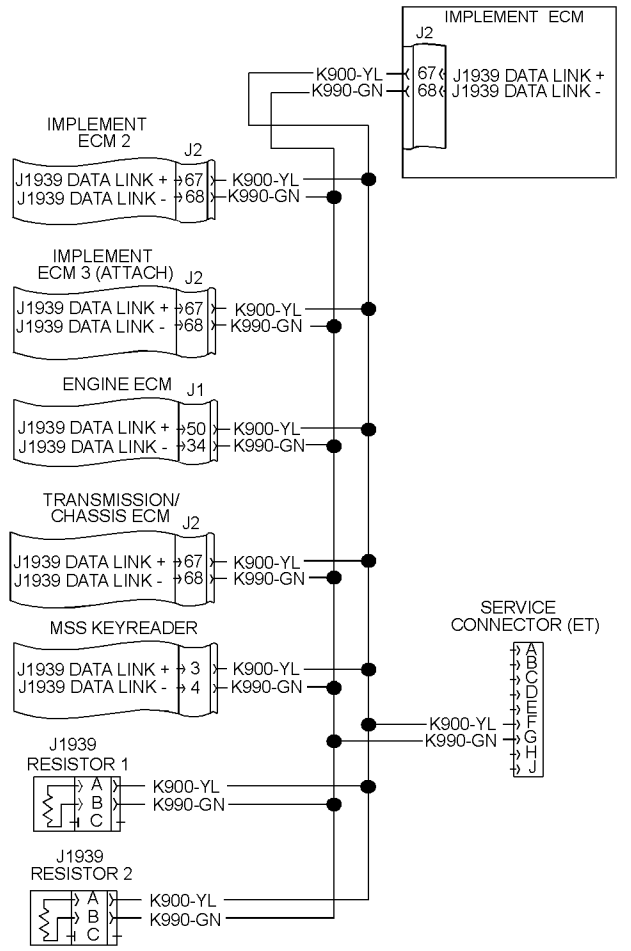


Illustration 257 g01319936

SAE J1939 Data Link Circuit connections

A. Turn the key switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J2 from the Implement ECM. Disconnect the machine harness connector J2 from the Implement ECM 2.

C. Inspect the harness connectors and clean all of the contacts of the harness connectors. Refer to the illustration above to check the SAE J1939 Data Link connection on each of the machine harness connectors. Ensure that the wires are secured in the connector, the contacts are clean and the contacts are in good condition.

D. At the disconnected harness connector J2 for the Implement ECM 2, connect a jumper wire between contact J2-67 (wire K900-YL(Yellow)) and contact J2-68 (wire K990-GN(Green)).

E. At the disconnected harness connector J2 for the Implement ECM, measure the resistance between contact J2-67 (wire K900-YL(Yellow)) and contact J2-68 (wire K990-GN(Green)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The SAE J1939 Data Link circuit in the machine harness is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the SAE J1939 Data Link circuit in the machine harness.

  Repair: Refer to the complete machine Electrical System Schematic. Locate and examine all of the machine harness connections that are involved in the data link circuit. Check each wire section from connector to connector for an open or a bad connection. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the data link circuit.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 1558 FMI 09 diagnostic code.

Expected Result:

The CID 1558 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 1558 FMI 09 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 1558 FMI 09 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, one of the ECM modules may have failed. The ECM that activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02535036

MID 082 - CID 2113 - FMI 03

SMCS Code: 1435-038

Conditions Which Generate This Code:

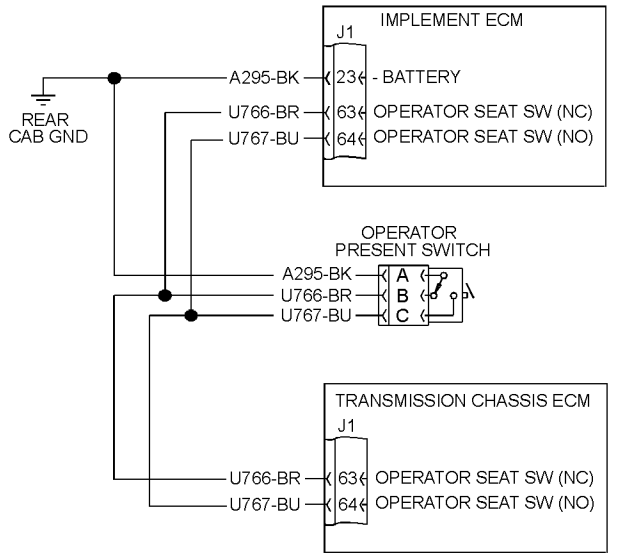


Illustration 258 g01268293

Operator Present Switch connections

This diagnostic code is associated with the operator present switch. The switch supplies two switch to ground type inputs to the Implement ECM and to the Transmission Chassis ECM. The ECM expects one of the two switch inputs to be grounded at all times. When the ECM detects that neither of the switch inputs is grounded, the ECM will activate an FMI 03 diagnostic code for voltage above normal.

Possible conditions that can cause this diagnostic code are listed:

- One or both of the switch circuits is open in the machine harness.
- One or both of the switch inputs is shorted to a voltage source.
- The switch has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Table 21

Operator Present Switch Contact States		
Operator Status	N/O Input J1-64 (wire U767-BU(Blue))	N/C Input J1-63 (wire U766-BR(Brown))
Operator Not Present	Open(1)	Closed(2)
Operator Present	Closed	Open

(1) Open to ECM return J1-23 (A295-BK(Black) - ground).
(2) Closed to ECM return J1-23 (A295-BK(Black) - ground).

Note: The operator present switch provides two inputs to the Implement ECM and to the Transmission Chassis ECM. If one ECM has activated the diagnostic code and the other ECM has not activated the diagnostic code, most likely the switch is operating correctly. This condition would indicate that there is a problem in the machine harness. In either case, perform this procedure in order to find the cause of the problem.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SWITCH INPUT CIRCUITS FOR AN OPEN

A. Turn the disconnect switch and the key switch to the OFF position.

B. Disconnect the machine harness connector from the switch.

C. At the machine harness connector for the switch, connect a jumper wire between the normally open (N/O) contact C (wire U767-BU(Blue)) and the normally closed (N/C) contact B (wire U766-BR(Brown)).

D. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

E. At the Implement ECM machine harness connector J1, measure the resistance between N/C contact J1-63 (wire U766-BR(Brown)) and N/O contact J1-64 (wire U767-BU(Blue)).

Expected Result:

Both of the resistance measurements are less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The switch input circuits are not open in the machine harness.Proceed to Test Step 2.
- NOT OK – The resistance measurement is greater than 5 ohms. One of the switch input circuits is open or has a poor connection in the machine harness.

  Repair: There is an open or poor connection in switch input wire U766-BR(Brown) or switch input wire U767-BU(Blue). Check each switch input circuit individually in order to determine which circuit has the problem.

  If both of the ECMs have activated this diagnostic code, there is most likely an open or a bad connection on the switch side of the machine harness splice connection for the signal wire.

  If only one ECM has activated this diagnostic code, there is most likely an open or a bad connection on the ECM side of the machine harness splice connection for the switch circuit wire.

  Refer to the complete machine Electrical System Schematic. Verify that all connection points in the suspected part of the for the circuits are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE SWITCH GROUND CIRCUIT FOR AN OPEN

The disconnect switch and the key switch remain in the OFF position. The machine harness connectors remain disconnected from the Implement ECM and the switch.

A. At the machine harness connector for the switch, connect the jumper wire that was used in the last test step between the common ground contact A (wire A295-BK(Black)) and the normally closed (N/C) contact B (wire U766-BR(Brown)).

B. At the Implement ECM machine harness connector J1, measure the resistance between common ground contact J1-23 (wire A295-BK(Black)) and N/C contact J1-63 (wire U766-BR(Brown)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The common ground circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. The ground common circuit is open or has a poor connection in the machine harness.

  Repair: There is an open or poor connection in switch ground wire A295-BK(Black). Refer to the complete machine Electrical System Schematic. Check all of the connectors that are in the common ground circuit. Verify that all connection points for the circuit are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE HARNESS FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

The switch and the connectors for the Implement ECM remain disconnected from the machine harness.

A. Disconnect the jumper wire that was used in the last test step.

B. At the Implement ECM machine harness connector J1, measure the resistance between contact J1-63 (wire U766-BR(Brown)) to all of the other contacts that are used in the J1 and J2 connectors for the ECM.

C. At the Implement ECM machine harness connector J1, measure the resistance between contact J1-64 (wire U767-BU(Blue)) to all of the other contacts that are used in the J1 and J2 connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The switch input circuits are not shorted in the machine harness.Proceed to Test Step 4.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms.

  Repair: There is a short circuit in a switch input circuit. The short is between the input circuit that measured the low resistance measurement to another circuit. Refer to the complete machine Electrical System Schematic. Check the connectors that are in the involved circuits. Verify that all connection points for the circuit are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SWITCH OPERATION

The switch remains disconnected from the machine harness. The disconnect switch and the key switch remain in the OFF position.

A. At the connector for the switch, measure the resistance (continuity) between common contact A and the switch N/C contact B when an operator is present in the operator seat and when no operator is present in the operator seat.

B. At the connector for the switch, measure the resistance (continuity) between common contact A and the switch N/O contact C when an operator is present in the operator seat and when no operator is present in the operator seat.

Expected Result:

The switch continuity checks are correct according to the table at the beginning of this procedure.

Results:

- OK – The continuity checks between common contact A to the switch contacts are correct. The switch is operating correctly.Proceed to Test Step 5.
- NOT OK – The continuity checks between the common contact A to the switch contacts are not correct. The switch is not working correctly.

  Repair: The operator present switch has failed. Replace the switch. After replacement of the switch, verify that the operation of the new switch is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2113 FMI 03 diagnostic code is active.

Expected Result:

The CID 2113 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2113 FMI 03 diagnostic code is active. The problem has not been corrected.

  Repair: Repeat this procedure. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the switch circuits in the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2113 FMI 03 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably cause by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02535050

MID 082 - CID 2113 - FMI 04

SMCS Code: 1435-038

Conditions Which Generate This Code:

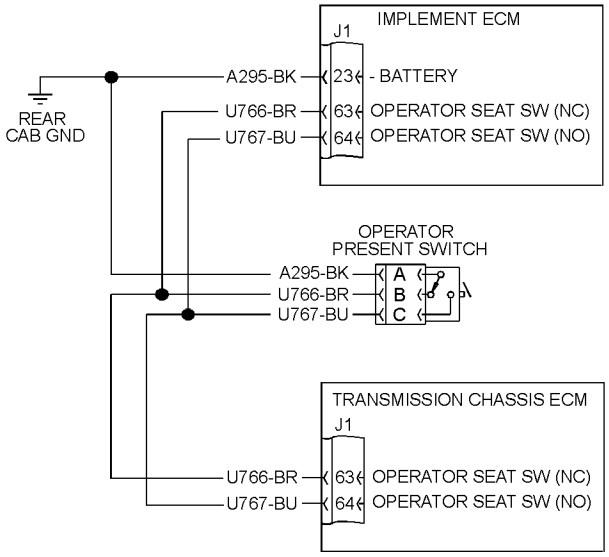


Illustration 259 g01268293

Operator Present Switch connections

This diagnostic code is associated with the operator present switch. The switch supplies two switch to ground type inputs to the Implement ECM and to the Transmission Chassis ECM. The ECM expects one of the two switch inputs to be grounded at all times. When the ECM detects that both of the switch inputs are grounded at the same time, the ECM will activate an FMI 04 diagnostic code for voltage below normal.

Some conditions that can cause this diagnostic code are listed:

- One or both of the switch inputs is shorted to a ground source.
- The switch has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Table 22

Operator Present Switch Contact States		
Operator Status	N/O Input J1-64 (wire U767-BU(Blue))	N/C Input J1-63 (wire U766-BR(Brown))
Operator Not Present	Open(1)	Closed(2)
Operator Present	Closed	Open

(1) Open to ECM return J1-23 (A295-BK(Black) - ground).
(2) Closed to ECM return J1-23 (A295-BK(Black) - ground).

Note: The operator present switch provides two inputs to the Implement ECM and to the Transmission Chassis ECM. If one ECM has activated the diagnostic code and the other ECM has not activated the diagnostic code, most likely the switch is operating correctly. This condition would indicate that there is a problem in the machine harness. In either case, perform this procedure in order to find the cause of the problem.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SWITCH

A. Turn the disconnect switch and the key start switch to the ON position.

B. Ensure that the diagnostic code is active.

C. Observe the status of the diagnostic code while disconnecting the switch connector from the machine harness.

Expected Result:

The CID 2113 FMI 04 diagnostic code will remain active if the switch is not the cause of the diagnostic code. The switch is the cause of the diagnostic code if the CID 2113 FMI 04 diagnostic code is NO longer active and a CID 2113 FMI 03 diagnostic code becomes active.

Results:

- OK – The CID 2113 FMI 04 diagnostic code remains active. The switch has not failed. Proceed to Test Step 2.
- NOT OK – The CID 2113 FMI 04 diagnostic code is NO longer active. A CID 2113 FMI 03 diagnostic code becomes active when the switch connector is disconnected. The machine harness and the Implement ECM are operating correctly. The switch has failed.

  Repair: Replace the operator present switch. After replacement of the switch, verify that the operation of the new switch is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE HARNESS FOR A SHORT

The switch remains disconnected from the machine harness.

A. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

B. At the ECM machine harness connector J1, measure the resistance between contact J1-63 (wire U766-BR(Brown)) to frame ground. Measure the resistance between contact J1-63 (wire U766-BR(Brown)) to all of the other contacts that are used in the J1 and J2 connectors for the ECM.

C. At the ECM machine harness connector J1, measure the resistance between contact J1-64 (wire U767-BU(Blue)) to frame ground. Measure the resistance between contact J1-64 (wire U767-BU(Blue)) to all of the other contacts that are used in the J1 and J2 connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The switch input circuits are not shorted in the machine harness.Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms.

  Repair: A switch input circuit is shorted to the circuit with the low resistance measurement. Refer to the complete machine Electrical System Schematic. Check the connectors that are in the involved circuits. Verify that all connection points for the circuit are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the switch circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2113 FMI 04 diagnostic code is active.

Expected Result:

The CID 2113 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2113 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2113 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02634245

MID 082 - CID 2143 - FMI 09

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

The CID 2143 FMI 09 diagnostic code is associated with the communication between the Implement ECM and the Implement ECM 3 that is conducted on the Cat Data Link circuit or the communication that is conducted over the SAE J1939 Data Link circuit.

The FMI 09 means that the Implement ECM is not receiving any communication from the Implement ECM 3 on the involved data link circuit.

When this diagnostic code is activated by the Implement ECM, a “companion” diagnostic code will be activated in order to indicate which data link system is involved. The companion diagnostic code that has been activated will be either of the following:

CID 0247 FMI 09 – SAE J1939 Data Link

CID 0248 FMI 09 – Cat Data Link

Determine which one of the companion diagnostic codes has been activated along with the CID 2143 FMI 09 diagnostic code to indicate which data link system is involved.

When the CID 2143 FMI 09 diagnostic code is cleared, the data link companion code will also clear.

The possible causes of the CID 2143 FMI 09 diagnostic code are listed below:

- An open or a poor connection in the data link circuit.
- The Implement ECM 3 has failed. This is unlikely
- The Implement ECM has failed. This is unlikely.

Note: A loss of system power to the Implement ECM 3 can cause the Implement ECM to activate this diagnostic code. Ensure that the Implement ECM 3 is powered up before proceeding with this procedure.

Note: Ensure that the CID 2143 FMI 09 diagnostic code is active before performing this procedure.

Test Step 1. DETERMINE WHICH DATA LINK COMPANION CODE IS ACTIVE

A. Check the list of active diagnostic codes in order to determine which of the following companion diagnostic codes is active: **CID 0247 FMI 09 - SAE J1939 Data Link CID 0248 FMI 09 - Cat Data Link**

Results:

- OK – The CID 0248 FMI 09 diagnostic code is active indicating that the problem is in the Cat Data Link system.In order to perform the troubleshooting procedure for the Cat Data Link, proceed to Test Step 2.
- OK – The CID 0247 FMI 09 diagnostic code is active indicating that the problem is in the SAE J1939 Data Link system.In order to perform the troubleshooting procedure for the SAE J1939 Data Link, proceed to Test Step 4.

Test Step 2. CHECK THE CAT DATA LINK CIRCUIT FOR AN OPEN

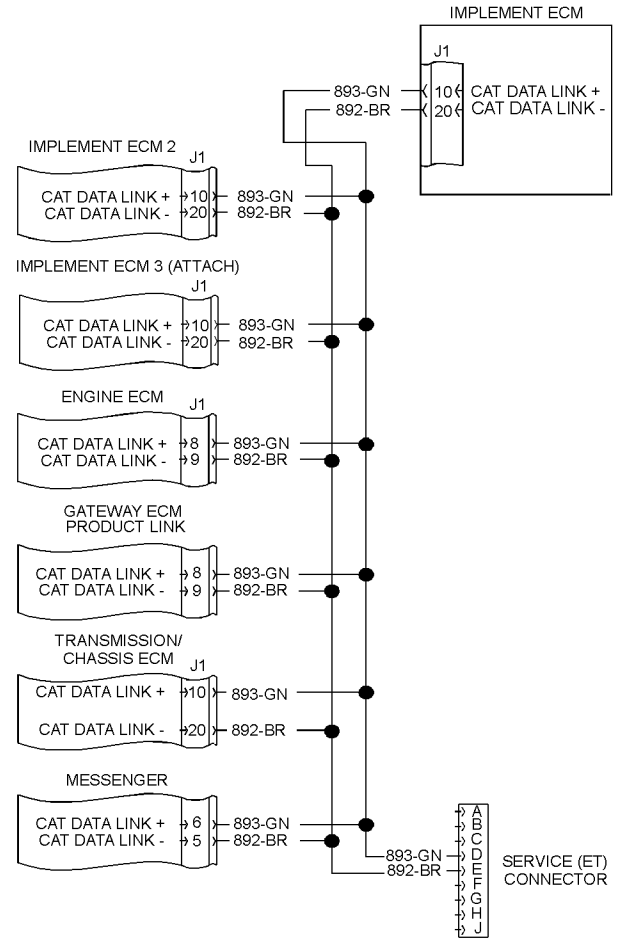


Illustration 260 g01243564

Cat Data Link connections

A. Turn the key switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM. Disconnect the machine harness connector J1 from the Implement ECM 3.

C. Inspect the harness connectors and clean all of the contacts of the harness connectors. Refer to the illustration above to check the Cat Data Link connection on each of the machine harness connectors. Ensure that the wires are secured in the connector, the contacts are clean and the contacts are in good condition.

D. At the disconnected harness connector J1 for the Implement ECM 3, connect a jumper wire between contact J1-10 (wire 893-GN(Green)) and contact J1-20 (wire 892-BR(Brown)).

E. At the disconnected harness connector J1 for the Implement ECM, measure the resistance between contact J1-10 (wire 893-GN(Green)) and contact J1-20 (wire 892-BR(Brown)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The Cat Data Link circuit in the machine harness is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the Cat Data Link circuit in the machine harness.

  Repair: A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the wires or one of the connection points in the circuit is not open but is not a good connection.

  Refer to the complete machine Electrical System Schematic. Locate and examine all of the machine harness connections that are involved in the data link circuit. Check each wire section from connector to connector for an open or a bad connection. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the data link circuit.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 2143 FMI 09 diagnostic code.

Expected Result:

The CID 2143 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 2143 FMI 09 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.
- NOT OK – The CID 2143 FMI 09 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, one of the ECM modules may have failed. The ECM that activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE SAE J1939 DATA LINK CIRCUIT FOR AN OPEN

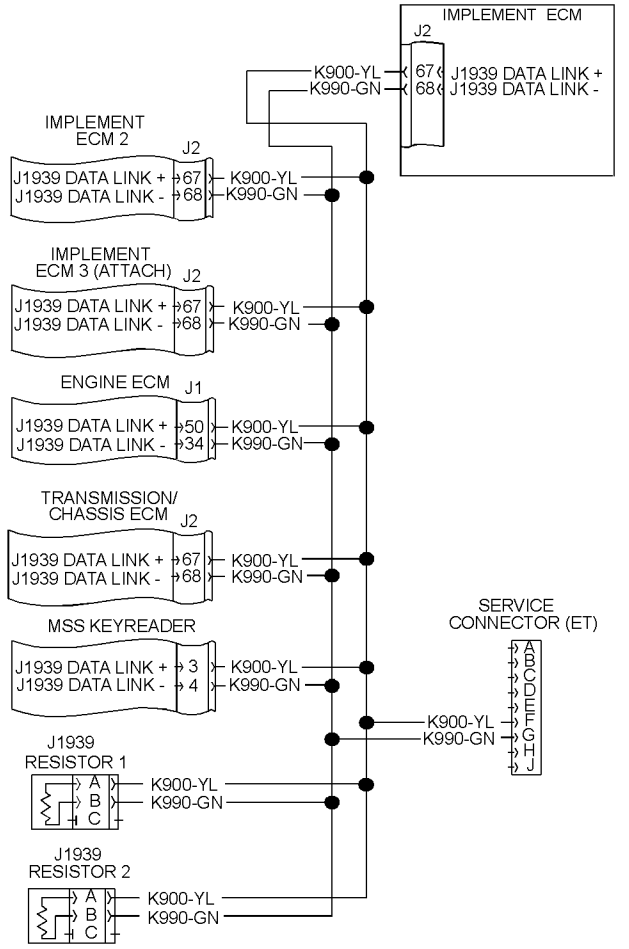


Illustration 261 g01319936

SAE J1939 Data Link Circuit connections

A. Turn the key switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J2 from the Implement ECM. Disconnect the machine harness connector J2 from the Implement ECM 3.

C. Inspect the harness connectors and clean all of the contacts of the harness connectors. Refer to the illustration above to check the SAE J1939 Data Link connection on each of the machine harness connectors. Ensure that the wires are secured in the connector, the contacts are clean and the contacts are in good condition.

D. At the disconnected harness connector J2 for the Implement ECM 3, connect a jumper wire between contact J2-67 (wire K900-YL(Yellow)) and contact J2-68 (wire K990-GN(Green)).

E. At the disconnected harness connector J2 for the Implement ECM, measure the resistance between contact J2-67 (wire K900-YL(Yellow)) and contact J2-68 (wire K990-GN(Green)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The SAE J1939 Data Link circuit in the machine harness is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the SAE J1939 Data Link circuit in the machine harness.

  Repair: Refer to the complete machine Electrical System Schematic. Locate and examine all of the machine harness connections that are involved in the data link circuit. Check each wire section from connector to connector for an open or a bad connection. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the data link circuit.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 2143 FMI 09 diagnostic code.

Expected Result:

The CID 2143 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 2143 FMI 09 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2143 FMI 09 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, one of the ECM modules may have failed. The ECM that activated the diagnostic code may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04994329

MID 082 - CID 2146 - FMI 02

SMCS Code: 5737-038-ART

Conditions Which Generate This Code:

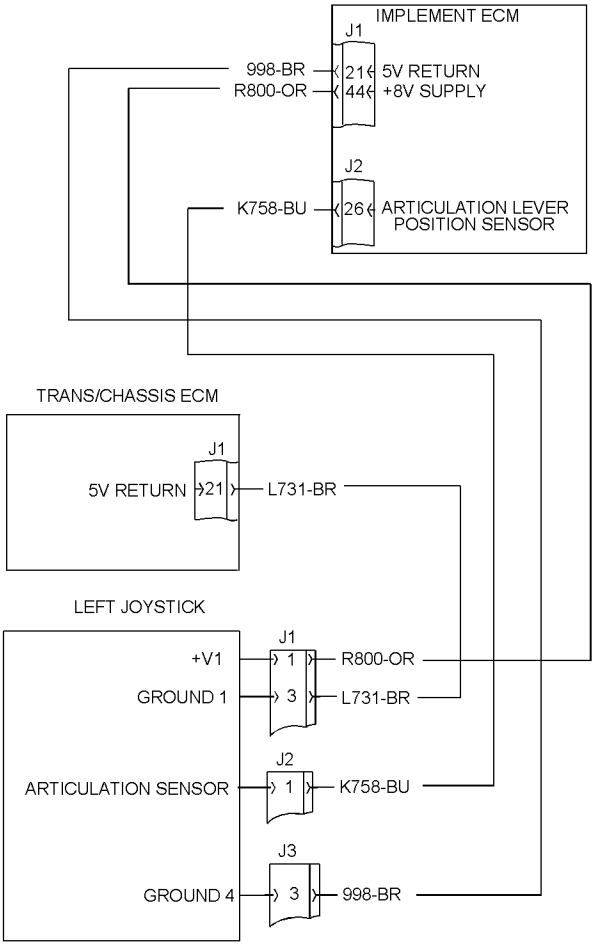


Illustration 262 g03172818

Articulation Lever Position sensor connections

The “articulation lever position” sensor is located in the left assembly of the joystick. The sensor provides an input signal to the ECM. This diagnostic code is recorded when the ECM reads the input signal from the “articulation lever position” sensor and the signal is erratic or intermittent.

The articulation position sensor receives power from the 8 V power supply of the Implement ECM. The articulation sensor is connected to ground at the 5 V sensor return (ECM ground) of the Transmission/ Chassis ECM and the 5 V sensor return (ECM ground) of the Implement ECM. The articulation sensor must lose both power supplies or both ground connections in order to lose power. The illustration above indicates the power and ground connections for the articulation position sensor.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will vary from approximately 10% at the joystick full articulate left position to approximately 90% at the joystick full articulate right position. When the joystick is in the center (neutral) position, the duty cycle will be approximately 50%.

The possible causes of this active diagnostic code are listed:

- The sensor has failed.
- Intermittent connections or poor connections exist in the sensor circuit.
- The signal circuit is shorted to another circuit in the machine harness.
- The ECM has failed. This is unlikely.

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by either the Transmission/Chassis ECM (MID 027) or the Implement ECM (MID 082), investigate the problem and fix the problem before proceeding with this procedure.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLIES

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left joystick, insert 7X-1710 Multimeter Probes along the +V1 power supply contact J1-1 (wire R800-OR(Orange)) and along ground 1 contact J1-3 (wire L731-BR(Brown)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

D. At the J3 harness connector for the left joystick, insert 7X-1710 Multimeter Probes along the +V1 power supply contact J1-1 (wire 998-BR(Brown)) and along ground 4 contact J3-3 (wire 998-BR(Brown)). Do not disconnect the machine harness from the J1 connector.

E. Measure the DC voltage of the sensor power supply.

Expected Result:

Each voltage measurement is approximately 8.0 ± 0.4 VDC.

Results:

- OK – Each voltage measurement is approximately 8.0 ± 0.4 VDC. The power supplies for the sensor are correct. Proceed to Test Step 2.
- NOT OK – One or both of the voltage measurements is less than 8.0 ± 0.4 VDC. The power supplies for the sensor are not correct.

  Repair: Either one or both of the ground wires of the sensor circuit or one or both of the sensor supply circuits is an open connection or a poor connection.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the circuits. Ensure that the connections are clean, that the connections are secure and that the connections are in good condition.

  For troubleshooting one or both of the separate ECM power supplies that provide power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Transmission/Chassis ECM or the Implement ECM.

  Repair the faulty power supply circuit before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Inspect all of the harness connectors for the joystick and the ECM. Clean the contacts of the harness connectors and check the wires for damage to the insulation. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

B. At the machine harness connector J2 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire K758-BU(Blue) and socket at contact J2-1 from the harness connector. The machine harness connector J2 remains connected to the left connector of the joystick.

C. At the back of the joystick connectors J1 and J2, insert 7X-1710 Multimeter Probes along the sensor signal contact J2-1 and the ground 1 contact at J1-3.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor between the connector contacts of the joystick J1-3 and J2-1. Rotate the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “articulation lever position” sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick.Proceed to Test Step 3.

- NOT OK – The duty cycle of the “articulation lever position” sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the “articulation lever position” sensor signal is not correct according to the description at the beginning of this procedure, replace the left assembly of the joystick. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 3. CHECK THE SIGNAL AT THE ECM

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the machine harness connector J1 for the Implement ECM, insert a multimeter probe along return contact J1-21 (wire 998-BR(Brown)). At the machine harness connector J2 for the Implement ECM, insert a multimeter probe along signal contact J2-26 (wire U758-BU(Blue)). The machine harness connectors remain connected to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Measure the duty cycle of the sensor between the connector contacts of the ECM J1-21 and J2-26. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “articulation lever position” sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct at the ECM. The machine harness does not appear to be the cause of the problem. An intermittent open or a short could still be causing the problem.Proceed to Test Step 4.

- NOT OK – The duty cycle of the “articulation lever position” sensor is NOT correct at the ECM connector according to the description at the beginning of this procedure. There is a problem in the machine harness.

  Repair: The “articulation lever position” sensor signal circuit in the machine harness is not correct. Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the sensor signal circuit. Verify that the connections are clean, that the connections are secure and that the connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors for the joystick remain disconnected.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-26 (wire K758-BU(Blue)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurements do not indicate a short in the circuit.Proceed to Test Step 5.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2146 FMI 02 diagnostic code is active.

Expected Result:

The CID 2146 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 2146 FMI 02 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.
- NOT OK – The CID 2146 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04994332

MID 082 - CID 2146 - FMI 03

SMCS Code: 5737-038-ART

Conditions Which Generate This Code:

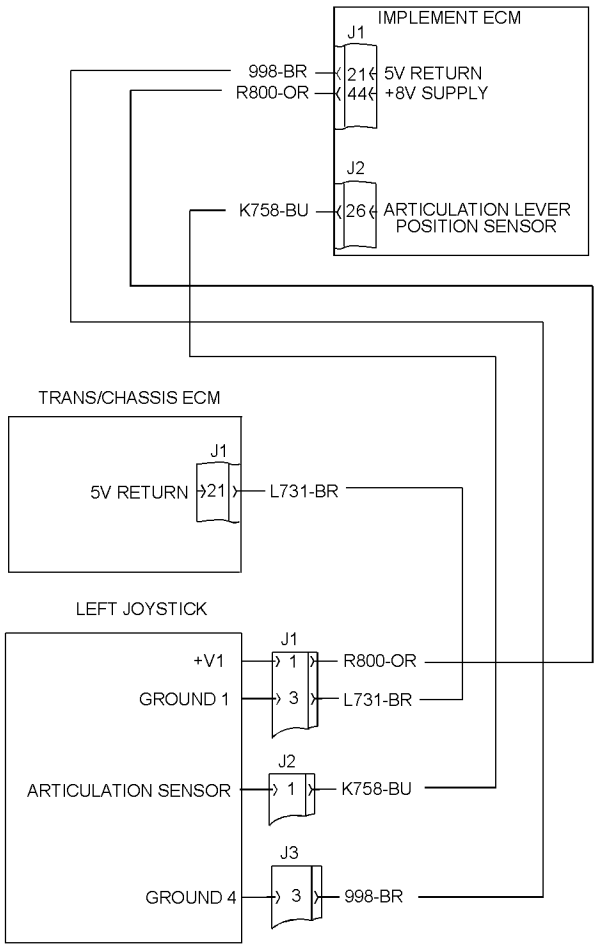


Illustration 263 g03172818

Articulation Lever Position Sensor connections

The position sensor for the articulation lever is located in the assembly of the left joystick. The sensor provides an input signal to the ECM. This diagnostic code is activated when the ECM reads the input signal from the position sensor for the articulation lever and the voltage of the signal is above normal.

The articulation position sensor receives power from the 8 V power supply of the Implement ECM. The sensor is internally connected to the ground that is supplied by the 5 V sensor return of the Transmission/Chassis ECM and to the ground that is supplied by the 5 V sensor return of the Implement ECM. The sensor must lose both grounds in order to lose the ground connection. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will vary from approximately 10 ± 5% at the joystick full articulate left position to approximately 90 ± 5% at the joystick full articulate right position. When the joystick is in the center (neutral) position, the duty cycle will be approximately 50%.

The possible causes of this active diagnostic code are listed:

- The circuit for the sensor power supply is open.
- The circuit for the sensor return is open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. ECM failure is unlikely.

Points to Consider When This Code Is Active:

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate the problem and fix the problem before proceeding with this procedure.

Note: The correct operating temperature range for the position sensor of the articulation lever is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2146 FMI 03 diagnostic code is active before performing this procedure.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY CIRCUIT

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left joystick, insert 7X-1710 Multimeter Probes along the +V1 power supply contact J1-1 (wire R800-OR(Orange)) and along ground 1 contact J1-3 (wire L731-BR(Brown)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

D. At the harness connectors for the left joystick, remove the multimeter probe that is inserted along the ground 1 contact J1-3 and insert the probe along ground 4 contact J3-3 (wire 998-BR(Brown)). Do not disconnect the machine harness from the J3 connector.

E. Measure the DC voltage of the sensor power supply.

Expected Result:

Each voltage measurement is approximately 8.0 ± 0.4 VDC.

Results:

- OK – Each voltage measurement is approximately 8.0 ± 0.4 VDC. The power supply for the sensor is correct. Proceed to Test Step 2.

- NOT OK – Both of the voltage measurements are less than 8.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: If both of the voltage measurements are not correct, the problem is most likely in the power circuit wire. This condition will cause multiple diagnostic codes to activate.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the circuits. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition.

  For troubleshooting the ECM power supply that is providing power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Implement ECM.

  Repair the defective power supply circuit before proceeding with this procedure.

  STOP.

- NOT OK – One of the voltage measurements is not correct.

  Repair: If one of the voltage measurements is correct and the other voltage measurement is not correct, there is a problem in the ground circuit that registered the bad measurement. This condition will not cause this diagnostic code to activate. There is another problem causing this active diagnostic code, however, the ground circuit must be repaired before proceeding with this procedure.

  Do not operate the machine with only one ground connection for the left joystick.

  Repair the defective ground circuit or power supply circuit before proceeding with this procedure.

  After repairing the faulty ground circuit, proceed to Test Step 2.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the three machine harness connectors from the left joystick. At the harness connectors for the joystick, place a jumper wire between the ground 4 contact J3-3 (wire 998-BR(Brown)) and the signal contact J2-1 (wire K758-BU(Blue)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connector for the Implement ECM, measure the resistance from return contact J1-21 (wire 998-BR(Brown)) to signal contact J2-26 (wire K758-BU(Blue)).

E. While observing the resistance measurement, wiggle the ECM connector and the sensor connector. Gently pull on the wires and move the wires around for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The signal circuit of the sensor and the ground circuits of the sensor are not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement for the signal circuit is greater than 5 ohms. There is an open or a bad connection in the circuit.

Repair: Check the signal circuit for opens or for a bad connection.

A resistance measurement that is greater than 5 ohms but less than 5000 ohms would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5000 ohms would indicate an open in the circuit.

Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors for the joystick remain disconnected.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-26 (wire K758-BU(Blue)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurements do not indicate a short in the circuit.Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Inspect all of the harness connectors for the joystick and the ECM. Clean the contacts of the harness connectors and check the wires for damage to the insulation. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

B. At the machine harness connector J2 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire K758-BU(Blue) and the socket at contact J2-1 from the harness connector. The machine harness connector J2 remains connected to the connector of the left joystick.

C. At the back of the joystick connectors J1 and J2, insert 7X-1710 Multimeter Probes along the sensor signal contact J2-1 and the ground 1 contact at J1-3.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor between the connector contacts of the joystick J1-3 and J2-1. Rotate the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the position sensor of the articulation lever is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick.Proceed to Test Step 5.
- NOT OK – The duty cycle of the articulation lever position sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

Repair: Perform this test step again in order to verify that the sensor signal is not correct.

If the articulation lever position sensor signal is not correct according to the description at the beginning of this procedure, replace the left joystick assembly. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2146 FMI 03 diagnostic code is active.

Expected Result:

The CID 2146 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2146 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2146 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04994369

MID 082 - CID 2146 - FMI 04

SMCS Code: 5737-038-ART

Conditions Which Generate This Code:

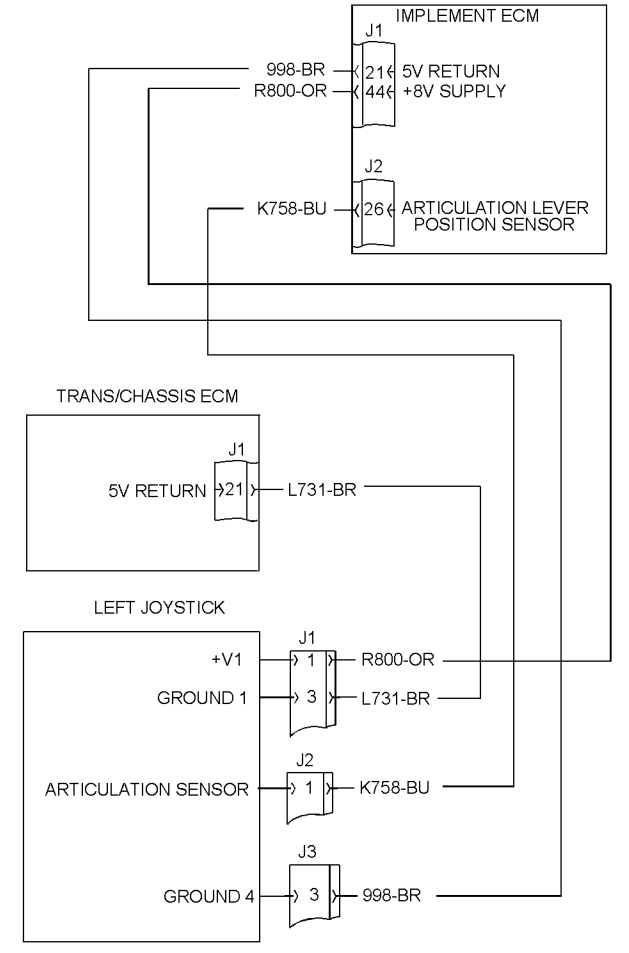


Illustration 264 g03172818

Articulation Lever Position Sensor connections

The position sensor of the articulation lever is located in the assembly of the left joystick. The sensor provides an input signal to the ECM. This diagnostic code is recorded when the ECM reads the input signal from the position sensor of the articulation lever and the voltage of the signal is below normal.

The articulation position sensor receives power from the Implement ECM 8 V power supply. The sensor is internally connected to the ground from the Implement ECM 5 V sensor return (ECM ground) and to the ground from the Implement ECM 5 V sensor return (ECM ground). The sensor must lose both grounds in order to lose the ground connection. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will vary from approximately 10% at the joystick full articulate left position to approximately 90% at the joystick full articulate right position. When the joystick is in the center (neutral) position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Ensure that the CID 2146 FMI 04 diagnostic code is active before performing this procedure.

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate the problem and fix the problem before proceeding with this procedure.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J2 from the left joystick. Observe the status of the active CID 2146 FMI 04 diagnostic code.

Expected Result:

The status of the CID 2146 FMI 04 diagnostic code did not change when the joystick connector was disconnected. A CID 2146 FMI 03 diagnostic code has NOT been activated the ECM. The CID 2146 FMI 04 diagnostic code remains active when the joystick connector is disconnected.

Results:

- YES – The CID 2146 FMI 04 diagnostic code remains active when the joystick connector is disconnected. The sensor is not causing the problem.Proceed to Test Step 2.
- NO – The CID 2146 FMI 04 diagnostic code is no longer active when the joystick connector is disconnected. A CID 2146 FMI 03 diagnostic code has been activated by the ECM when the joystick connector is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The articulation position sensor is causing the problem. There is an internal short to ground in the left joystick. Replace the assembly of the left joystick. After replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the joystick J2 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J2 for the Implement ECM, measure the resistance from contact J2-26 (wire K758-BU(Blue)) to frame ground and measure the resistance to all of the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and either the frame ground or the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2146 FMI 04 diagnostic code is active.

Expected Result:

The CID 2146 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2146 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.
- NOT OK – The CID 2146 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04994373

MID 082 - CID 2146 - FMI 08

SMCS Code: 5737-038-ART

Conditions Which Generate This Code:

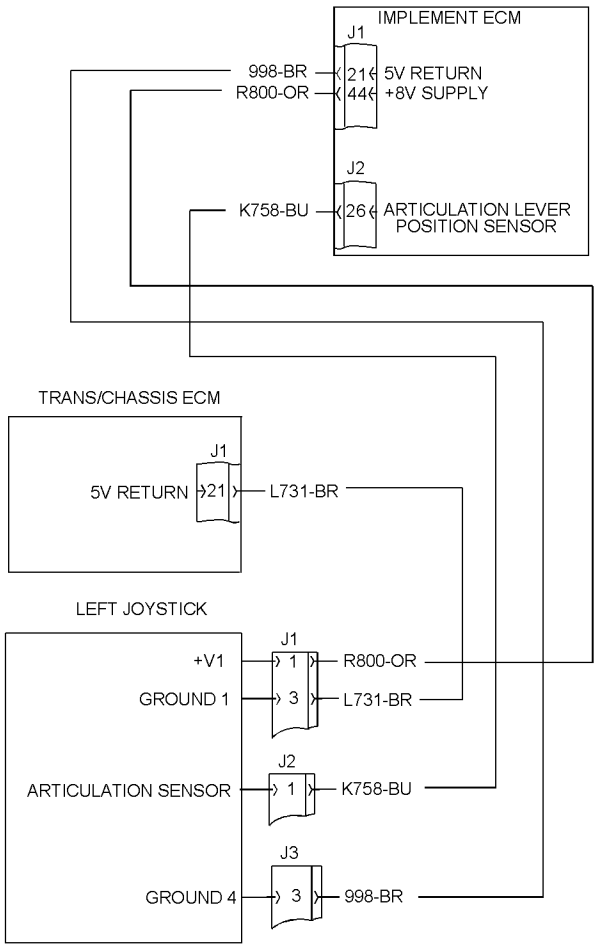


Illustration 265 g03172818

Articulation Lever Position Sensor connections

The articulation lever position sensor is located in the left joystick assembly. The sensor provides an input signal to the ECM. The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range.

The articulation position sensor receives power from the Implement ECM 8 V power supply. The sensor is internally connected to the ground from the Implement ECM 5 V sensor return (ECM ground) and to the ground from the Implement ECM 5 V sensor return (ECM ground). The sensor must lose both grounds in order to lose the ground connection. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will vary from approximately 10% at the joystick full articulate left position to approximately 90% at the joystick full articulate right position. When the joystick is in the center (neutral) position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Points to Consider When This Code Is Active:

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate the problem and fix the problem before proceeding with this procedure.

Note: The correct operating temperature range for the sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for an articulation lever position sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2146 FMI 08 diagnostic code is active before performing this procedure.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J2 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire (wire K758-BU(Blue)) and the socket at contact J2-1. The machine harness connector J2 remains connected to the connector for the left joystick.

B. At the back of the joystick connector J1 and J2, insert 7X-1710 Multimeter Probes along the sensor signal contact J2-1 and the return contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. With the joystick stationary, measure the frequency of the signal from the sensor.

E. Observe the measurement and wiggle the connector of the joystick. Gently pull on the wires and wiggle the wires.

F. Measure the duty cycle of the sensor at the connector contacts of the joystick J2-1 and J1-3. Rotate the joystick through the full range of the sensor that is described at the beginning of this procedure.

G. Observe the measurement and wiggle the connector of the joystick. Gently pull on the wires and wiggle the wires.

Expected Result:

The frequency of the articulation lever position sensor signal is 500 ± 100 Hz. The duty cycle of the articulation lever position sensor is correct according to the description at the beginning of this procedure. The frequency and the duty cycle are stable during the manipulation of the harness connector and the wiring.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not causing the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick. Verify that all the wires of the joystick are secure in the connector. Proceed to the next step. Proceed to Test Step 2.

- NOT OK – The signal frequency or the duty cycle of the articulation lever position sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the signal from the position sensor of the articulation lever is not correct according to the description at the beginning of this procedure, replace the assembly of the left joystick. After replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J2 and J3 from the left joystick. At machine harness sensor connectors, place a jumper wire between the sensor return contact at J3-3 (wire 998-BR(Brown)) and the signal contact at J2-1 (wire K758-BU(Blue)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-21 (wire 998-BR(Brown)) to signal contact J2-26 (wire K758-BU(Blue)).

E. Observe the resistance measurement and wiggle the ECM connector and the sensor connector. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor signal circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement for the signal circuit is greater than 5 ohms. There is an open or a bad connection in the circuit.

  Repair: Check the signal circuit for opens or for a bad connection.

  A resistance measurement that is greater than 5 ohms but less than 5000 ohms would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5000 ohms would indicate an open in the circuit.

Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit or in the ground circuits. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2146 FMI 08.

Expected Result:

The CID 2146 FMI 08 is not active.

Results:

- OK – The CID 2146 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2146 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05720670

MID 082 - CID 2147 - FMI 03

SMCS Code: 5705-038-ZS; 7332-038

Conditions Which Generate This Code:

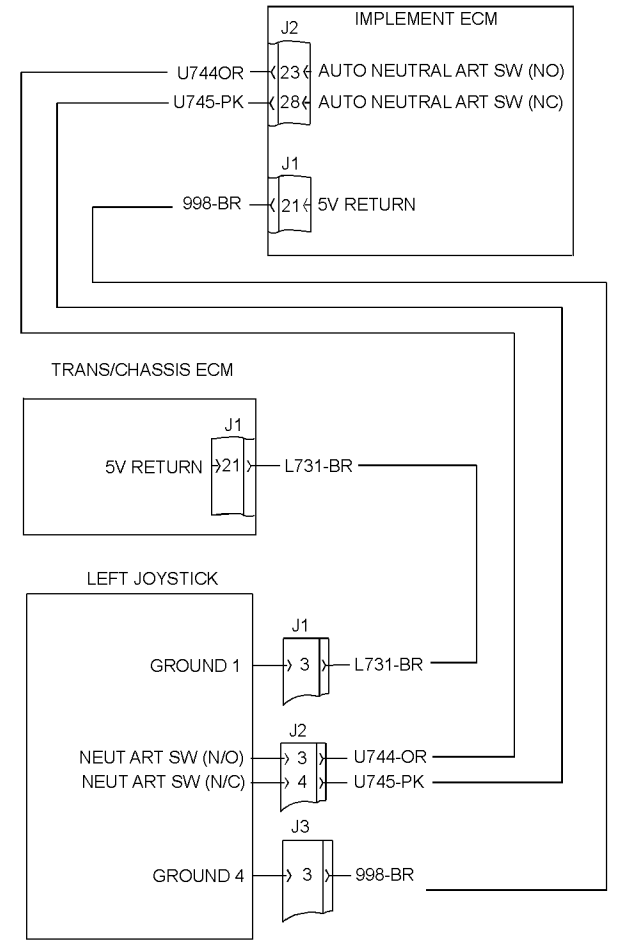


Illustration 266 g03172896

Automatic Neutral Articulation Switch connections

This diagnostic code is associated with the automatic neutral articulation switch that is located on the left joystick handle. The switch supplies two switch to ground type inputs to the Implement ECM. The ECM expects one of the two switch inputs to be grounded at all times. When the ECM detects that neither of the switch inputs is grounded, the ECM will activate an FMI 03 diagnostic code for voltage above normal.

The automatic neutral articulation switch is connected to ground at the Implement ECM 5 V sensor return (ECM ground) and the Transmission Chassis ECM 5 V sensor return (ECM ground). The switch must lose both grounds in order to disrupt the switch operation. The illustration above indicates the power and ground connections for the switch.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

Possible conditions that can cause this diagnostic code are listed:

- One or both of the input circuits of the switch are open in the machine harness.
- Both of the switch ground circuits are open in the machine harness.
- One or more of the switch inputs is shorted to a voltage source.
- The switch has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SWITCH CIRCUITS FOR AN OPEN

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the connector of the left joystick J2 from the machine harness connector.

C. At the joystick connector J2, connect a jumper wire between the normally open (N/O) contact J2-3 (wire U744-OR(Orange)) and the normally closed (N/C) contact J2-3 (wire U745-PK(Pink)).

D. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

E. At the Implement ECM machine harness connector J2, measure the resistance between N/O contact J2-23 (wire U744-OR(Orange)) and N/C contact J2-28 (wire U745-PK(Pink)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The input circuits of the switch are not open in the machine harness.Proceed to Test Step 2.
- NOT OK – The resistance measurement is greater than 5 ohms. One of the switch circuits is open in the machine harness.

  Repair: There is an open or a bad connection in the input wire of the switch U744-OR(Orange) or wire U745-PK(Pink). Refer to the complete Electrical System Schematic of the machine. Check the connectors that are in the switch circuits for loose connections or corroded connections. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE GROUND CIRCUITS FOR AN OPEN

The disconnect switch and the key start switch remain in the OFF position. The connector of the left joystick J2 remains disconnected from the machine harness. The Implement ECM connectors remain disconnected from the machine harness.

A. Disconnect the connector for the left joystick J1 from the machine harness connector.

B. Disconnect the connector for the machine harness J1 from the Transmission/Chassis ECM.

C. At the connectors for the joystick J1 and J2, connect a jumper wire between the ground 1 contact J1-3 (wire L731-BR(Brown)) and ground 4 contact J3-3 (wire 998-BR(Brown)).

D. Obtain a spare length of wire that is long enough to reach from the Transmission Chassis ECM to the cab of the machine. Connect one end of the spare wire to the Transmission/Chassis ECM return contact J1-21 (wire L731-BR(Brown)).

E. At the machine harness connector of the Implement ECM J1, measure the resistance between return contact J1-21 (wire 998-BR(Brown)) and the end of the spare wire that is connected to the return contact of the Transmission/Chassis ECM J1-21 (wire L731-BR(Brown)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The ground circuits are not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. One of the switch ground circuits is open or has a bad connection in the machine harness.

  Repair: Verify that the connection of the spare wire at the Transmission/Chassis ECM connector is a good connection and check the ground circuits again to verify that there is an open or bad connection present in the ground circuits.

  If the resistance measurement is still greater than 5 ohms, there is an open or a bad connection in ground wire 998-BR(Brown) or wire L731-BR(Brown).

  NOTE: Both of the ground circuits must be open in order to cause this diagnostic code to activate, however, if one of the ground circuits is defective, the faulty circuit must be repaired before proceeding with this procedure.

  Refer to the complete Electrical System Schematic of the machine. Check the connectors that are in the ground circuits for loose connections or corroded connections. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE HARNESS FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

The harness connector J2 for the joystick and the ECM harness connectors remain disconnected.

A. Connect the jumper wire that was used in the last test step between the joystick harness connector contact J2-3 (wire U744-OR(Orange)) and contact J2-4 (wire U745-PK(Pink)).

B. At the Implement ECM machine harness connector J2, measure the resistance between contact J2-23 (wire U744-OR(Orange)) to all of the other contacts that are used in the J1 and J2 connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The input circuits for the switch are not shorted in the machine harness.Proceed to Test Step 4.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between one of the switch circuits and the circuit with the low resistance measurement.

  Check each switch input circuit individually for a short in order to determine which circuit is shorted to the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the switch circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SWITCH OPERATION

The connectors of the left joystick remain disconnected from the machine harness. The disconnect switch and the key start switch remain in the OFF position.

A. At the joystick connectors, measure the resistance (continuity) between ground 1 contact J1-3 and the joystick N/O switch contact J2-3 when the switch is not depressed and when the switch is depressed.

B. At the joystick connectors, measure the resistance (continuity) between ground 1 contact J1-3 and the joystick N/C switch contact J2-4 when the switch is not depressed and when the switch is depressed.

Expected Result:

When the switch is NOT depressed, the measurement results are as listed:

J1-3 (ground) to J2-3 (N/O) - No continuity (Open)

J1-3 (ground) to J2-4 (N/C) - Continuity (Closed)

When the switch IS depressed, the measurement results are as listed:

J1-3 (ground) to J2-3 (N/O) - Continuity (Closed)

J1-3 (ground) to J2-4 (N/C) - No continuity (Open)

Results:

- OK – The continuity checks between ground contact J1-3 to the switch contacts are correct. The switch is operating correctly.Proceed to Test Step 5.
- NOT OK – The continuity checks between the ground contact J1-3 to the switch contacts are not correct. The switch is not working correctly.

  Repair: The automatic neutral articulation switch is not correct. Replace the joystick faceplate. Refer to Special Instruction, REHS7448, “Procedure To Remove And Replace The Left-Hand Joystick Push-Button Faceplate on M Series And M Series 2 Motor Graders”. Verify that the operation of the joystick is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the contacts. Clean the contacts of any harness connectors that are disconnected.

B. Reconnect all harness connectors.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 2147 FMI 03 diagnostic code is not active.

Expected Result:

The CID 2147 FMI 03 diagnostic code is active.

Results:

- OK – The CID 2147 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.
- NOT OK – The CID 2147 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator (TC) of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05732071

MID 082 - CID 2147 - FMI 04

SMCS Code: 5705-038-ZS; 7332-038

Conditions Which Generate This Code:

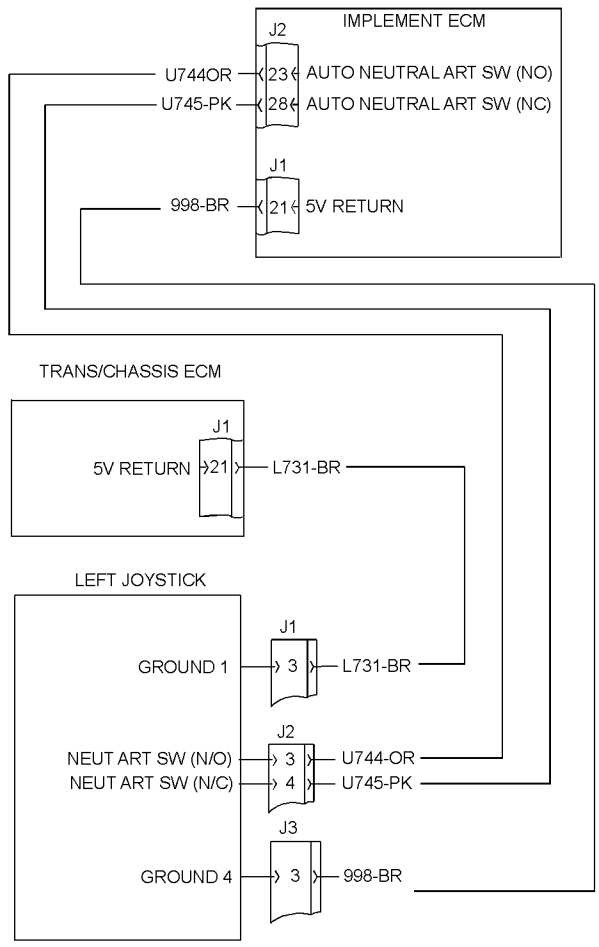


Illustration 267 g03172896

Automatic Neutral Articulation Switch connections

This diagnostic code is associated with the automatic neutral articulation switch that is located on the left joystick handle. The switch supplies two switch to ground type inputs to the Implement ECM. The ECM expects one of the two switch inputs to be grounded at all times. When the ECM detects that both of the switch inputs are grounded at the same time, the ECM will activate an FMI 04 diagnostic code for voltage below normal.

The automatic neutral articulation switch is connected to ground at the Implement ECM 5 V sensor return (ECM ground) and the Transmission Chassis ECM 5 V sensor return (ECM ground). The switch must lose both grounds in order to disrupt the switch operation. The illustration above indicates the power and ground connections for the switch.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

Possible conditions that can cause this diagnostic code are listed:

- One or both of the switch inputs is shorted to a ground source.
- The switch has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SWITCH

A. Turn the disconnect switch and the key start switch to the ON position.

B. Ensure that the diagnostic code is active.

C. Observe the status of the diagnostic code while disconnecting left joystick J2 connector from the machine harness.

Expected Result:

The CID 2147 FMI 04 diagnostic code will remain active if the switch is not the cause of the diagnostic code. The switch is the cause of the diagnostic code if the CID 2147 FMI 04 diagnostic code is NO longer active and a CID 2147 FMI 03 diagnostic code becomes active.

Results:

- OK – The CID 2147 FMI 04diagnostic code remains active. The switch has not failed. Proceed to Test Step 3.
- NOT OK – The CID 2147 FMI 04 diagnostic code is NO longer active. A CID 2147 FMI 03 diagnostic code becomes active when the J2 connector is disconnected. The machine harness and the ECM are operating correctly.The switch may be faulty. Verify that the switch is not operating correctly. Proceed to Test Step 2.

Test Step 2. CHECK THE SWITCH OPERATION

The left joystick connector J2 remains disconnected from the machine harness. The disconnect switch and the key start switch remain in the OFF position.

A. Disconnect the joystick J1 connector from the machine harness.

B. At the joystick connectors, measure the resistance (continuity) between ground 1 contact J1-3 and the joystick N/O switch contact J2-3 when the switch is not depressed and when the switch is depressed.

C. At the joystick connectors, measure the resistance (continuity) between ground 1 contact J1-3 and the joystick N/C switch contact J2-4 when the switch is not depressed and when the switch is depressed.

Expected Result:

When the switch is NOT depressed, the measurement results are as listed:

J1-3 (ground) to J2-3 (N/O) - No continuity (Open)

J1-3 (ground) to J2-4 (N/C) - Continuity (Closed)

When the switch IS depressed, the measurement results are as listed:

J1-3 (ground) to J2-3 (N/O) - Continuity (Closed)

J1-3 (ground) to J2-4 (N/C) - No continuity (Open)

Results:

- OK – The continuity checks between ground contact J1-3 to the switch contacts are correct. The switch is operating correctly.Proceed to Test Step 3.
- NOT OK – The continuity checks between the ground contact J1-3 to the switch contacts are not correct. The switch is not working correctly switch.

  Repair: The automatic neutral articulation switch is not correct. Replace the joystick faceplate. Refer to Special Instruction, REHS7448, “Procedure To Remove And Replace The Left-Hand Joystick Push-Button Faceplate on M Series And M Series 2 Motor Graders”. Verify that the operation of the joystick is correct before operating the machine.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

The connector for the left joystick J2 remains disconnected from the machine harness. The disconnect switch and the key start switch remain in the OFF position.

A. Disconnect the J1 and J2 machine harness connectors from the ECM.

B. At machine harness connector J2 for the ECM, measure the resistance from contact J2-23 (wire U744-OR(Orange)) to frame ground. Measure the resistance to all of the contacts that are used in the J1 and J2 connectors for the ECM.

C. At machine harness connector J2 for the ECM, measure the resistance from contact J2-28 (wire U745-PK(Pink)) to frame ground. Measure the resistance to all of the contacts that are used in the J1 and J2 connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The switch circuits are not shorted to another circuit in the machine harness. Proceed to Test Step 4.
- NOT OK – One or more of the resistance measurements is NOT correct. The machine harness has failed.

  Repair: There is a short in the machine harness. The short is between the switch circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the switch circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2147 FMI 04 diagnostic code is active.

Expected Result:

The CID 2147 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2147 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2147 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator (TC) of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04994833

MID 082 - CID 2150 - FMI 03

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

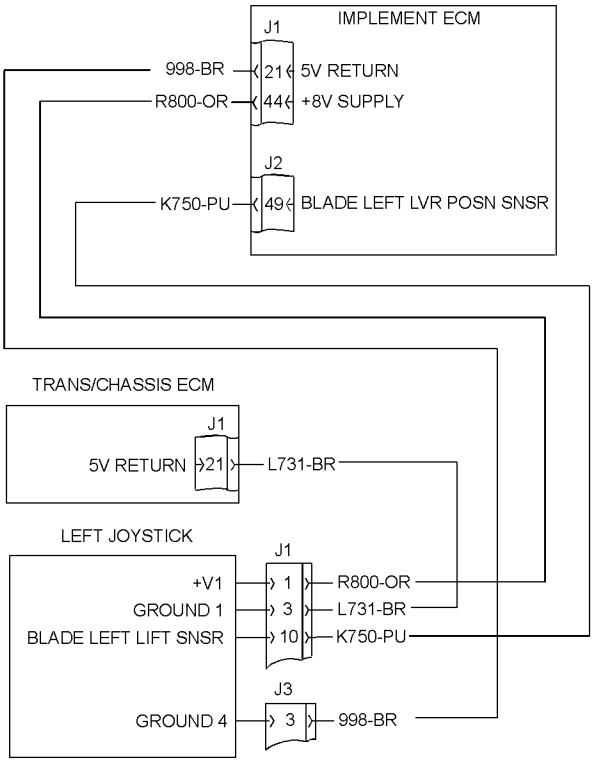


Illustration 268 g03173296

“Blade Left Lift Lever Position” Sensor connections

This diagnostic code is recorded when the ECM reads the input signal from the “blade left lift lever position” sensor and the voltage of the signal is above normal. The sensor is located in the left joystick.

The “blade left lift lever position” sensor receives power from the 8 V power supply of the Implement ECM. The sensor is internally connected to the ground from the 5 V sensor return for the Implement ECM (ECM ground) and to the ground from the 5 V sensor return of the Transmission/Chassis ECM (ECM ground). The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% at the lever full rearward position to approximately 90% at the lever full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate the problem and fix the problem before proceeding with this procedure.

Note: The correct operating temperature range for the “blade left lift lever position” sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2146 FMI 03 diagnostic code is active before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY CIRCUIT

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left joystick, insert 7X-1710 Multimeter Probes along the +V1 power supply, contact J1-1 (wire R800-OR(Orange)) and along ground 4 contact J3-3 (wire 998-BR(Brown)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

D. At the harness connectors for the left joystick, remove the multimeter probe that is inserted at +V1 power supply J1-1 (wire R800-OR(Orange) and insert the probe along ground 4 contact J3-3 (wire 998-BR(Brown)). Do not disconnect the machine harness from the J1 connector.

E. Measure the DC voltage of the sensor power supply.

Expected Result:

Each voltage measurement is approximately 8.0 ± 0.4 VDC.

Results:

- OK – Each voltage measurement is approximately 8.0 ± 0.4 VDC. The power supplies for the sensor are correct. Proceed to Test Step 2.
- NOT OK – Both of the voltage measurements are less than 8.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: If both of the voltage measurements are not correct, the problem is most likely in the wire of the power circuit. This condition will cause multiple diagnostic codes to activate.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the circuits. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition.

  For troubleshooting the ECM power supply that is providing power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Implement ECM.

  Repair the faulty power supply circuit before proceeding with this procedure.

  STOP.

- NOT OK – One of the voltage measurements is not correct.

  Repair: If one of the voltage measurements is correct and the other voltage measurement is not correct, there is a problem in the ground

circuit that registered the bad measurement. This condition will not cause this diagnostic code to activate. There is another problem that is causing this active diagnostic code, however, the ground circuit must be repaired before proceeding with this procedure.

Do not operate the machine with only one ground connection for the left joystick.

Repair the faulty ground circuit or the power supply circuit before proceeding with this procedure.

After repairing the faulty ground circuit, proceed to Test Step 2.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the left joystick. At the harness connectors for the joystick, place a jumper wire between the ground 4 contact J3-3 (wire 998-BR(Brown)) and the signal contact J1-10 (wire K750-PU(Purple)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connector for the Implement ECM, measure the resistance from return contact J1-21 (wire 998-BR(Brown)) to signal contact J2-49 (wire K750-PU(Purple)).

E. Observe the resistance measurement and wiggle the ECM connector and the sensor connector. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor signal circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement for the signal circuit is greater than 5 ohms. There is an open or a bad connection in one of the circuits.

  Repair: Check the signal circuit for opens or for a bad connection.

  A resistance measurement that is greater than 5 ohms but less than 5000 ohms would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5000 ohms would indicate an open in the circuit.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit or in the ground circuits. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the ECM, measure the resistance from the sensor signal contact J2-49 (wire K750-PU(Purple)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurements do not indicate a short in the circuit.Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Inspect all of the harness connectors for the joystick and the ECM. Clean the contacts of the harness connectors and check the wires for damage to the insulation. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

B. At the machine harness connector J1 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire K750-PU(Purple) and the socket at contact J1-10 from the harness connector. The machine harness connector J1 remains connected to the connector of the left joystick.

C. At the back of the joystick are connector J1, insert 7X-1710 Multimeter Probes along the ground 1 contact at J3-3 and the signal contact at J1-10.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor at the steering control connector pins between the contacts J3-3 and J1-10. Move the joystick through the full blade control range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the blade lift sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick.Proceed to Test Step 5.

- NOT OK – The duty cycle of the blade lift sensor is not correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  If the “blade lift lever position” sensor signal is not correct according to the description at the beginning of this procedure, replace the assembly of the left joystick. After replacement of the assembly of the left joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2150 FMI 03 diagnostic code is active.

Expected Result:

The CID 2150 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2150 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2150 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i04995010

MID 082 - CID 2150 - FMI 04

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

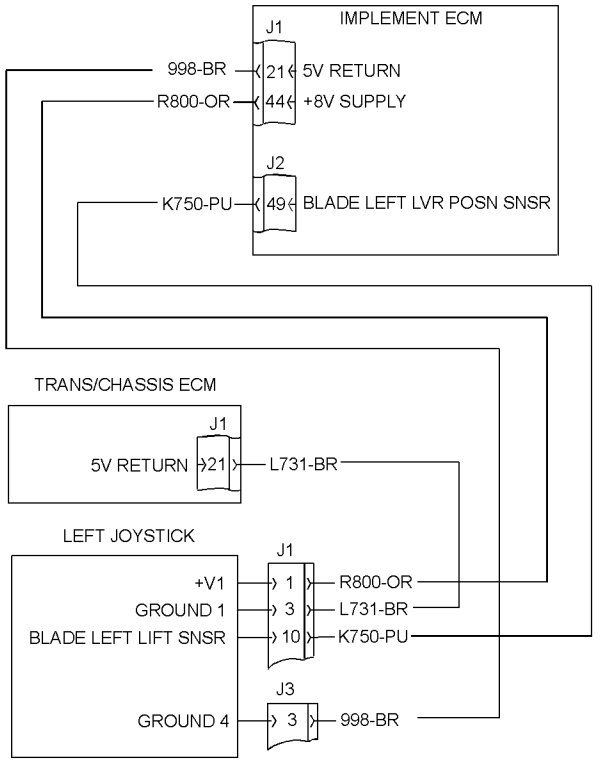


Illustration 269 g03173296

Connections of “Blade Left Lift Lever” position sensor

This diagnostic code is recorded when the Implement ECM reads the signal from the “blade left lift lever” position sensor and the voltage of the signal is below normal. The position sensor is located in the left joystick.

The “blade left lift lever” position sensor receives power from the 8 V power supply of the Implement ECM. The sensor is internally connected to the ground from the 5 V sensor return of the Implement ECM (ECM ground) and to the ground from the 5 V sensor return of the Transmission/Chassis ECM (ECM ground). The sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will vary from approximately 10% at the lever full rearward position to approximately 90% at the lever full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate the problem and fix the problem before proceeding with this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the left joystick. Observe the status of the active CID 2150 FMI 04 diagnostic code.

Expected Result:

The status of the CID 2150 FMI 04 diagnostic code did not change when the connector for the joystick was disconnected. A CID 2150 FMI 03 diagnostic code has NOT been activated the ECM. The CID 2150 FMI 04 diagnostic code remains active when the connector for the joystick is disconnected.

Results:

- YES – The CID 2150 FMI 04 diagnostic code remains active when the connector for the joystick is disconnected. The sensor is not the cause of the problem.Proceed to Test Step 2.
- NOT OK – The CID 2150 FMI 04 diagnostic code is no longer active when the connector for the joystick is disconnected. A CID 2150 FMI 03 diagnostic code has been activated by the ECM when the connector for the joystick is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the “blade lift” sensor is the cause of the problem. Replace the assembly of the left joystick. After replacement of the assembly for the steering lever, verify that the operation of the assembly for the new lever is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector for the steering lever J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J2 for the ECM, measure the resistance from contact J2-49 (wire K750-PU(Purple)) to frame ground and measure the resistance to all of the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is NOT correct. The machine harness has failed.

  Repair: There is a short in the machine harness. The short is between the signal circuit and either the frame ground or the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2150 FMI 04 diagnostic code is active.

Expected Result:

The CID 2150 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2150 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2150 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04995016

MID 082 - CID 2150 - FMI 08

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

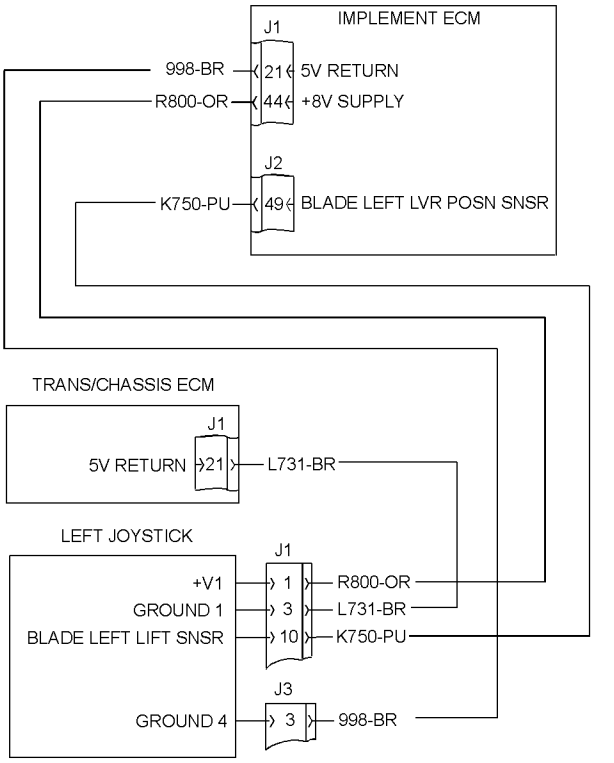


Illustration 270 g03173296

Connections of “Blade Left Lift Lever” position sensor

This diagnostic code is associated with the “blade left lift lever” position sensor. The position sensor is located in the left joystick. The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range.

The “blade left lift lever” position sensor receives power from the 8 V power supply of the Implement ECM. The sensor is internally connected to the ground from the 5 V sensor return of the Implement ECM (ECM ground) and to the ground from the 5 V sensor return of the Transmission/Chassis ECM (ECM ground). The sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The sensor sends a PWM input signal to the Implement ECM and to the Machine ECM. The duty cycle of the signal will vary from approximately 10% at the joystick full left position to approximately 90% at the joystick full right position. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate and fix the problem before proceeding with this procedure.

Note: The correct operating temperature range for the sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for an articulation lever position sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2146 FMI 08 diagnostic code is active before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire K750-PU(Purple) and the socket at contact J1-10 from the harness connector. The connector for the machine harness J1 remains connected to the connector of the left joystick.

B. At the back of the joystick connector J1, insert 7X-1710 Multimeter Probes along the ground 4 contact J3-3 and the signal contact at J1-10.

C. Turn the disconnect switch and the key start switch to the ON position.

D. With the joystick stationary, measure the frequency of the signal from the sensor.

E. Observe the measurement and wiggle the connector of the joystick. Gently pull on the wires and wiggle the wires.

F. Measure the duty cycle of the sensor at the connector pins of the joystick between the contacts J3-3 and J1-10. Move the joystick through the full blade control range of the sensor that is described at the beginning of this procedure.

Expected Result:

The frequency of the “blade left lift lever” sensor signal is 500 ± 100 Hz. The duty cycle of the signal is correct according to the description at the beginning of this procedure. The frequency and the duty cycle are stable during the manipulation of the harness connector and the wiring.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the wire and the socket into the original locations in the ECM connector. Verify that all wires of the joystick are secure in the connector. Proceed to the next step.Proceed to Test Step 2.
- NOT OK – The signal frequency or the duty cycle of the blade lift sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

  The blade lift sensor operation is not correct according to the description at the beginning of this procedure, replace the left joystick assembly. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connectors J1 and J3 from the left joystick. At machine harness connectors, place a jumper wire between the ground 4 contact J3-3 (wire 998-BR(Brown)) and the signal contact J1-10 (wire K750-PU(Purple)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-21 (wire 998-BR(Brown)) to signal contact J2-49 (wire K750-PU(Purple)).

E. Observe the resistance measurement and wiggle the ECM connector and the sensor connector. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor signal circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement for the signal circuit is greater than 5 ohms. There is an open or a bad connection in the circuit.

  Repair: Check the signal circuit for opens or for a bad connection.

  A resistance measurement that is greater than 5 ohms but less than 5000 ohms would indicate a loose or corroded connection in the circuit. A resistance measurement that is greater than 5000 ohms would indicate an open in the circuit.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit or in the ground circuits. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2150 FMI 08.

Expected Result:

The CID 2150 FMI 08 is not active.

Results:

- OK – The CID 2150 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2150 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02962476

MID 082 - CID 2151 - FMI 03

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

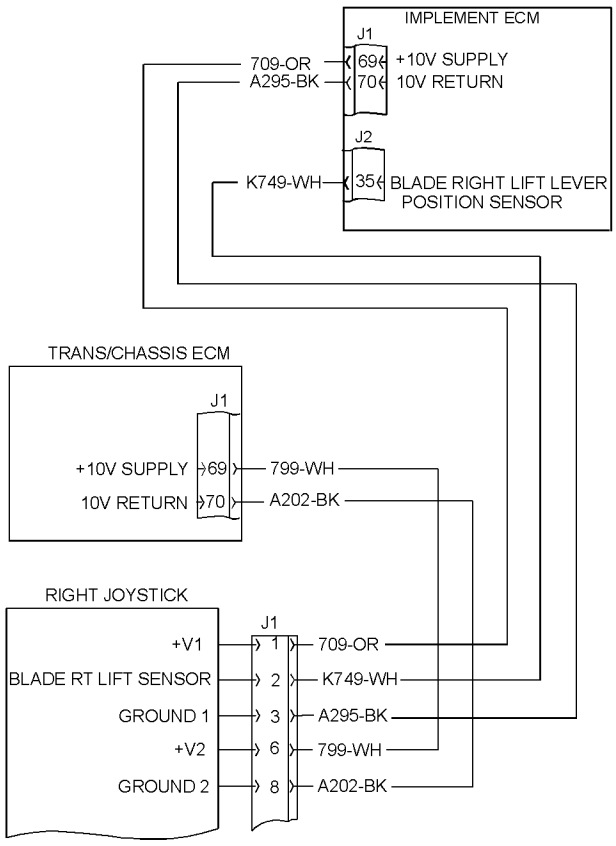


Illustration 271 g01482893

Blade Right Lift Lever Position Sensor connections

This diagnostic code is recorded when the ECM detects that the voltage of the input signal from the blade right lift lever position sensor is above normal. The sensor is located in the assembly of the right joystick.

The blade right lift lever position sensor receives power from the Transmission Chassis ECM 10 volt power supply and the Implement ECM 10 volt power supply. The blade right lift lever position sensor is connected to ground at the Implement ECM 10 volt sensor return (ECM ground) and the Implement ECM 10 volt sensor return (ECM ground). The blade right lift lever position sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the blade right lift lever position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% at the lever full rearward position to approximately 90% at the lever full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- Both of the circuits for the sensor power supply are open.
- Both of the circuits for the sensor return are open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the Implement ECM 10 volt sensor power supply or the Transmission Chassis 10 volt power supply. Correct any problem with either 10 volt power supply before performing this procedure.

Note: The correct operating temperature range for the position sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2151 FMI 03 diagnostic code is active before performing this procedure.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLIES

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the machine harness connector J1 connector for the right joystick, insert 7X-1710 Multimeter Probes along the +V1 power supply contact J1-1 (wire 709-OR(Orange)) and along ground 2 contact J1-8 (wire A202-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the +V1 sensor power supply.

D. At the machine harness connector J1 connector for the right joystick, insert 7X-1710 Multimeter Probes along the +V2 power supply contact J1-6 (wire 799-WH(White)) and along ground 1 contact J1-3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

E. Measure the DC voltage of the +V2 sensor power supply.

Expected Result:

Both of the voltage measurements are 10.0 ± 0.4 VDC.

Results:

- OK – The voltage measurements for both power supplies are 10.0 ± 0.4 VDC. The power supplies for the sensor are correct. Proceed to Test Step 2.
- NOT OK – One or both of the voltage measurements is less than 10.0 ± 0.4 VDC. The power supplies for the sensor are not correct.

  Repair: NOTE: A loss of one of the sensor power supplies will not cause this diagnostic code to be activated, however, a faulty power supply must be repaired before proceeding with this procedure.

  The loss of both of the sensor power supplies will cause this diagnostic code to be activated.

  Either the wires of the return circuit or the wires of the supply circuit have a bad connection or an open in the machine harness. Refer to the complete Electrical System Schematic for your machine. Examine all of the connectors that are in the power supply circuits. Ensure that the connections are clean, that the connections are secure and that the connections are in good condition. Refer to the CID 1482 procedures in this manual for troubleshooting the 10 VDC power supply. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right joystick. At machine harness connector J1, place a jumper wire between the ground 1 contact J1-3 (wire A295-BK(Black)) and the signal contact J1-2 (wire K749-WH(White)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-70 (wire A295-BK(Black)) to signal contact J2-35 (wire K749-WH(White)).

Expected Result:

The resistance measurement should be less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit and the return circuit. Ensure that all connections are clean, that all connections are

secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire that was installed in the last step.

B. At the disconnected machine harness connector J1 for the ECM, measure the resistance from the sensor signal contact J2-35 (wire K749-WH(White)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted. Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. At the connector for the right joystick J1, use a 151-6320 Removal Tool to remove the signal wire K749-WH(White) and the socket at contact J1-2 from the harness connector. The machine harness connector J1 remains connected to the connector for the right joystick.

B. **At the back of the joystick connector J1**, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-2 and the ground 1 contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Measure the duty cycle of the sensor at the joystick connector contacts J1-2 and J1-3. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the blade right lift lever position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the problem.Proceed to Test Step 5.
- NOT OK – The duty cycle of the sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The blade right lift lever position sensor operation is not correct. Replace the assembly of the right joystick. After replacement of the right joystick assembly, verify that the operation of the new joystick assembly is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2151 FMI 03 diagnostic code is active.

Expected Result:

The CID 2151 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2151 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2151 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02962442

MID 082 - CID 2151 - FMI 04

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

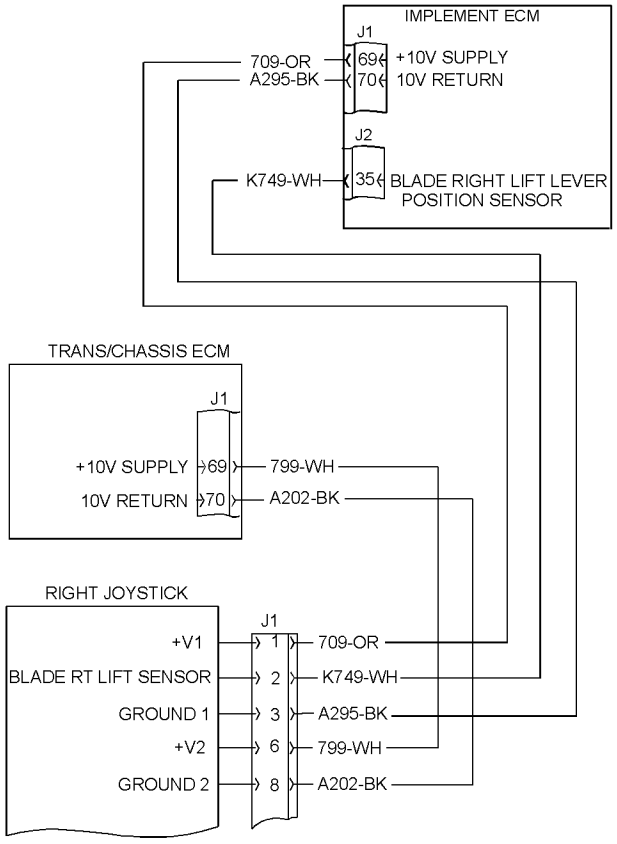


Illustration 272 g01482893

Blade Right Lift Lever Position Sensor connections

This diagnostic code is recorded when the ECM detects that the input signal voltage from the blade right lift lever position sensor is below normal. The position sensor is located in the right joystick.

The blade right lift lever position sensor receives power from the Transmission Chassis ECM 10 volt power supply and the Implement ECM 10 volt power supply. The blade right lift lever position sensor is connected to ground at the Implement ECM 10 volt sensor return (ECM ground) and the Implement ECM 10 volt sensor return (ECM ground). The blade right lift lever position sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the blade right lift lever position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 hertz. The position sensor sends a PWM input signal to the Implement ECM. The duty cycle of the signal will vary from approximately 10% at the lever full rearward position to approximately 90% at the lever full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the right joystick. Observe the status of the active CID 2151 FMI 04 diagnostic code.

Expected Result:

The status of the CID 2151 FMI 04 diagnostic code did not change when the connector of the joystick was disconnected. A CID 2151 FMI 03 diagnostic code has NOT been activated the ECM. The CID 2151 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected.

Results:

- YES – The CID 2151 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected. The sensor is not causing the problem. Proceed to Test Step 2.
- NO – The CID 2151 FMI 04 diagnostic code is no longer active when the connector of the joystick is disconnected. A CID 2151 FMI 03 diagnostic code has been activated by the ECM when the joystick connector is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The blade right lift lever position sensor operation is causing the problem. Replace the assembly of the right joystick. After replacement of the assembly of the right joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector for the joystick J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J1 for the ECM, measure the resistance from contact J2-35 (wire K749-WH(White)) to frame ground and measure the resistance to all of the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is NOT correct.

Repair: There is a short in the machine harness. The short is between the signal circuit and either frame ground or the circuit with the low resistance measurement.

Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2151 FMI 04 diagnostic code is active.

Expected Result:

The CID 2151 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2151 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2151 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02962342

MID 082 - CID 2151 - FMI 08

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

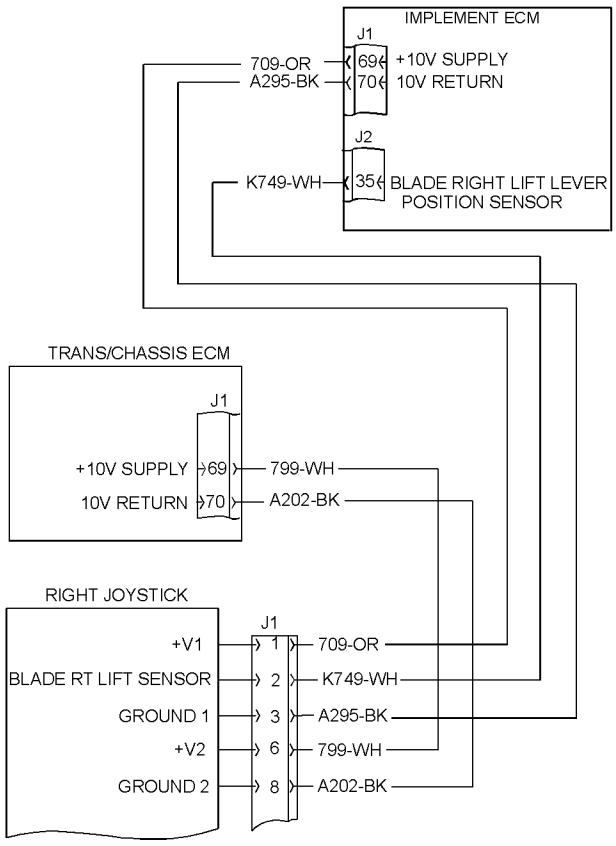


Illustration 273 g01482893

Blade Right Lift Lever Position Sensor connections

This diagnostic code is associated with the blade right lift lever position sensor. The position sensor is located in the right joystick. The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range.

The blade right lift lever position sensor receives power from the Transmission Chassis ECM 10 volt power supply and the Implement ECM 10 volt power supply. The blade right lift lever position sensor is connected to ground at the Implement ECM 10 volt sensor return (ECM ground) and the Implement ECM 10 volt sensor return (ECM ground). The blade right lift lever position sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the blade right lift lever position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 hertz. The sensor sends a PWM input signal to the Implement ECM and to the Machine ECM. The duty cycle of the signal will vary from approximately 10% at the lever full left position to approximately 90% at the lever full right position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the Implement ECM 10 volt sensor power supply or the Transmission Chassis ECM 10 volt sensor power supply. Correct any problem with the 10 volt power supplies before performing this procedure.

Note: The correct operating temperature range for the position sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2151 FMI 08 diagnostic code is active before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SIGNAL AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the connector of the right joystick J1, use a 151-6320 Removal Tool to remove the signal wire and the socket at contact J1-2 (wire K749-WH(White)) from the harness connector. The machine harness connector J1 remains connected to the connector of the right joystick.

B. At the back of the joystick connector J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-2 and the ground 1 contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Measure the duty cycle of the sensor at the connector contacts of the joystick J1-2 and J1-3. Move the joystick through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the blade right lift lever position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the problem.Proceed to Test Step 2.
- NOT OK – The duty cycle of the sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The blade right lift lever position sensor operation is not correct. Replace the assembly of the right joystick. After replacement of the assembly of the right joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right joystick. At the machine harness sensor connector J1, place a jumper wire between the ground 1 contact J1-3 (wire A295-BK(Black)) and the signal contact J1-2 (wire K749-WH(White)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-70 (wire A295-BK(Black)) to signal contact J2-35 (wire K749-WH(White)).

Expected Result:

The resistance measurement should be less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit and the return circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2151 FMI 08.

Expected Result:

The CID 2151 FMI 08 is not active.

Results:

- OK – The CID 2151 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2151 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i07383757

MID 082 - CID 2152 - FMI 03

SMCS Code: 5737-038-WLN

Conditions Which Generate This Code:

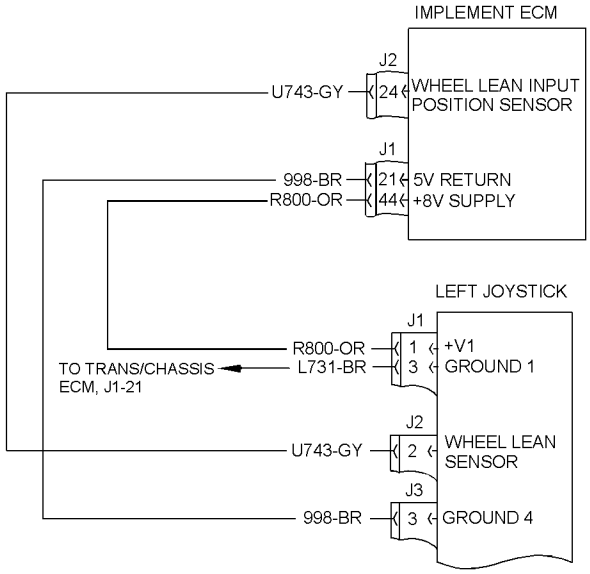


Illustration 274 g03168697

“Wheel Lean Control Position” Sensor connections

The “wheel lean control position” sensor is located in the assembly of the left joystick. The sensor provides an input signal to the ECM that is dependent on the state of the two-wheel lean push buttons that are located on the joystick handle. This diagnostic code is recorded when the ECM reads the input signal from the “wheel lean control position” sensor and the voltage of the signal is above normal.

The “wheel lean position” sensor receives power from the 8 V power supply of the Implement ECM. The sensor is internally connected to the ground that is supplied by the 5 V sensor return of the Transmission/Chassis ECM and to the ground that is supplied by the 5 V sensor return of the Implement ECM. The sensor must lose both grounds to lose the ground connection. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The duty cycle of the signal will be approximately 10 ± 5 percent when the “wheel lean” push button of the left joystick is fully depressed. The duty cycle of the signal will be approximately 90 ± 5 percent when the “wheel lean” push button of the right joystick is fully depressed. When neither push button is depressed, the duty cycle will be approximately 50 ± 5 percent.

The possible causes of this diagnostic code are listed:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Points to Consider When This Code Is Active:

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate the problem and fix the problem before proceeding with this procedure.

Note: The correct operating temperature range for the “wheel lean control position” sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, reduce the temperature inside of the cab to keep the sensor operating in the acceptable temperature range. After the temperature has been reduced, verify that the diagnostic code is still active before proceeding with this procedure. Verify that the CID 2152 FMI 03 diagnostic code is active before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure, and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY CIRCUIT

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left joystick, insert 7X-1710 Multimeter Probes along the +V1 power supply, contact J1-1 (wire R800-OR(Orange)) and along ground 1 contact J1-3 (wire L731-BR(Brown)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

D. At the harness connectors for the left joystick, remove the multimeter probe that is inserted along the ground 1 contact J1-3 and insert the probe along ground 4 contact J3-3 (wire 998-BR(Brown)). Do not disconnect the machine harness from the J3 connector.

E. Measure the DC voltage of the sensor power supply.

Expected Result:

Each voltage measurement is approximately 8.0 ± 0.4 VDC.

Results:

- OK – Each voltage measurement is approximately 8.0 ± 0.4 VDC. The power supply for the sensor is correct.Proceed to Test Step 2.
- NOT OK – Both of the voltage measurements are less than 8.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: If both of the voltage measurements are not correct, the problem is most likely in the wire of the power circuit. This condition will cause multiple diagnostic codes to activate.

  Refer to the complete Electrical System Schematic of the machine. Examine all the connectors that are in the circuits. Ensure that the connections are clean, that all connections are secure, and that all connections are in good condition.

  For troubleshooting the ECM power supply that is providing power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Implement ECM.

  Repair the faulty power supply circuit before proceeding with this procedure.

  STOP.

- NOT OK – One of the voltage measurements is not correct.

  Repair: If one of the voltage measurements is correct and the other voltage measurement is not correct, there is a problem in the ground circuit that registered the bad measurement. This condition will not cause this diagnostic code to activate. There is another problem that caused this active diagnostic code, however, the ground circuit must be repaired before proceeding with this procedure.

  Do not operate the machine with only one ground connection for the left joystick.

  Repair the faulty ground circuit or the power supply circuit before proceeding with this procedure.

  After repairing the faulty ground circuit, proceed to Test Step 2.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the three machine harness connectors from the left joystick. At the harness connectors for the joystick, place a jumper wire between the ground 4 contact J3-3 (wire 998-BR(Brown)) and the signal contact J2-2 (wire U743-GY(Grey)).

C. Disconnect machine harness connectors J1 and J2 from the ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-21 (wire 998-BR(Brown)) to signal contact J2-24 (wire U743-GY(Grey)).

E. While observing the resistance measurement, wiggle the ECM connector and the sensor connector. Gently pull on the wires and wiggle the wires around for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor signal circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement for the signal circuit is greater than 5 ohms. There is an open or a bad connection in the circuit.

  Repair: Check the signal circuit for opens or for a bad connection.

  A resistance measurement that is greater than 5 ohms but less than 5000 ohms would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5000 ohms would indicate an open in the circuit.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-24 (wire U743-GY(Grey)) to all the other J1 and J2 contacts that are used for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low-resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Inspect all the harness connectors for the joystick and the ECM. Clean the contacts of the harness connectors and check the wires for damage to the insulation. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

B. At the machine harness connector J2 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire U743-GY(Grey)and the socket at contact J2-2 from the harness connector. The machine harness connector J2 remains connected to the left connector of the joystick.

C. At the back of the joystick connectors J1 and J2, insert 7X-1710 Multimeter Probes along the sensor signal contact J2-2 and the ground 1 contact at J1-3.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor signal between the connector contacts of the joystick J1-3 and J2-2. Note the value of the signal when neither push button is depressed. Depress each “wheel lean” push button individually and compare the signal to the signal range that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the “wheel lean control position” sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick. Verify that all the wires of the joystick are secure in the connector before proceeding to the next step. Proceed to Test Step 5.
- NOT OK – The duty cycle of the “wheel lean control position” sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again to verify that the sensor signal is not correct.

  If the “wheel lean control position” sensor signal is not correct according to the description at the beginning of this procedure, replace the joystick faceplate. Refer to Special Instruction, REHS7448, “Procedure To Remove And Replace The Left-Hand Joystick Push-Button Faceplate on M Series And M Series 2 Motor Graders”. Verify that the operation of the joystick is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2152 FMI 03 diagnostic code is active.

Expected Result:

The CID 2152 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2152 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2152 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator (TC) at your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i05732084

MID 082 - CID 2152 - FMI 04

SMCS Code: 5737-038-WLN

Conditions Which Generate This Code:

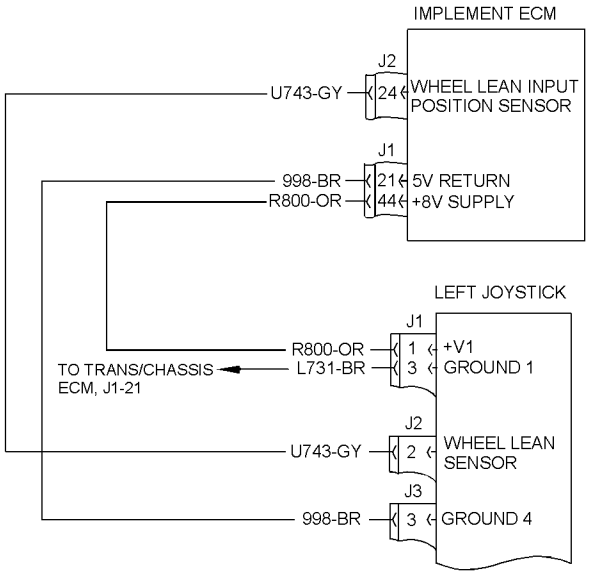


Illustration 275 g03168697

Wheel Lean Control Position Sensor connections

The wheel lean control position sensor is located in the assembly of the left joystick. The sensor provides an input signal to the ECM that is dependent on the state of the two-wheel lean push buttons that are located on the joystick handle. This diagnostic code is recorded when the ECM reads the input signal from the wheel lean control position sensor and the voltage of the signal is below normal.

The wheel lean position sensor receives power from the Implement ECM 8 V power supply. The sensor is internally connected to the ground that is supplied by the 5 V sensor return of the Transmission/Chassis ECM and to the ground that is supplied by the 5 V sensor return of the Implement ECM. The sensor must lose both grounds in order to lose the ground connection. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The duty cycle of the signal will be approximately 10 ± 5 percent when the joystick left wheel lean push button is fully depressed. The duty cycle of the signal will be approximately 90 ± 5 percent when the joystick right wheel lean push button is fully depressed. When neither push button is depressed, the duty cycle will be approximately 50 ± 5 percent.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate and fix the problem before proceeding with this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J2 from the left joystick. Observe the status of the diagnostic code. Observe the status of the active CID 2152 FMI 04 diagnostic code.

Expected Result:

The status of the CID 2152 FMI 04 diagnostic code did not change when the connector of the joystick was disconnected. A CID 2152 FMI 03 diagnostic code has NOT been activated the ECM. The CID 2152 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected.

Results:

- OK – The CID 2152 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected. The sensor is not causing the problem.Proceed to Test Step 2.
- NOT OK – The CID 2152 FMI 04 diagnostic code is no longer active when the connector of the joystick is disconnected. A CID 2152 FMI 03 diagnostic code has been activated by the ECM when the connector of the joystick is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the wheel lean position sensor is causing the problem. Replace the joystick faceplate. Refer to Special Instruction, REHS7448, “Procedure To Remove And Replace The Left-Hand Joystick Push-Button Faceplate on M Series And M Series 2 Motor Graders”. Verify that the operation of the joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the joystick J2 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J2 for the ECM, measure the resistance from contact J2-24 (wire U743-GY(Grey)) to all possible sources of ground. Measure the resistance to all contacts of the ECM machine harness connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is NOT correct. The machine harness has failed.

  Repair: There is a short in the machine harness. The short is between the signal circuit and either frame ground or the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2152 FMI 04 diagnostic code is active.

Expected Result:

The CID 2152 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2152 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably

caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

STOP.

- NOT OK – The CID 2152 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator (TC) at your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05730153

MID 082 - CID 2152 - FMI 08

SMCS Code: 5737-038-WLN

Conditions Which Generate This Code:

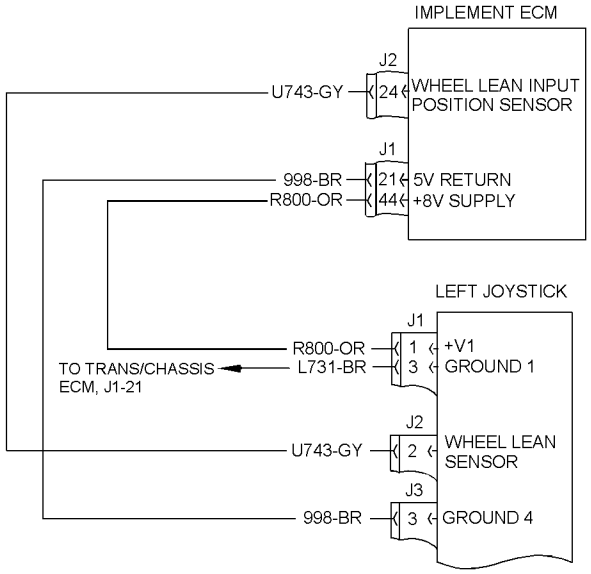


Illustration 276 g03168697

“Wheel Lean Control Position” Sensor connections

The “wheel lean control position” sensor is located in the assembly of the left joystick. The sensor provides an input signal to the ECM that is dependent on the state of the two-wheel lean push buttons that are located on the joystick handle. The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range.

The “wheel lean position” sensor receives power from the 8 V power supply of the Implement ECM. The sensor is internally connected to the ground that is supplied by the 5 V sensor return of the Transmission/Chassis ECM and to the ground that is supplied by the 5 V sensor return of the Implement ECM. The sensor must lose both grounds in order to lose the ground connection. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The duty cycle of the signal will be approximately 10 ± 5 percent when the “wheel lean” push button of the left joystick is fully depressed. The duty cycle of the signal will be approximately 90 ± 5 percent when the “wheel lean” push button of the right joystick is fully depressed. When neither push button is depressed, the duty cycle will be approximately 50 ± 5 percent.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Points to Consider When This Code Is Active:

Note: If a CID 0041 diagnostic code for the 8 V power supply has been activated by the Implement ECM (MID 082), investigate the problem and fix the problem before proceeding with this procedure.

Note: The correct operating temperature range for the sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the diagnostic code is still active before proceeding with this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J2 for the left joystick, use a 151-6320 Removal Tool to remove the signal wire (wire U743-GY(Grey)) and the socket at contact J2-2. The machine harness connector J2 remains connected to the connector of the left joystick.

B. At the back of the joystick connector J1 and J2, insert 7X-1710 Multimeter Probes along the sensor signal contact J2-2 and the ground 1 contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. With the joystick stationary, measure the frequency of the signal from the sensor.

E. While observing the measurement, wiggle the joystick connector. Gently pull on the wires and move the wires around.

F. Measure the duty cycle of the sensor at the connector contacts of the joystick J2-2 and J1-3. Note the value of the signal when neither push button is depressed. Depress each “wheel lean” push button individually and compare the signal to the signal range that is described at the beginning of this procedure.

G. While observing the measurement, wiggle the joystick connector. Gently pull on the wires and move the wires around.

Expected Result:

The frequency of the “wheel lean control position” sensor signal is 500 ± 80 Hz. The duty cycle of the “wheel lean control position” sensor is correct according to the description at the beginning of this procedure. The frequency and the duty cycle are stable during the manipulation of the harness connector and the wiring.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not causing the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick. Verify that all the wires of the joystick are secure in the connector before proceeding to the next step. Proceed to Test Step 2.
- NOT OK – The signal frequency or the duty cycle of the “wheel lean control position” sensor is not correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again in order to verify that the sensor signal is not correct.

If the “wheel lean control position” sensor signal is not correct according to the description at the beginning of this procedure, replace the joystick faceplate. Refer to Special Instruction, REHS7448, “Procedure To Remove And Replace The Left-Hand Joystick Push-Button Faceplate on M Series And M Series 2 Motor Graders”. Verify that the operation of the joystick is correct before operating the machine.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 and J2 from the left joystick. At machine harness connectors, place a jumper wire between the ground 1 contact at J1-3 (wire L731-BR(Brown)) and the signal contact at J2-2 (wire U743-GY(Grey)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-21 (wire 998-BR(Brown)) to signal contact J2-24 (wire U743-GY(Grey)).

E. While observing the resistance measurement, wiggle the ECM connector and the sensor connector. Gently pull on the wires and move the wires around for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor signal circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement for the signal circuit is greater than 5 ohms. There is an open or a bad connection in the circuit.

  Repair: Check the signal circuit for opens or for a bad connection.

  A resistance measurement that is greater than 5 ohms but less than 5000 ohms would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5000 ohms would indicate an open in the circuit.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit or in the ground circuits. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2152 FMI 08.

Expected Result:

The CID 2152 FMI 08 is not active.

Results:

- OK – The CID 2152 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2150 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator (TC) at your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02955361

MID 082 - CID 2153 - FMI 03

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

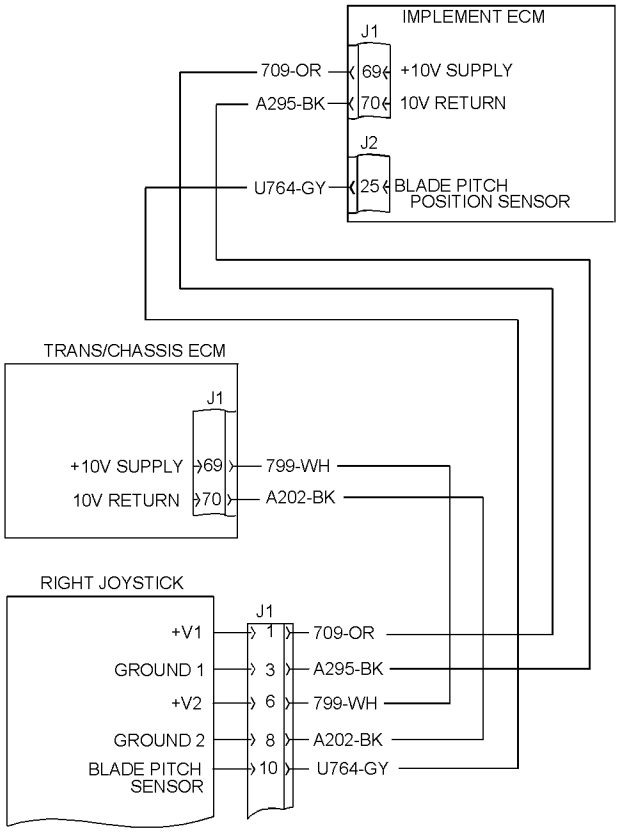


Illustration 277 g01482413
“Blade Pitch Position” Sensor connections

The “blade pitch position” sensor is located in the assembly of the right joystick. The sensor provides an input signal to the ECM that is dependent on the position of the “thumbrocker” control button that is located on the joystick handle. This diagnostic code is recorded when the ECM detects that the input signal voltage from the “blade pitch position” sensor is above normal.

The “blade pitch position” sensor receives power from the 10 volt power supply of the Transmission/ Chassis ECM and the 10 volt power supply of the Implement ECM. The “blade pitch position” sensor is connected to ground at the Implement ECM 10 volt sensor return (ECM ground) and the Implement ECM 10 volt sensor return (ECM ground). The position sensor for the blade pitch must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the “thumbrocker” is at the full lower position to approximately 90% when the “thumbrocker” is at the full upper position. When the “thumbrocker” is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- Both of the power supply circuits of the sensor are open.
- Both of the return circuits of the sensor are open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the 10 volt sensor power supply of the Implement ECM or the 10 volt power supply of the Transmission/Chassis ECM. Correct any problem with either 10 volt power supply before performing this procedure.

Points to Consider When This Code Is Active:

Note: The correct operating temperature range for the position sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2153 FMI 03 diagnostic code is active before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLIES

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the machine harness connector J1 connector for the right joystick, insert 7X-1710 Multimeter Probes along the +V1 contact for the power supply J1-1 (wire 709-OR(Orange)) and along ground 1 contact J1-3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the +V1 sensor power supply.

D. At the machine harness connector J1 connector for the right joystick, insert 7X-1710 Multimeter Probes along the +V2 contact of the power supply J1-6 (wire 799-WH(White)) and along ground 2 contact J1-8 (wire A202-BK(Black)). Do not disconnect the machine harness from the J1 connector.

E. Measure the DC voltage of the +V2 sensor power supply.

Expected Result:

Both of the voltage measurements are 10.0 ± 0.4 VDC.

Results:

- OK – The voltage measurements for both power supplies are 10.0 ± 0.4 VDC. The power supplies for the sensor are correct. Proceed to Test Step 2.
- NOT OK – The voltage measurement for one or both of the power supplies are less than 10.0 ± 0.4 VDC. The power supplies for the sensor are not correct.

  Repair: NOTE: A loss of one of the sensor power supplies will not cause this diagnostic code to be activated, however, a faulty power supply must be repaired before proceeding with this procedure.

  The loss of both of the sensor power supplies will cause this diagnostic code to be activated.

  Either the wires for the return circuit or the wires for the supply circuit have a bad connection or an open in the machine harness. Refer to the complete Electrical System Schematic for your machine. Examine all of the connectors that are in the power supply circuits. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition. Refer to the CID 1482 procedures in this manual for troubleshooting the 10 VDC power supply of the Implement ECM. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right joystick. At harness connector J1 for the joystick, place a jumper wire between the ground 1 contact J1-3 (wire A295-BK(Black)) and the signal contact J1-10 (wire U764-GY(Grey)) .

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-70 (wire A295-BK(Black)) to signal contact J2-25 (wire U764-GY(Grey)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-25 (wire U764-GY(Grey)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the sensor signal circuit and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the right joystick, use a 151-6320 Removal Tool to remove the signal wire U764-GY(Grey) and the socket at contact J1-10 from the harness connector. The machine harness connector J1 remains connected to the connector of the right joystick.

B. At the back of the joystick connector J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-10 and the ground 1 contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Measure the duty cycle of the sensor between the connector contacts of the joystick J1-3 and J1-10. Move the “thumbrocker” to all of the positions that are described at the beginning of the procedure. Compare the signal of the duty cycle at each position to the values that are described at the beginning of this procedure.

Expected Result:

The duty cycle of the position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the machine harness connector for the joystick. Proceed to Test Step 5.

- NOT OK – The duty cycle of the “blade pitch position” sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The operation of the “blade pitch position” sensor is not correct. Replace the assembly of the right joystick. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2153 FMI 03 diagnostic code is active.

Expected Result:

The CID 2153 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2153 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2153 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary shorts or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02962206

MID 082 - CID 2153 - FMI 04

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

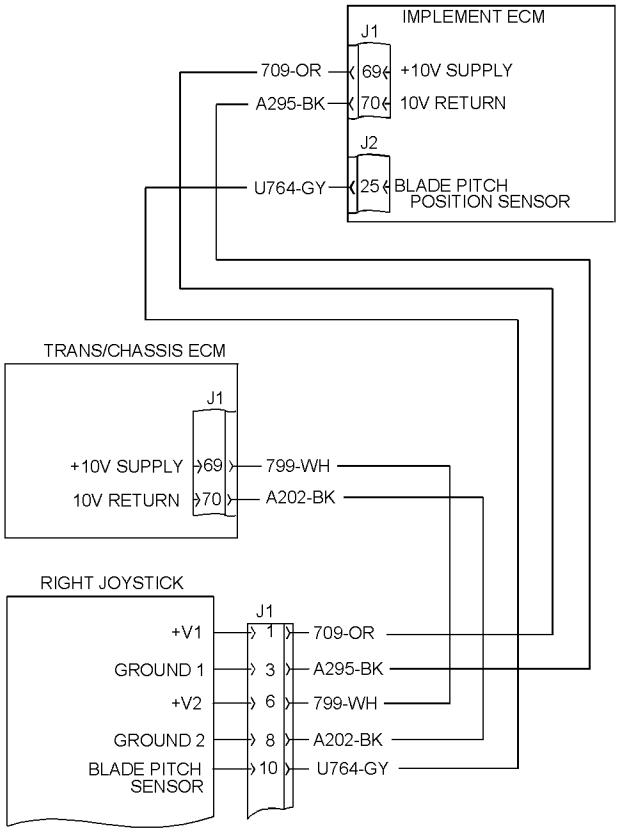


Illustration 278 g01482413

Blade Pitch Position Sensor connections

The blade pitch position sensor is located in the right joystick assembly. The sensor provides an input signal to the ECM that is dependent on the position of the thumbrocker control button that is located on the joystick handle. This diagnostic code is recorded when the ECM detects that the input signal voltage from the blade pitch position sensor is below normal.

The blade pitch position sensor receives power from the Transmission/Chassis ECM 10 volt power supply and the Implement ECM 10 volt power supply. The blade pitch position sensor is connected to ground at the Implement ECM 10 volt sensor return (ECM ground) and the Implement ECM 10 volt sensor return (ECM ground). The blade pitch position sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the blade right lift lever position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the thumbrocker is at the full lower position to approximately 90% when the thumbrocker is at the full upper position. When the thumbrocker is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the right joystick. Observe the status of the active CID 2153 FMI 04 diagnostic code.

Expected Result:

The status of the CID 2153 FMI 04 diagnostic code did not change when the connector for the joystick was disconnected. A CID 2153 FMI 03 diagnostic code has NOT been activated the ECM. The CID 2153 FMI 04 diagnostic code remains active when the joystick connector is disconnected.

Results:

- YES – The CID 2153 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected. The sensor is not causing the problem. Proceed to Test Step 2.
- NO – The CID 2153 FMI 04 diagnostic code is no longer active when the connector of the joystick is disconnected. A CID 2153 FMI 03 diagnostic code has been activated by the ECM when the connector of the joystick is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the position sensor for the blade pitch is not correct. Replace the assembly of the right joystick. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector for the joystick J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J2 for the ECM, measure the resistance from contact J2-25 (wire U764-GY(Grey)) to frame ground and measure the resistance to all of the other contacts that are used in the machine harness connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is NOT correct. The machine harness has failed.

  Repair: There is a short in the machine harness. The short is between the signal circuit and either frame ground or the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  There is a short in the machine harness between the signal circuit and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2153 FMI 04 diagnostic code is active.

Expected Result:

The CID 2153 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2153 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2153 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02962180

MID 082 - CID 2153 - FMI 08

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

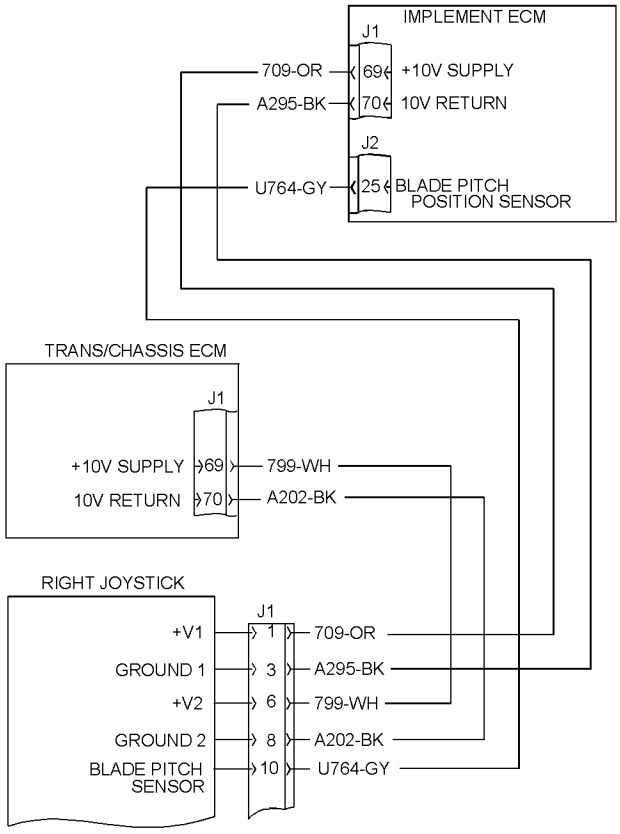


Illustration 279 g01482413

Connections of “Blade Pitch” position sensor

The position sensor for the “blade pitch” is located in the assembly of the right joystick. The sensor provides an input signal to the ECM that is dependent on the position of the thumbrocker control button that is located on the joystick handle. The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range.

The “blade pitch” position sensor receives power from the 10 volt power supply of the Transmission/ Chassis ECM and the 10 volt power supply of the Implement ECM. The position sensor for the “blade pitch” is connected to ground at the 10 volt sensor return of the Implement ECM (ECM ground) and the 10 volt sensor return of the Implement ECM (ECM ground). The “blade pitch” position sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the blade right lift lever position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the thumbrocker is at the full lower position to approximately 90% when the thumbrocker is at the full upper position. When the thumbrocker is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Points to Consider When This Code Is Active:

Note: The correct operating temperature range for the sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2153 FMI 08 diagnostic code is active before performing this procedure.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the right joystick, use a 151-6320 Removal Tool to remove the signal wire (wire U764-GY(Grey)) and the socket at contact J1-10. The machine harness connector J1 remains connected to the right connector of the joystick.

B. At the back of the connector of the joystick J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-10 and the ground 1 contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. With the thumbrocker stationary, measure the frequency of the signal from the sensor.

E. Measure the duty cycle of the sensor at the connector contacts of the joystick J1-10 and J1-3. Move the thumbrocker to all of the positions that are described at the beginning of the procedure. Compare the duty cycle of the signal at each position to the values that are described at the beginning of this procedure.

Expected Result:

The frequency of the “blade pitch” position sensor signal is 500 ± 100 Hz. The duty cycle of the “blade pitch” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not causing the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick.Proceed to Test Step 2.

- NOT OK – The signal frequency or the duty cycle of the “blade pitch” position sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The operation of the “blade pitch” position sensor is not correct. Replace the assembly of the right joystick. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right joystick. At machine harness connectors, place a jumper wire between the ground 1 contact at J1-3 (wire A295-BK(Black)) and the signal contact at J1-10 (wire U764-GY(Grey)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-70 (wire A295-BK(Black)) to signal contact J2-25 (wire U764-GY(Grey)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit or the return circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit and the return circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated and that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2153 FMI 08.

Expected Result:

The CID 2153 FMI 08 is not active.

Results:

- OK – The CID 2153 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2153 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02955377

MID 082 - CID 2154 - FMI 03

SMCS Code: 5737-038-JI

Conditions Which Generate This Code:

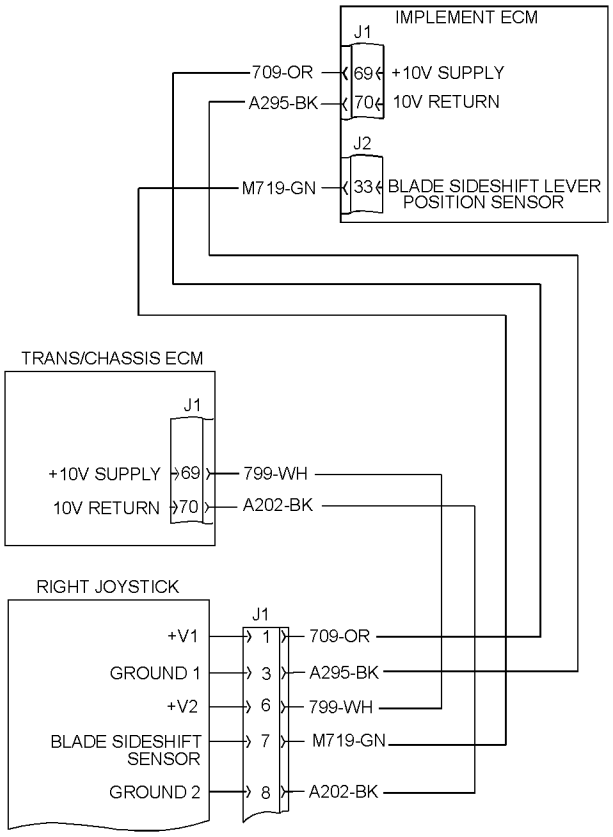


Illustration 280 g01482293

“Blade Sideshift Position” Sensor connections

The “blade sideshift position” sensor is located in the assembly of the right joystick. The sensor provides an input signal to the ECM that is dependent on the position of the joystick handle. The diagnostic code is recorded if the Implement ECM detects that the voltage of the input signal from the “blade sideshift position” sensor is above normal.

The “blade sideshift position” sensor receives power from the 10 volt power supply of the Transmission/ Chassis ECM and the 10 volt power supply of the Implement ECM. The blade sideshift position sensor is connected to ground at the 10 volt sensor return of the Implement ECM (ECM ground) and the 10 volt sensor return of the Transmission/Chassis ECM (ECM ground). The “blade sideshift position” sensor must lose both of the power supplies or both of the grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10%, when the joystick is at the full left position, to approximately 90%, when the joystick is at the full right position. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- Both of the power supply circuits of the sensor are open.
- Both of the return circuits of the sensor are open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the 10 volt sensor power supply of the Implement ECM or the 10 volt power supply of the Transmission/Chassis ECM. Correct any problem with either 10 volt power supply before performing this procedure.

Points to Consider When This Code Is Active:

Note: The correct operating temperature range for the position sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2154 FMI 03 diagnostic code is active before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLIES

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the machine harness connector J1 connector for the right joystick, insert 7X-1710 Multimeter Probes along the +V1 contact of the power supply J1-1 (wire 709-OR(Orange)) and along ground 1 contact J1-3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the +V1 sensor power supply.

D. At the machine harness connector J1 connector for the right joystick, insert 7X-1710 Multimeter Probes along the +V2 contact of the power supply J1-6 (wire 799-WH(White)) and along ground 2 contact J1-8 (wire A202-BK(Black)). Do not disconnect the machine harness from the J1 connector.

E. Measure the DC voltage of the +V2 sensor power supply.

Expected Result:

Both voltage measurements are 10.0 ± 0.4 VDC.

Results:

- OK – The voltage measurements for both power supplies are 10.0 ± 0.4 VDC. The power supplies for the sensor are correct. Proceed to Test Step 2.
- NOT OK – The voltage measurement for one or both of the power supplies is less than 10.0 ± 0.4 VDC. The power supplies for the sensor are not correct.

Repair: NOTE: A loss of one of the power supplies of the sensor will not cause this

diagnostic code to be activated, however, a faulty power supply must be repaired before proceeding with this procedure.

The loss of both of the sensor power supplies will cause this diagnostic code to be activated.

Either the wires of the return circuit or the wires of the supply circuit have a bad connection or an open in the machine harness. Refer to the complete Electrical System Schematic for the machine. Examine all of the connectors that are in the power supply circuits. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition. Refer to the CID 1482 diagnostic code procedures in this manual for troubleshooting the 10 VDC power supply of the Implement ECM. Repair the machine harness or replace the machine harness.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right joystick. At harness connector J1 for the joystick, place a jumper wire between the ground 1 contact J1-3 (wire A295-BK(Black)) and the signal contact J1-7 (wire M719-GN(Green)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-70 (wire A295-BK(Black)) to signal contact J2-33 (wire M719-GN(Green)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-33 (wire M719-GN(Green)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the sensor signal circuit and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replacethe machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the right joystick, use a 151-6320 Removal Tool to remove the signal wire M719-GN(Green) and the socket at contact J1-7 from the harness connector. The machine harness connector J1 remains connected to the connector of the right joystick.

B. At the back of the J1 connector of the joystick., insert 7X-1710 Multimeter Probes along the sensor signal contact J1-7 and the ground 1 contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Measure the duty cycle of the sensor between the connector contacts J1-3 and J1-7 of the joystick. Move the joystick to all of the positions that are described at the beginning of the procedure. Compare the signal of the duty cycle at each position to the values that are described at the beginning of this procedure.

Expected Result:

The duty cycle of the position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the machine harness connector for the joystick. Proceed to Test Step 5.

- NOT OK – The duty cycle of the “blade sideshift position” sensor is not correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The operation of the “blade sideshift position” sensor is not correct. Replace the assembly of the right joystick. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2154 FMI 03 diagnostic code is active.

Expected Result:

The CID 2154 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2154 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2154 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02961661

MID 082 - CID 2154 - FMI 04

SMCS Code: 5737-038-JI

Conditions Which Generate This Code:

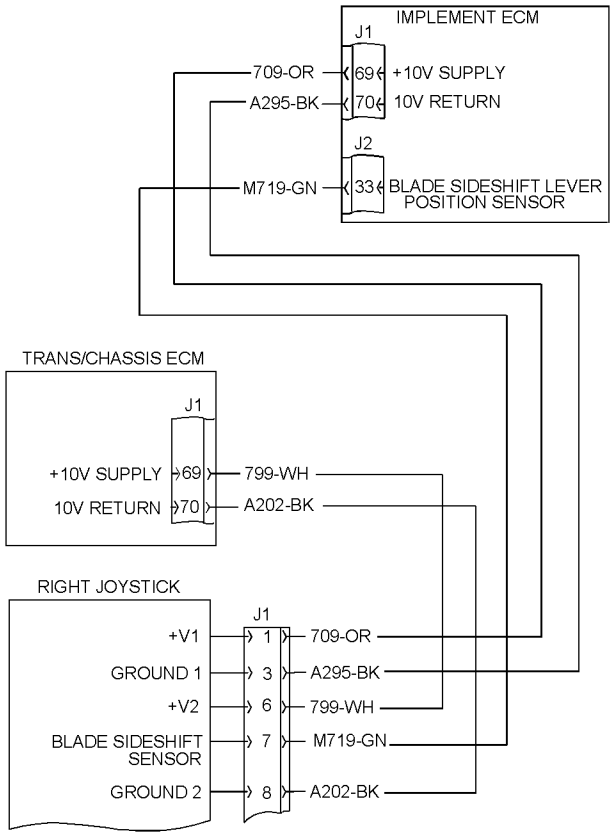


Illustration 281 g01481533

Blade Sideshift Position Sensor connections

The blade sideshift position sensor is located in the right joystick assembly. The sensor provides an input signal to the ECM that is dependant on the position of the joystick handle. This diagnostic code is recorded when the ECM detects that the input signal voltage from the blade sideshift position sensor is below normal.

The blade sideshift position sensor receives power from the Transmission Chassis ECM 10 volt power supply and the Implement ECM 10 volt power supply. The blade sideshift position sensor is connected to ground at the Implement ECM 10 volt sensor return (ECM ground) and the Implement ECM 10 volt sensor return (ECM ground). The blade sideshift position sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the joystick is at the full left position to approximately 90% when the joystick is at the full right position. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the right joystick. Observe the status of the active CID 2154 FMI 04 diagnostic code.

Expected Result:

The status of the CID 2154 FMI 04 diagnostic code did not change when the joystick connector was disconnected. A CID 2154 FMI 03 diagnostic code has NOT been activated the ECM. The CID 2154 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected.

Results:

- YES – The CID 2154 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected. The sensor is not causing the problem. Proceed to Test Step 2.
- NO – The CID 2154 FMI 04 diagnostic code is no longer active when the connector of the joystick is disconnected. A CID 2154 FMI 03 diagnostic code has been activated by the ECM when the connector of the joystick is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the position sensor for the blade sideshift is not correct. Replace the assembly of the right joystick. After replacement of the joystick assembly, verify that the operation of the new joystick assembly is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the joystick J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J2 for the ECM, measure the resistance from contact J2-33 (wire M719-GN(Green)) to frame ground and measure the resistance to all of the other contacts that are used in the machine harness connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is NOT correct. The machine harness has failed.

  Repair: There is a short in the machine harness between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2154 FMI 04 diagnostic code is active.

Expected Result:

The CID 2154 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2154 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2154 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the active diagnostic code is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02961660

MID 082 - CID 2154 - FMI 08

SMCS Code: 5737-038-JI

Conditions Which Generate This Code:

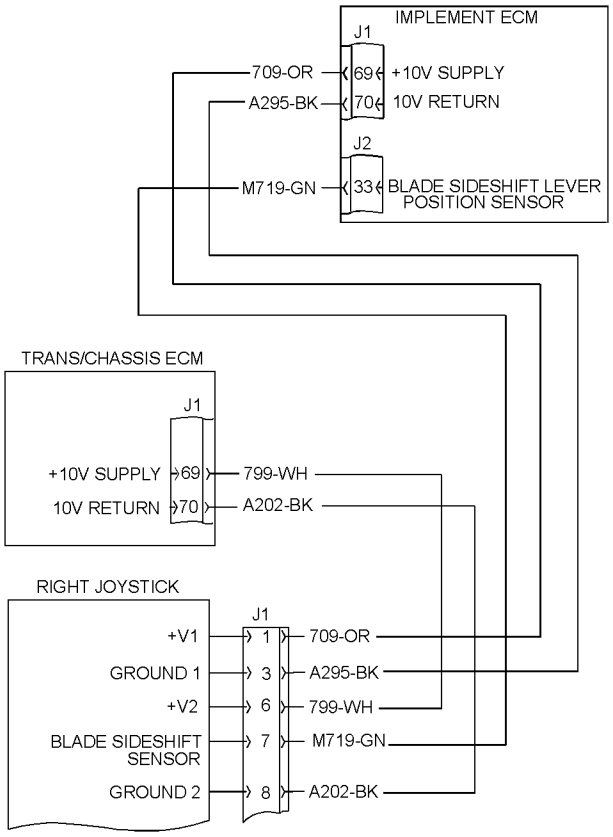


Illustration 282 g01481518

Connections of “Blade Sideshift” position sensor

The “blade sideshift” position sensor is located in the assembly of the right joystick. The sensor provides an input signal to the ECM that is dependent on the position of the joystick handle. The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range.

The “blade sideshift” position sensor receives power from the 10 volt power supply of the Transmission/ Chassis ECM and the 10 volt power supply of the Implement ECM. The “blade sideshift” position sensor is connected to ground at the 10 volt sensor return of the Implement ECM (ECM ground) and the 10 volt sensor return of the Implement ECM (ECM ground). The “blade sideshift” position sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the joystick is at the full left position to approximately 90% when the joystick is at the full right position. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Points to Consider When This Code Is Active:

Note: The correct operating temperature range for the sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2154 FMI 08 diagnostic code is active before performing this procedure.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the right joystick, use a 151-6320 Removal Tool to remove the signal wire M719-GN(Green) and the socket at contact J1-7. The machine harness connector J1 remains connected to the connector of the right joystick.

B. At the back of the connector of the joystick J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-7 and the return contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. With the thumbrocker stationary, measure the frequency of the signal from the sensor.

E. Measure the duty cycle of the sensor at the connector contacts of the joystick J1-7 and J1-3. Move the thumbrocker to all of the positions that are described at the beginning of the procedure. Compare the duty cycle of the signal at each position to the values that are described at the beginning of this procedure.

Expected Result:

The frequency of the blade sideshift position sensor signal is 500 ± 100 Hz. The duty cycle of the “blade sideshift” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not causing the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick.Proceed to Test Step 2.
- NOT OK – The signal frequency or the duty cycle of the “blade sideshift” position sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The operation of the “blade sideshift” position sensor is not correct. Replace the assembly of the right joystick. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right joystick. At machine harness connectors, place a jumper wire between the return contact of the sensor at J1-3 (wire A295-BK(Black)) and the signal contact at J1-7 (wire M719-GN(Green)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-70 (wire A295-BK(Black)) to signal contact J2-33 (wire M719-GN(Green)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit or the return circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit and the return circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2154 FMI 08.

Expected Result:

The CID 2154 FMI 08 is not active.

Results:

- OK – The CID 2154 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2154 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02955392

MID 082 - CID 2155 - FMI 03

SMCS Code: 5737-038-CDR

Conditions Which Generate This Code:

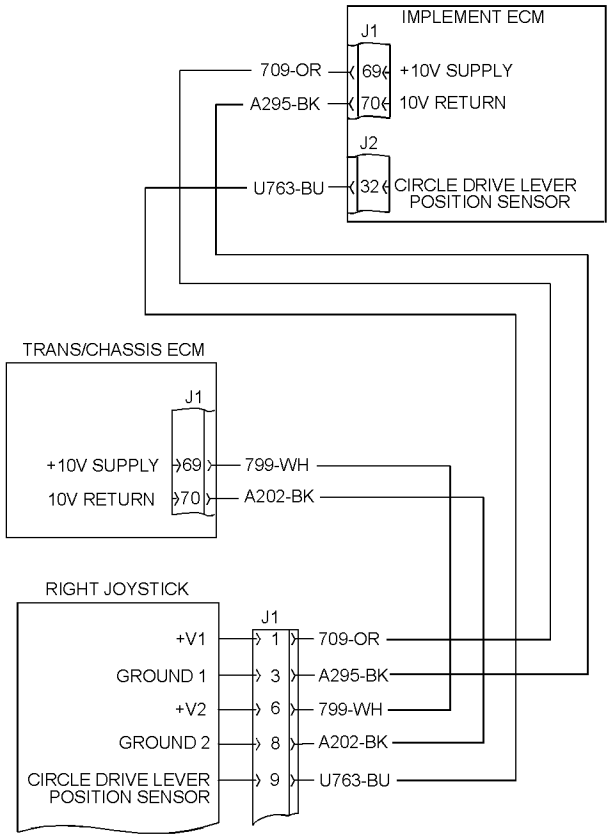


Illustration 283 g01481517

"Circle Drive Position" Sensor connections

The "blade circle drive position" sensor is located in the assembly of the right joystick. The sensor provides an input signal to the ECM that is dependent on the rotation position of the joystick handle. This diagnostic code is recorded when the ECM detects that the input signal voltage from the "blade circle drive position" sensor is above normal.

The "blade circle drive position" sensor receives power from the 10 volt power supply of the Transmission/Chassis ECM and the 10 volt power supply of the Implement ECM. The "blade circle drive position" sensor is connected to ground at the 10 volt sensor return of the Implement ECM (ECM ground) and the 10 volt sensor return of the Transmission/Chassis ECM (ECM ground). The "blade circle drive position" sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, "Features" section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the joystick is rotated to the full left position to approximately 90% when the joystick is rotated to the full right position. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- Both of the power supply circuits of the sensor are open.
- Both of the return circuits of the sensor are open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the 10 volt sensor power supply of the Implement ECM or the 10 volt power supply of the Transmission/Chassis ECM. Correct any problem with either 10 volt power supply before performing this procedure.

Points to Consider When This Code Is Active:

Note: The correct operating temperature range for the position sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the temperature of the cab in order to keep the sensor operating in the acceptable temperature range. After the temperature has been normalized, verify that the CID 2155 FMI 03 diagnostic code is active before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLIES

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the machine harness connector J1 connector for the right joystick, insert 7X-1710 Multimeter Probes along the +V1 contact of the power supply J1-1 (wire 709-OR(Orange)) and the ground 1 contact J1-3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the +V1 sensor power supply.

D. At the machine harness connector J1 connector for the right joystick, insert 7X-1710 Multimeter Probes along the +V2 contact of the power supply J1-6 (wire 799-WH(White)) and along ground 2 contact J1-8 (wire A202-BK(Black)). Do not disconnect the machine harness from the J1 connector.

E. Measure the DC voltage of the +V2 sensor power supply.

Expected Result:

Both of the voltage measurements are 10.0 ± 0.4 VDC.

Results:

- OK – The voltage measurements for both power supplies are 10.0 ± 0.4 VDC. The power supplies for the sensor are correct. Proceed to Test Step 2.
- NOT OK – The voltage measurements for one or both of the power supplies are less than 10.0 ± 0.4 VDC. The power supplies for the sensor are not correct.

  Repair: NOTE: A loss of one of the sensor power supplies will not cause this diagnostic code to be activated, however, a faulty power supply must be repaired before proceeding with this procedure.

  The loss of both of the sensor power supplies will cause this diagnostic code to be activated.

  Either of the wires of the return circuit or the wires of the supply circuit have a bad connection or an open in the machine harness. Refer to the complete Electrical System Schematic for the machine. Examine all of the connectors that are in the power supply circuits. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition. Refer to the CID 1482 procedures in this manual for troubleshooting the 10 VDC power supply of the Implement ECM. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right joystick. At harness connector J1 for the joystick, place a jumper wire between the ground 1 contact J1-3 (wire A295-BK(Black)) and the signal contact J1-9 (wire U763-BU(Blue)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-70 (wire A295-BK(Black)) to signal contact J2-32 (wire U763-BU(Blue)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all

connectors are secure and that all connectors are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-32 (wire U763-BU(Blue)) to all of the other J1 and J2 contacts that are used in the connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the sensor signal circuit and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the right joystick, use a 151-6320 Removal Tool to remove the signal wire U763-BU(Blue) and the socket at contact J1-9 from the harness connector. The machine harness connector J1 remains connected to the connector of the right joystick.

B. **At the back of the joystick connector J1**, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-9 and the return contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Measure the duty cycle of the sensor between the connector contacts J1-3 and J1-9 of the joystick. Rotate the joystick to all of the positions that are described at the beginning of the procedure. Compare the signal of the duty cycle at each position to the values that are described at the beginning of this procedure.

Expected Result:

The duty cycle of the position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the machine harness connector for the joystick. Proceed to Test Step 5.
- NOT OK – The duty cycle of the “blade circle drive position” sensor is not correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The operation of the “blade circle drive position” sensor is not correct. Replace the assembly of the right joystick. After the replacement of the assembly of the joystick, verify that the operation of the assembly of the new joystick is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2155 FMI 03 diagnostic code is active.

Expected Result:

The CID 2155 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2155 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2155 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02961632

MID 082 - CID 2155 - FMI 04

SMCS Code: 5737-038-CDR

Conditions Which Generate This Code:

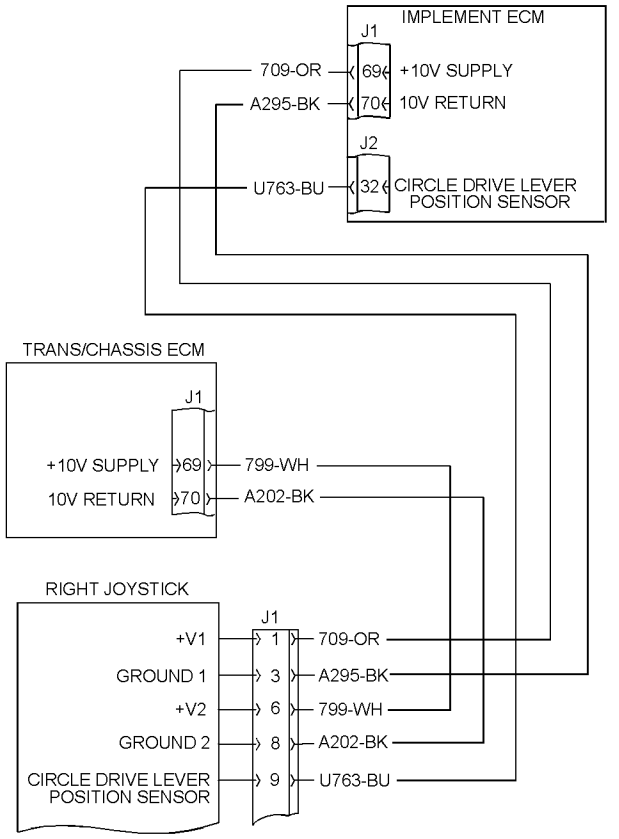


Illustration 284 g01481453

Circle Drive Position Sensor connections

The blade circle drive position sensor is located in the assembly of the right joystick. The sensor provides an input signal to the ECM that is dependent on the rotation position of the joystick handle. This diagnostic code is recorded when the ECM detects that the input signal voltage from the position sensor for the circle drive is below normal.

The blade circle drive position sensor receives power from the Transmission Chassis ECM 10 volt power supply and the Implement ECM 10 volt power supply. The blade circle drive position sensor is connected to ground at the Implement ECM 10 volt sensor return (ECM ground) and the Implement ECM 10 volt sensor return (ECM ground). The blade circle drive position sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the joystick is rotated to the full left position to approximately 90% when the joystick is rotated to the full right position. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the right joystick. Observe the status of the diagnostic code. Observe the status of the active CID 2155 FMI 04 diagnostic code.

Expected Result:

The status of the CID 2155 FMI 04 diagnostic code did not change when the connector of the joystick was disconnected. A CID 2155 FMI 03 diagnostic code has NOT been activated the ECM. The CID 2155 FMI 04 diagnostic code remains active when the joystick connector is disconnected.

Results:

- YES – The CID 2154 FMI 04 diagnostic code remains active when the connector of the joystick is disconnected. The sensor is not causing the problem. Proceed to Test Step 2.
- NO – The CID 2155 FMI 04 diagnostic code is no longer active when the connector of the joystick is disconnected. A CID 2155 FMI 03 diagnostic code has been activated by the ECM when the connector of the joystick is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the position sensor for the circle drive is not correct. Replace assembly of the right joystick. After replacement of the joystick assembly, verify that the operation of the new joystick assembly is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the joystick J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J2 for the ECM, measure the resistance from contact J2-32 (wire U763-BU(Blue)) to frame ground and measure the resistance to all of the other contacts that are used in the machine harness connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is NOT correct. The machine harness has failed.

Repair: There is a short in the machine harness between the signal circuit and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2155 FMI 04 diagnostic code is active.

Expected Result:

The CID 2155 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2155 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2155 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02961628

MID 082 - CID 2155 - FMI 08

SMCS Code: 5737-038-CDR

Conditions Which Generate This Code:

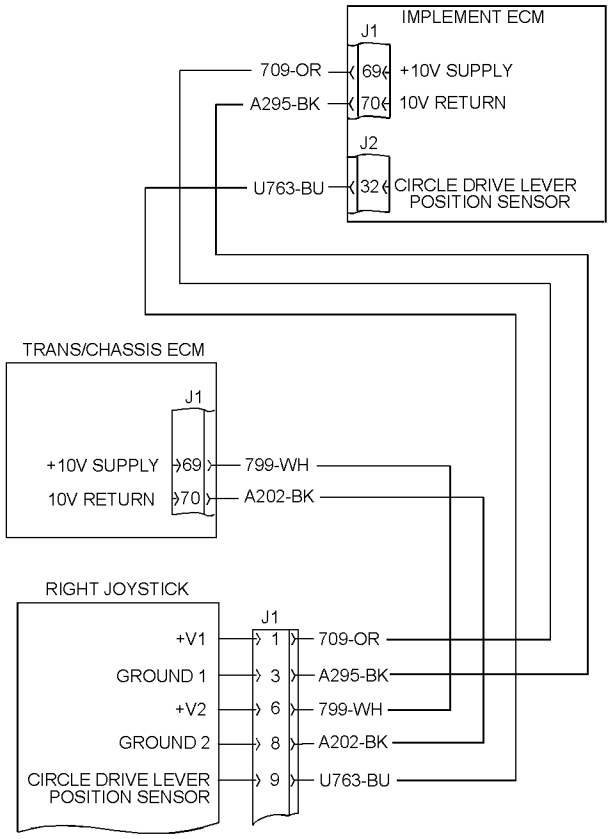


Illustration 285 g01481453

Connections of “Circle Drive” position sensor

The position sensor for the “blade circle drive” is located in the assembly of the right joystick. The sensor provides an input signal to the ECM that is dependent on the rotation position of the joystick handle. The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range.

The “blade circle drive” position sensor receives power from the 10 volt power supply of the Transmission/Chassis ECM and the 10 volt power supply of the Implement ECM. The “blade circle drive” position sensor is connected to ground at the 10 volt sensor return of the Implement ECM (ECM ground) and the 10 volt sensor return of the Transmission/Chassis ECM (ECM ground). The “blade circle drive” position sensor must lose both of the power supplies or lose both of the grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the joystick is rotated to the full left position to approximately 90% when the joystick is rotated to the full right position. When the joystick is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Points to Consider When This Code Is Active:

Note: The correct operating temperature range for the sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2155 FMI 08 diagnostic code is active before performing this procedure.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the right joystick, use a 151-6320 Removal Tool to remove the signal wire U763-BU(Blue) and the socket at contact J1-9. The machine harness connector J1 remains connected to the connector of the right joystick.

B. At the back of the joystick connector J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-9 and the ground 1 contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. With the joystick handle stationary, measure the frequency of the signal from the sensor.

E. Measure the duty cycle of the sensor at the connector contacts of the joystick J1-9 and J1-3. Rotate the joystick handle to all of the positions that are described at the beginning of the procedure. Compare the duty cycle of the signal at each position to the values that are described at the beginning of this procedure.

Expected Result:

The frequency of the “circle drive” position sensor signal is 500 ± 100 Hz. The duty cycle of the “circle drive” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick.Proceed to Test Step 2.
- NOT OK – The signal frequency or the duty cycle of the “circle drive” position sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The operation of the “circle drive” position sensor is not correct. Replace the assembly of the right joystick. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right joystick. At machine harness connectors, place a jumper wire between the ground 1 contact at J1-3 (wire A295-BK(Black)) and the signal contact at J1-9 (wire U763-BU(Blue)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-70 (wire A295-BK(Black)) to signal contact J2-32 (wire U763-BU(Blue)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit or the return circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit and the return circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2155 FMI 08.

Expected Result:

The CID 2155 FMI 08 is not active.

Results:

- OK – The CID 2155 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2155 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02955612

MID 082 - CID 2156 - FMI 03

SMCS Code: 5737-038-JI

Conditions Which Generate This Code:

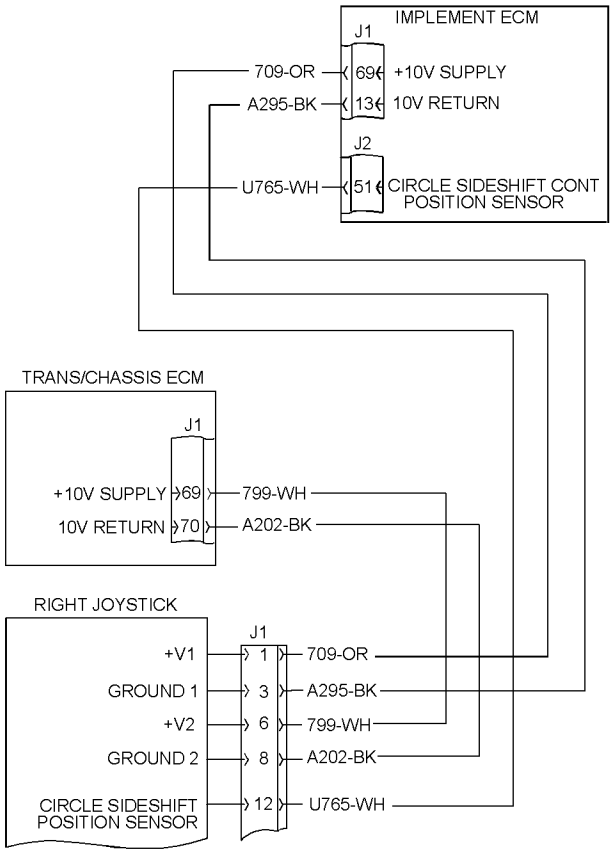


Illustration 286 g01481390

“Circle Sideshift Position” Sensor connections

The “circle sideshift position” sensor is located in the assembly of the right joystick. The sensor provides an input signal to the ECM that is dependent on the position of the “thumbrocker” control button that is located on the joystick handle. This diagnostic code is recorded when the ECM detects that the input of the signal voltage from the “circle sideshift position” sensor is above normal.

The “circle sideshift position” sensor receives power from the 10 volt power supply of the Transmission/ Chassis ECM and the 10 volt power supply of the Implement ECM. The “circle sideshift position” sensor is connected to ground at the 10 volt sensor return of the Implement ECM (ECM ground) and the 10 volt sensor return of the Transmission/Chassis ECM (ECM ground). The “circle sideshift position” sensor must lose both of the power supplies or both of the grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the “thumbrocker” switch is at the full left position to approximately 90% when the “thumbrocker” switch is at the full right position. When the “thumbrocker” switch is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Points to Consider When This Code Is Active:

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the 10 volt sensor power supply of the Implement ECM or the 10 volt power supply of the Transmission/Chassis ECM. Correct any problem with either 10 volt power supply before performing this procedure.

Note: The correct operating temperature range for the position sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2156 FMI 03 diagnostic code is active before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLIES

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the machine harness connector J1 connector for the right joystick, insert 7X-1710 Multimeter Probes along the +V1 contact of the power supply J1-1 (wire 709-OR(Orange)) and along ground 1 contact J1-3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the +V1 sensor power supply.

D. At the machine harness connector J1 connector for the right joystick, insert 7X-1710 Multimeter Probes along the +V2 contact of the power supply J1-6 (wire 799-WH(White)) and along ground 2 contact J1-8 (wire A202-BK(Black)). Do not disconnect the machine harness from the J1 connector.

E. Measure the DC voltage of the +V2 sensor power supply.

Expected Result:

Both of the voltage measurements are 10.0 ± 0.4 VDC.

Results:

- OK – The voltage measurements for both power supplies are 10.0 ± 0.4 VDC. The power supplies for the sensor are correct. Proceed to Test Step 2.
- NOT OK – The voltage measurements for one or both of the power supplies are less than 10.0 ± 0.4 VDC. The power supplies for the sensor are not correct.

Repair: NOTE: A loss of one of the sensor power supplies will not cause this diagnostic code to be activated, however, a faulty power supply must be repaired before proceeding with this procedure.

The loss of both of the sensor power supplies will cause this diagnostic code to be activated.

Either the wires of the return circuit or the wires of the supply circuit have a bad connection or an open in the machine harness. Refer to the complete Electrical System Schematic for your machine. Examine all of the connectors that are in the power supply circuits. Ensure that the connections are clean, that the connections are secure and that the connections are in good condition. Refer to the CID 1482 procedures in this manual for troubleshooting the 10 VDC power supply of the Implement ECM. Repair the machine harness or replace the machine harness.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right joystick. At harness connector J1 for the joystick, place a jumper wire between the ground 1 contact J1-3 (wire A295-BK(Black)) and the signal contact J1-12 (wire U765-WH(White)) .

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-70 (wire A295-BK(Black)) to signal contact J2-51 (wire U765-WH(White)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-51 (wire U765-WH(White)) to all of the other J1 and J2 contacts that are used in the connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the sensor signal circuit and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the right joystick, use a 151-6320 Removal Tool to remove the signal wire U765-WH(White) and the socket at contact J1-12 from the harness connector. The machine harness connector J1 remains connected to the connector of the right joystick.

B. At the back of the joystick connector J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-12 and the ground 1 contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Measure the duty cycle of the sensor between the connector contacts of the joystick J1-3 and J1-12. Move the “thumbrocker” to all of the positions that are described at the beginning of the procedure. Compare the signal of the duty cycle at each position to the values that are described at the beginning of this procedure.

Expected Result:

The duty cycle of the position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the machine harness connector for the joystick. Proceed to Test Step 5.

- NOT OK – The duty cycle of the “circle sideshift position” sensor is not correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The operation of the “circle sideshift position” sensor is not correct. Replace the assembly of the right joystick. After replacement of the assembly of the joystick, verify that the operation of the new assembly of the joystick is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2156 FMI 03 diagnostic code is active.

Expected Result:

The CID 2156 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2156 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2156 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02961624

MID 082 - CID 2156 - FMI 04

SMCS Code: 5737-038-JI

Conditions Which Generate This Code:

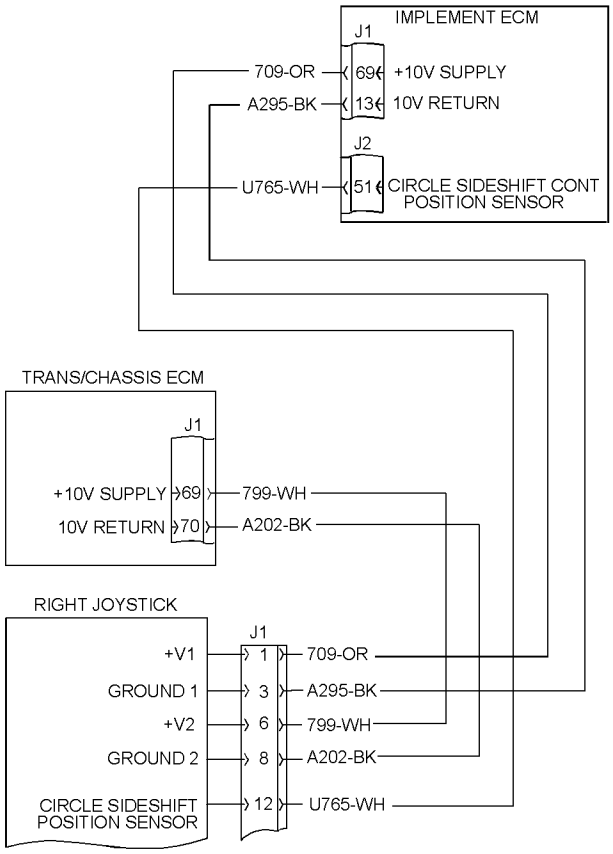


Illustration 287 g01481393

Circle Sideshift Position Sensor connections

The circle sideshift position sensor is located in the right joystick assembly. The sensor provides an input signal to the ECM that is dependant on the position of the thumbrocker control button that is located on the joystick handle. This diagnostic code is recorded when the ECM detects that the input signal voltage from the circle sideshift position sensor is below normal.

The circle sideshift position sensor receives power from the Transmission Chassis ECM 10 volt power supply and the Implement ECM 10 volt power supply. The circle sideshift position sensor is connected to ground at the Implement ECM 10 volt sensor return (ECM ground) and the Implement ECM 10 volt sensor return (ECM ground). The circle sideshift position sensor would have to lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the thumbrocker is at the full left position to approximately 90% when the thumbrocker is at the full right position. When the thumbrocker is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the right joystick. Observe the status of the diagnostic code. Observe the status of the active CID 2156 FMI 04 diagnostic code.

Expected Result:

The status of the CID 2156 FMI 04 diagnostic code did not change when the joystick connector was disconnected. A CID 2156 FMI 03 diagnostic code has NOT been activated the ECM. The CID 2156 FMI 04 diagnostic code remains active when the joystick connector is disconnected.

Results:

- YES – The CID 2156 FMI 04 diagnostic code remains active when the joystick connector is disconnected. The sensor is not causing the problem. Proceed to Test Step 2.
- NO – The CID 2156 FMI 04 diagnostic code is no longer active when the joystick connector is disconnected. A CID 2156 FMI 03 diagnostic code has been activated by the ECM when the joystick connector is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The circle sideshift position sensor operation is not correct. Replace the right joystick assembly. After replacement of the joystick assembly, verify that the operation of the new joystick assembly is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The joystick connector J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J2 for the ECM, measure the resistance from contact J2-51 (wire U765-WH(White)) to frame ground and measure the resistance to all of the other contacts that are used in the machine harness connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is NOT correct. The machine harness has failed.

  Repair: There is a short in the machine harness between the signal circuit and the circuit with the low resistance measurement. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2156 FMI 04 diagnostic code is active.

Expected Result:

The CID 2156 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2156 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2156 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the active diagnostic code is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02961625

MID 082 - CID 2156 - FMI 08

SMCS Code: 5737-038-JI

Conditions Which Generate This Code:

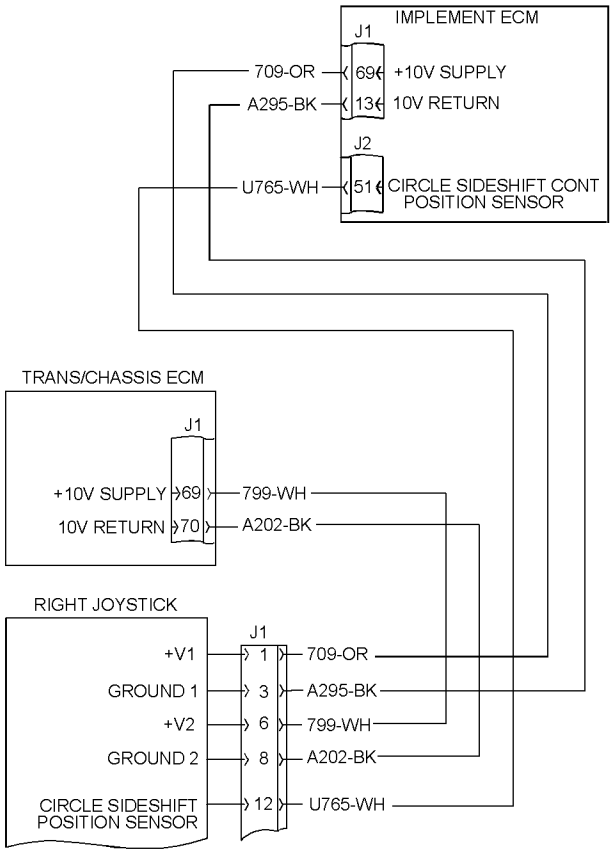


Illustration 288 g01481413

Connections of “Circle Sideshift” position sensor

The “circle sideshift” position sensor is located in the assembly of the right joystick. The sensor provides an input signal to the ECM that is dependent on the position of the thumbrocker control button that is located on the joystick handle. The FMI “08” means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range.

The “circle sideshift” position sensor receives power from the 10 volt power supply of the Transmission/ Chassis ECM and the 10 volt power supply of the Implement ECM. The “circle sideshift” position sensor is connected to ground at the 10 volt sensor return of the Implement ECM (ECM ground) and the 10 volt sensor return of the Transmission/Chassis ECM (ECM ground). The “circle sideshift” position sensor must lose both power supplies or both grounds in order to lose power. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right joystick, refer to the Systems Operation, “Features” section of this manual.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 hertz. The position sensor sends a PWM input signal to the ECM. The duty cycle of the signal will vary from approximately 10% when the thumbrocker is at the full left position to approximately 90% when the thumbrocker is at the full right position. When the thumbrocker is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Points to Consider When This Code Is Active:

Note: The correct operating temperature range for the sensor is −40 °C (−40.0 °F) to 75 °C (167.0 °F). If an FMI 03 or an FMI 08 diagnostic code becomes active for a sensor when the cab environment is at extreme temperatures, normalize the cab environment in order to keep the sensor operating in the acceptable temperature range. After temperature normalization, verify that the CID 2156 FMI 08 diagnostic code is active before performing this procedure.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the right joystick, use a 151-6320 Removal Tool to remove the signal wire (wire U765-WH(White)) and the socket at contact J1-12. The machine harness connector J1 remains connected to the connector of the right joystick.

B. At the back of the connector of the joystick J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-12 and the ground 1 contact at J1-3.

C. Turn the disconnect switch and the key start switch to the ON position.

D. With the thumbrocker stationary, measure the frequency of the signal from the sensor.

E. Measure the duty cycle of the sensor at the connector contacts of the joystick J1-12 and J1-3. Move the thumbrocker to all of the positions that are described at the beginning of the procedure. Compare the duty cycle of the signal at each position to the values that are described at the beginning of this procedure.

Expected Result:

The frequency of the “blade pitch” position sensor is 500 ± 100 Hz. The duty cycle of the “blade pitch” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the joystick.Proceed to Test Step 2.
- NOT OK – The signal frequency or the duty cycle of the “circle sideshift” position sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The operation of the “circle sideshift” position sensor is not correct. Replace the assembly of the right joystick . After replacement of the assembly of the joystick , verify that the operation of the new assembly of the joystick is correct before operating the machine.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right joystick. At the machine harness connector, place a jumper wire between the ground 1 contact at J1-3 (wire A295-BK(Black)) and the signal contact at J1-12 (wire U765-WH(White)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-70 (wire A295-BK(Black)) to signal contact J2-51 (wire U765-WH(White)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit or the return circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit and the return circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2156 FMI 08.

Expected Result:

The CID 2156 FMI 08 is not active.

Results:

- OK – The CID 2156 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2156 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02509235

MID 082 - CID 2160 - FMI 03

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

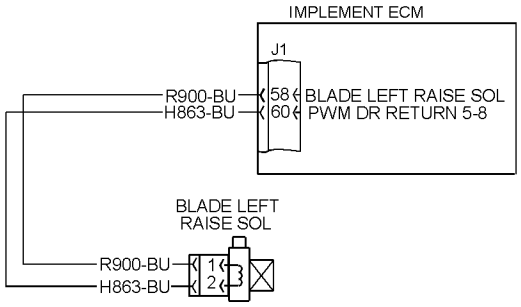


Illustration 289 g01256153

Blade Left Raise Solenoid connections

This diagnostic code is associated with the blade left raise solenoid. The FMI 03 means that the ECM has determined that the voltage of the solenoid circuit is above normal.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Some possible causes of the diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected. **Verify that the CID 2160 FMI 03 diagnostic code is active before performing this procedure.**

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-58 (wire R900-BU(Blue)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire R900-BU(Blue) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire R900-BU(Blue) and socket at contact J1-58 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2160 FMI 03 diagnostic code.

Expected Result:

The CID 2160 FMI 03 diagnostic code is no longer active. A CID 2160 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2160 FMI 03 diagnostic code is no longer active. A CID 2160 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2160 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2160 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2160 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2160 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2160 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986935

MID 082 - CID 2160 - FMI 05

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

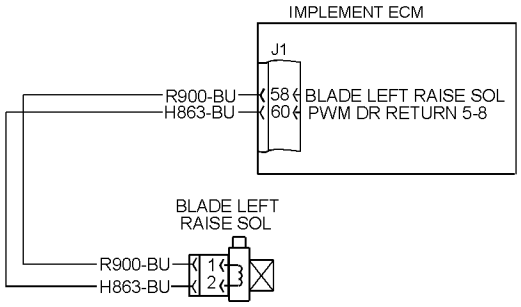


Illustration 290 g01256153

Connections of “Blade Left Raise” solenoid

This diagnostic code is associated with the “blade left raise” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM signal (output) in order to provide proportional control of the solenoid.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected. **Verify that the CID 2160 FMI 05 diagnostic code is active before performing this procedure.**

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections in the circuit are secure and that all connections in the circuit are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire R900-BU(Blue)) to contact 2 (wire H863-BU(Blue)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2160 FMI 05 diagnostic code.

Expected Result:

The diagnostic code changes from a FMI “05” to a FMI “06” diagnostic code as the jumper wire is installed.

Results:

- YES – The diagnostic code changes from a FMI “05” diagnostic code to a FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2160 FMI 05 diagnostic code remains active. The jumper wire does not affect the diagnostic code. The solenoid is correct. Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from contact J1-58 (wire R900-BU(Blue)) to contact J1-60 (wire H863-BU(Blue)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible bad connection is in the supply wire R900-BU(Blue) or in the return wire H863-BU(Blue) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections in the circuit are secure and that all connections in the circuit are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid R900-BU(Blue) from the harness connector and the socket at contact J1-58 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-58 through the empty space in the J1 connector.

F. Observe the status of the active CID 2160 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2160 FMI 05 diagnostic code is no longer active. A CID 2160 FMI 06 diagnostic code becomes active when the ECM pin at J1-58 is grounded.

Results:

- YES – The CID 2160 FMI 05 diagnostic code is no longer active. A CID 2160 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2160 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2160 FMI 05 diagnostic code.

Expected Result:

The CID 2160 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2160 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine . The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2160 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02509594

MID 082 - CID 2160 - FMI 06

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

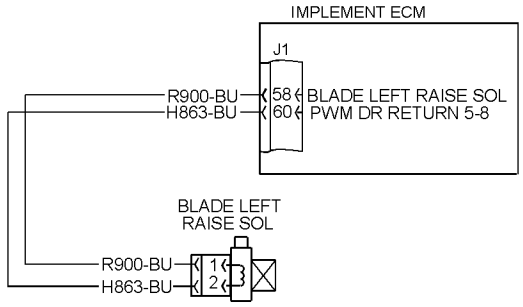


Illustration 291 g01256153

Blade Left Raise Solenoid connections

This diagnostic code is associated with the blade left raise solenoid. The FMI 06 means that the ECM has determined that the current for the solenoid is above normal.

The ECM uses a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected. **Verify that the CID 2160 FMI 06 diagnostic code is active before performing this procedure.**

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The CID 2160 FMI 06 changes to CID 2160 FMI 05 when the solenoid is disconnected.

Results:

- YES – CID 2160 FMI 06 changes to CID 2160 FMI 05 when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – CID 2160 FMI 06 remains active.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-58 (wire R900-BU(Blue)) to frame ground. Measure the resistance from the signal contact J1-58 (wire R900-BU(Blue)) to all of the other contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire R900-BU(Blue) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2160 FMI 06 diagnostic code.

Expected Result:

The CID 2160 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2160 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may be faulty.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2160 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02509642

MID 082 - CID 2160 - FMI 13

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

This diagnostic code is associated with the blade left raise solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Note: Before performing this procedure, verify that no other active CID 2160 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may be faulty.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02509756

MID 082 - CID 2161 - FMI 03

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

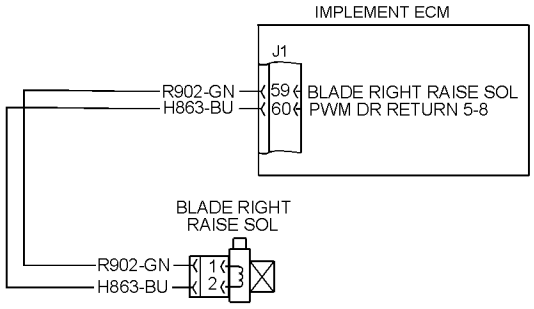


Illustration 292 g01256400

Blade Right Raise Solenoid connections

This diagnostic code is associated with the blade right raise solenoid. The FMI 03 means that the ECM has determined that the voltage of the solenoid circuit is above normal.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Some possible causes of the diagnostic code are listed:

- The energize circuit of the solenoid is shorted to shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-59 (wire R902-GN(Green)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire R902-GN(Green) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire R902-GN(Green) and socket at contact J1-59 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2161 FMI 03 diagnostic code.

Expected Result:

The CID 2161 FMI 03 diagnostic code is no longer active. A CID 2161 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2161 FMI 03 diagnostic code is no longer active. A CID 2161 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2161 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2161 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2161 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2161 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2161 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986926

MID 082 - CID 2161 - FMI 05

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

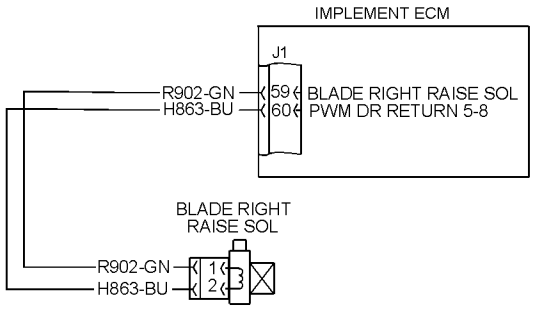


Illustration 293 g01256400

Connections of “Blade Right Raise” solenoid

This diagnostic code is associated with the “blade right raise” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM signal (output) in order to provide proportional control of the solenoid.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections in the circuit are secure and that all connections in the circuit are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected. **Verify that the CID 2161 FMI 05 diagnostic code is active before performing this procedure.**

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire R902-GN(Green)) to contact 2 (wire H863-BU(Blue)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2161 FMI 05 diagnostic code.

Expected Result:

The diagnostic code changes from a FMI “05” diagnostic code to a FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The diagnostic code changes from a FMI “05” diagnostic code to a FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2161 FMI 05 diagnostic code remains active. The jumper wire does not affect the diagnostic code. The solenoid is correct. Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from contact J1-59 (wire R902-GN(Green)) to contact J1-60 (wire H863-BU(Blue)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible bad connection is in supply wire R902-GN(Green) or in the return wire H863-BU(Blue) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid R902-GN(Green) and the socket at contact J1-59 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-59 through the empty space in the J1 connector.

F. Observe the status of the active CID 2161 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2161 FMI 05 diagnostic code is no longer active. A CID 2161 FMI 06 diagnostic code becomes active when the ECM pin at J1-59 is grounded.

Results:

- YES – The CID 2161 FMI 05 diagnostic code is no longer active. A CID 2161 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2161 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2161 FMI 05 diagnostic code.

Expected Result:

The CID 2161 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2161 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2161 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02510035

MID 082 - CID 2161 - FMI 06

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

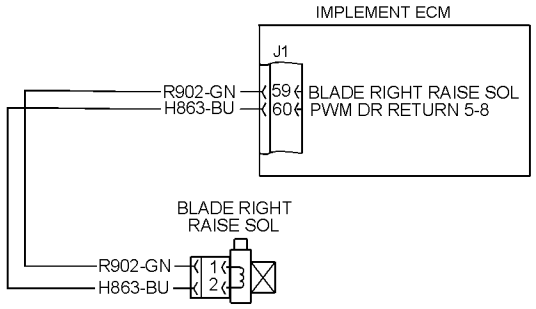


Illustration 294 g01256400

Blade Right Raise Solenoid connections

This diagnostic code is associated with the blade right raise solenoid. The FMI 06 means that the ECM has determined that the current for the solenoid is above normal.

The ECM uses a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected. **Verify that the CID 2161 FMI 06 diagnostic code is active before performing this procedure.**

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The CID 2161 FMI 06 changes to CID 2161 FMI 05 when the solenoid is disconnected.

Results:

- YES – CID 2161 FMI 06 changes to CID 2161 FMI 05 when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – CID 2161 FMI 06 remains active.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-59 (wire R902-GN(Green)) to frame ground. Measure the resistance from the signal contact J1-59 (wire R902-GN(Green)) to all of the other contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire R902-GN(Green) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2161 FMI 06 diagnostic code.

Expected Result:

The CID 2161 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2161 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may be faulty.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2161 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02510042

MID 082 - CID 2161 - FMI 13

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

This diagnostic code is associated with the blade right raise solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Note: Before performing this procedure, verify that no other active CID 2161 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may be faulty.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02509672

MID 082 - CID 2162 - FMI 03

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

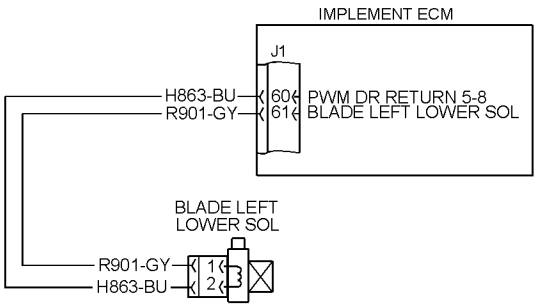


Illustration 295 g01256388

Blade Left Lower Solenoid connections

This diagnostic code is associated with the blade left lower solenoid. The FMI 03 means that the ECM has determined that the voltage of the solenoid circuit is above normal.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Some possible causes of the diagnostic code are listed:

- The energize circuit of the solenoid is shorted to the +battery circuit.
- The ECM has failed. This is unlikely.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected. **Ensure that the CID 2162 FMI 03 diagnostic code is active before performing this procedure.**

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-61 (wire R901-GY(Grey)) to all J1 and J2 contacts that are used on the Master ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire R901-GY(Grey) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire R901-GY(Grey) and socket at contact J1-61 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2162 FMI 03 diagnostic code.

Expected Result:

The CID 2162 FMI 03 diagnostic code is no longer active. A CID 2162 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2162 FMI 03 diagnostic code is no longer active. A CID 2162 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2162 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the contacts of the harness connectors that are used in the solenoid circuit. Ensure that the contacts are secure. Clean all of the contacts in the harness connectors.

B. Reconnect all harness connectors.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 2162 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2162 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2162 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2162 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986916

MID 082 - CID 2162 - FMI 05

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

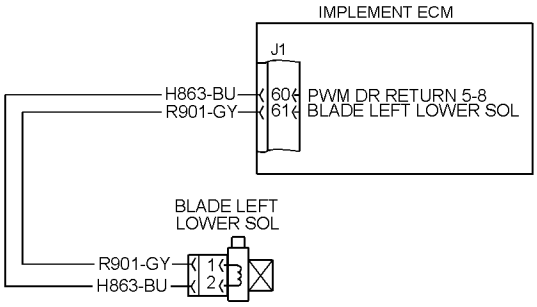


Illustration 296 g01256388

Connections of “Blade Left Lower” solenoid

This diagnostic code is associated with the “blade left lower” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM signal (output) in order to provide proportional control of the solenoid.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected. **Verify that the CID 2162 FMI 05 diagnostic code is active before performing this procedure.**

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire R901-GY(Grey)) to contact 2 (wire H863-BU(Blue)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2162 FMI 05 diagnostic code.

Expected Result:

The diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code as the jumper wire is installed.

Results:

- YES – The diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2162 FMI 05 diagnostic code remains active. The jumper wire does not affect the diagnostic code. The solenoid is correct. Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from contact J1-61 (wire R901-GY(Grey)) to contact J1-60 (wire H863-BU(Blue)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible bad connection is in the supply wire R901-GY(Grey) or in the return wire H863-BU(Blue) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the harness connector of the machine J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid R901-GY(Grey) and the socket at contact J1-61 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-61 through the empty space in the J1 connector.

F. Observe the status of the active CID 2162 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2162 FMI 05 diagnostic code is no longer active. A CID 2162 FMI 06 diagnostic code becomes active when the ECM pin at J1-61 is grounded.

Results:

- YES – The CID 2162 FMI 05 diagnostic code is no longer active. A CID 2162 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2162 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with “Caterpillar” . This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2162 FMI 05 diagnostic code.

Expected Result:

The CID 2162 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2162 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2162 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02509749

MID 082 - CID 2162 - FMI 06

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

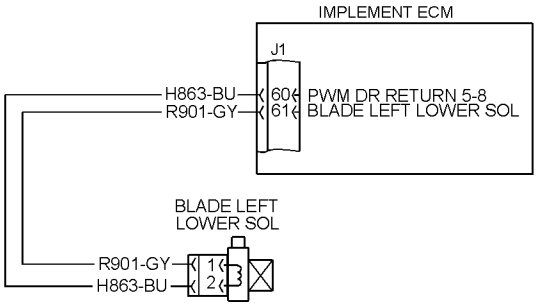


Illustration 297 g01256388

Blade Left Lower Solenoid connections

This diagnostic code is associated with the blade left lower solenoid. The FMI 06 means that the ECM has determined that the current for the solenoid is above normal.

The ECM uses a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected. **Verify that the CID 2162 FMI 06 diagnostic code is active before performing this procedure.**

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The CID 2162 FMI 06 changes to CID 2162 FMI 05 when the solenoid is disconnected.

Results:

- YES – CID 2162 FMI 06 changes to CID 2162 FMI 05 when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – CID 2162 FMI 06 remains active.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-61 (wire R901-GY(Grey)) to frame ground. Measure the resistance from the signal contact J1-61 (wire R901-GY(Grey) to all of the other contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire R901-GY(Grey) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2162 FMI 06 diagnostic code.

Expected Result:

The CID 2162 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2162 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may be faulty.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2162 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02509752

MID 082 - CID 2162 - FMI 13

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

This diagnostic code is associated with the blade left lower solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Note: Before performing this procedure, verify that no other active CID 2162 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure. **Ensure that the CID 2162 FMI 13 diagnostic code is active before performing this procedure.**

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may be faulty.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02510264

MID 082 - CID 2163 - FMI 03

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

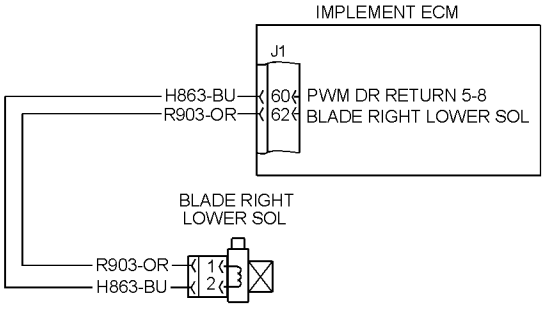


Illustration 298 g01256673

Blade Right Lower Solenoid connections

This diagnostic code is associated with the blade right lower solenoid. The FMI 03 means that the ECM has determined that the voltage of the solenoid circuit is above normal.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected. **Ensure that the CID 2163 FMI 03 diagnostic code is active before performing this procedure.**

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-62 (wire R903-OR(Orange)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire R903-OR(Orange) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire R903-OR(Orange) and socket at contact J1-62 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2163 FMI 03 diagnostic code.

Expected Result:

The CID 2163 FMI 03 diagnostic code is no longer active. A CID 2163 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2163 FMI 03 diagnostic code is no longer active. A CID 2163 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2163 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2163 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2163 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2163 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, replace the solenoid. After the solenoid is replaced, verify that the problem has been corrected. If the diagnostic code is still active, the ECM may have failed.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2163 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986898

MID 082 - CID 2163 - FMI 05

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

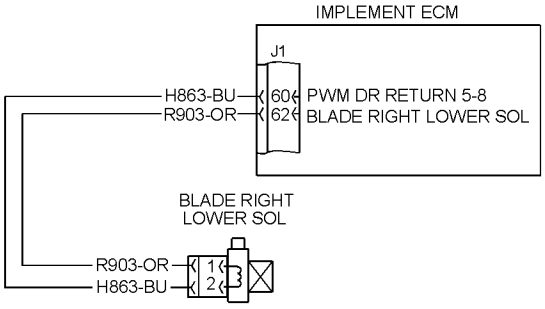


Illustration 299 g01256673

Connections of “Blade Right Lower” solenoid

This diagnostic code is associated with the “blade right lower” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The ECM provides a PWM signal (output) in order to control the solenoid. The ECM will vary the electrical current of the PWM signal in order to provide proportional control of the solenoid.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire R903-OR(Orange)) to contact 2 (wire H863-GY(Grey)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2163 FMI 05 diagnostic code.

Expected Result:

The diagnostic code changes from a FMI “05” diagnostic code to a FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The diagnostic code changes from a FMI “05” diagnostic code to a FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2163 FMI 05 diagnostic code remains active. The jumper wire does not affect the diagnostic code. The solenoid is correct. Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from contact J1-62 (wire R903-OR(Orange)) to contact J1-60 (wire H863-BU(Blue)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible bad connection is in the supply wire R903-OR(Orange) of the machine harness or in the return wire H863-BU(Blue) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid R903-OR(Orange) and the socket at contact J1-62 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-62 through the empty space in the J1 connector.

F. Observe the status of the active CID 2163 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2163 FMI 05 diagnostic code is no longer active. A CID 2163 FMI 06 diagnostic code becomes active when the ECM pin at J1-62 is grounded.

Results:

- YES – The CID 2163 FMI 05 diagnostic code is no longer active. A CID 2163 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2163 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2163 FMI 05 diagnostic code.

Expected Result:

The CID 2163 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2163 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2163 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02510328

MID 082 - CID 2163 - FMI 06

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

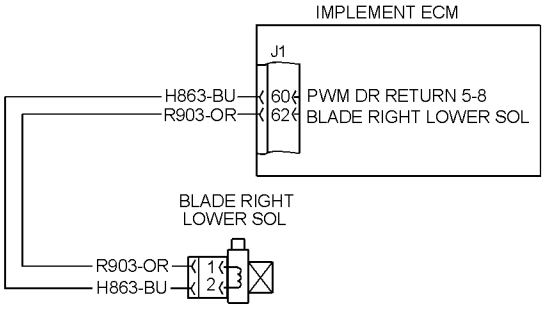


Illustration 300 g01256673

Blade Right Lower Solenoid connections

This diagnostic code is associated with the blade right lower solenoid. The FMI 06 means that the ECM has determined that the current for the solenoid is above normal.

The ECM uses a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2163 FMI 06 diagnostic code changes to CID 2163 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2163 FMI 06 diagnostic code changes to a CID 2163 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2163 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-62 (wire R903-OR(Orange)) to frame ground. Measure the resistance from the signal contact J1-62 (wire R903-OR(Orange) to all of the other contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire R903-OR(Orange) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2163 FMI 06 diagnostic code.

Expected Result:

The CID 2163 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2163 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2163 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02510410

MID 082 - CID 2163 - FMI 13

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

This diagnostic code is associated with the blade right lower solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The ECM provides a PWM signal in order to control the solenoid. The ECM will vary the electrical current of the PWM output signal in order to provide proportional control of the solenoid.

Note: Before performing this procedure, verify that no other active CID 2163 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure. **Ensure that the CID 2163 FMI 13 diagnostic code is active before performing this procedure.**

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may be faulty.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02536203

MID 082 - CID 2165 - FMI 03

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

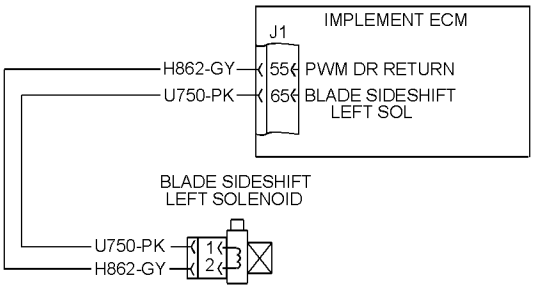


Illustration 301 g01269197

Blade Sideshift Left Solenoid connections

This diagnostic code is associated with the blade sideshift left solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade sideshift position sensor that is located in the right joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-65 (wire U750-PK(Pink)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the

machine harness. The short is between wire U750-PK(Pink) and the circuit that has a low resistance measurement.

Repair: Repair the machine harness or replace the machine harness.

STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U750-PK(Pink) and socket at contact J1-65 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2165 FMI 03 diagnostic code.

Expected Result:

The CID 2165 FMI 03 diagnostic code is no longer active. A CID 2165 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2165 FMI 03 diagnostic code is no longer active. A CID 2165 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2165 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2165 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2165 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2165 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2165 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986861

MID 082 - CID 2165 - FMI 05

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

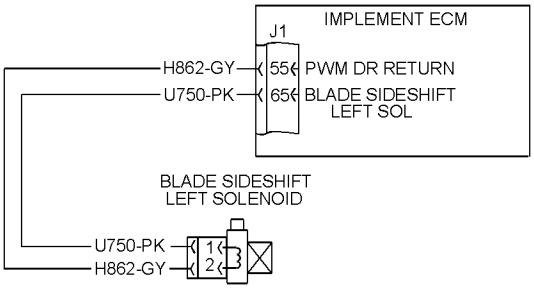


Illustration 302 g01269197

Connections of “Blade Sideshift Left” solenoid

This diagnostic code is associated with the “blade sideshift left” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The Implement ECM provides a PWM signal (output) to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the “blade sideshift” position sensor that is located in the assembly of the right joystick .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U750-PK(Pink)) to contact 2 (wire H862-GY(Grey)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2165 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2165 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-55 (wire H862-GY(Grey)) to the energize contact J1-65 (wire U750-PK(Pink)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in the supply wire U750-PK(Pink) or in the return wire H862-GY(Grey) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that the connections are secure and that the connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U750-PK(Pink) and the socket at contact J1-65 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-65 through the empty space in the J1 connector.

F. Observe the status of the active CID 2165 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2165 FMI 05 diagnostic code is no longer active. A CID 2165 FMI 06 diagnostic code becomes active when the ECM pin at J1-65 is grounded.

Results:

- YES – The CID 2165 FMI 05 diagnostic code is no longer active. A CID 2165 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2165 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2165 FMI 05 diagnostic code.

Expected Result:

The CID 2165 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2165 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2165 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536239

MID 082 - CID 2165 - FMI 06

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

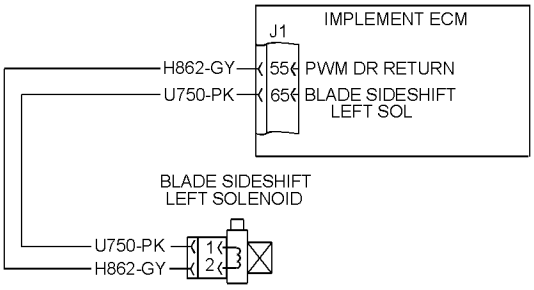


Illustration 303 g01269197

Blade Sideshift Left Solenoid connections

This diagnostic code is associated with the blade sideshift left solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade sideshift position sensor that is located in the right joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2165 FMI 06 diagnostic code changes to a CID 2165 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2165 FMI 06 diagnostic code changes to a CID 2165 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2165 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-65 (wire U750-PK(Pink)) to frame ground. Measure the resistance from the signal contact J1-65 (wire U750-PK(Pink)) to all of the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U750-PK(Pink) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2165 FMI 06 diagnostic code.

Expected Result:

The CID 2165 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2165 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2165 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536260

MID 082 - CID 2165 - FMI 13

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

This diagnostic code is associated with the blade sideshift left solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade sideshift position sensor that is located in the right joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2165 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02536453

MID 082 - CID 2166 - FMI 03

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

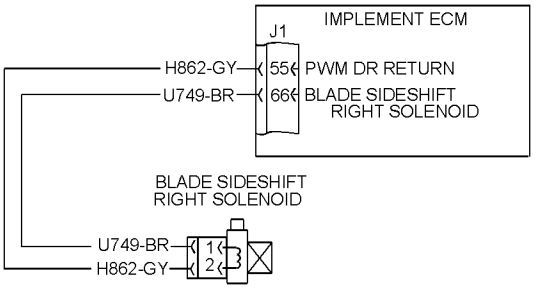


Illustration 304 g01269268

Blade Sideshift Right Solenoid connections

This diagnostic code is associated with the blade sideshift right solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade sideshift position sensor that is located in the right joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-66 (wire U749-BR(Brown)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U749-BR(Brown) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire U749-BR(Brown) and socket at contact J1-66 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2166 FMI 03 diagnostic code.

Expected Result:

The CID 2166 FMI 03 diagnostic code is no longer active. A CID 2166 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2166 FMI 03 diagnostic code is no longer active. A CID 2166 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2166 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2166 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2166 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2166 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2166 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986826

MID 082 - CID 2166 - FMI 05

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

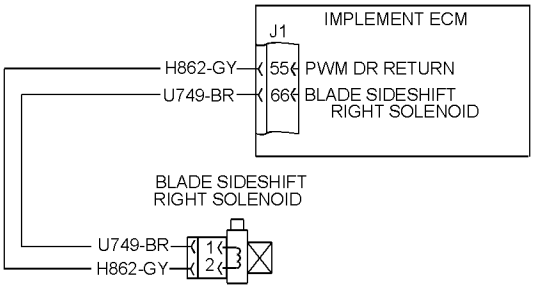


Illustration 305 g01269268

Connections of “Blade Sideshift Right” solenoid

This diagnostic code is associated with the “blade sideshift right” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The Implement ECM provides a PWM signal (output) to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM signal (output) based on the input command that is received from the “blade sideshift” position sensor that is located in the assembly of the right joystick .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.

- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U749-BR(Brown)) to contact 2 (wire H862-GY(Grey)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2166 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2166 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-55 (wire H862-GY(Grey)) to the energize contact J1-66 (wire U749-BR(Brown)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in supply wire U749-BR(Brown) or in the return wire H862-GY(Grey) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U749-BR(Brown) and the socket at contact J1-66 from the harness connector.

C. Reconnect the machine harness J2 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-66 through the empty space in the J1 connector.

F. Observe the status of the active CID 2166 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2166 FMI 05 diagnostic code is no longer active. A CID 2166 FMI 06 diagnostic code becomes active when the ECM pin at J1-66 is grounded.

Results:

- YES – The CID 2166 FMI 05 diagnostic code is no longer active. A CID 2166 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector in the ECM. Proceed to Test Step 4.

- NO – The CID 2166 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2166 FMI 05 diagnostic code.

Expected Result:

The CID 2166 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2166 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2166 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i02536486

MID 082 - CID 2166 - FMI 06

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

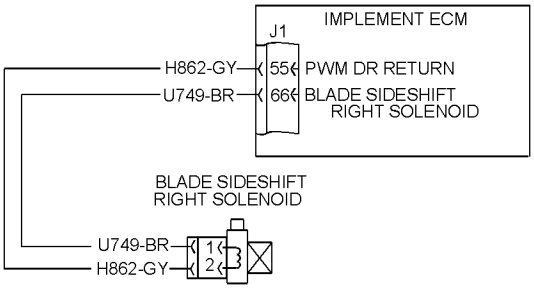


Illustration 306 g01269268

Blade Sideshift Right Solenoid connections

This diagnostic code is associated with the blade sideshift right solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade sideshift position sensor that is located in the right joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2166 FMI 06 diagnostic code changes to a CID 2166 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2166 FMI 06 diagnostic code changes to a CID 2166 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2166 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-66 (wire U749-BR(Brown)) to frame ground. Measure the resistance from the signal contact J1-66 (wire U749-BR(Brown)) to all of the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U749-BR(Brown) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2166 FMI 06 diagnostic code.

Expected Result:

The CID 2166 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2166 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2166 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536496

MID 082 - CID 2166 - FMI 13

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

This diagnostic code is associated with the blade sideshift right solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade sideshift position sensor that is located in the right joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2166 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02536509

MID 082 - CID 2167 - FMI 03

SMCS Code: 5479-038-CDR

Conditions Which Generate This Code:

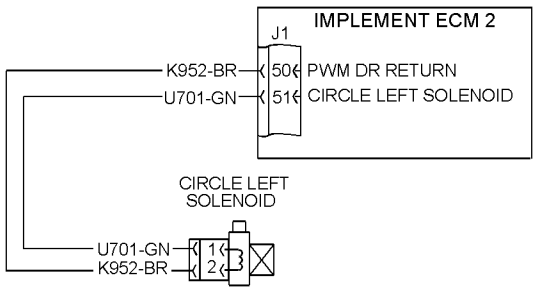


Illustration 307 g01269303

Circle Left Solenoid connections

This diagnostic code is associated with the circle left solenoid. The FMI 03 means that the Implement ECM 2 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle drive position sensor that is located in the right joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire U701-GN(Green) and socket at contact J1-51 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2167 FMI 03 diagnostic code.

Expected Result:

The CID 2167 FMI 03 diagnostic code is no longer active. A CID 2167 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2167 FMI 03 diagnostic code is no longer active. A CID 2167 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 2.
- NO – The CID 2167 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-51 (wire U701-GN(Green)) to all J1 and J2 contacts that are used on the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U701-GN(Green) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2167 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2167 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2167 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2167 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986814

MID 082 - CID 2167 - FMI 05

SMCS Code: 5479-038-CDR

Conditions Which Generate This Code:

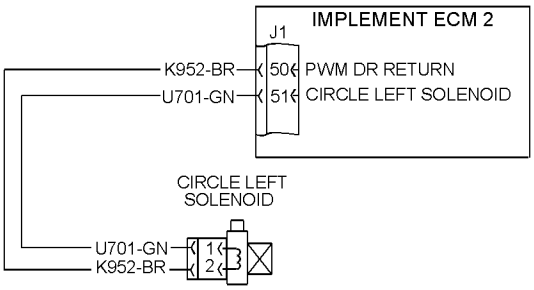


Illustration 308 g01269303

Connections of “Circle Left” solenoid

This diagnostic code is associated with the “circle left” solenoid. The FMI 05 means that the Implement ECM 2 has determined that the current for the solenoid circuit is below normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM signal (output) to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM signal based on the input command that is received from the “circle drive” position sensor that is located in the assembly of the right joystick .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U701-GN(Green)) to contact 2 (wire K952-BR(Brown)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2167 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2167 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 2.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 2, measure the resistance from the return contact J1-50 (wire K952-BR(Brown)) to the energize contact J1-51 (wire U701-GN(Green)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in the supply wire U701-GN(Green) or in the return wire K952-BR(Brown) of the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U701-GN(Green) and the socket at contact J1-51 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-51 through the empty space in the J1 connector.

F. Observe the status of the active CID 2167 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2167 FMI 05 diagnostic code is no longer active. A CID 2167 FMI 06 diagnostic code becomes active when the ECM pin at J1-51 is grounded.

Results:

- YES – The CID 2167 FMI 05 diagnostic code is no longer active. A CID 2167 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2167 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2167 FMI 05 diagnostic code.

Expected Result:

The CID 2167 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2167 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2167 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536521

MID 082 - CID 2167 - FMI 06

SMCS Code: 5479-038-CDR

Conditions Which Generate This Code:

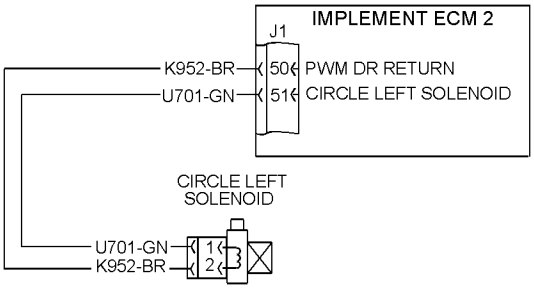


Illustration 309 g01269303

Circle Left Solenoid connections

This diagnostic code is associated with the circle left solenoid. The FMI 06 means that the Implement ECM 2 has determined that the current of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle drive position sensor that is located in the right joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2167 FMI 06 diagnostic code changes to a CID 2167 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2167 FMI 06 diagnostic code changes to a CID 2167 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2167 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-51 (wire U701-GN(Green)) to frame ground. Measure the resistance from the contact J1-51 (wire U701-GN(Green)) to all of the other J1 and J2 contacts that are used in the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U701-GN(Green) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2167 FMI 06 diagnostic code.

Expected Result:

The CID 2167 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2167 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2167 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536553

MID 082 - CID 2167 - FMI 13

SMCS Code: 5479-038-CDR

Conditions Which Generate This Code:

This diagnostic code is associated with the circle left solenoid. The FMI 13 diagnostic code is activated when the Implement ECM 2 detects that the solenoid needs calibration. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle drive position sensor that is located in the right joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2167 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02536562

MID 082 - CID 2168 - FMI 03

SMCS Code: 5479-038-CDR

Conditions Which Generate This Code:

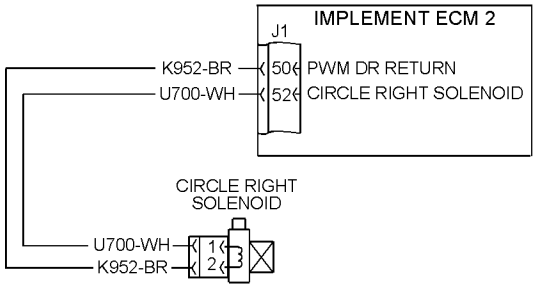


Illustration 310 g01269345

Circle Right Solenoid connections

This diagnostic code is associated with the circle right solenoid. The FMI 03 means that the Implement ECM 2 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle drive position sensor that is located in the right joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-52 (wire U700-WH(White)) to all J1 and J2 contacts that are used on the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U700-WH(White) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire U700-WH(White) and socket at contact J1-52 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2168 FMI 03 diagnostic code.

Expected Result:

The CID 2168 FMI 03 diagnostic code is no longer active. A CID 2168 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2168 FMI 03 diagnostic code is no longer active. A CID 2168 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2168 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2168 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2168 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2168 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2168 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i02986762

MID 082 - CID 2168 - FMI 05

SMCS Code: 5479-038-CDR

Conditions Which Generate This Code:

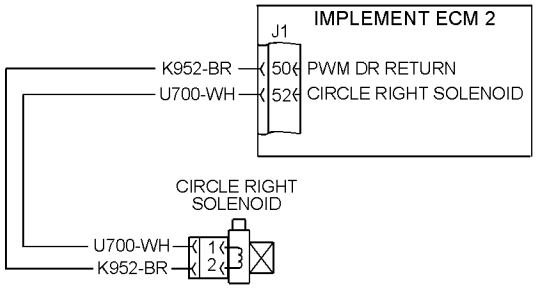


Illustration 311 g01269345

Connections of “Circle Right” solenoid

This diagnostic code is associated with the “circle right” solenoid. The FMI 05 means that the Implement ECM 2 has determined that the current for the solenoid circuit is below normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM signal (output) to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM signal based on the input command that is received from the circle drive position sensor that is located in the assembly of the right joystick .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U700-WH(White)) to contact 2 (wire K952-BR(Brown)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2168 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2168 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 2.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 2, measure the resistance from the return contact J1-50 (wire K952-BR(Brown)) to the energize contact J1-52 (wire U700-WH(White)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in supply wire U700-WH(White) or in the return wire K952-BR(Brown) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid G953-BU(Blue) and the socket at contact J1-52 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-52 through the empty space in the J1 connector.

F. Observe the status of the active CID 2168 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2168 FMI 05 diagnostic code is no longer active. A CID 2168 FMI 06 diagnostic code becomes active when the ECM pin at J1-52 is grounded.

Results:

- YES – The CID 2168 FMI 05 diagnostic code is no longer active. A CID 2168 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2168 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2168 FMI 05 diagnostic code.

Expected Result:

The CID 2168 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2168 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2168 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536566

MID 082 - CID 2168 - FMI 06

SMCS Code: 5479-038-CDR

Conditions Which Generate This Code:

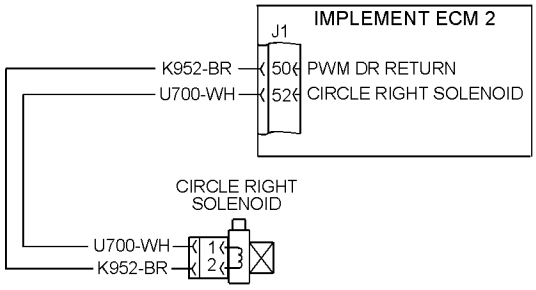


Illustration 312 g01269345

Circle Right Solenoid connections

This diagnostic code is associated with the circle right solenoid. The FMI 06 means that the Implement ECM 2 has determined that the current of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle drive position sensor that is located in the right joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2168 FMI 06 diagnostic code changes to a CID 2168 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2168 FMI 06 diagnostic code changes to a CID 2168 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2168 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-52 (wire U700-WH(White)) to frame ground. Measure the resistance from the contact J1-52 (wire U700-WH(White)) to all of the other J1 and J2 contacts that are used in the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U700-WH(White) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2168 FMI 06 diagnostic code.

Expected Result:

The CID 2168 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2168 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2168 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536575

MID 082 - CID 2168 - FMI 13

SMCS Code: 5479-038-CDR

Conditions Which Generate This Code:

This diagnostic code is associated with the circle right solenoid. The FMI 13 diagnostic code is activated when the Implement ECM 2 detects that the solenoid needs calibration. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle drive position sensor that is located in the right joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2168 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02536670

MID 082 - CID 2169 - FMI 03

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

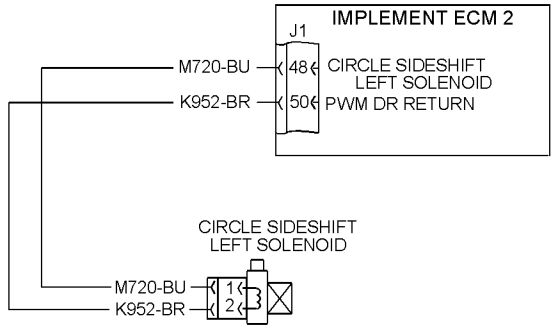


Illustration 313 g01269472

Circle Sideshift Left Solenoid connections

This diagnostic code is associated with the circle sideshift left solenoid. The FMI 03 means that the Implement ECM 2 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle sideshift position sensor that is located in the right joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-48 (wire M720-BU(Blue)) to all J1 and J2 contacts that are used on the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire M720-BU(Blue) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire M720-BU(Blue) and socket at contact J1-48 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2169 FMI 03 diagnostic code.

Expected Result:

The CID 2169 FMI 03 diagnostic code is no longer active. A CID 2169 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2169 FMI 03 diagnostic code is no longer active. A CID 2169 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2169 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2169 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2169 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2169 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2169 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986722

MID 082 - CID 2169 - FMI 05

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

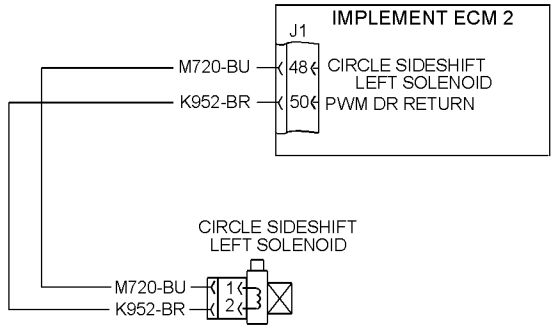


Illustration 314 g01269472

Connections of “Circle Sideshift Left” solenoid

This diagnostic code is associated with the “circle sideshift left” solenoid. The FMI 05 means that the Implement ECM 2 has determined that the current for the solenoid circuit is below normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM signal (output) to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM signal based on the input command that is received from the “circle sideshift” position sensor that is located in the assembly of the “right joystick” .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire M720-BU(Blue)) to contact 2 (wire K952-BR(Brown)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2169 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2169 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 2.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 2, measure the resistance from the return contact J1-50 (wire K952-BR(Brown)) to the energize contact J1-48 (wire M720-BU(Blue)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in supply wire M720-BU(Blue) or in the return wire K952-BR(Brown) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid M720-BU(Blue) and the socket at contact J1-48 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-48 through the empty space in the J1 connector.

F. Observe the status of the active CID 2169 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2169 FMI 05 diagnostic code is no longer active. A CID 2169 FMI 06 diagnostic code becomes active when the ECM pin at J1-48 is grounded.

Results:

- YES – The CID 2169 FMI 05 diagnostic code is no longer active. A CID 2169 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2169 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2169 FMI 05 diagnostic code.

Expected Result:

The CID 2169 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2169 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2169 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536672

MID 082 - CID 2169 - FMI 06

SMCS Code: 5479-038-CDR

Conditions Which Generate This Code:

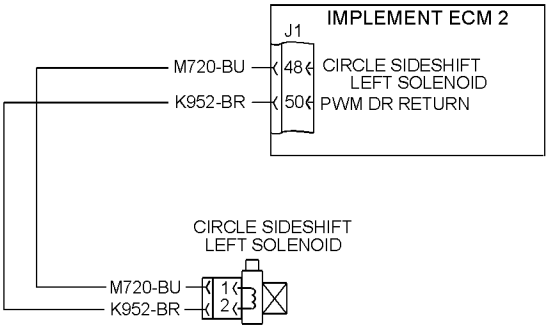


Illustration 315 g01269472

Circle Sideshift Left Solenoid connections

This diagnostic code is associated with the circle sideshift left solenoid. The FMI 06 means that the Implement ECM 2 has determined that the current of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle sideshift position sensor that is located in the right joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2169 FMI 06 diagnostic code changes to a CID 2169 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2169 FMI 06 diagnostic code changes to a CID 2169 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2169 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-48 (wire M720-BU(Blue)) to frame ground. Measure the resistance from the contact J1-48 (wire M720-BU(Blue)) to all of the other J1 and J2 contacts that are used in the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire M720-BU(Blue) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2169 FMI 06 diagnostic code.

Expected Result:

The CID 2169 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2169 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2169 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536676

MID 082 - CID 2169 - FMI 13

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

This diagnostic code is associated with the circle sideshift left solenoid. The FMI 13 diagnostic code is activated when the Implement ECM 2 detects that the solenoid needs calibration. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle sideshift position sensor that is located in the right joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2169 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02536790

MID 082 - CID 2170 - FMI 03

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

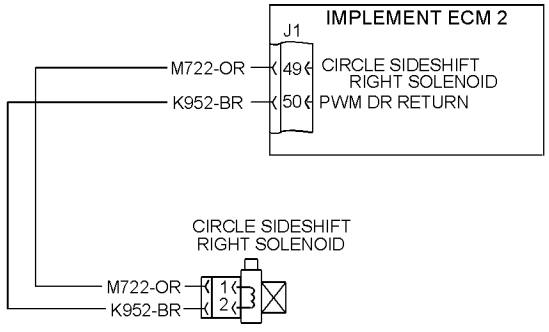


Illustration 316 g01269642

Circle Sideshift Right Solenoid connections

This diagnostic code is associated with the circle sideshift right solenoid. The FMI 03 means that the Implement ECM 2 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle sideshift position sensor that is located in the right joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-49 (wire M722-OR(Orange)) to all J1 and J2 contacts that are used on the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire M722-OR(Orange) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire M722-OR(Orange) and socket at contact J1-49 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2170 FMI 03 diagnostic code.

Expected Result:

The CID 2170 FMI 03 diagnostic code is no longer active. A CID 2170 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2170 FMI 03 diagnostic code is no longer active. A CID 2170 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2170 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2170 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2170 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2170 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2170 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986654

MID 082 - CID 2170 - FMI 05

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

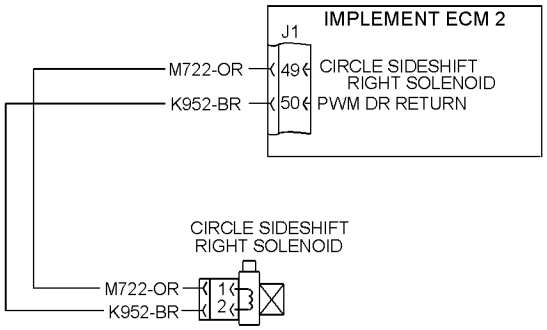


Illustration 317 g01269642

Connections of “Circle Sideshift Right” solenoid

This diagnostic code is associated with the “circle sideshift right” solenoid. The FMI 05 means that the Implement ECM 2 has determined that the current for the solenoid circuit is below normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM signal (output) to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the “circle sideshift” position sensor that is located in the assembly of the right joystick .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire M722-OR(Orange)) to contact 2 (wire K952-BR(Brown)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2170 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2170 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 2.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 2, measure the resistance from the return contact J1-50 (wire K952-BR(Brown)) to the energize contact J1-49 (wire M722-OR(Orange)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in supply wire M722-OR(Orange) or in return wire K952-BR(Brown) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid M722-OR(Orange) and the socket at contact J1-49 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-49 through the empty space in the J1 connector.

F. Observe the status of the active CID 2170 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2170 FMI 05 diagnostic code is no longer active. A CID 2170 FMI 06 diagnostic code becomes active when the ECM pin at J1-49 is grounded.

Results:

- YES – The CID 2170 FMI 05 diagnostic code is no longer active. A CID 2170 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the disconnected solenoid energize wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 4.

- NO – The CID 2170 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2170 FMI 05 diagnostic code.

Expected Result:

The CID 2170 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2170 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2170 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536796

MID 082 - CID 2170 - FMI 06

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

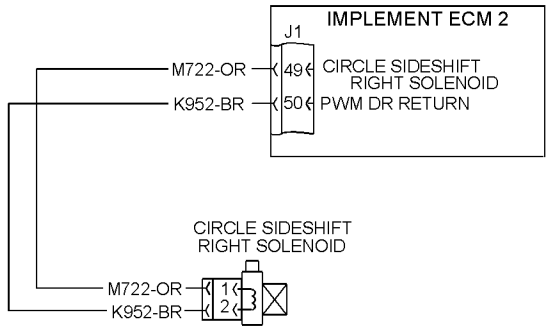


Illustration 318 g01269642

Circle Sideshift Right Solenoid connections

This diagnostic code is associated with the circle sideshift right solenoid. The FMI 06 means that the Implement ECM 2 has determined that the current of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle sideshift position sensor that is located in the right joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2170 FMI 06 diagnostic code changes to a CID 2170 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2170 FMI 06 diagnostic code changes to a CID 2170 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2170 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-49 (wire M722-OR(Orange)) to frame ground. Measure the resistance from the contact J1-49 (wire M722-OR(Orange)) to all of the other J1 and J2 contacts that are used in the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire M722-OR(Orange) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2170 FMI 06 diagnostic code.

Expected Result:

The CID 2170 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2170 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2170 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02536797

MID 082 - CID 2170 - FMI 13

SMCS Code: 5479-038-JI

Conditions Which Generate This Code:

This diagnostic code is associated with the circle sideshift right solenoid. The FMI 13 diagnostic code is activated when the Implement ECM 2 detects that the solenoid needs calibration. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the circle sideshift position sensor that is located in the right joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2170 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02537933

MID 082 - CID 2171 - FMI 03

SMCS Code: 5479-038-ART

Conditions Which Generate This Code:

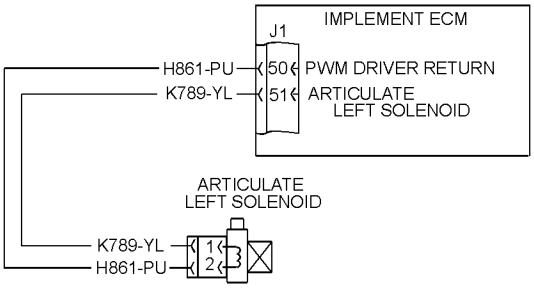


Illustration 319 g01270366

Articulate Left Solenoid connections

This diagnostic code is associated with the articulate left solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the articulation lever position sensor that is located in the left joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-51 (wire K789-YL(Yellow)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire K789-YL(Yellow) and the circuit that has a low resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire K789-YL(Yellow) and socket at contact J1-50 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2171 FMI 03 diagnostic code.

Expected Result:

The CID 2171 FMI 03 diagnostic code is no longer active. A CID 2171 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2171 FMI 03 diagnostic code is no longer active. A CID 2171 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2171 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2171 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2171 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2171 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2171 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986615

MID 082 - CID 2171 - FMI 05

SMCS Code: 5479-038-ART

Conditions Which Generate This Code:

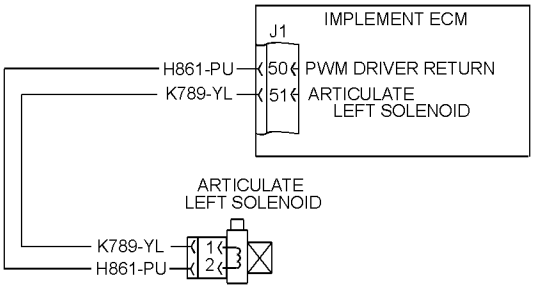


Illustration 320 g01270366

Connections of “Articulate Left” solenoid

This diagnostic code is associated with the “articulate left” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The Implement ECM provides a PWM signal (output) to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM signal (output) based on the input command that is received from the “articulation lever” position sensor that is located in the assembly of the “left joystick” .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, connect a jumper wire from contact 1 (wire K789-YL(Yellow)) to contact 2 (wire H861-PU(Purple)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2171 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2171 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-50 (wire H861-PU(Purple)) to the energize contact J1-51 (wire K789-YL(Yellow)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in the energize wire K789-YL(Yellow) of the machine harness or is in the return wire H861-PU(Purple) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid K789-PU(Purple) and the socket at contact J1-51 from the harness connector.

C. Reconnect the machine harness J2 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-51 through the empty space in the J1 connector.

F. Observe the status of the active CID 2171 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2171 FMI 05 diagnostic code is no longer active. A CID 2171 FMI 06 diagnostic code becomes active when the ECM pin at J1-51 is grounded.

Results:

- YES – The CID 2171 FMI 05 diagnostic code is no longer active. A CID 2171 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2171 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2171 FMI 05 diagnostic code.

Expected Result:

The CID 2171 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2171 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2171 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02537935

MID 082 - CID 2171 - FMI 06

SMCS Code: 5479-038-ART

Conditions Which Generate This Code:

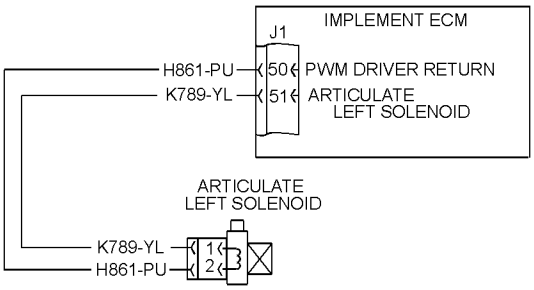


Illustration 321 g01270366

Articulate Left Solenoid connections

This diagnostic code is associated with the articulate left solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the articulation lever position sensor that is located in the left joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2171 FMI 06 diagnostic code changes to a CID 2171 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2171 FMI 06 diagnostic code changes to a CID 2171 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2171 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-51 (wire K789-YL(Yellow)) to frame ground. Measure the resistance from the signal contact J1-51 (wire K789-YL(Yellow)) to all of the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire K789-YL(Yellow) and the circuit with the low resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2171 FMI 06 diagnostic code.

Expected Result:

The CID 2171 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2171 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2171 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02537936

MID 082 - CID 2171 - FMI 13

SMCS Code: 5479-038-ART

Conditions Which Generate This Code:

This diagnostic code is associated with the articulate left solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the articulation lever position sensor that is located in the left joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2171 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02538114

MID 082 - CID 2172 - FMI 03

SMCS Code: 5479-038-ART

Conditions Which Generate This Code:

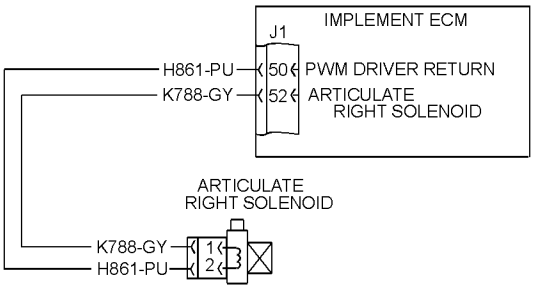


Illustration 322 g01270535

Articulate Right Solenoid connections

This diagnostic code is associated with the articulate right solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the articulation lever position sensor that is located in the left joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-52 (wire K788-GY(Grey)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the

machine harness. The short is between wire K788-GY(Grey) and the circuit that has a low resistance measurement.

Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire K788-GY(Grey) and socket at contact J1-52 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2172 FMI 03 diagnostic code.

Expected Result:

The CID 2172 FMI 03 diagnostic code is no longer active. A CID 2172 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2172 FMI 03 diagnostic code is no longer active. A CID 2172 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2172 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2172 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2172 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2172 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2172 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986594

MID 082 - CID 2172 - FMI 05

SMCS Code: 5479-038-ART

Conditions Which Generate This Code:

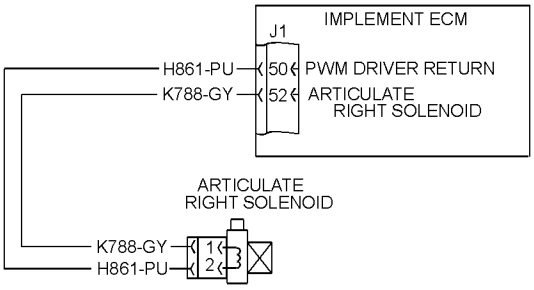


Illustration 323 g01270535

Connections of “Articulate Right” solenoid

This diagnostic code is associated with the “articulate right” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The Implement ECM provides a PWM signal (output) to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM signal based on the input command that is received from the “articulation lever” position sensor that is located in the assembly of the “left joystick” .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, connect a jumper wire from contact 1 (wire K788-GY(Grey)) to contact 2 (wire H861-PU(Purple)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2172 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnsotic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2172 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-50 (wire H861-PU(Purple)) to the energize contact J1-52 (wire K788-GY(Grey)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in the energize wire K788-GY(Grey) of the machine harness or in the return wire H861-PU(Purple) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid K788-GY(Grey) and the socket at contact J1-52 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-52 through the empty space in the J1 connector.

F. Observe the status of the active CID 2172 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2172 FMI 05 diagnostic code is no longer active. A CID 2172 FMI 06 diagnostic code becomes active when the ECM pin at J1-52 is grounded.

Results:

- YES – The CID 2172 FMI 05 diagnostic code is no longer active. A CID 2172 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2172 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2172 FMI 05 diagnostic code.

Expected Result:

The CID 2172 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2172 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2172 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02538120

MID 082 - CID 2172 - FMI 06

SMCS Code: 5479-038-ART

Conditions Which Generate This Code:

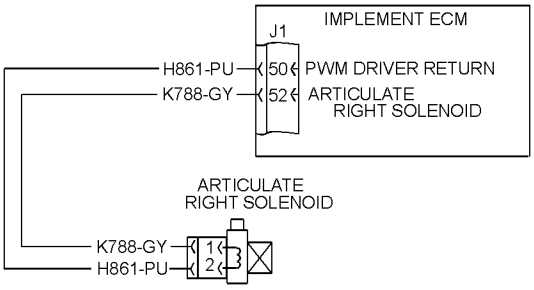


Illustration 324 g01270535

Articulate Right Solenoid connections

This diagnostic code is associated with the articulate right solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the articulation lever position sensor that is located in the left joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2172 FMI 06 diagnostic code changes to a CID 2172 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2172 FMI 06 diagnostic code changes to a CID 2172 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2172 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-52 (wire K788-GY(Grey)) to frame ground. Measure the resistance from the signal contact J1-52 (wire K788-GY(Grey)) to all of the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire K788-GY(Grey) and the circuit with the low resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2172 FMI 06 diagnostic code.

Expected Result:

The CID 2172 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2172 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The

wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2172 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02538121

MID 082 - CID 2172 - FMI 13

SMCS Code: 5479-038-ART

Conditions Which Generate This Code:

This diagnostic code is associated with the articulate right solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the articulation lever position sensor that is located in the left joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2172 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06679314

MID 082 - CID 2173 - FMI 03

SMCS Code: 5479-038-WLN

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Conditions Which Generate This Code:

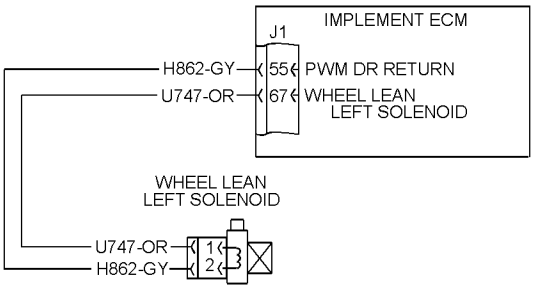


Illustration 325 g01270675

Wheel Lean Left Solenoid connections

This diagnostic code is associated with the wheel lean left solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the wheel lean control position sensor that is located in the left joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-67 (wire U747-OR(Orange)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U747-OR(Orange)and the circuit that has a low-resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U747-OR(Orange)and socket at contact J1-67 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2173 FMI 03 diagnostic code.

Expected Result:

The CID 2173 FMI 03 diagnostic code is no longer active. A CID 2173 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2173 FMI 03 diagnostic code is no longer active. A CID 2173 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit.Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2173 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2173 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2173 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2173 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This situation is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2173 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i06703018

MID 082 - CID 2173 - FMI 03

SMCS Code: 5479-038-WLN

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

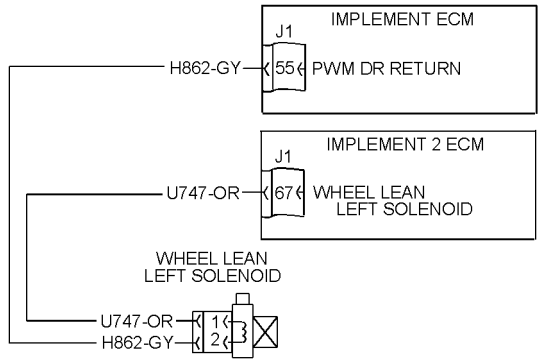


Illustration 326 g06071744

Wheel Lean Left Solenoid connections

This diagnostic code is associated with the wheel lean left solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the wheel lean control position sensor that is located in the left joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-67 (wire U747-OR(Orange)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U747-OR(Orange)and the circuit that has a low-resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U747-OR(Orange)and socket at contact J1-67 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2173 FMI 03 diagnostic code.

Expected Result:

The CID 2173 FMI 03 diagnostic code is no longer active. A CID 2173 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2173 FMI 03 diagnostic code is no longer active. A CID 2173 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit.Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2173 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2173 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2173 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2173 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. Failure of the ECM is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2173 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i06679320

MID 082 - CID 2173 - FMI 05

SMCS Code: 5479-038-WLN

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Conditions Which Generate This Code:

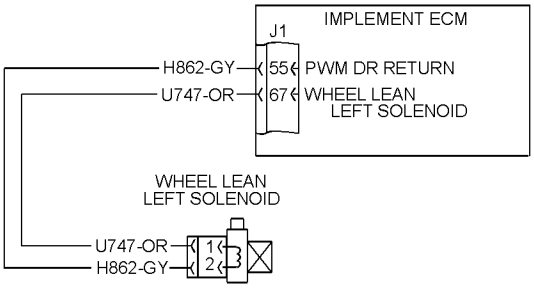


Illustration 327 g01270675

Connection of “Wheel Lean Left” solenoid

This diagnostic code is associated with the “wheel lean left” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The Implement ECM provides a PWM signal (output) to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the “wheel lean control” position sensor that is located in the assembly of the “left joystick” .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure, and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U747-OR(Orange)) to contact 2 (wire H862-GY(Grey)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2173 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2173 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector for the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-55 (wire H862-GY(Grey)) to the energize contact J1-67 (wire U747-OR(Orange)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in the supply wire U747-OR(Orange)or in the return wire H862-GY(Grey)of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U747-OR(Orange) and the socket at contact J1-67 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-67 through the empty space in the J1 connector.

F. Observe the status of the active CID 2173 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2173 FMI 05 diagnostic code is no longer active. A CID 2173 FMI 06 diagnostic code becomes active when the ECM pin at J2-7 is grounded.

Results:

- YES – The CID 2173 FMI 05 diagnostic code is no longer active. A CID 2173 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2173 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2173 FMI 05 diagnostic code.

Expected Result:

The CID 2173 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2173 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2173 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06703319

MID 082 - CID 2173 - FMI 05

SMCS Code: 5479-038-WLN

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

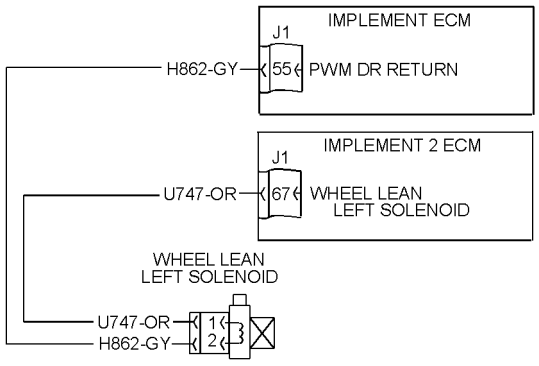


Illustration 328 g06071744

Wheel Lean Left Solenoid connections

This diagnostic code is associated with the “wheel lean left” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The Implement ECM provides a PWM signal (output) to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the “wheel lean control” position sensor that is located in the assembly of the “left joystick” .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure, and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U747-OR(Orange)) to contact 2 (wire H862-GY(Grey)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2173 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2173 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector for the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-55 (wire H862-GY(Grey)) to the energize contact J1-67 (wire U747-OR(Orange)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in the supply wire U747-OR(Orange)or in the return wire H862-GY(Grey)of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U747-OR(Orange) and the socket at contact J1-67 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-67 through the empty space in the J1 connector.

F. Observe the status of the active CID 2173 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2173 FMI 05 diagnostic code is no longer active. A CID 2173 FMI 06 diagnostic code becomes active when the ECM pin at J2-7 is grounded.

Results:

- YES – The CID 2173 FMI 05 diagnostic code is no longer active. A CID 2173 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2173 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connectorarecompletely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2173 FMI 05 diagnostic code.

Expected Result:

The CID 2173 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2173 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2173 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06679169

MID 082 - CID 2173 - FMI 06

SMCS Code: 5479-038-WLN

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Conditions Which Generate This Code:

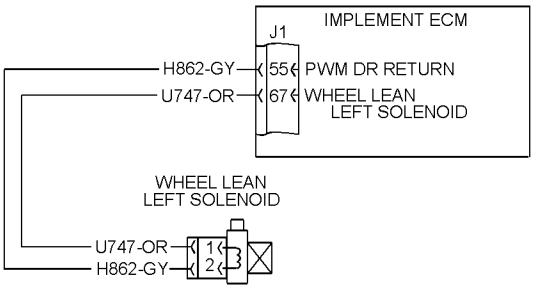


Illustration 329 g01270675

Wheel Lean Left Solenoid connections

This diagnostic code is associated with the wheel lean left solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the wheel lean control position sensor that is located in the left joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2173 FMI 06 diagnostic code changes to a CID 2173 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2173 FMI 06 diagnostic code changes to a CID 2173 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2173 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-67 (wire U747-OR(Orange)) to frame ground. Measure the resistance from the signal contact J1-67 (wire U747-OR(Orange)) to all the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements are less than 5000 ohms. There is a short in the machine harness. The short is between wire U747-OR(Orange)and the circuit with the low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2173 FMI 06 diagnostic code.

Expected Result:

The CID 2173 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2173 FMI 06 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  Failure of the ECM is unlikely. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2173 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06703354

MID 082 - CID 2173 - FMI 06

SMCS Code: 5479-038-WLN

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

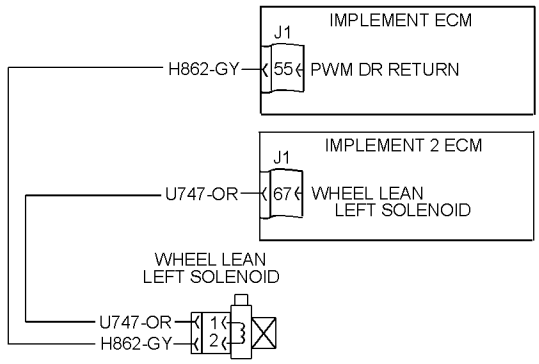


Illustration 330 g06071744

Wheel Lean Left Solenoid connections

This diagnostic code is associated with the wheel lean left solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the wheel lean control position sensor that is located in the left joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2173 FMI 06 diagnostic code changes to a CID 2173 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2173 FMI 06 diagnostic code changes to a CID 2173 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2173 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-67 (wire U747-OR(Orange)) to frame ground. Measure the resistance from the signal contact J1-67 (wire U747-OR(Orange)) to all the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements are less than 5000 ohms. There is a short in the machine harness. The short is between wire U747-OR(Orange)and the circuit with the low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2173 FMI 06 diagnostic code.

Expected Result:

The CID 2173 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2173 FMI 06 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

Failure of the ECM is unlikely. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2173 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02538312

MID 082 - CID 2173 - FMI 13

SMCS Code: 5479-038-WLN

Conditions Which Generate This Code:

This diagnostic code is associated with the wheel lean left solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the wheel lean control position sensor that is located in the left joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2173 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06679334

MID 082 - CID 2174 - FMI 03

SMCS Code: 5479-038-WLN

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Conditions Which Generate This Code:

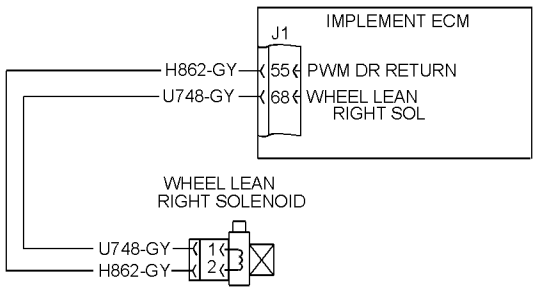


Illustration 331 g01270720

Wheel Lean Right Solenoid connections

This diagnostic code is associated with the wheel lean right solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the wheel lean control position sensor that is located in the left joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-68 (wire U748-GY(Grey)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U748-GY(Grey)and the circuit that has a low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire U748-GY(Grey)and socket at contact J1-68 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2174 FMI 03 diagnostic code.

Expected Result:

The CID 2174 FMI 03 diagnostic code is no longer active. A CID 2174 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2174 FMI 03 diagnostic code is no longer active. A CID 2174 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit.Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2174 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2174 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2174 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2174 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This situation is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.
- NO – The CID 2174 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06703401

MID 082 - CID 2174 - FMI 03

SMCS Code: 5479-038-WLN

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

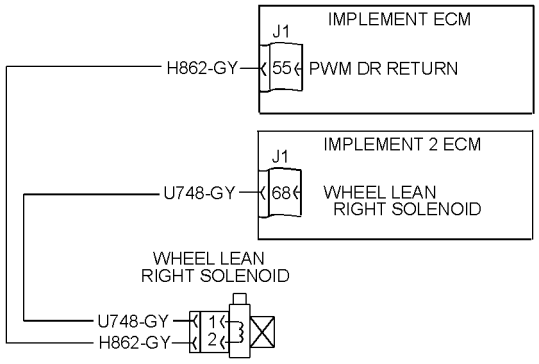


Illustration 332 g06071776

Wheel Lean Left Solenoid connections

This diagnostic code is associated with the wheel lean right solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the wheel lean control position sensor that is located in the left joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-68 (wire U748-GY(Grey)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U748-GY(Grey)and the circuit that has a low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U748-GY(Grey)and socket at contact J1-68 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2174 FMI 03 diagnostic code.

Expected Result:

The CID 2174 FMI 03 diagnostic code is no longer active. A CID 2174 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2174 FMI 03 diagnostic code is no longer active. A CID 2174 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit.Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2174 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2174 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2174 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2174 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This situation is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.
- NO – The CID 2174 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06679349

MID 082 - CID 2174 - FMI 05

SMCS Code: 5479-038-WLN

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Conditions Which Generate This Code:

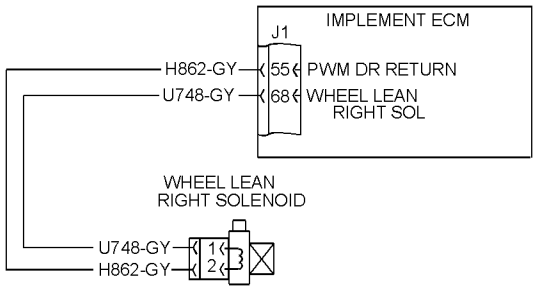


Illustration 333 g01270720

connection of “Wheel Lean Right” solenoid

This diagnostic code is associated with the “wheel lean right” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The Implement ECM provides a PWM signal (output) to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the “wheel lean control” position sensor that is located in the assembly of the “left joystick” .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure, and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U748-GY(Grey)) to contact 2 (wire H862-GY(Grey)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2174 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2174 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-55 (wire H862-GY(Grey)) to the energize contact J1-68 (wire U748-GY(Grey)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good .

  Repair: The open connection or the possible poor connection is in supply wire U748-GY(Grey)or in the return wire H862-GY(Grey)of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U748-GY(Grey)and the socket at contact J1-68 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-68 through the empty space in the J1 connector.

F. Observe the status of the active CID 2174 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2174 FMI 05 diagnostic code is no longer active. A CID 2174 FMI 06 diagnostic code becomes active when the ECM pin at J1-68 is grounded.

Results:

- YES – The CID 2174 FMI 05 diagnostic code is no longer active. A CID 2174 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2174 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2174 FMI 05 diagnostic code.

Expected Result:

The CID 2174 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2174 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This situation is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2174 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06703441

MID 082 - CID 2174 - FMI 05

SMCS Code: 5479-038-WLN

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

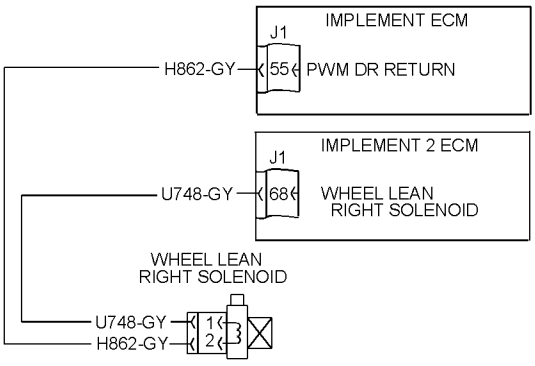


Illustration 334 g06071776

Wheel Lean Left Solenoid connections

This diagnostic code is associated with the “wheel lean right” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The Implement ECM provides a PWM signal (output) to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the “wheel lean control” position sensor that is located in the assembly of the “left joystick” .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure, and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U748-GY(Grey)) to contact 2 (wire H862-GY(Grey)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2174 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2174 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-55 (wire H862-GY(Grey)) to the energize contact J1-68 (wire U748-GY(Grey)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good .

  Repair: The open connection or the possible poor connection is in supply wire U748-GY(Grey)or in the return wire H862-GY(Grey)of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U748-GY(Grey)and the socket at contact J1-68 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-68 through the empty space in the J1 connector.

F. Observe the status of the active CID 2174 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2174 FMI 05 diagnostic code is no longer active. A CID 2174 FMI 06 diagnostic code becomes active when the ECM pin at J1-68 is grounded.

Results:

- YES – The CID 2174 FMI 05 diagnostic code is no longer active. A CID 2174 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2174 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2174 FMI 05 diagnostic code.

Expected Result:

The CID 2174 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2174 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This situation is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2174 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i06679379

MID 082 - CID 2174 - FMI 06

SMCS Code: 5479-038-WLN

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Conditions Which Generate This Code:

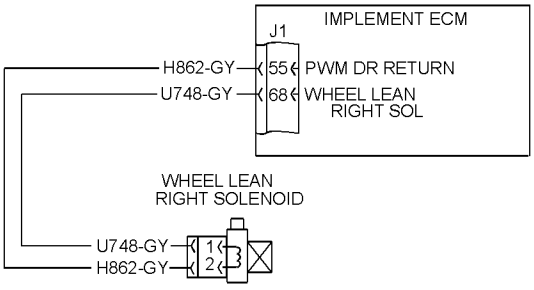


Illustration 335 g01270720

Wheel Lean Right Solenoid connections

This diagnostic code is associated with the wheel lean right solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the wheel lean control position sensor that is located in the left joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2174 FMI 06 diagnostic code changes to a CID 2174 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2174 FMI 06 diagnostic code changes to a CID 2174 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2174 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-68 (wire U748-GY(Grey)) to frame ground. Measure the resistance from the signal contact J1-68 (wire U748-GY(Grey)) to all the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements are less than 5000 ohms. There is a short in the machine harness. The short is between wire U748-GY(Grey)and the circuit with the low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2174 FMI 06 diagnostic code.

Expected Result:

The CID 2174 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2174 FMI 06 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2174 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06703457

MID 082 - CID 2174 - FMI 06

SMCS Code: 5479-038-WLN

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

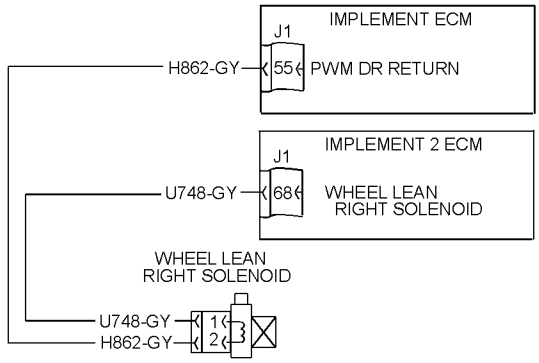


Illustration 336 g06071776

Wheel Lean Left Solenoid connections

This diagnostic code is associated with the wheel lean right solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the wheel lean control position sensor that is located in the left joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2174 FMI 06 diagnostic code changes to a CID 2174 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2174 FMI 06 diagnostic code changes to a CID 2174 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2174 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-68 (wire U748-GY(Grey)) to frame ground. Measure the resistance from the signal contact J1-68 (wire U748-GY(Grey)) to all the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements are less than 5000 ohms. There is a short in the machine harness. The short is between wire U748-GY(Grey)and the circuit with the low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2174 FMI 06 diagnostic code.

Expected Result:

The CID 2174 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2174 FMI 06 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2174 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02538366

MID 082 - CID 2174 - FMI 13

SMCS Code: 5479-038-WLN

Conditions Which Generate This Code:

This diagnostic code is associated with the wheel lean right solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the wheel lean control position sensor that is located in the left joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2174 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06679724

MID 082 - CID 2177 - FMI 03

SMCS Code: 5479-038-ZI

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

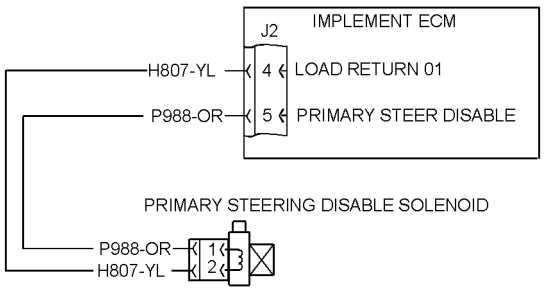


Illustration 337 g06072266

Primary Steering Disable Solenoid connections

This diagnostic code is associated with the primary steer (disable) pilot supply solenoid. The FMI 03 diagnostic code means that the ECM has determined that the voltage of the solenoid circuit is above normal.

The possible causes of the diagnostic code are listed below:

- The solenoid has failed.
- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. A failure of the ECM is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J2, measure the resistance from contact J2-5 (wire P988-OR(Orange)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire P988-OR(Orange)and the circuit that has a low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire P988-OR(Orange)and socket at contact J2-5 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2177 FMI 03 diagnostic code.

Expected Result:

The CID 2177 FMI 03 diagnostic code is no longer active. A CID 2177 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2177 FMI 03 diagnostic code is no longer active. A CID 2177 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit.Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2177 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2177 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2177 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2177 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This situation is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2177 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06679725

MID 082 - CID 2177 - FMI 05

SMCS Code: 5479-038-ZI

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

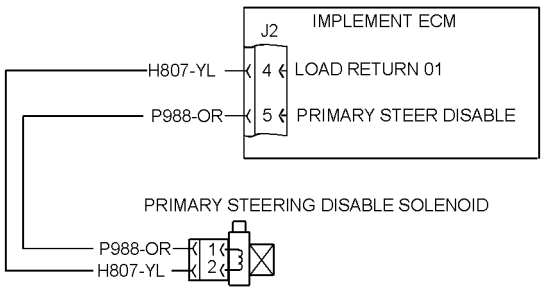


Illustration 338 g06072266

Connections of Primary Steering Disable solenoid

This diagnostic code is associated with the primary steering (disable) pilot supply solenoid. The FMI 05 diagnostic code is activated when the ECM detects a below normal current for the solenoid circuit.

The following conditions that cause the diagnostic code to be activated are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This condition is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure, and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire P988-OR(Orange)) to contact 2 (wire H807-YL(Yellow)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2177 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2177 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J2 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J2 for the ECM, measure the resistance from the return contact J2-4 (wire H807-YL(Yellow)) to the energize contact J2-5 (wire P988-OR(Orange)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection in the

machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good .

Repair: The open connection or the possible poor connection is in the supply wire P988-OR(Orange)or in the return wire H807-YL(Yellow)of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J2 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid P988-OR(Orange) and the socket at contact J2-5 from the harness connector.

C. Reconnect the machine harness J2 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to contact the ECM pin at J2-5 through the empty space in the J2 connector.

F. Observe the status of the active CID 2177 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2177 FMI 05 diagnostic code is no longer active. A CID 2177 FMI 06 diagnostic code becomes active when the ECM pin at J2-5 is grounded.

Results:

- YES – The CID 2177 FMI 05 diagnostic code is no longer active. A CID 2177 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2177 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2177 FMI 05 diagnostic code.

Expected Result:

The CID 2177 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2177 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the

wiring harness of the machine . The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the problem is not found in the machine harness, the ECM may have failed. This situation is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2177 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06679728

MID 082 - CID 2177 - FMI 06

SMCS Code: 5479-038-ZI

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

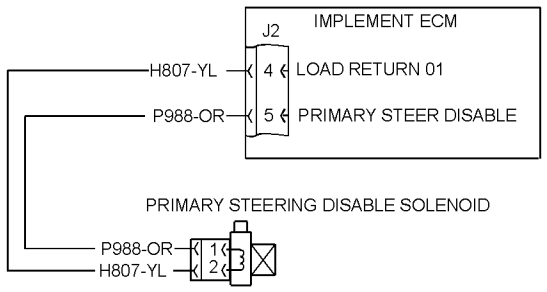


Illustration 339 g06072266

Primary Steering Disable Solenoid connections

This diagnostic code is associated with the primary steer (disable) pilot supply solenoid. The FMI 06 diagnostic code is activated when the ECM detects an above normal current for the solenoid circuit.

The following conditions that cause the diagnostic code to be active are listed below:

- The energize circuit of the solenoid is shorted to a ground source.
- The solenoid has failed.
- The ECM has failed. This condition is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2177 FMI 06 diagnostic code changes to a CID 2177 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2177 FMI 06 diagnostic code changes to a CID 2177 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2177 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J2–5 (wire P988-OR(Orange)) to frame ground. Measure the resistance from the signal contact J2–5 (wire P988-OR(Orange)) to all the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements are less than 5000 ohms. There is a short in the machine harness. The short is between wire P988-OR(Orange)and the circuit with the low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2177 FMI 06 diagnostic code.

Expected Result:

The CID 2177 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2177 FMI 06 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  Failure of the ECM is unlikely. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2177 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02538527

MID 082 - CID 2181 - FMI 03

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

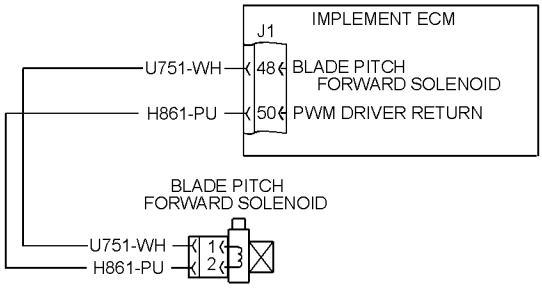


Illustration 340 g01270806

Blade Pitch Forward Solenoid connections

This diagnostic code is associated with the blade pitch forward solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade pitch control position sensor that is located in the right joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-48 (wire U751-WH(White)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U751-WH(White) and the circuit that has a low resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U751-WH(White) and socket at contact J1-48 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2181 FMI 03 diagnostic code.

Expected Result:

The CID 2181 FMI 03 diagnostic code is no longer active. A CID 2181 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2181 FMI 03 diagnostic code is no longer active. A CID 2181 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2181 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2181 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2181 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2181 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2181 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i02986509

MID 082 - CID 2181 - FMI 05

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

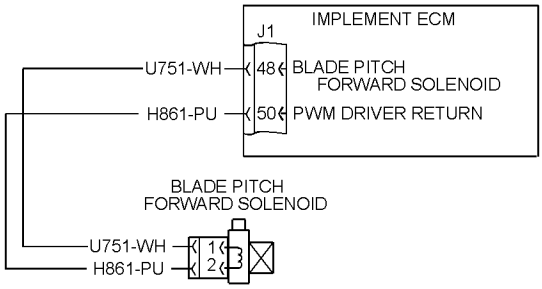


Illustration 341 g01270806

Connections of “Blade Pitch Forward” solenoid

This diagnostic code is associated with the “blade pitch forward” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The Implement ECM provides a PWM signal (output) to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM signal based on the input command that is received from the “blade pitch control” position sensor that is located in the assembly of the “right joystick” .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U751-WH(White)) to contact 2 (wire H861-PU(Purple)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2181 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2181 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-50 (wire H861-PU(Purple)) to the energize contact J1-48 (wire U751-WH(White)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good .

  Repair: The open connection or the possible poor connection is in the supply wire U751-WH(White) or in the return wire H861-PU(Purple) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U751-WH(White) and the socket at contact J1-48 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-48 through the empty space in the J1 connector.

F. Observe the status of the active CID 2181 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2181 FMI 05 diagnostic code is no longer active. A CID 2181 FMI 06 diagnostic code becomes active when the ECM pin at J1-48 is grounded.

Results:

- YES – The CID 2181 FMI 05 diagnostic code is no longer active. A CID 2181 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2181 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2181 FMI 05 diagnostic code.

Expected Result:

The CID 2181 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2181 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine . The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2181 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02538534

MID 082 - CID 2181 - FMI 06

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

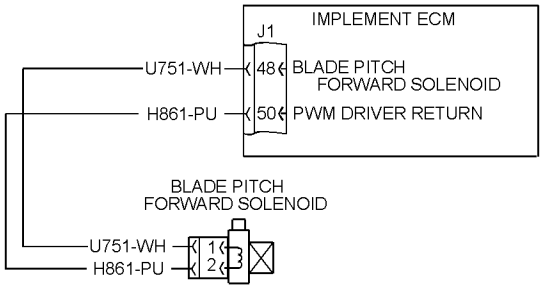


Illustration 342 g01270806

Blade Pitch Forward Solenoid connections

This diagnostic code is associated with the blade pitch forward solenoid. The FMI 06 indicates that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade pitch control position sensor that is located in the right joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2181 FMI 06 diagnostic code changes to a CID 2181 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2181 FMI 06 diagnostic code changes to a CID 2181 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2181 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-48 (wire U751-WH(White)) to frame ground. Measure the resistance from the signal contact J1-48 (wire U751-WH(White)) to all of the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U751-WH(White) and the circuit with the low resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2181 FMI 06 diagnostic code.

Expected Result:

The CID 2181 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2181 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2181 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02538541

MID 082 - CID 2181 - FMI 13

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

This diagnostic code is associated with the blade pitch forward solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade pitch control position sensor that is located in the right joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2181 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02538917

MID 082 - CID 2182 - FMI 03

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

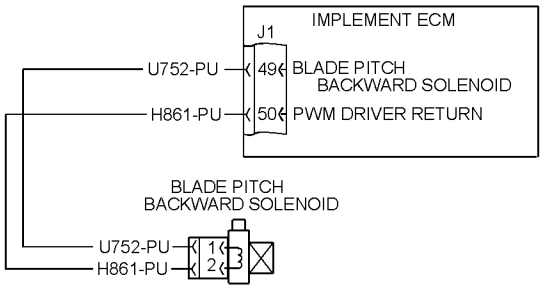


Illustration 343 g01270915

Blade Pitch Backward Solenoid connections

This diagnostic code is associated with the blade pitch backward solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade pitch control position sensor that is located in the right joystick assembly.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-49 (wire U752-PU(Purple)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U752-PU(Purple) and the circuit that has a low resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U752-PU(Purple) and socket at contact J1-49 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2182 FMI 03 diagnostic code.

Expected Result:

The CID 2182 FMI 03 diagnostic code is no longer active. A CID 2182 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2182 FMI 03 diagnostic code is no longer active. A CID 2182 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2182 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2182 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2182 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2182 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2182 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986498

MID 082 - CID 2182 - FMI 05

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

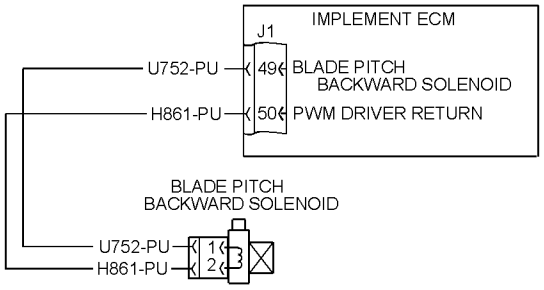


Illustration 344 g01270915

Connections of “Blade Pitch Backward” solenoid

This diagnostic code is associated with the “blade pitch backward” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The Implement ECM provides a PWM signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM signal based on the input command that is received from the “blade pitch control” position sensor that is located in the assembly of the “right joystick” .

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.

- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U752-PU(Purple)) to contact 2 (wire H861-PU(Purple)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2182 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2182 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness ECM connector J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-50 (wire H861-PU(Purple)) to the energize contact J1-49 (wire U752-PU(Purple)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good .

  Repair: The open connection or the possible poor connection is in supply wire U752-PU(Purple) or in return wire H861-PU(Purple) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U752-PU(Purple) and the socket at contact J1-49 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-49 through the empty space in the J1 connector.

F. Observe the status of the active CID 2182 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2182 FMI 05 diagnostic code is no longer active. A CID 2182 FMI 06 diagnostic code becomes active when the ECM pin at J1-49 is grounded.

Results:

- YES – The CID 2182 FMI 05 diagnostic code is no longer active. A CID 2182 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2182 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2182 FMI 05 diagnostic code.

Expected Result:

The CID 2182 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2182 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2182 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i02538938

MID 082 - CID 2182 - FMI 06

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

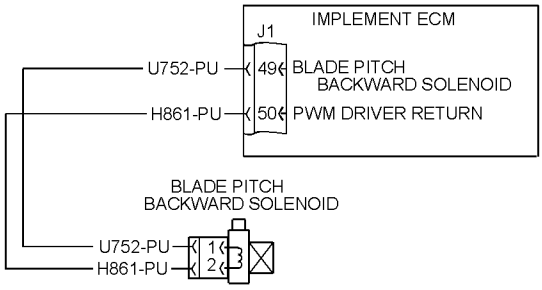


Illustration 345 g01270915

Blade Pitch Backward Solenoid connections

This diagnostic code is associated with the blade pitch backward solenoid. The FMI 06 indicates that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade pitch control position sensor that is located in the right joystick assembly.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2182 FMI 06 diagnostic code changes to a CID 2182 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2182 FMI 06 diagnostic code changes to a CID 2182 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2182 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-49 (wire U752-PU(Purple)) to frame ground. Measure the resistance from the signal contact J1-49 (wire U752-PU(Purple)) to all of the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U752-PU(Purple) and the circuit with the low resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2182 FMI 06 diagnostic code.

Expected Result:

The CID 2182 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2182 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2182 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02538942

MID 082 - CID 2182 - FMI 13

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

This diagnostic code is associated with the blade pitch forward solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

The Implement ECM provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that is received from the blade pitch control position sensor that is located in the right joystick assembly.

Note: Before performing this procedure, verify that no other active CID 2182 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06214842

MID 082 - CID 2200 - FMI 00

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

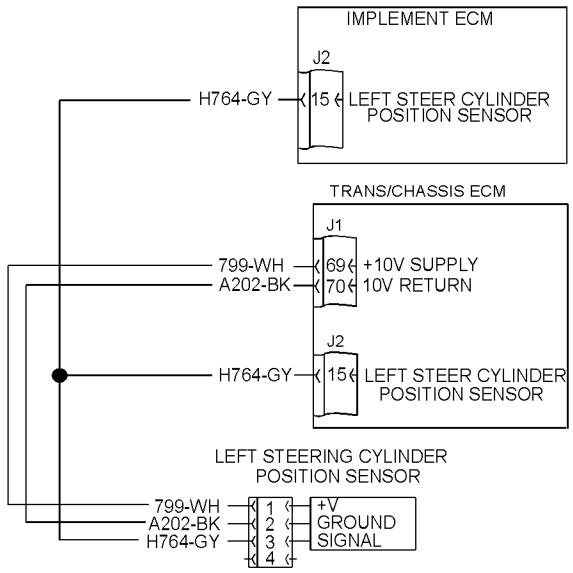


Illustration 346 g01254277

Left Steering Cylinder Position Sensor connections

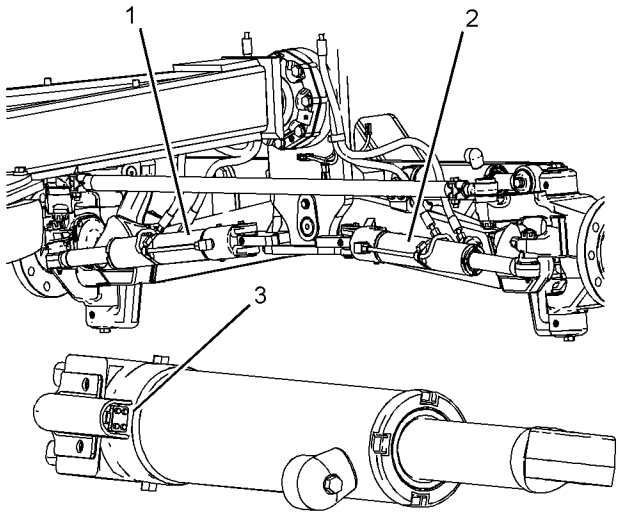


Illustration 347 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the left steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 00 means that the ECM is receiving a valid signal from the sensor, however, the signal is above the high limit for the expected signal range.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

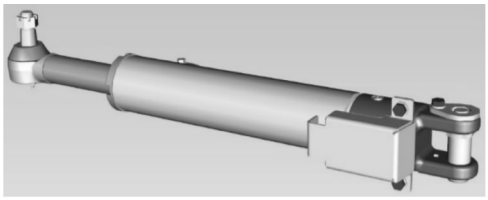


Illustration 348 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed below:

- Mechanical devices are broken or loose.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the Transmission Chassis ECM (MID 027) 10 VDC sensor power supply. Correct any problem with the 10 VDC power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the left steer cylinder position sensor. Both ECM's can activate a CID 2200 FMI 00 diagnostic code when the signal is above the normal range. If one ECM has activated a CID 2200 FMI 00 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM's have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Visually inspect the mechanical connections for the left steering cylinder. Verify that all mechanical connections and adjustments for the steering cylinder are in good condition and verify that none of the mechanical connections are loose.

Expected Result:

All mechanical connections for the steering cylinder are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical connections for the steering cylinder are correct. Proceed to Test Step 2.
- NOT OK – All mechanical connections for the steering cylinder are not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the steering

cylinder. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

STOP.

Test Step 2. CHECK THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the left steering cylinder position sensor and disconnect the machine harness connector from the right steering cylinder position sensor. Mark the harness connector for the left steering sensor.

B. Connect the marked connector for the left steering sensor to the right steering sensor connector. Connect the unmarked connector for the right steering sensor to the left steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the left steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2200 FMI 00 diagnostic code for the left steering sensor is not active. A CID 2201 FMI 00 diagnostic code for the right steering sensor is now active.

Results:

- YES – The CID 2200 FMI 00 diagnostic code is no longer active. A CID 2201 FMI 00 diagnostic code is now active. The sensor has failed.

  Repair: The left steering cylinder position sensor is the cause of the problem. Replace the left steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2200 FMI 00 diagnostic code did not change when the sensor connectors were switched. The CID 2200 FMI 00 diagnostic code is still active. The sensor does not appear to be causing the problem. It is unlikely that a harness condition is causing this code to be activated. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR.Proceed to Test Step 3.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2200 FMI 00 diagnostic code.

Expected Result:

The CID 2200 FMI 00 diagnostic code is not active.

Results:

- OK – The CID 2200 FMI 00 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably

caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

STOP.

- NOT OK – The CID 2200 FMI 00 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06214886

MID 082 - CID 2200 - FMI 01

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

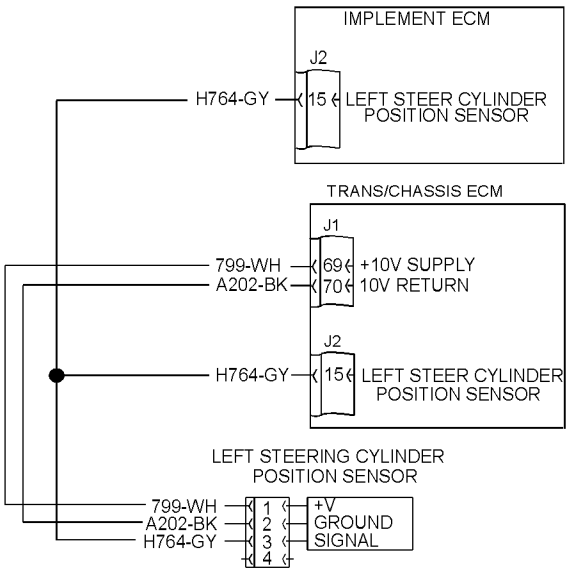


Illustration 349 g01254277

Left Steering Cylinder Position Sensor connections

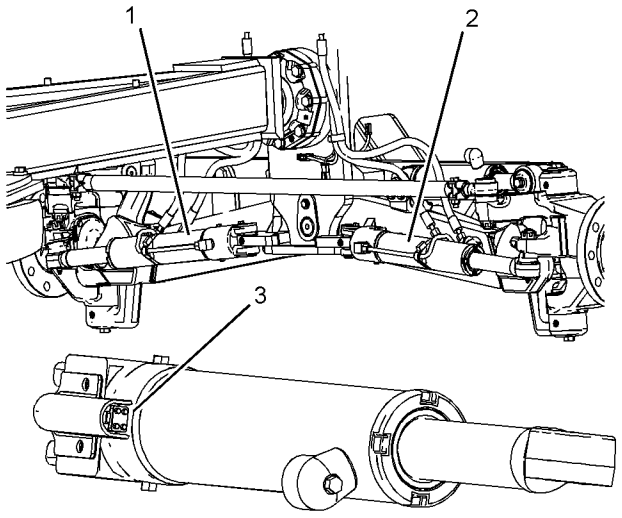


Illustration 350 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the left steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM.

The FMI 01 means that the ECM is receiving a valid signal from the sensor, however, the signal is below the low limit of the expected signal range.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

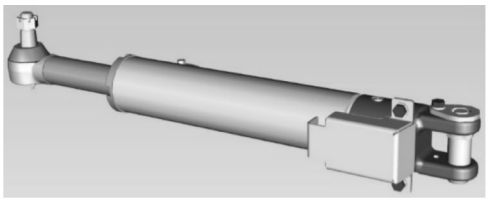


Illustration 351 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed below:

- Mechanical devices are broken or loose.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: The Transmission Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the left steer cylinder position sensor. Both ECM's can activate a CID 2200 FMI 01 diagnostic code when the signal is below the normal range. If one ECM has activated a CID 2200 FMI 01 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM's have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Visually inspect the mechanical connections for the left steering cylinder. Verify that all mechanical connections and adjustments for the steering cylinder are in good condition and verify that none of the mechanical connections are loose.

Expected Result:

All mechanical connections for the steering cylinder are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical connections for the steering cylinder are correct. Proceed to Test Step 2.
- NOT OK – All mechanical connections for the steering cylinder are not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the steering cylinder. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the left steering cylinder position sensor and disconnect the machine harness connector from the right steering cylinder position sensor. Mark the harness connector for the left steering sensor.

B. Connect the marked connector for the left steering sensor to the right steering sensor connector. Connect the unmarked connector for the right steering sensor to the left steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the left steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2200 FMI 01 diagnostic code for the left steering sensor is not active. A CID 2201 FMI 01 diagnostic code for the right steering sensor is now active.

Results:

- YES – The CID 2200 FMI 01 diagnostic code is no longer active. A CID 2201 FMI 01 diagnostic code is now active. The sensor has failed.

  Repair: The left steering cylinder position sensor is the cause of the problem. Replace the left steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2200 FMI 01 diagnostic code did not change when the sensor connectors were switched. The CID 2200 FMI 01 diagnostic code is still active. The sensor does not appear to be causing the problem. It is unlikely that a harness condition is causing this code to be activated. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. Proceed to Test Step 3.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2200 FMI 01 diagnostic code.

Expected Result:

The CID 2200 FMI 01 diagnostic code is not active.

Results:

- OK – The CID 2200 FMI 01 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2200 FMI 01 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The

wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the active diagnostic code is not found, the Implement ECM may have failed.

An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i05086369

MID 082 - CID 2200 - FMI 02

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

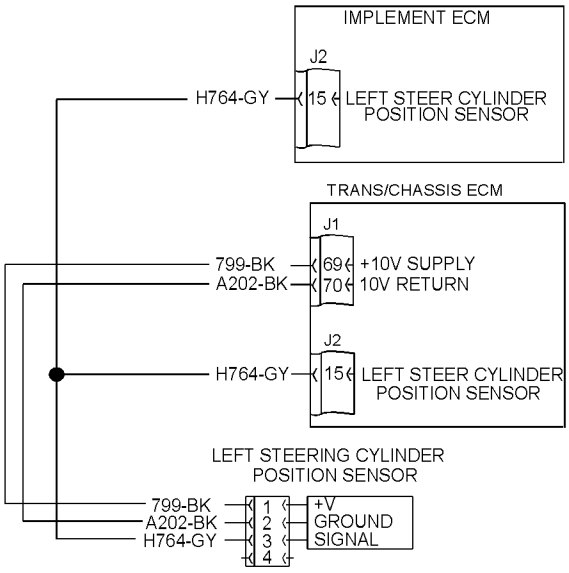


Illustration 352 g02919377

Left Steering Cylinder Position Sensor connections

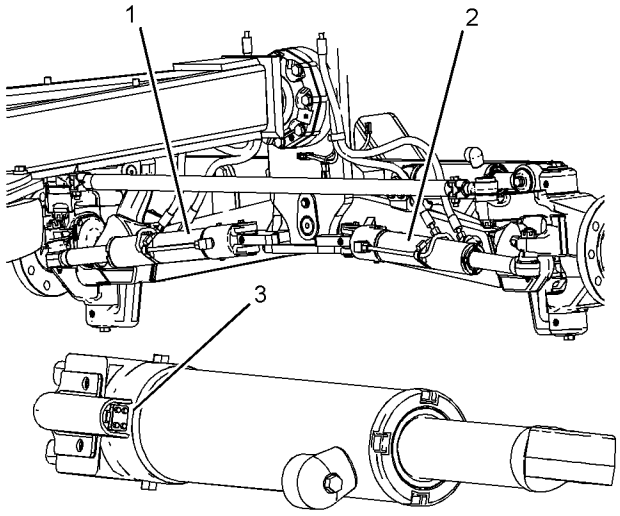


Illustration 353 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the left steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 02 means that the ECM has determined that the input signal from the sensor is erratic, intermittent, or incorrect.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

The possible causes of this diagnostic code are listed below:

- Mechanical devices are loose or not adjusted correctly.
- Intermittent connections or opens in the sensor circuit.
- The sensor has failed.
- An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the Transmission Chassis ECM (MID 027) 10 V sensor power supply. Correct any problem with the 10 V power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) will also activate a CID 2200 FMI 02 diagnostic code when an erratic or intermittent signal is detected. If one ECM has activated a CID 2200 FMI 02 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection or an open in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Visually inspect the mechanical connections for the left steering cylinder. Verify that all mechanical connections and adjustments for the steering cylinder are in good condition and verify that none of the mechanical connections are loose.

Expected Result:

All mechanical connections for the steering cylinder are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical connections for the steering cylinder are correct. Proceed to Test Step 2.
- NOT OK – All mechanical connections for the steering cylinder are not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the steering cylinder. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK FOR POWER AT THE SENSOR

A. The key start switch and the disconnect switch remain in the OFF position.

B. Do not disconnect the harness connector from the sensor.

C. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along supply contact 1 (wire 799-BK(Black)). Insert a multimeter probe along return contact 2 (wire A202-BK(Black)).

D. Turn the key start switch and the disconnect switch to the ON position.

E. Measure the voltage from contact 1 to contact 2.

Expected Result:

The voltage measurement is 10 ± 0.5 VDC.

Results:

- OK – The voltage measurement is 10 ± 0.5 VDC. The power supply circuit is correct.Proceed to Test Step 3.
- NOT OK – The voltage measurement is not 10 ± 0.5 VDC. The power supply circuit is not correct.

  Repair: There is a problem with the power supply circuit for the sensor. Refer to the complete machine Electrical System Schematic. Check all of the connections that are in the power supply circuit and the return circuit. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the left steering cylinder position sensor and disconnect the machine harness connector from the right steering cylinder position sensor. Mark the harness connector for the left steering sensor.

B. Connect the marked connector for the left steering sensor to the right steering sensor connector. Connect the unmarked connector for the right steering sensor to the left steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the left steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2200 FMI 02 diagnostic code for the left steering sensor is not active. A CID 2201 FMI 02 diagnostic code for the right steering sensor is now active.

Results:

- YES – The CID 2200 FMI 02 diagnostic code is no longer active. A CID 2201 FMI 02 diagnostic code is now active. The sensor has failed.

  Repair: The left steering cylinder position sensor is the cause of the problem. Replace the left steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2200 FMI 02 diagnostic code did not change when the sensor connectors were switched. The CID 2200 FMI 02 diagnostic code is still active. There is a problem in the machine harness. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. Proceed to Test Step 4.

Test Step 4. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

Before performing this Test Step, verify that the machine harness connectors are connected to their original left and right steering cylinder position sensor connectors.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the left steering cylinder position sensor.

C. At the machine harness connector for the left steering sensor, place a jumper wire between return contact 2 (wire A202-BK(Black)) and signal contact 3 (wire H764-GY(Grey)).

D. Disconnect the machine harness connectors J1 and J2 from the Transmission Chassis ECM and from the Implement ECM.

E. At the Transmission Chassis ECM, measure the resistance from return contact J1-70 (wire A202-BK(Black)) to signal contact J2-15 (wire H764-GY(Grey)).

F. Obtain a spare length of wire that will reach from the Implement ECM connectors to the steer cylinder position sensor connector.

G. At the steer cylinder position sensor connector, connect one end of the spare wire to the signal contact 3 (wire H764-GY(Grey)).

H. At the Implement ECM connector J2, measure the resistance between the other end of the spare wire and the signal contact J2-15 (wire H764-GY(Grey)).

Expected Result:

Each of the resistance measurements is less than 5 ohms.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The signal circuit is not open. Proceed to Test Step 5.

- NOT OK – One or both of the resistance measurements is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a

wire is either not connected or is open. A resistance measurement that is greater 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but is not a good connection.

If the circuit at one of the ECMs checks correct and the circuit at the other ECM indicates an open or a bad connection, most likely there is a problem in the machine harness on the ECM side of the splice.

If the resistance checks both indicate an open or a bad connection, a problem in the sensor side of the splice in the machine harness is most likely causing the problem.

Refer to the complete machine Electrical System Schematic. Verify that all connection points in the suspected part of the circuit are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2200 FMI 02 diagnostic code.

Expected Result:

The CID 2200 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 2200 FMI 02 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2200 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM may have failed.

  Failure of the ECM is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05086432

MID 082 - CID 2200 - FMI 03

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

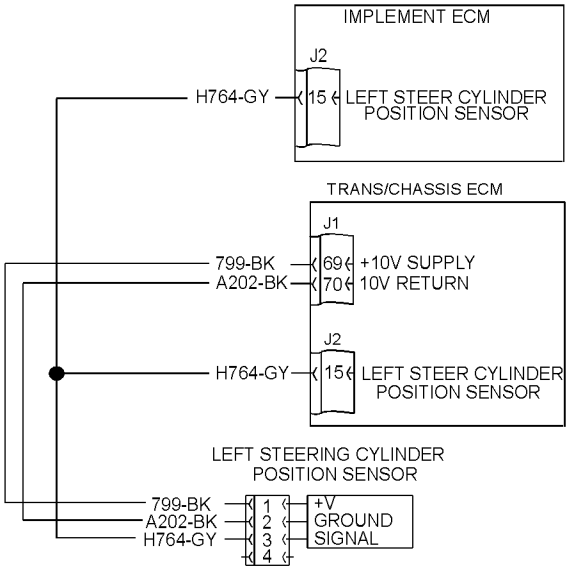


Illustration 354 g02919377

Left Steering Cylinder Position Sensor connections

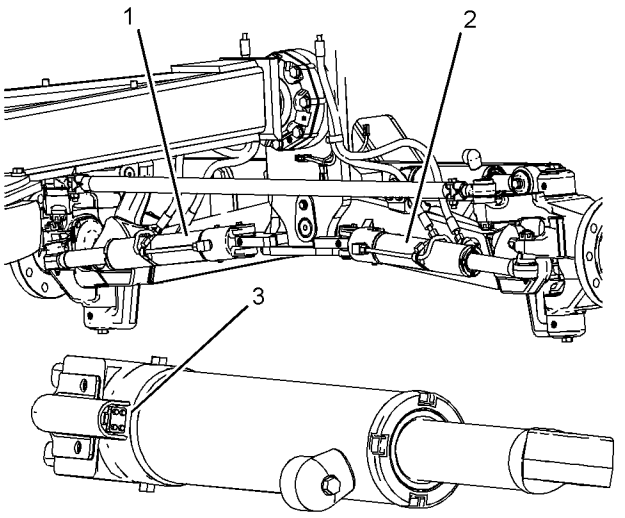


Illustration 355 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the left steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 03 diagnostic code is activated when the ECM reads the input signal from the sensor and the voltage of the signal is above normal.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

The possible causes of this diagnostic code are listed:

- The sensor power supply circuit is open.
- The return circuit is open.
- The signal circuit is open or the sensor is disconnected.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the Transmission Chassis ECM (MID 027) 10 VDC sensor power supply. Correct any problem with the 10 VDC power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) will also activate a CID 2200 FMI 03 diagnostic code when an above normal signal voltage is detected. If one ECM has activated a CID 2200 FMI 03 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection or an open in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SUPPLY VOLTAGE AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Do not disconnect the harness connector from the sensor.

C. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along supply contact 1 (wire 799-BK(Black)). Insert a multimeter probe along return contact 2 (wire A202-BK(Black)).

D. Turn the key start switch and the disconnect switch to the ON position.

E. Measure the voltage from contact 1 to contact 2.

Expected Result:

The voltage measurement is 10 ± 0.5 DCV.

Results:

- OK – The voltage measurement is 10 ± 0.5 DCV. The Transmission Chassis ECM power supply circuit is correct.Proceed to Test Step 2.
- NOT OK – The voltage measurement is not 10 ± 0.5 DCV. The power supply circuit that is coming from the Transmission Chassis ECM is not correct.

Repair: Verify that the Transmission Chassis ECM has not lost the machine system power. Loss of power to the Transmission Chassis ECM can cause this code to activate.

If the Transmission Chassis ECM is powered up, check the sensor return circuit wire A202-BK(Black) or the supply wire 799-WH(White) in the machine harness for an open circuit or a bad connection.

Refer to the complete machine Electrical System Schematic. Examine all of the connectors that are in the circuit. Ensure that the connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness in order to restore the power supply to the sensor.

STOP.

Test Step 2. CHECK THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joy-stick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the left steering cylinder position sensor and disconnect the machine harness connector from the right steering cylinder position sensor. Mark the harness connector for the left steering sensor.

B. Connect the marked connector for the left steering sensor to the right steering sensor connector. Connect the unmarked connector for the right steering sensor to the left steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the left steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2200 FMI 03 diagnostic code for the left steering sensor is not active. A CID 2201 FMI 03 diagnostic code for the right steering sensor is now active.

Results:

- YES – The CID 2200 FMI 03 diagnostic code is no longer active. A CID 2201 FMI 03 diagnostic code is now active. The sensor has failed.

  Repair: The left steering cylinder position sensor is the cause of the problem. Replace the left steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2200 FMI 03 diagnostic code did not change when the sensor connectors were switched. The CID 2200 FMI 03 diagnostic code is still active. There is a problem in the machine harness. DISCONNECT THE SENSORS THAT WERE SWITCHED AND RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. Proceed to Test Step 3.

Test Step 3. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

Before performing this Test Step, verify that the machine harness connectors are connected to their original left and right steering cylinder position sensor connectors.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the left steering cylinder position sensor.

C. At the machine harness connector for the left steering sensor, place a jumper wire between return contact 2 (wire A202-BK(Black)) and signal contact 3 (wire H764-GY(Grey)).

D. Disconnect the machine harness connectors J1 and J2 from the Transmission Chassis ECM and from the Implement ECM.

E. At the Transmission Chassis ECM, measure the resistance from return contact J1-70 (wire A202-BK(Black)) to signal contact J2-15 (wire H764-GY(Grey)).

F. Obtain a spare length of wire that will reach from the Implement ECM connectors to the steer cylinder position sensor connector.

G. At the steer cylinder position sensor connector, connect one end of the spare wire to the signal contact 3 (wire H764-GY(Grey)).

H. At the Implement ECM connector J2, measure the resistance between the other end of the spare wire and the signal contact J2-15 (wire H764-GY(Grey)).

Expected Result:

Each of the resistance measurements is less than 5 ohms.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The signal circuit is not open. Proceed to Test Step 4.
- NOT OK – One or both of the resistance measurements is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is either not connected or is open. A resistance measurement that is greater 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but is not a good connection.

  If the circuit at one of the ECMs checks correct and the circuit at the other ECM indicates an open or a bad connection, most likely there is a problem in the machine harness on the ECM side of the splice.

  If the resistance checks both indicate an open or a bad connection, a problem in the sensor side of the splice in the machine harness is most likely causing the problem.

  Refer to the complete machine Electrical System Schematic. Verify that all connection points in the suspected part of the circuit are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The Transmission Chassis ECM harness connectors and the Implement ECM connectors remain disconnected from the machine harness.

A. Remove the jumper wire that was installed in the last step.

B. At the J1 and J2 machine harness connectors for the Implement ECM, measure the resistance from the sensor signal contact J2-15 (wire H764-GY(Grey)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

C. If any of the resistance measurements in the last test step are less than 5000 ohms, skip the next test step and proceed to the "Expected Result" step. If all of the resistance measurements in the last test step are above 5000 ohms, perform the next test step.

D. At the disconnected J1 and J2 machine harness connectors for the Transmission Chassis ECM, measure the resistance from the sensor signal contact J2-15 (wire H764-GY(Grey)) to all of the other J1 and J2 contacts that are used for the Transmission Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted. Proceed to Test Step 5.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement. Repair the machine harness or replace machine harness.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2200 FMI 03 diagnostic code is active.

Expected Result:

The CID 2200 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2200 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2200 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06214888

MID 082 - CID 2200 - FMI 04

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

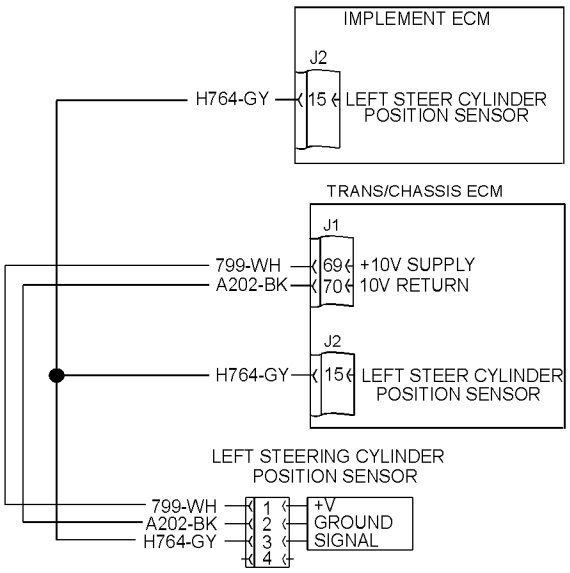


Illustration 356 g01254277

Left Steering Cylinder Position Sensor connections

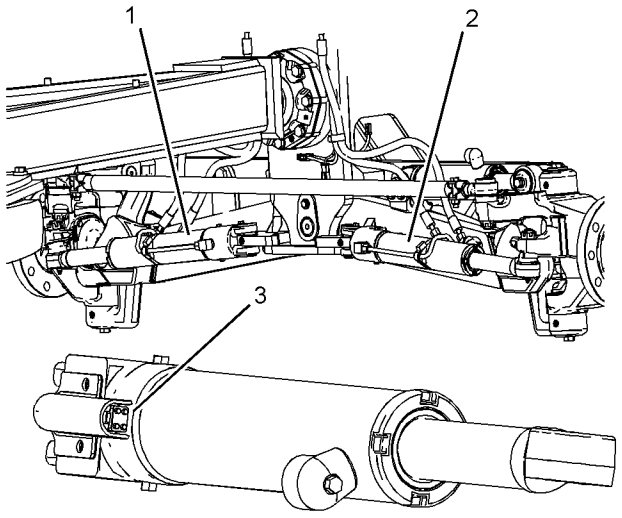


Illustration 357 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the left steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 04 diagnostic code is activated when the ECM reads the input signal from the sensor and the voltage of the signal is below normal.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

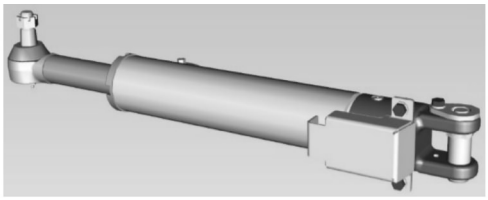


Illustration 358 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to a ground source.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the Transmission Chassis ECM (MID 027) 10 VDC sensor power supply. Correct any problem with the 10 VDC power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the left steer cylinder position sensor. Both ECM's can activate a CID 2200 FMI 04 diagnostic code when the signal is below normal. If one ECM has activated a CID 2200 FMI 04 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM's have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the left steering cylinder position sensor and disconnect the machine harness connector from the right steering cylinder position sensor. Mark the harness connector for the left steering sensor.

B. Connect the marked connector for the left steering sensor to the right steering sensor connector. Connect the unmarked connector for the right steering sensor to the left steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the left steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2200 FMI 04 diagnostic code for the left steering sensor is not active. A CID 2201 FMI 04 diagnostic code for the right steering sensor is now active.

Results:

- YES – The CID 2200 FMI 04 diagnostic code is no longer active. A CID 2201 FMI 04 diagnostic code is now active. The sensor has failed.

  Repair: The left steering cylinder position sensor is the cause of the problem. Replace the left steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2200 FMI 04 diagnostic code did not change when the sensor connectors were switched. The CID 2200 FMI 04 diagnostic code is still active. There is a problem in the machine harness. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. Proceed to Test Step 2.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

Before performing this Test Step, verify that the machine harness connectors are connected to the original left and right steering cylinder position sensor connectors.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the left steering cylinder position sensor.

C. Disconnect the J1 and J2 machine harness connectors from the Transmission Chassis ECM and from the Implement ECM.

D. At machine harness connector J2 for the Transmission Chassis ECM, measure the resistance from signal contact J2-15 (wire H764-GY(Grey)) to frame ground and measure the resistance to all of the contacts that are used in the machine harness connectors for the Transmission Chassis ECM.

E. At machine harness connector J2 for the Implement ECM, measure the resistance from signal contact J2-15 (wire H764-GY(Grey)) to frame ground and measure the resistance to all of the contacts that are used in the machine harness connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. The resistance measurement is indicating a short in the machine harness.

  Repair: There is a short in the machine harness between the signal circuit and the circuit with the low resistance measurement.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2200 FMI 04 diagnostic code is active.

Expected Result:

The CID 2200 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2200 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2200 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06215007

MID 082 - CID 2200 - FMI 08

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

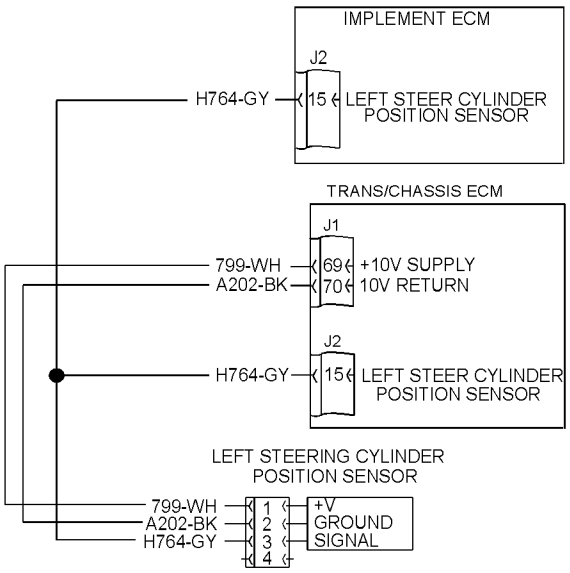


Illustration 359 g01254277

Left Steering Cylinder Position Sensor connections

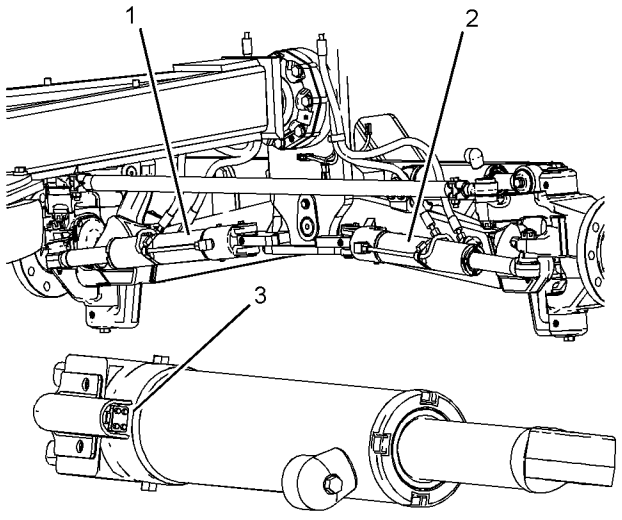


Illustration 360 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the left steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 08 diagnostic code is activated when the ECM detects that the input signal from the sensor has an abnormal frequency or pulse width.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

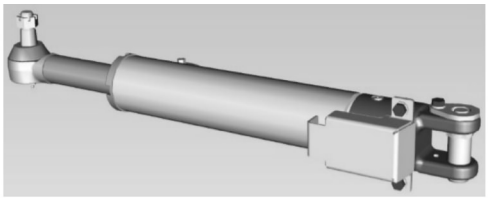


Illustration 361 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed:

- Mechanical devices in the cylinder assembly are loose.
- The sensor has failed.
- Intermittent connections or poor connections in the signal circuit.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the Transmission Chassis ECM (MID 027) 10 VDC sensor power supply. Correct any problem with the 10 VDC power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) will also activate a CID 2200 FMI 08 diagnostic code when an above normal signal frequency or pulse width. If one ECM has activated a CID 2200 FMI 08 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, an intermittent open or a poor connection in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Visually inspect the mechanical connections for the left steering cylinder. Verify that all mechanical connections and adjustments for the steering cylinder are in good condition and verify that none of the mechanical connections are loose.

Expected Result:

All mechanical connections for the steering cylinder are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical connections for the steering cylinder are correct. Proceed to Test Step 2.
- NOT OK – All mechanical connections for the steering cylinder are not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the steering cylinder. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

STOP.

Test Step 2. CHECK THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the left steering cylinder position sensor and disconnect the machine harness connector from the right steering cylinder position sensor. Mark the harness connector for the left steering sensor.

B. Connect the marked connector for the left steering sensor to the right steering sensor connector. Connect the unmarked connector for the right steering sensor to the left steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the left steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2200 FMI 08 diagnostic code for the left steering sensor is not active. A CID 2201 FMI 08 diagnostic code for the right steering sensor is now active.

Results:

- YES – The CID 2200 FMI 08 diagnostic code is no longer active. A CID 2201 FMI 08 diagnostic code is now active. The sensor has failed.

  Repair: The left steering cylinder position sensor is the cause of the problem. Replace the left steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2200 FMI 08 diagnostic code did not change when the sensor connectors were switched. The CID 2200 FMI 08 diagnostic code is still active. There is a problem in the machine harness. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. Proceed to Test Step 3.

Test Step 3. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

Before performing this Test Step, verify that the machine harness connectors are connected to the original left and right steering cylinder position sensor connectors.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the left steering cylinder position sensor.

C. At the machine harness connector for the left steering sensor, place a jumper wire between return contact 2 (wire A202-BK(Black)) and signal contact 3 (wire H764-GY(Grey)).

D. Disconnect the machine harness connectors J1 and J2 from the Transmission Chassis ECM and from the Implement ECM.

E. At the Transmission Chassis ECM, measure the resistance from return contact J1-70 (wire A202-BK(Black)) to signal contact J2-15 (wire H764-GY(Grey)).

F. Obtain a spare length of wire that will reach from the Implement ECM connectors to the steer cylinder position sensor connector.

G. At the steer cylinder position sensor connector, connect one end of the spare wire to the signal contact 3 (wire H764-GY(Grey)).

H. At the Implement ECM connector J2, measure the resistance between the other end of the spare wire and the signal contact J2-15 (wire H764-GY(Grey)).

Expected Result:

Each of the resistance measurements is less than 5 ohms.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The signal circuit is not open. Proceed to Test Step 4.
- NOT OK – One or both of the resistance measurements is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is either not connected or is open. A resistance measurement that is greater 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but is not a good connection.

  If the circuit at one of the ECMs checks correct and the circuit at the other ECM indicates an open or a bad connection, most likely there is a problem in the machine harness on the ECM side of the splice.

  If the resistance checks both indicate an open or a bad connection, a problem in the sensor side of the splice in the machine harness is most likely causing the problem.

  Refer to the complete machine Electrical System Schematic. Verify that all connection points in the suspected part of the circuit are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2200 FMI 08 diagnostic code is active.

Expected Result:

The CID 2200 FMI 08 diagnostic code is not active.

Results:

- OK – The CID 2200 FMI 08 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.
- NOT OK – The CID 2200 FMI 08 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06215028

MID 082 - CID 2200 - FMI 13

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

This diagnostic code is associated with the left steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 13 diagnostic code is activated when the ECM detects that the sensor needs calibration.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

CALIBRATION

A. Perform the calibration procedure for the sensor. Refer to Testing and Adjusting, “Calibration” section of this manual for information on how to access the calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the sensor.

  If the second calibration procedure is not successful, replace the steer cylinder position sensor.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  After cylinder replacement, refer to Testing and Adjusting, “Calibration” section of this manual for information on how to access the calibration procedure. If the problem is still present after replacement and calibration of the new sensor, the ECM may have failed.

  Prior to replacing an ECM, always contact your local Cat Dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06215036

MID 082 - CID 2200 - FMI 14

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

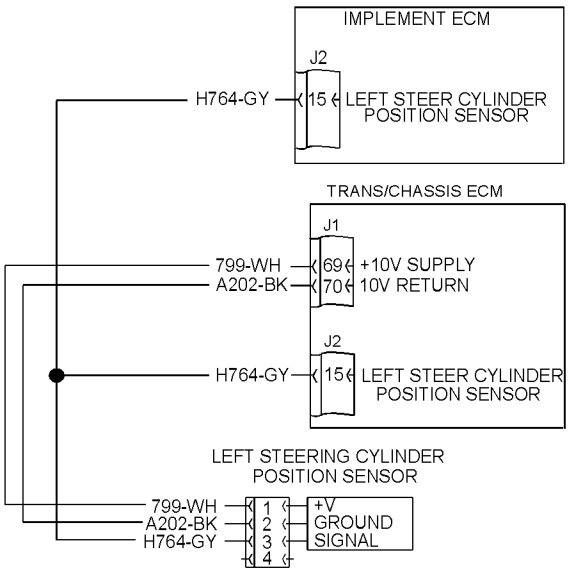


Illustration 362 g01254277

Left Steering Cylinder Position Sensor connections

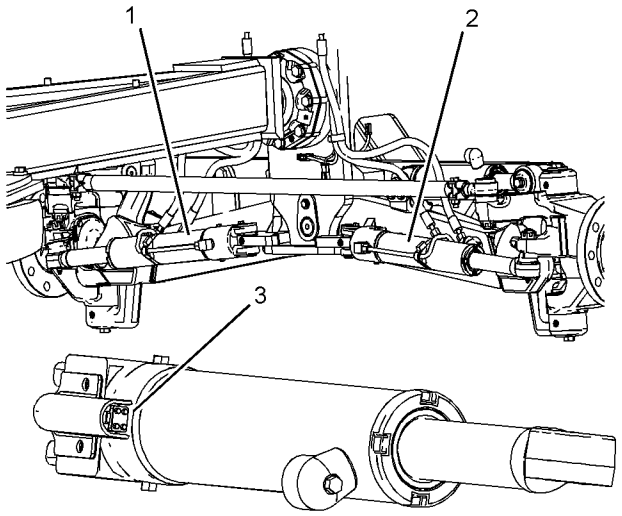


Illustration 363 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the left steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 14 diagnostic code is activated when the ECM detects that the sensor is not responding as expected and no external conditions that could cause this problem have been detected.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

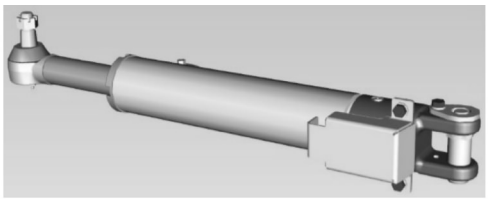


Illustration 364 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed:

- Mechanical devices are broken or loose.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 1482 diagnostic code for the Transmission Chassis ECM (MID 027) 10 VDC sensor power supply. Correct any problem with the 10 VDC power supply before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Visually inspect the mechanical connections for the left steering cylinder. Verify that all mechanical connections and adjustments for the steering cylinder are in good condition and verify that none of the mechanical connections are loose.

Expected Result:

All mechanical connections for the steering cylinder are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical connections for the steering cylinder are correct. Proceed to Test Step 2.
- NOT OK – All mechanical connections for the steering cylinder are not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the steering cylinder. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the left steering cylinder position sensor and disconnect the machine harness connector from the right steering cylinder position sensor. Mark the harness connector for the left steering sensor.

B. Connect the marked connector for the left steering sensor to the right steering sensor connector. Connect the unmarked connector for the right steering sensor to the left steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the left steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2200 FMI 14 diagnostic code for the left steering sensor is not active. A CID 2201 FMI 14 diagnostic code for the right steering sensor is now active.

Results:

- YES – The CID 2200 FMI 14 diagnostic code is no longer active. A CID 2201 FMI 14 diagnostic code is now active. The sensor has failed.

  Repair: The left steering cylinder position sensor is the cause of the problem. Replace the left steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2200 FMI 14 diagnostic code did not change when the sensor connectors were switched. The CID 2200 FMI 14 diagnostic code is still active. There is a problem in the machine harness. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. Proceed to Test Step 3.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

Before performing this Test Step, verify that the machine harness connectors are connected to their original left and right steering cylinder position sensor connectors.

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2200 FMI 14 diagnostic code is active.

Expected Result:

The CID 2200 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 2200 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2200 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service

tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the problem is not found in the machine harness, the ECM may have failed.

An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i06215072

MID 082 - CID 2201 - FMI 00

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

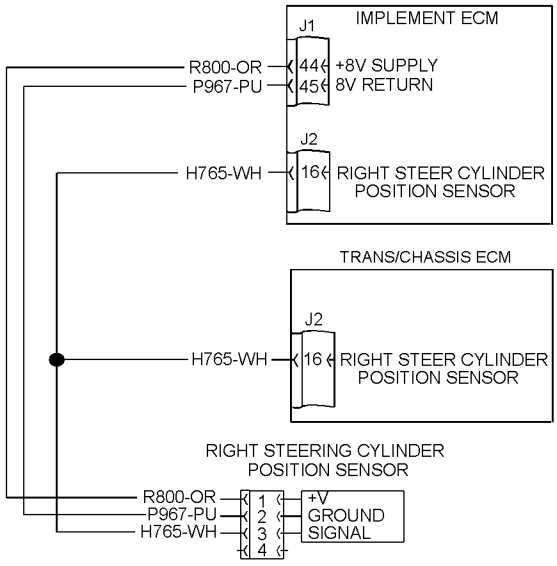


Illustration 365 g01254393

Right Steering Cylinder Position Sensor connections

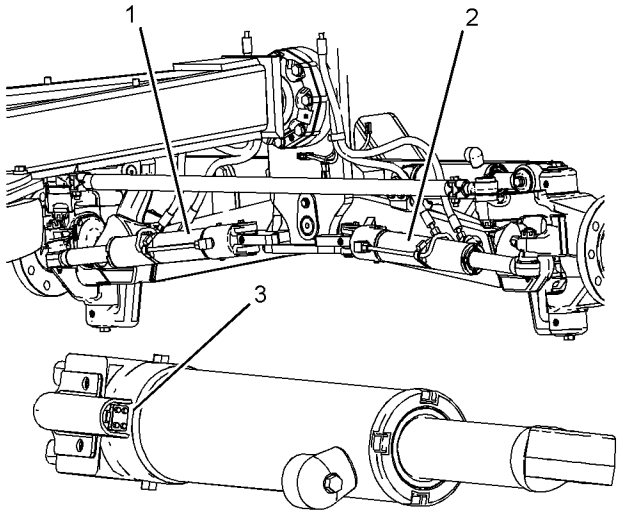


Illustration 366 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the left steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 00 means that the ECM is receiving a valid signal from the sensor, however, the signal is above the high limit for the expected signal range.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

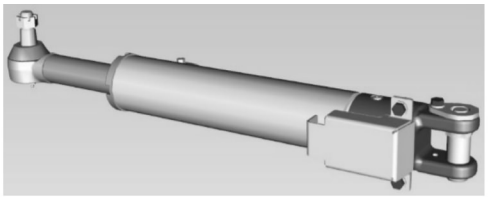


Illustration 367 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed below:

- Mechanical devices are broken or loose.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the ECM 8 VDC sensor power supply. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the left steer cylinder position sensor. Both ECM's can activate a CID 2201 FMI 00 diagnostic code when the signal is above the normal range. If one ECM has activated a CID 2201 FMI 00 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM's have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Visually inspect the mechanical connections for the left steering cylinder. Verify that all mechanical connections and adjustments for the steering cylinder are in good condition and verify that none of the mechanical connections are loose.

Expected Result:

All mechanical connections for the steering cylinder are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical connections for the steering cylinder are correct. Proceed to Test Step 2.
- NOT OK – All mechanical connections for the steering cylinder are not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the steering cylinder. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Observe the status of the active diagnostic code for the right steering sensor.

B. Disconnect the machine harness connector from the right steering cylinder position sensor and disconnect the machine harness connector from the left steering cylinder position sensor. Mark the harness connector for the right steering sensor.

C. Connect the marked connector for the right steering sensor to the left steering sensor connector. Connect the unmarked connector for the left steering sensor to the right steering sensor connector.

D. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

Expected Result:

When the harness connectors are switched, the CID 2201 FMI 00 diagnostic code for the right steering sensor is not active. A CID 2200 FMI 00 diagnostic code for the left steering sensor is now active.

Results:

- YES – The CID 2201 FMI 00 diagnostic code is no longer active. A CID 2200 FMI 00 diagnostic code is now active. The sensor has failed.

  Repair: The right steering cylinder position sensor is the cause of the problem. Replace the right steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2201 FMI 00 diagnostic code did not change when the sensor connectors were switched. The CID 2201 FMI 00 diagnostic code is still active. The sensor does not appear to be causing the problem. It is unlikely that a harness condition is causing this code to be activated. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. Proceed to Test Step 3.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) Pull Test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2201 FMI 00 diagnostic code.

Expected Result:

The CID 2201 FMI 00 diagnostic code is not active.

Results:

- OK – The CID 2201 FMI 00 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2201 FMI 00 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06215093

MID 082 - CID 2201 - FMI 01

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

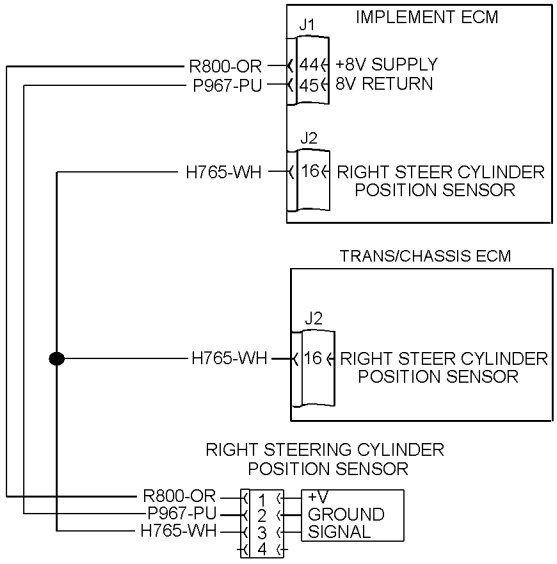


Illustration 368 g01254393

Right Steering Cylinder Position Sensor connections

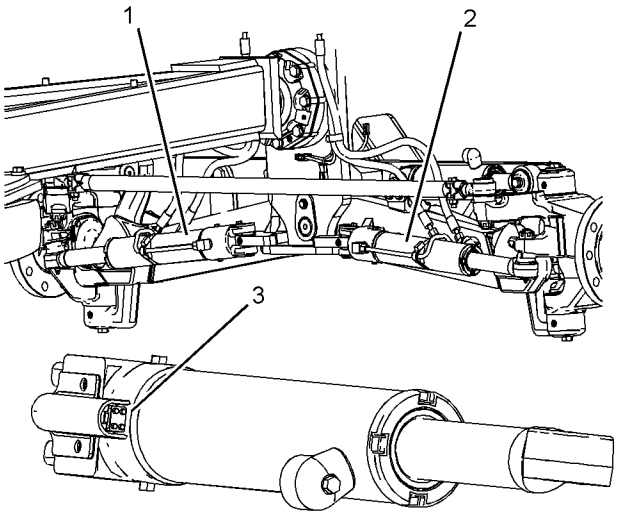


Illustration 369 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the right steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 01 means that the ECM is receiving a valid signal from the sensor, however, the signal is below the low for the expected signal range.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

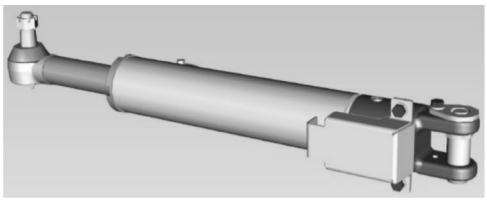


Illustration 370 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed below:

- Mechanical devices are broken or loose.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the ECM 8 VDC sensor power supply. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the left steer cylinder position sensor. Both ECM's can activate a CID 2201 FMI 01 diagnostic code when the signal is below the normal range. If one ECM has activated a CID 2201 FMI 01 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM's have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Visually inspect the mechanical connections for the left steering cylinder. Verify that all mechanical connections and adjustments for the steering cylinder are in good condition and verify that none of the mechanical connections are loose.

Expected Result:

All mechanical connections for the steering cylinder are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical connections for the steering cylinder are correct. Proceed to Test Step 2.
- NOT OK – All mechanical connections for the steering cylinder are not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the steering cylinder. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the right steering cylinder position sensor and disconnect the machine harness connector from the left steering cylinder position sensor. Mark the harness connector for the right steering sensor.

B. Connect the marked connector for the right steering sensor to the left steering sensor connector. Connect the unmarked connector for the left steering sensor to the right steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the right steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2201 FMI 01 diagnostic code for the right steering sensor is not active. A CID 2200 FMI 01 diagnostic code for the left steering sensor is now active.

Results:

- YES – The CID 2201 FMI 01 diagnostic code is no longer active. A CID 2200 FMI 01 diagnostic code is now active. The sensor has failed.

  Repair: The right steering cylinder position sensor is the cause of the problem. Replace the right steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR9704, “Clevis Style Cylinder Sensor - Remove and Install”.

After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

STOP.

- NO – The status of the CID 2201 FMI 01 diagnostic code did not change when the sensor connectors were switched. The CID 2201 FMI 01 diagnostic code is still active. The sensor does not appear to be causing the problem. It is unlikely that a harness condition is causing this code to be activated. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR.Proceed to Test Step 3.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2201 FMI 01 diagnostic code.

Expected Result:

The CID 2201 FMI 01 diagnostic code is not active.

Results:

- OK – The CID 2201 FMI 01 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2201 FMI 01 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06215101

MID 082 - CID 2201 - FMI 02

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

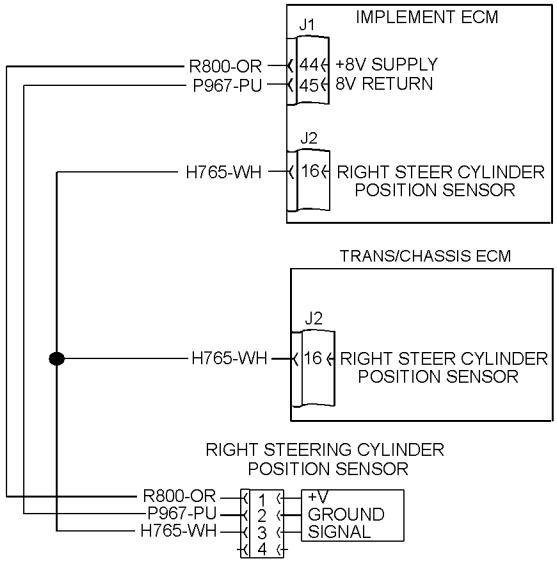


Illustration 371 g01254393

Right Steering Cylinder Position Sensor connections

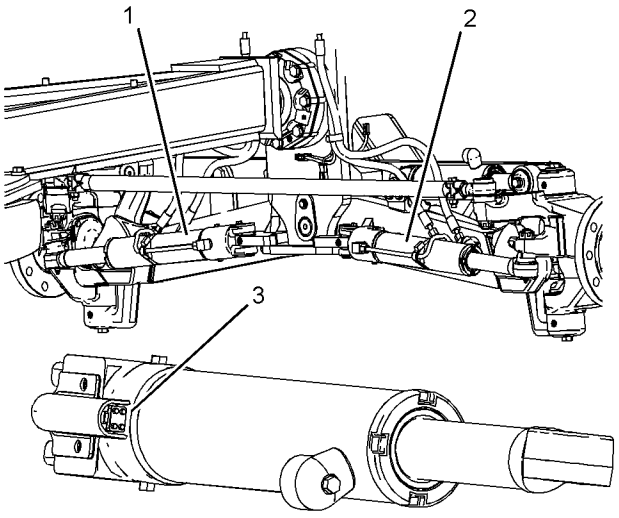


Illustration 372 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the right steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 02 means that the ECM has determined that the input signal from the sensor is erratic, intermittent, or incorrect.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

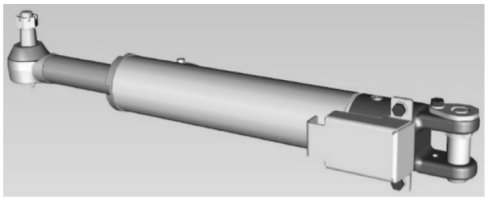


Illustration 373 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed below:

- Mechanical devices are loose or not adjusted correctly.
- Intermittent connections or opens in the sensor circuit.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the Implement ECM 8 VDC sensor power supply. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) will also activate a CID 2201 FMI 02 diagnostic code when an above erratic or intermittent signal is detected. If one ECM has activated a CID 2201 FMI 02 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection or an open in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Visually inspect the mechanical connections for the right steering cylinder. Verify that all mechanical connections and adjustments for the steering cylinder are in good condition and verify that no mechanical connections are loose.

Expected Result:

All mechanical connections for the steering cylinder are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical connections for the steering cylinder are correct. Proceed to Test Step 2.
- NOT OK – All mechanical connections for the steering cylinder are not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the steering cylinder. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK FOR POWER AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Do not disconnect the harness connector from the sensor.

C. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along supply contact A (wire R800-OR(Orange)) and along return contact B (wire P967-PU(Purple)).

D. Turn the key start switch and the disconnect switch to the ON position.

E. Measure the voltage from contact A to contact B.

Expected Result:

The voltage measurement is 8 ± 0.3 VDC.

Results:

- OK – The voltage measurement is 8 ± 0.3 VDC. The power supply circuit is correct.Proceed to Test Step 3.
- NOT OK – The voltage measurement is not 8 ± 0.3 VDC. The power supply circuit is not correct.

  Repair: There is a problem with the power supply circuit for the sensor. Refer to the complete machine Electrical System Schematic. Check all of the connections that are in the power supply circuit and the return circuit. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the right steering cylinder position sensor and disconnect the machine harness connector from the left steering cylinder position sensor. Mark the harness connector for the right steering sensor.

B. Connect the marked connector for the right steering sensor to the left steering sensor connector. Connect the unmarked connector for the left steering sensor to the right steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the right steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2201 FMI 02 diagnostic code for the right steering sensor is not active. A CID 2200 FMI 02 diagnostic code for the left steering sensor is now active.

Results:

- YES – The CID 2201 FMI 02 diagnostic code is no longer active. A CID 2200 FMI 02 diagnostic code is now active. The sensor has failed.

  Repair: The right steering cylinder position sensor is the cause of the problem. Replace the right steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2201 FMI 02 diagnostic code did not change when the sensor connectors were switched. The CID 2201 FMI 02 diagnostic code is still active. There is a problem in the machine harness. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR.Proceed to Test Step 4.

Test Step 4. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

Before performing this Test Step, verify that the machine harness connectors are connected to the original right and left steering cylinder position sensor connectors.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the right steering cylinder position sensor.

C. At the machine harness connector for the right steering sensor, place a jumper wire between return contact 2 (wire P967-PU(Purple)) and signal contact 3 (wire H765-WH(White)).

D. Disconnect the machine harness connectors J1 and J2 from the Implement ECM and the Transmission Chassis ECM.

E. At the Implement ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-16 (wire H765-WH(White)).

F. Obtain a spare length of wire that will reach from the Transmission Chassis ECM connectors to the steer cylinder position sensor connector.

G. At the steer cylinder position sensor connector, connect one end of the spare wire to the signal contact 3 (wire H765-WH(White)).

H. At the Transmission Chassis ECM connector J2, measure the resistance between the other end of the spare wire and the signal contact J2-16 (wire H765-WH(White)).

Expected Result:

Each of the resistance measurements is less than 5 ohms.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The signal circuit is not open. Proceed to Test Step 5.

- NOT OK – One or both of the resistance measurements is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is either not connected or is open. A

resistance measurement that is greater 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but is not a good connection.

If the circuit at one of the ECMs checks correct and the circuit at the other ECM indicates an open or a bad connection, most likely there is a problem in the machine harness on the ECM side of the splice.

If the resistance checks both indicate an open or a bad connection, a problem in the sensor side of the splice in the machine harness is most likely causing the problem.

Refer to the complete machine Electrical System Schematic. Verify that all connection points in the suspected part of the circuit are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2201 FMI 02 diagnostic code.

Expected Result:

The CID 2201 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 2201 FMI 02 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2201 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06215105

MID 082 - CID 2201 - FMI 03

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

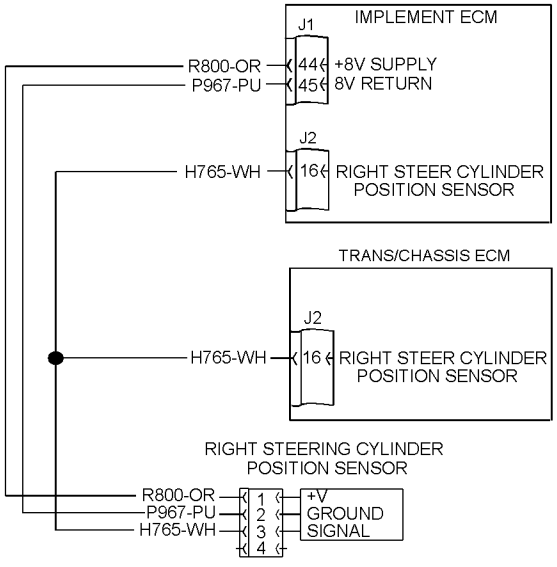


Illustration 374 g01254393

Right Steering Cylinder Position Sensor connections

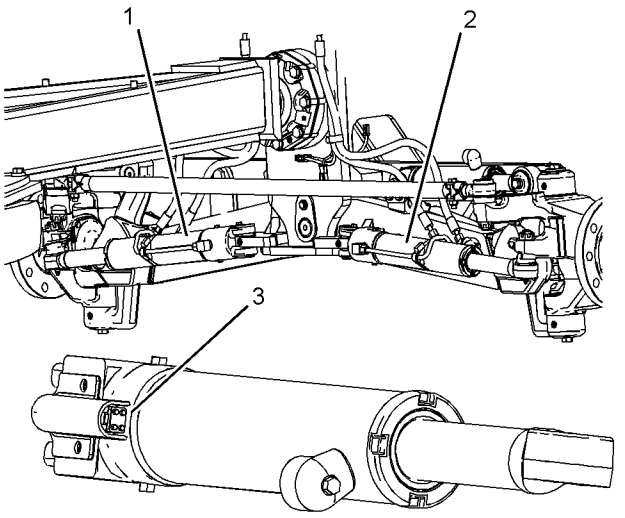


Illustration 375 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the right steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 03 diagnostic code is activated when the ECM reads the input signal from the sensor and the voltage of the signal is above normal.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

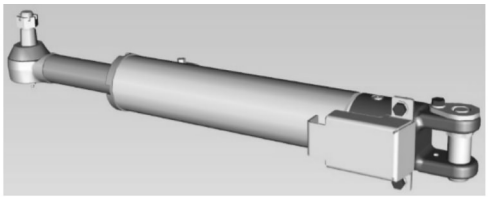


Illustration 376 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed:

- The sensor power supply circuit is open.
- The return circuit is open.
- The signal circuit is open or the sensor is disconnected.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the ECM 8 VDC sensor power supply. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) will also activate a CID 2201 FMI 03 diagnostic code when an above normal signal voltage is detected. If one ECM has activated a CID 2201 FMI 03 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection or an open in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected. Verify that the CID 2201 FMI 03 diagnostic code is active before performing this procedure.

Test Step 1. CHECK FOR POWER AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Do not disconnect the harness connector from the sensor.

C. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along supply contact A (wire R800-OR(Orange)) and along return contact B (wire P967-PU(Purple)).

D. Turn the key start switch and the disconnect switch to the ON position.

E. Measure the voltage from contact A to contact B.

Expected Result:

The voltage measurement is 8.0 ± 0.5 VDC.

Results:

- OK – The voltage measurement is 8.0 ± 0.5 VDC. The power supply circuit is correct.Proceed to Test Step 2.
- NOT OK – The voltage measurement is not 8.0 ± 0.5 VDC. The power supply circuit is not correct.

  Repair: There is a problem with the power supply circuit for the sensor. Refer to the complete machine Electrical System Schematic. Check all of the connections that are in the power supply circuit and the return circuit. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joy-stick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the right steering cylinder position sensor and disconnect the machine harness connector from the left steering cylinder position sensor. Mark the harness connector for the right steering sensor.

B. Connect the marked connector for the right steering sensor to the left steering sensor connector. Connect the unmarked connector for the left steering sensor to the right steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the right steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2201 FMI 03 diagnostic code for the right steering sensor is not active. A CID 2200 FMI 03 diagnostic code for the left steering sensor is now active.

Results:

- YES – The CID 2201 FMI 03 diagnostic code is no longer active. A CID 2200 FMI 03 diagnostic code is now active. The sensor has failed.

  Repair: The right steering cylinder position sensor is the cause of the problem. Replace the right steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2201 FMI 03 diagnostic code did not change when the sensor connectors were switched. The CID 2201 FMI 03 diagnostic code is still active. There is a problem in the machine harness. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. Proceed to Test Step 3.

Test Step 3. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

Before performing this Test Step, verify that the machine harness connectors are connected to the original right and left steering cylinder position sensor connectors.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the right steering cylinder position sensor.

C. At the machine harness connector for the right steering sensor, place a jumper wire between return contact 2 (wire P967-PU(Purple)) and signal contact 3 (wire H765-WH(White)).

D. Disconnect the machine harness connectors J1 and J2 from the Implement ECM and the Transmission Chassis ECM.

E. At the Implement ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-16 (wire H765-WH(White)).

F. Obtain a spare length of wire that will reach from the Transmission Chassis ECM connectors to the steer cylinder position sensor connector.

G. At the steer cylinder position sensor connector, connect one end of the spare wire to the signal contact 3 (wire H765-WH(White)).

H. At the Transmission Chassis ECM connector J2, measure the resistance between the other end of the spare wire and the signal contact J2-16 (wire H765-WH(White)).

Expected Result:

Each of the resistance measurements is less than 5 ohms.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The signal circuit is not open. Proceed to Test Step 4.
- NOT OK – One or both of the resistance measurements is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is either not connected or is open. A resistance measurement that is greater 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but is not a good connection.

  If the circuit at one of the ECMs checks correct and the circuit at the other ECM indicates an open or a bad connection, most likely there is a problem in the machine harness on the ECM side of the splice.

  If the resistance checks both indicate an open or a bad connection, a problem in the sensor side of the splice in the machine harness is most likely causing the problem.

  Refer to the complete machine Electrical System Schematic. Verify that all connection points in the suspected part of the circuit are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The Transmission Chassis ECM harness connectors and the Implement ECM connectors remain disconnected from the machine harness.

A. Remove the spare wire that was installed in the last step.

B. At the J1 and J2 machine harness connectors for the Implement ECM, measure the resistance from the sensor signal contact J2-16 (wire H765-WH(White)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

C. If any of the resistance measurements in the last test step are less than 3000 ohms, skip the next test step and proceed to the "Expected Result" step. If all of the resistance measurements in the last test step are above 3000 ohms, perform the next test step.

D. At the disconnected J1 and J2 machine harness connectors for the Transmission Chassis ECM, measure the resistance from the sensor signal contact J2-16 (wire H765-WH(White)) to all of the other J1 and J2 contacts that are used for the Transmission Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted. Proceed to Test Step 5.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2201 FMI 03 diagnostic code is active.

Expected Result:

The CID 2201 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2201 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2201 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06215109

MID 082 - CID 2201 - FMI 04

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

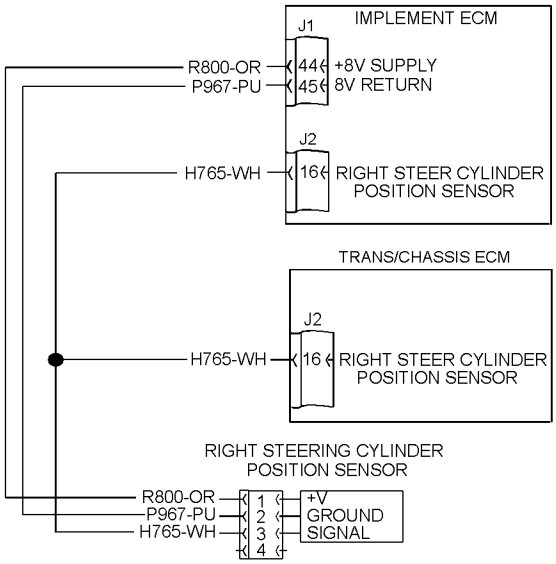


Illustration 377 g01254393

Right Steering Cylinder Position Sensor connections

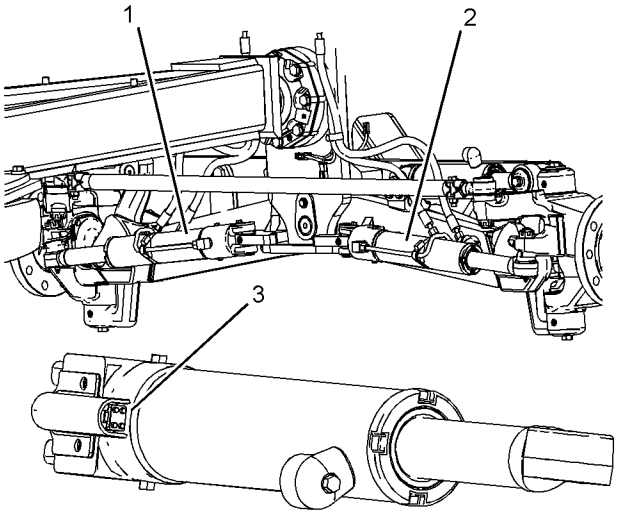


Illustration 378 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the right steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 04 diagnostic code is activated when the ECM reads the input signal from the sensor and the voltage of the signal is below normal.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

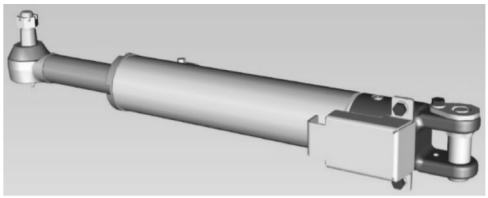


Illustration 379 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to a ground source.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Before performing this procedure, check for an active CID 0041 diagnostic code for the ECM 8 VDC sensor power supply. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the left steer cylinder position sensor. Both ECM's can activate a CID 2201 FMI 04 diagnostic code when the signal is below normal. If one ECM has activated a CID 2201 FMI 04 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM's have activated the diagnostic code, it is unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the right steering cylinder position sensor and disconnect the machine harness connector from the left steering cylinder position sensor. Mark the harness connector for the right steering sensor.

B. Connect the marked connector for the right steering sensor to the left steering sensor connector. Connect the unmarked connector for the left steering sensor to the right steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the right steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2201 FMI 04 diagnostic code for the right steering sensor is not active. A CID 2200 FMI 04 diagnostic code for the left steering sensor is now active.

Results:

- YES – The CID 2201 FMI 04 diagnostic code is no longer active. A CID 2200 FMI 04 diagnostic code is now active. The sensor has failed.

  Repair: The right steering cylinder position sensor is the cause of the problem. Replace the right steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2201 FMI 04 diagnostic code did not change when the sensor connectors were switched. The CID 2201 FMI 04 diagnostic code is still active. There is a problem in the machine harness. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR.Proceed to Test Step 2.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

Before performing this Test Step, verify that the machine harness connectors are connected to the original right and left steering cylinder position sensor connectors.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the right steering cylinder position sensor.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECMand from the Transmission Chassis ECM.

D. At the J1 and J2 machine harness connectors for the Implement ECM, measure the resistance from the sensor signal contact J2-16 (wire H765-WH(White)) to frame ground and measure the resistance to all of the other contacts that are used in the machine harness connectors of the Implement ECM.

E. At machine harness connector J2 for the Transmission Chassis ECM, measure the resistance from signal contact J2-16 (wire H765-WH(White)) to frame ground and measure the resistance to all of the contacts that are used in the machine harness connectors for the Transmission Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. The resistance measurement is indicating a short in the machine harness.

  Repair: There is a short in the machine harness between the signal circuit and the circuit with the low resistance measurement.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2201 FMI 04 diagnostic code is active.

Expected Result:

The CID 2201 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2201 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2201 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06215120

MID 082 - CID 2201 - FMI 08

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

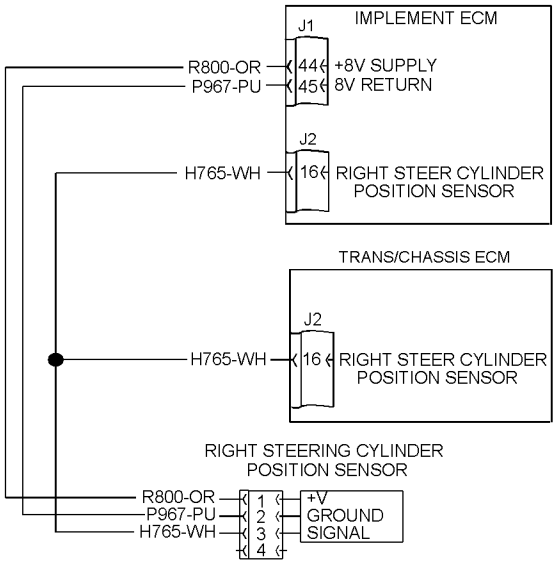


Illustration 380 g01254393

Right Steering Cylinder Position Sensor connections

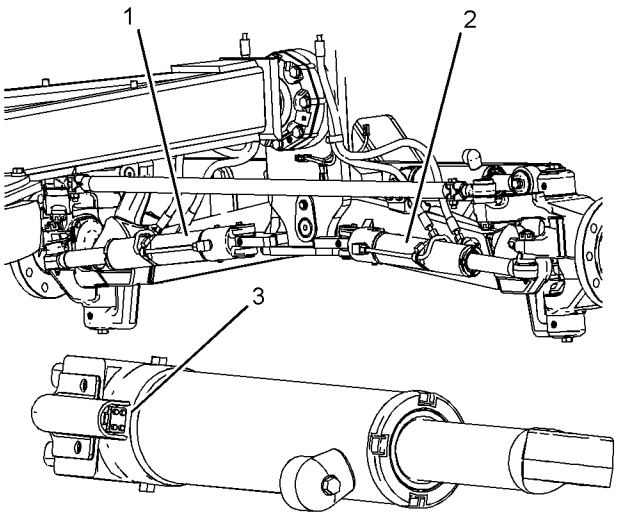


Illustration 381 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the right steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 08 diagnostic code is activated when the ECM detects that the input signal from the sensor has an abnormal frequency or pulse width.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

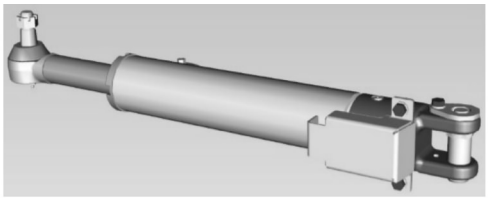


Illustration 382 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed:

- Mechanical devices in the cylinder assembly are loose.
- The sensor has failed.
- Intermittent connections or poor connections in the signal circuit.
- The ECM has failed. An ECM failure is unlikely

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the ECM 8 VDC sensor power supply. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: The Transmission Chassis ECM (MID 027) will also activate a CID 2201 FMI 08 diagnostic code when an above normal signal voltage is detected. If one ECM has activated a CID 2201 FMI 08 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, an intermittent open or a poor connection in the machine harness would be suspected. When both ECM's have activated the diagnostic code, either the sensor OR a harness problem could be the cause. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Visually inspect the mechanical connections for the right steering cylinder. Verify that all mechanical connections and adjustments for the steering cylinder are in good condition and verify that none of the mechanical connections are loose.

Expected Result:

All mechanical connections for the steering cylinder are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical connections for the steering cylinder are correct. Proceed to Test Step 2.
- NOT OK – All mechanical connections for the steering cylinder are not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the steering cylinder. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joystick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the right steering cylinder position sensor and disconnect the machine harness connector from the left steering cylinder position sensor. Mark the harness connector for the right steering sensor.

B. Connect the marked connector for the right steering sensor to the left steering sensor connector. Connect the unmarked connector for the left steering sensor to the right steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the right steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2201 FMI 08 diagnostic code for the right steering sensor is not active. A CID 2200 FMI 08 diagnostic code for the left steering sensor is now active.

Results:

- YES – The CID 2201 FMI 08 diagnostic code is no longer active. A CID 2200 FMI 08 diagnostic code is now active. The sensor has failed.

  Repair: The right steering cylinder position sensor is the cause of the problem. Replace the right steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2201 FMI 08 diagnostic code did not change when the sensor connectors were switched. The CID 2201 FMI 08 diagnostic code is still active. There is a problem in the machine harness. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. Proceed to Test Step 3.

Test Step 3. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

Before performing this Test Step, verify that the machine harness connectors are connected to the original right and left steering cylinder position sensor connectors.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the right steering cylinder position sensor.

C. At the machine harness connector for the right steering sensor, place a jumper wire between return contact 2 (wire P967-PU(Purple)) and signal contact 3 (wire H765-WH(White)).

D. Disconnect the machine harness connectors J1 and J2 from the Implement ECM and from the Transmission Chassis ECM.

E. At the Implement ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-16 (wire H765-WH(White)).

F. Obtain a spare length of wire that will reach from the Transmission Chassis ECM connectors to the steer cylinder position sensor connector.

G. At the steer cylinder position sensor connector, connect one end of the spare wire to the signal contact 3 (wire H765-WH(White)).

H. At the Transmission Chassis ECM connector J2, measure the resistance between the other end of the spare wire and the signal contact J2-16 (wire H765-WH(White)).

Expected Result:

Each of the resistance measurements is less than 5 ohms.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The signal circuit is not open. Proceed to Test Step 4.
- NOT OK – One or both of the resistance measurements is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is either not connected or is open. A resistance measurement that is greater 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but is not a good connection.

  If the circuit at one of the ECMs checks correct and the circuit at the other ECM indicates an open or a bad connection, most likely there is a problem in the machine harness on the ECM side of the splice.

  If the resistance checks both indicate an open or a bad connection, a problem in the sensor side of the splice in the machine harness is most likely causing the problem.

  Refer to the complete machine Electrical System Schematic. Verify that all connection points in the suspected part of the circuit are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2201 FMI 08 diagnostic code is active.

Expected Result:

The CID 2201 FMI 08 diagnostic code is not active.

Results:

- OK – The CID 2201 FMI 08 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2201 FMI 08 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed.

An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i06215126

MID 082 - CID 2201 - FMI 13

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

This diagnostic code is associated with the right steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 13 diagnostic code is activated when the ECM detects that the sensor needs calibration.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

CALIBRATION

A. Perform the calibration procedure for the sensor. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the sensor.

  If the second calibration procedure is not successful, replace the steer cylinder position sensor.

For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

After cylinder replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new sensor, the ECM may have failed.

Prior to replacing an ECM, always contact your local Caterpillar Dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i06215129

MID 082 - CID 2201 - FMI 14

SMCS Code: 1439-038-CD

Conditions Which Generate This Code:

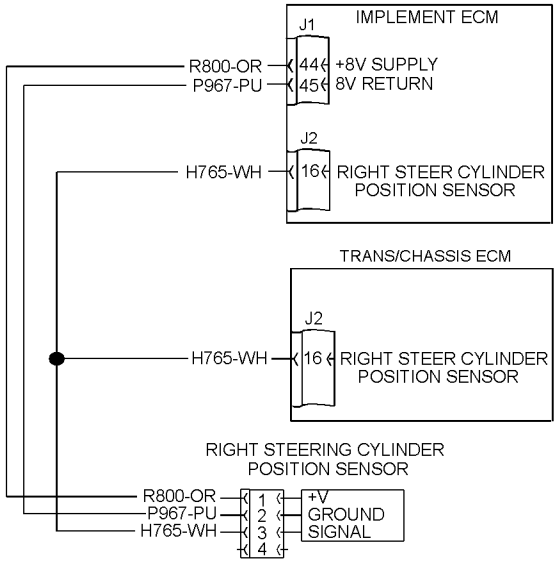


Illustration 383 g01254393

Right Steering Cylinder Position Sensor connections

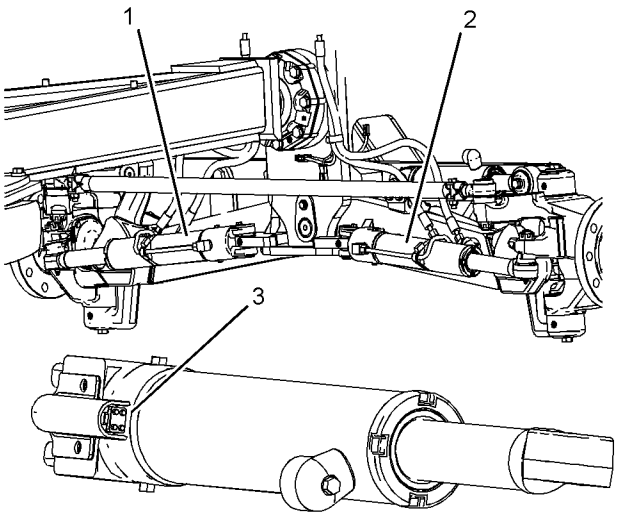


Illustration 384 g01254278

(1) Left Steering Cylinder
(2) Right Steering Cylinder
(3) Steering Position Sensor Connector on the Back Side of the Cylinders

This diagnostic code is associated with the right steering cylinder position sensor. The position sensor provides a PWM input signal to the Implement ECM and to the Transmission Chassis ECM. The FMI 14 diagnostic code is activated when the ECM detects that the sensor is not responding as expected and no external conditions that could cause this problem have been detected.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. The duty cycle of the PWM signal that is supplied to the ECM is measured in small increments. The changes in the duty cycle of the sensor cannot be measured with a digital multimeter.

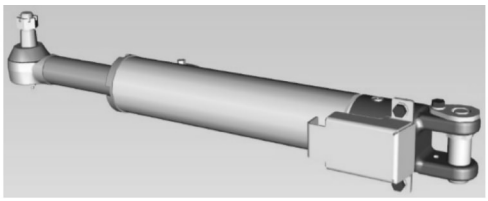


Illustration 385 g03856446

Illustration above shows new style sensor that replaces old style sensor previously shown.

The new steering cylinder position sensor can be measured using PWM signals with a meter. Acceptable PWM range is approx. 11% retracted and 76% extended. The Sensor operating frequency is 500 Hz. When the new sensor detects an internal fault, the frequency will drop to 250 Hz and the PWM duty cycle will stay at 50% even when the rod is moved.

Note: The new style sensors**do not** need to have trim files downloaded.

The new style sensor will use the existing wire harness.

The possible causes of this diagnostic code are listed:

- Mechanical devices are loose or not adjusted correctly.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the ECM 8 VDC sensor power supply. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Visually inspect the mechanical connections for the right steering cylinder. Verify that all mechanical connections and adjustments for the steering cylinder are in good condition and verify that none of the mechanical connections are loose.

Expected Result:

All mechanical connections for the steering cylinder are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical connections for the steering cylinder are correct. Proceed to Test Step 2.
- NOT OK – All mechanical connections for the steering cylinder are not correct.

Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the steering cylinder. After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

STOP.

Test Step 2. CHECK THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

⚠ WARNING

Do not start the engine when performing this step. If the engine is started, any change in joy-stick position will result in steering to maximum wheel angle. Steering to maximum wheel angle may result in severe injury or death.

A. Disconnect the machine harness connector from the right steering cylinder position sensor and disconnect the machine harness connector from the left steering cylinder position sensor. Mark the harness connector for the right steering sensor.

B. Connect the marked connector for the right steering sensor to the left steering sensor connector. Connect the unmarked connector for the left steering sensor to the right steering sensor connector.

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the active diagnostic code for the right steering sensor.

Expected Result:

When the harness connectors are switched, the CID 2201 FMI 14 diagnostic code for the right steering sensor is not active. A CID 2200 FMI 14 diagnostic code for the left steering sensor is now active.

Results:

- YES – The CID 2201 FMI 14 diagnostic code is no longer active. A CID 2200 FMI 14 diagnostic code is now active. The sensor has failed.

  Repair: The right steering cylinder position sensor is the cause of the problem. Replace the right steering cylinder position sensor.

  BEFORE REPLACING THE STEERING POSITION SENSOR, RECONNECT THE HARNESS CONNECTORS TO THE CORRECT STEERING SENSOR CONNECTORS.

  For removal of the position sensor from the steering cylinder, refer to Disassembly and Assembly, RENR 9704, “Clevis Style Cylinder Sensor - Remove and Install”.

  After sensor replacement, the new position sensor parameters MUST be entered in Cat ET before the machine can be operated. Refer to the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” section of this manual for the correct procedure.

  STOP.

- NO – The status of the CID 2201 FMI 14 diagnostic code did not change when the sensor connectors were switched. The CID 2201 FMI 14 diagnostic code is still active. There is a problem in the machine harness. ENSURE THAT THE MACHINE HARNESS CONNECTORS ARE CONNECTED TO THE CORRECT POSITION SENSOR. THE MARKED HARNESS CONNECTOR IS CONNECTED TO THE RIGHT STEERING SENSOR. THE UNMARKED HARNESS CONNECTOR IS CONNECTED TO THE LEFT STEERING SENSOR. Proceed to Test Step 3.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

Before performing this Test Step, verify that the machine harness connectors are connected to the original left and right steering cylinder position sensor connectors.

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2201 FMI 14 diagnostic code is active.

Expected Result:

The CID 2201 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 2201 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this

time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

STOP.

- NOT OK – The CID 2201 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that has activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i04715352

MID 082 - CID 2202 - FMI 12

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

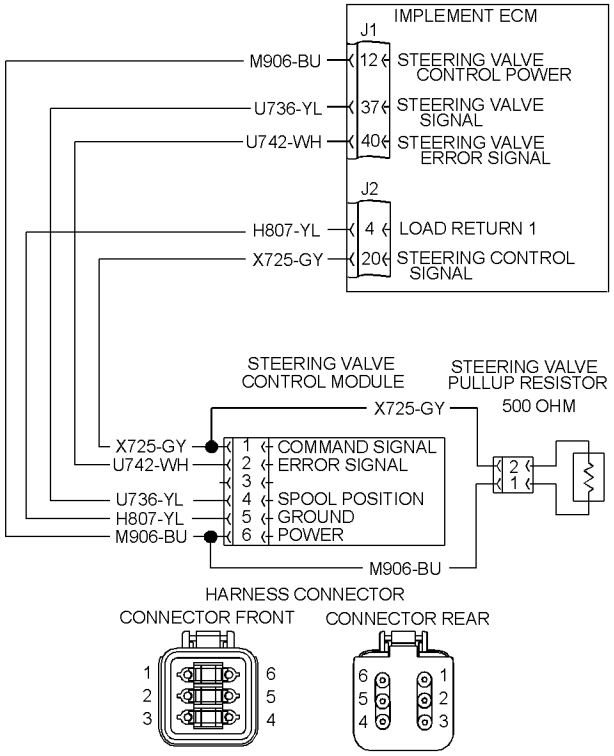


Illustration 386 g01254736

Steering Valve Control Module connections

This diagnostic code is associated with the steering valve control module error signal. The steering valve control module monitors the status of the various circuits that are connected between the Implement ECM 2 and the module. The FMI 12 diagnostic code is activated when the ECM receives an error signal from the control module. The steering valve control module has detected an abnormal condition and is not operating correctly.

The Implement ECM 2 has an internal pull-up voltage on the error signal input at contact J1-40. Under normal operating conditions, the steering valve control module holds the error signal circuit low (grounded). When an abnormal internal module condition or an external harness circuit condition is detected, the steering valve control module removes the ground from the circuit. The signal changes to a high signal at the ECM. The Implement ECM 2 detects this condition and activates the 2202 FMI 12 diagnostic code.

The following conditions could cause the steering control module to activate this diagnostic code:

- The power supply circuit for the steering valve control module has failed (CID 2650).
- The error signal circuit is open or is shorted to a voltage source in the machine harness.
- The steering control signal is shorted in the machine harness.
- There is a short to the spool position sensor signal circuit (CID 2203).
- There is a mechanical problem in the steering control valve.
- The steering valve control module has failed.
- The ECM may have failed, but is unlikely.

Note: When the steering control system is enabled, the Implement ECM 2 supplies system power for the steering valve control module. The power is supplied through an ON/OFF driver at contact J1-12. Before performing this procedure, check for an active CID 2650 diagnostic code for the Implement ECM 2 output power for the steering valve control module. Correct any problem with the power supply before performing this procedure.

Note: Before performing the procedure, verify that there are no active CID 2650 diagnostic codes for the steering valve control module power supply. Also verify that there are no active CID 2203 diagnostic codes for the steering valve spool position sensor. Correct and clear any active CID 2203 or CID 2650 diagnostic codes before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. The 70 pin connector that passes the chassis circuits through the bulkhead at the front of the cab should be inspected for poor connections. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE POWER SUPPLY CIRCUIT AND THE RESISTOR CIRCUIT FOR AN OPEN

A. Turn the key switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the steering valve control module. Inspect all of the harness connectors and clean the contacts of the harness connectors that are involved in the steering valve control circuits. Check the wires for damage to the insulation that can be caused by excessive heat or chafing.

C. Disconnect the machine harness connector for the steering valve pull up resistor. At the connector for the resistor, measure the resistance between contact 1 and contact 2.

D. At the machine harness connector for the steering valve pull up resistor, connect a jumper wire between contact 1 and contact 2.

E. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

F. At the Implement ECM 2 connectors, measure the resistance between power supply contact J1-12 (wire M906-BU(Blue)) and control signal contact J2-20 (wire X725-GY(Grey)).

G. While observing the resistance measurement, wiggle the machine harness connectors for the ECM and for the steering valve control module. Wiggle the wires and move the wires around.

Expected Result:

Resistance measurement across the resistor is 500 ± 50 ohms.

Resistance measurement between ECM contacts J1-12 and J2-20 remains less than 5.0 ohms at all times during manipulation of the harness connectors.

Results:

- YES – The resistance measurement across the resistor is 500 ± 50 ohms. The resistance measurement between the ECM contacts J1-12 and J2-20 is less than 5.0 ohms. The resistor circuit, the signal control circuit, and the power circuit are not open in the machine harness. Proceed to Test Step 2.
- NO – One or both of the resistance measurements are not correct. There is either a problem with the pull up resistor or the circuit resistance measurement is greater than 5.0 ohms.

  Repair: If the resistance of the pull up resistor is not in the correct resistance range, replace the pull up resistor. After replacing the resistor, verify that the new resistor corrected the problem.

If the resistance measurement between ECM contacts J1-12 and J2-20 is greater than 5.0 ohms, further resistance measurements are required. The additional measurements are needed in order to isolate the open circuit section in the machine harness.

Resistance measurements greater than 5 ohms, but less than 5000 ohms indicate a connection is not open, but is not a good connection. Resistance measurements greater than 5000 ohms indicate that a wire is either not connected or is open in the machine harness.

Check the continuity of the resistor circuit individually. Check the continuity of the control signal circuit connector contact 1 (wire X725-GY(Grey)) and the power circuit connector contact 6 (wire M906-BU(Blue)) individually in order to isolate the open or poor connection in the circuit.

Once the problem has been isolated, refer to the complete machine Electrical System Schematic. Verify that all connection points in the suspected part of the circuit are clean, secure and in good condition.

Check the 70 pin connector that passes the circuits through the bulkhead at the front of the cab. Verify that the connections for suspect circuit are clean, secure and in good condition.

Repair the machine harness or replace the machine harness.

STOP.

Test Step 2. CHECK THE GROUND CIRCUIT AND THE ERROR SIGNAL CIRCUIT FOR AN OPEN

The key switch and the disconnect switch remain in the OFF position. The machine harness connectors from the steering valve control module and the Implement ECM 2 remain disconnected.

A. At the machine harness connector for the steering valve control module, connect the jumper wire that was used in the last test step between ground contact 5 (wire H807-YL(Yellow)) and error signal contact 2 (wire U742-WH(White)).

B. At the Implement ECM 2 connectors, measure the resistance between return contact J2-4 (wire H807-YL(Yellow)) and error signal contact J1-40 (wire U742-WH(White)).

C. While observing the resistance measurement, wiggle the machine harness connectors for the ECM and for the steering valve control module. Wiggle the wires and move the wires around.

Expected Result:

The resistance measurement is less than 5.0 ohms at all times during the manipulation of the wires and harness connectors.

Results:

- YES – The resistance measurement is less than 5.0 ohms. The error signal circuit and the return circuit are not open in the machine harness. Proceed to Test Step 3.
- NO – The resistance measurement is greater than 5.0 ohms. There is an open or a bad connection in one of the circuits.

  Repair: Further resistance measurements are required in order to isolate the circuit that has the open or the poor connection.

  Resistance measurements greater 5 ohms but less than 5000 ohms indicate that a connection point is not open, but is not a good connection. Resistance measurements greater than 5000 ohms could indicate a wire is either not connected or is open in the machine harness.

  Check the resistance of each circuit individually. Check the continuity of the return circuit (connector contact 5 (wire H807-YL(Yellow)) and the error signal circuit (connector contact 2 (wire U742-WH(White)) individually in order to isolate the open or poor connection in the circuit.

  Once the problem has been isolated, refer to the complete machine Electrical System Schematic. Verify that all connection points in the suspected part of the circuit are clean, secure and in good condition.

  Check the 70 pin connector that passes the circuits through the bulkhead at the front of the cab. Verify that the connections for suspect circuit are clean, secure and in good condition.

  Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE ERROR AND CONTROL SIGNAL CIRCUITS FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors from the steering valve control module and the Implement ECM 2 remain disconnected.

A. At the J1 machine harness connector for the Implement ECM 2, measure the resistance between the error signal contact J1-40 (wire U742-WH(White)) and frame ground. measure the resistance between the error signal contact J1-40 (wire U742-WH(White)) and all of the other J1 and J2 contacts that are used on the Implement ECM 2 connectors.

B. At the J2 machine harness connector for the Implement ECM 2, measure the resistance between the steer control signal contact J2-20 (wire X725-GY(Grey)) and frame ground. Measure the resistance between the steer control signal contact J2-20 (wire X725-GY(Grey)) and all of the other J1 and J2 contacts that are used on the Implement ECM 2 connectors.

Expected Result:

Each of the resistance measurements for both circuits is greater than 5000 ohms.

Results:

- YES – Each of the resistance measurements for both circuits are greater than 5000 ohms. The resistance measurements are not indicating that there is a short in the control signal circuit or the error signal circuit.Proceed to Test Step 4.

- NO – One or more resistance measurements is less than 5000 ohms. There is a short in one or both of the circuits.

  Repair: There is a short in the control signal circuit or the error signal circuit. The short is between the two circuits that measure the low resistance between each other or between the measured circuit and frame ground.

  Refer to the complete machine Electrical System Schematic. Examine all of the suspect circuits for points in the machine harness where the circuits could be shorted.

  Examine all of the connectors in the suspect circuits for moisture or dirt contamination. Verify that all of the contacts in the connectors are clean, dry and in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect and clean the harness connectors. Check the wires for damage to the insulation that can be caused by excessive heat, battery acid, or chafing.

B. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are securely fastened.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 2202 FMI 12 diagnostic code is active.

Expected Result:

The CID 2202 FMI 12 diagnostic code is not active.

Results:

- YES – The CID 2202 FMI 12 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NO – The CID 2202 FMI 12 diagnostic code is active. The diagnostic code has not been corrected.Proceed to Test Step 5.

Test Step 5. CHECK THE CONTROL SIGNAL

Note: When the Implement ECM 2 activates the CID 2202 FMI 12 diagnostic code: The ECM turns OFF the power to the steering valve control module at contact J1-40. Is not possible to check any of the valve control signals, to verify that the voltage is correct, with the power off. Short the ECM error signal pin to ground. The short there will allow the ECM to supply power to the steering valve control module, to verify that the voltage is correct.

The disconnect switch and the key start switch remain in the OFF position.

A. Inspect and clean all machine harness connectors for the Implement ECM 2 and for the steering valve control module. Reconnect the machine harness connectors to the ECM and the steering valve control module.

B. Verify that the CID 2202 FMI 12 diagnostic code is still active.

C. At the machine harness connector J1 for the Implement ECM 2, use a 151-6320 Removal Tool to remove the error signal wire U742-WH(White) and socket at contact J1-40 from the harness connector. The J1 connector remains connected to the Implement ECM 2.

D. Through the vacant space in the J1 connector, connect a jumper wire from ECM pin J1-40 to frame ground.

E. This probe or jumper wire must remain connected during the rest of this procedure.

F. Turn the disconnect switch and the key start to the ON position.

G. With the jumper wire connected to frame ground and the ECM pin J1-40, the CID 2202 FMI 12 diagnostic code should no longer be active. If the diagnostic code is still active, verify that the jumper wire is securely connected to the ECM pin and to frame ground. If the CID 2202 FMI 12 diagnostic code is still active, there is a problem with the ECM. Proceed to the “Results” section below. If the CID 2202 FMI 12 diagnostic code is no longer active, proceed to the next step.

H. Start the engine. Run the engine at low idle speed.

I. Enable the steering system. The steering system must be enabled in order to check the voltage of the control signal.

J. Measure the supply voltage. At the back of the harness connector for the control module, insert 7X-1710 Multimeter Probes along supply contact 6 (wire M906-BU(Blue)) and along return contact 5 (wire H807-YL(Yellow)). Record the supply voltage.

K. Measure the control signal voltage. At the back of the harness connector for the steering valve control module, insert 7X-1710 Multimeter Probes along control signal contact 1 (wire X725-GY(Grey)) and along return contact 5 (wire H807-YL(Yellow)).

L. While observing the voltage measurement, move the left joystick to the full left steer position, the full right steer position and several positions in between.

Expected Result:

Acceptable power supply voltages are between 8.5 to 36.0 VDC. However, the supply voltage should be between 23.0 to 27.0 VDC.

The voltage range of the control signal is dependent on the power supply voltage. The voltage of the control signal must be between 15 percent and 85 percent of the voltage that the ECM is supplying as operating power.

With ECM supply voltage at 27.0 VDC: The control signal voltage must be between 4.0 VDC and 23.0 VDC during movement of the left joystick.

With the left joystick stationary at any position: The voltage should be approximately 50 percent of the supply voltage, or 13.5 VDC, at 27.0 VDC supply voltage.

Results:

- YES – With the ECM pin J1-40 connected to frame ground and the CID 2202 FMI 12 diagnostic code no longer active: The voltage of the power supply is in the correct range and the voltage of the control signal circuit is in the correct range. The ECM has responded correctly and the steering control module is producing the correct control signal voltage. The electrical components that are in the steering control system are working correctly.

  Repair: The mechanical components of the steering valve could be causing the problem. For a check of the valve, run a secondary steering test in order to check the operation of the valve.

  When active, the secondary steering system will bypass the electrical components used in the primary steering system. However, the secondary steering system uses the same steering valve.

  STOP.

- NO – The CID 2202 FMI 12 diagnostic code is still active with the jumper wire connected to frame ground and the ECM pin J1-40. The ECM has not responded correctly to the grounded circuit condition.

  Repair: Contact your dealership Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The voltage of the control signal is not between 15 percent and 85 percent of the ECM supply voltage for the steering module. There is a problem with the control signal circuit.

Repair: Verify that there are no active steering module diagnostic codes remaining. Not for the steering module power supply, CID 2650, and not for the spool position sensor, CID 2203. If any of those CID's are active, investigate and clear all, before investigating the CID 2202 FMI 12 diagnostic.

The steering valve control module may have failed.

Contact your dealership Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. Replace the steering valve control module if no cause for the active CID 2202 FMI 12 diagnostic code can be found.

STOP.

i02990221

MID 082 - CID 2203 - FMI 03

SMCS Code: 7610-038-II

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Conditions Which Generate This Code:

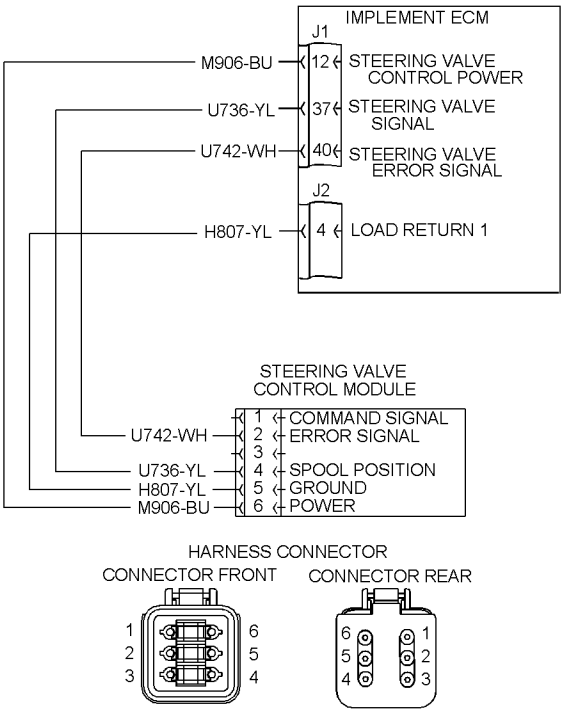


Illustration 387 g01271458

Connections of “Steering Valve Control Module Spool” position sensor

This diagnostic code is associated with the “steering valve control module spool” position sensor. The sensor provides an input to the Implement ECM. The position sensor is located in “steering valve” control module.

The FMI 03 means that the ECM has detected that the voltage of the sensor signal circuit is above normal.

The sensor for the “steering valve control module” spool position supplies an analog voltage signal to the ECM in order to indicate the position of the valve spool in the steering control module. The voltage of the signal will range from 1.25 VDC to 3.75 VDC. When the joystick is stationary and the spool is in the center position, a signal of between 2.2 VDC to 2.8 VDC (or approximately 2.5 VDC) will be supplied to the ECM.

The possible causes of this diagnostic code are listed:

- There is a problem with the power supply circuit for the steering control module.
- The signal circuit is open or the sensor is disconnected.
- The signal circuit is shorted to another voltage source.

- The position sensor has failed.
- The ECM has failed. This is unlikely.

Note: The Implement ECM supplies system power for the steering valve control module through an “ON/OFF” driver at contact J1-12. Before performing this procedure, check for an active CID 2650 diagnostic code from the output power of the Implement ECM for the control module of the steering valve. Correct any problem with the power supply before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. The 70 pin connector that passes the chassis circuits through the bulkhead at the front of the cab should be inspected for poor connections. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: Certain conditions that can cause the Implement ECM to activate a CID 2203 diagnostic code can also cause the Implement ECM to activate a CID 2202 FMI 12 (Steering Valve Control Module - bad component). If this occurs, correct the problem that is causing the CID 2203 diagnostic code before investigating the CID 2202 FMI 12 diagnostic code.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE VOLTAGE OF THE SENSOR SIGNAL AT THE SENSOR

Note: Certain conditions that cause the Implement ECM to activate the CID 2203 FMI 03 diagnostic code can also cause the Implement ECM to activate the CID 2202 FMI 12 (steering valve - bad component) diagnostic code. When this occurs, the ECM will turn OFF the output that supplies power to the “steering valve” control module at contact J1-12. If the CID 2202 FMI 12 diagnostic code is active, it is not possible to check the voltages of any of the control signals in order to verify that the voltage is correct. In this test step we will short the ECM error signal pin to ground in order to allow the ECM to supply power to the steering valve control module if the CID 2202 FMI 12 diagnostic code is active.

A. Verify that a CID 2202 FMI 12 diagnostic code is active. If a CID 2202 FMI 12 diagnostic code IS active, proceed to the next step. If the CID 2202 FMI 12 diagnostic code is NOT active, proceed to step “F” .

B. At the machine harness connector J1 for the Implement ECM, use a 151-6320 Removal Tool to remove the error signal wire U742-WH(White) and the socket at contact J1-40 from the harness connector. The J1 connector remains connected to the Implement ECM.

C. Using a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar jumper wire device, connect one end to the ECM pin at J1-40 through the empty space in the J1 connector.

D. Connect the other end of the jumper wire to frame ground. This probe or jumper wire must remain connected during the rest of this procedure.

E. Turn the disconnect switch and the key start switch to the ON position. With the jumper wire connected to the frame (ground) and the ECM pin J1-40, the CID 2202 FMI 12 diagnostic code should no longer be active.

F. At the machine harness connector for the steering control module, use a 151-6320 Removal Tool to remove the “spool position” signal wire U736-YL(Yellow) and socket at contact 4 from the harness connector. The machine harness connector remains connected to the steering control module.

G. Start the engine. Run the engine at low idle speed.

H. Enable the steering system. The steering system must be enabled in order to check the signal voltage.

I. At the harness connector for the control module, insert a 7X-1710 Multimeter Probe along return contact 5 (wire H807-YL(Yellow)). Insert the other multimeter probe through the empty space at contact 4 in order to contact the pin on the connector of the steering module.

J. While moving the left joystick to different steer positions, measure the voltage between contact 4 to contact 5.

Expected Result:

The voltage measurement is in the range that is described at the beginning of this procedure.

Results:

- OK – The voltage measurement is in the range that is described at the beginning of this

procedure. The voltage of the “spool position” sensor signal is correct. Before proceeding to the next test step, install the “spool position” signal wire U736-YL(Yellow) and the socket back into contact 4 of the harness connector for the steering control module.Proceed to Test Step 2.

- NOT OK – The voltage measurement is not in the range that is described at the beginning of this procedure. The signal voltage is not correct.

  Repair: Verify that there are no active CID 2202 or CID 2650 diagnostic codes and that the steering system is enabled.

  Verify that the multimeter probes are making good connections on return contact 5 and on spool position contact 4 at the module connector. Measure the voltage of the signal again.

  If the voltage measurement is not in the correct range, the steering control module may have failed.

  Prior to replacing the “steering valve” control module, contact your dealership's Technical Communicator for possible consultation with Caterpillar.

  STOP.

Test Step 2. CHECK THE VOLTAGE OF THE SENSOR SIGNAL AT THE ECM

If used in the last test step, the jumper wire that is connected between the frame ground and the Implement ECM contact at J1-40 remains connected.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the back of the J1 harness connector for the Implement ECM, insert 7X-1710 Multimeter Probes along “spool position” signal contact J1-37 (wire U736-YL(Yellow)) and along return contact J2-4 (wire H807-YL(Yellow)).

C. Turn the disconnect switch to the ON position and start the engine. Run the engine at low idle speed.

D. Enable the steering system. The steering system must be enabled in order to check the signal voltage.

E. While moving the left joystick to different steer positions, measure the voltage between contact J1-37 to contact J2-4.

Expected Result:

The voltage measurement is in the range that is described at the beginning of this procedure.

Results:

- OK – The voltage measurement is in the range that is described at the beginning of this procedure. The signal voltage of the “spool position” sensor is correct. Before proceeding to the next test step, if a jumper wire was connected, remove the jumper wire and reconnect the error signal wire back to the correct location at the ECM connector J1-40.Proceed to Test Step 5.

- NOT OK – The voltage measurement is not in the range that is described at the beginning of this procedure. The signal voltage is not correct. Before proceeding to the next test step, if a jumper wire was connected, remove the jumper wire and reconnect the error signal wire back to the correct location at the ECM connector J1-40.Proceed to Test Step 3.

Test Step 3. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the connector of the machine harness from the “steering valve” control module.

C. At the machine harness connector for the steering valve control module, place a jumper wire between return contact 5 (wire H807-YL(Yellow)) and spool signal contact 4 (wire U736-YL(Yellow)).

D. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

E. At the Implement ECM, measure the resistance from return contact J2-4 (wire H807-YL(Yellow)) to signal contact J1-37 (wire U736-YL(Yellow)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The signal circuit is not open in the circuit.Proceed to Test Step 4.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit for the Implement ECM.

  Repair: A measurement of the resistance that is greater than 5000 ohms could indicate that a wire is not connected or that a wire is open. A resistance measurement that is greater 5 ohms but less than 5000 ohms could indicate that one

of the connection points in the circuit is not an open connection but that the connection is not good.

Refer to the complete Electrical System Schematic of the machine. Verify that all connection points in the suspected part of the circuit are clean, that all connections are secure and that all connections are in good condition.

Check the 70 pin connector that passes the circuits through the bulkhead at the front of the cab. Verify that the connections for the “spool position” circuit are clean, that the connections are secure and that the connections are in good condition.

Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

The machine harness connectors J1 and J2 for the Implement ECM remain disconnected.

The machine harness connector remains disconnected from the control module of the steering valve.

A. At the J1 machine harness connector for the Implement ECM, measure the resistance from the spool position signal contact J1-37 (wire U736-YL(Yellow)) to all of the other J1 and J2 contacts that are used on the Implement ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurements are not indicating that there is a short in the circuit. Proceed to Test Step 6.
- NOT OK – One or more resistance measurements is less than 5000 ohms. The signal circuit is shorted to another circuit.

  Repair: There is a short in the machine harness. The short is between the spool position signal circuit wire U736-YL(Yellow) and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in circuits for points in the machine harness where the circuits could be shorted. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position.

A. Reconnect the machine harness connector to the “steering valve” control module.

B. Reconnect the machine harness connectors J1 and J2 to the Implement ECM.

C. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the spool position signal wire U736-YL(Yellow) and the socket at contact J1-37 from the harness connector. The J1 connector remains connected to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-37 through the empty space in the J1 connector.

F. Observe the status of the active CID 2203 FMI 03 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2203 FMI 03 diagnostic code is no longer active. A CID 2203 FMI 04 diagnostic code becomes active when the ECM pin at J1-37 is grounded.

Results:

- YES – The CID 2203 FMI 03 diagnostic code is no longer active. A CID 2203 FMI 04 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition. The ECM is not the most likely cause of the problem.Reinstall the disconnected signal wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 6.

- NO – The CID 2172 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the spool position circuit is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 6. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that can be caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2203 FMI 03 diagnostic code is active.

Expected Result:

The CID 2203 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2203 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2203 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06684224

MID 082 - CID 2203 - FMI 03

SMCS Code: 7610-038-II

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

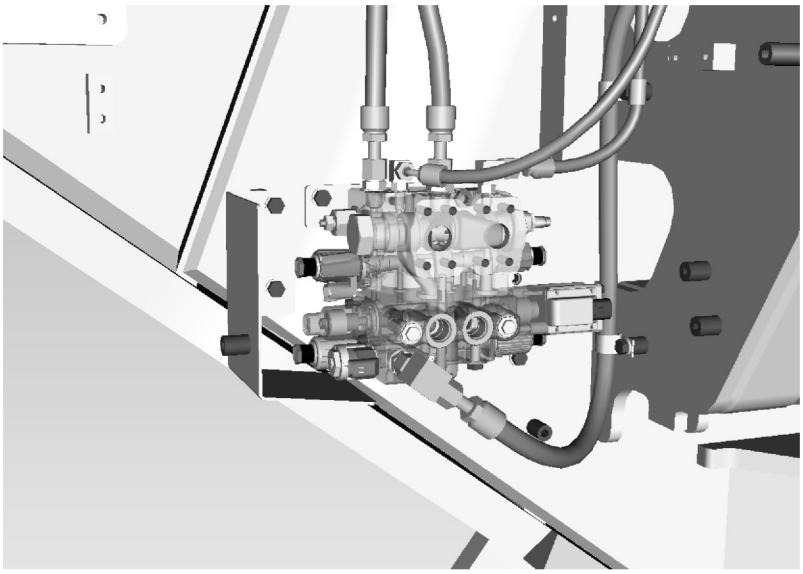


Illustration 388 g03385664

Steering Control Valve which is located in front of the cab on the left-hand side of the machine.

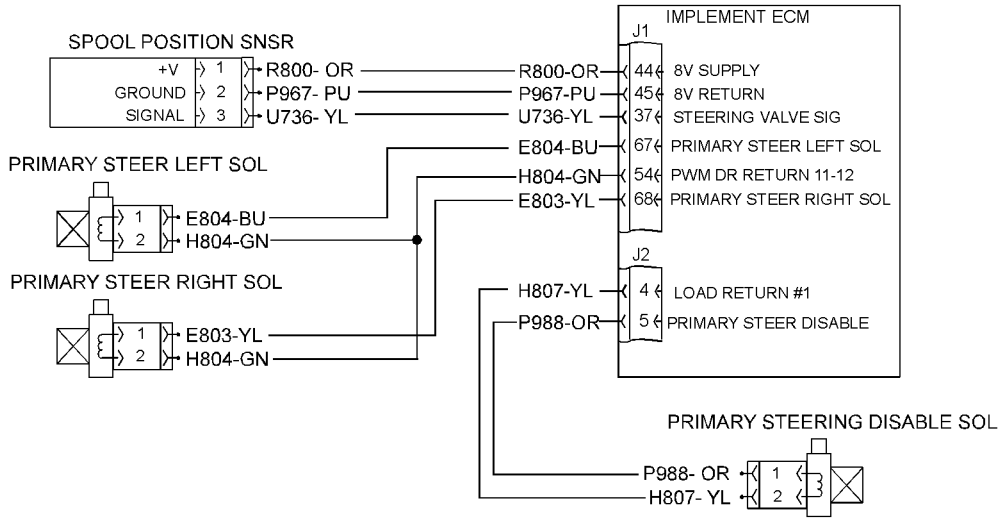


Illustration 389 g06075256

Primary Steering Valve Spool Displacement Line Sensor circuit connections

The CID 2203 diagnostic code is associated with the Primary Steering Valve Spool Displacement Line (steer valve spool position sensor). The Implement ECM will use the voltage input signal from the sensor to determine whether the steering control valve spool is operating as expected.

The FMI 03 indicates that the ECM has detected that the voltage of the input signal is above the high voltage threshold.

The Implement ECM monitors the signal circuit from the steer valve spool position sensor for diagnostics at all machine speeds.

At travel speeds below 7 km/h (4.3 mph), the ECM will use the valve spool position status to determine if the valve spool is responding as expected to the current commands that are being sent to the steer solenoid valves. The spool position feedback is not used for control of the steering system.

During steering operation, a probe on the end of the valve spool moves in and out of the position sensor. The sensor sends an analog voltage signal to the ECM on the signal circuit. As the position of the spool changes, the voltage of the signal changes.

When the sensor is powered, the ECM expects the voltage of the signal circuit to be in the range of 0.1 VDC to 4.9 VDC. When the left joystick is stationary in any position, the ECM expects the sensor signal voltage to be 2.5 ± 0.3 VDC.

When the joystick is moved to the right on the steering axis, the voltage of the signal circuit will decrease toward the 0.1 VDC end of the range. When the joystick is moved to the left on the steering axis, the voltage of the signal circuit will increase toward the 4.9 VDC end of the range.

When the joystick is stationary in any position on the steering axis, the voltage of the signal should return to the neutral range of 2.5 ± 0.3 VDC.

The possible conditions that could cause the Implement ECM to activate the CID 2203 FMI 03 diagnostic code are listed:

- The power supply for the position sensor has been interrupted.
- There is an open or a poor connection in the sensor signal circuit.
- The sensor signal circuit is shorted to another voltage source.
- The probe on the end of the valve spool is not installed.
- The steer valve spool position sensor is faulty.
- The ECM has failed or the operating software is not the latest version. ECM failure is the least likely cause.

Note: The Implement ECM 8 VDC power supply is also used to power the Right Steer Cylinder Position Sensor, the Lift cylinder Pressure Sensors (if equipped), the Secondary Steer Pressure Sensor, and the joystick axis position sensors 1 and 2. If the ECM has also activated an FMI 03 diagnostic code for all these components, the most likely cause is an open or poor connection near the ECM or a problem with the power supply. Refer to the MID 082, CID 0041 troubleshooting procedures to verify correct operation of the power supply.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections or contamination in a connector can often be the cause of a problem in an electrical circuit. Ensure that the circuit connections are clean, dry, and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may cause other diagnostic codes to be activated. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected. Ensure that the CID 2203 FMI 03 diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE POWER SUPPLY FOR THE POSITION SENSOR

A. Turn the key start switch and disconnect switch to the OFF position.

B. At the steer valve spool position sensor, disconnect the harness connector from the sensor connector.

C. Turn the key start switch and disconnect switch to the ON position.

D. At the harness connector, measure the DC voltage between power circuit contact 1 (wire R800-OR(Orange)) and ground contact 2 (wire P967-PU(Purple)).

Expected Result:

The voltage measurement is in the range of 8 ± 0.4 VDC.

Results:

- OK – The voltage is in the range of 8 ± 0.4 VDC. The power and ground circuits for the sensor are correct.Proceed to Test Step 3.
- NOT OK – The voltage is not in the range of 8 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: There is most likely an open or a poor connection between the sensor connector and the splice point in the harness. Start at the harness connector for the sensor. Follow the harness back toward the ECM. Check the power and ground circuits at each harness connector to determine where the problem is located.

  Resolve the problem with the sensor power supply and check the status of this diagnostic code.

Proceed to test step 6.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR SIGNAL CIRCUIT

The harness connector remains disconnected from the sensor connector.

A. Turn the key start switch and disconnect switch to the OFF position.

B. At the harness connector, connect a jumper wire between the power supply return contact 2 (wire P967-PU(Purple)) and the signal contact 3 (wire U736-YL(Yellow)).

C. Turn the key start switch and disconnect switch to the ON position. Observe the status of the CID 2203 FMI 03 diagnostic code.

Expected Result:

The CID 2203 FMI 03 diagnostic code is no longer active. A CID 2203 FMI 04 diagnostic code has been activated by the ECM.

Results:

- YES – A CID 2203 FMI 04 diagnostic code is now active. The Implement ECM has detected the grounded sensor signal circuit. The indication is that the sensor signal circuit is not open or does not have a poor connection. The ECM or the signal circuit is most likely not causing the problem.Proceed to Test Step 3.

- NO – The CID 2203 FMI 04 diagnostic code remains active. The status of the active diagnostic code does not change when the signal wire is grounded.

  Repair: Either the signal circuit is open or has a poor connection or the ECM could be failing to detect the grounded circuit.

  Proceed to Test Step 4. to check the operation of the ECM. If the ECM operation checks correct in step 4, the signal circuit wire is open or has a poor connection. Repair or replace the sensor signal circuit.

Test Step 3. CHECK THE OPERATION OF THE STEER VALVE SPOOL POSITION SENSOR

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Reconnect the harness connector to the position sensor.

C. At the harness connector for the position sensor, use spoon type multimeter probes to check the DC voltage of the position sensor. At the back of the harness connector for the sensor, Insert the positive probe along the signal contact 3 wire U736-YL(Yellow). Insert the negative probe along the power supply return contact 2 wire P967-PU(Purple). Ensure that the probes are in good contact with the wire contacts.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Do not move the left steering joystick. Observe the sensor signal voltage.

Expected Result:

When the left joystick is stationary in any position, the sensor signal voltage measures in the range of 2.5 ± 0.3 VDC.

Results:

- YES – The voltage measurement is in the range of 2.5 ± 0.3 VDC. The position sensor signal voltage is correct.Proceed to Test Step 4.

- NO – With the steering joystick stationary, the voltage measurement is not in the range of 2.5 ± 0.3 VDC. The position sensor signal voltage is not correct.

  Repair: Replace the steer valve spool position sensor. After replacement of the sensor, verify that diagnostic code is no longer active. Verify that the steering system is correct before operating the machine.

  STOP.

Test Step 4. CHECK THE OPERATION OF THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the harness connector J1 for the Implement ECM, use a 151-6320 Removal Tool to remove the sensor signal circuit wire U736-YL(Yellow)and the socket at contact J1-37 from the harness connector. The J1 harness connector remains connected to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Use a 7X-1710 Multimeter Probe or a similar device that is not connected to a multimeter to contact the ECM pin at J1-37 through the empty space in the J1 connector.

E. While observing the status of the active CID 2203 FMI 03 diagnostic code, ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2203 FMI 03 diagnostic code is no longer active. A CID 2203 FMI 04 diagnostic code becomes active when the ECM pin at J1-37 is grounded.

Results:

- YES – A CID 2203 FMI 04 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the circuit. The ECM is most likely not the cause of the problem.Install the enable circuit wire and socket in the original location in the J1 harness connector. Proceed to Test Step 5.

- NO – The CID 2203 FMI 03 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the enable circuit is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the enable circuit. The operation of the ECM is not correct.

  Ensure that the latest version of software is loaded on the Implement ECM.

  If the software is not the latest version, flash the latest version of software to the Implement ECM.

  If the diagnostic code remains active after flashing the latest software version to the ECM, the ECM could be causing the problem.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 5. CHECK THE CIRCUIT FOR A SHORT

The sensor harness connector remains disconnected.

A. Remove the jumper wire that was connected in the last step.

B. At the Implement ECM, disconnect the harness connectors J1 and J2.

C. Turn the disconnect switch and the key start switch to the ON position.

D. At the disconnected J1 harness connector, measure the resistance between the sensor signal contact J1-37 (wire U736-YL(Yellow)) and each individual circuit contact that is used in the J1 and J2 harness connectors.

Expected Result:

Each individual measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The measurements indicate that the signal circuit is not shorted to any of the circuits in the Implement ECM harness. Perform the same resistance checks between the feedback circuit and the other ECM circuits to rule out a short to a circuit in another harness.If a short circuit is not found, proceed to Test Step 6.

- NOT OK – At least one of the resistance measurements is less than 5000 ohms. There is a short circuit between the sensor signal circuit wire U736-YL(Yellow)and the circuit that measured the low resistance.

  Repair: Determine which circuit is causing the short. Repair the machine harness or replace the machine harness

  STOP.

Test Step 6. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and key start switch to the OFF position.

B. Reconnect any harness connectors that were disconnected and checked.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Determine if the CID 2203 FMI 03 diagnostic code is active.

Expected Result:

The CID 2203 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2203 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code could have been caused by a poor connection or a momentary condition that reset when the machine was restarted. Resume normal operation

STOP.

- NOT OK – The CID 2203 FMI 03 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Ensure that all possible causes of this diagnostic code have been investigated.

  If a cause of this problem cannot be found, contact the Dealer Solutions Network (DSN) for consultation with company personnel concerning this problem. Indicate the steps that have been taken and the results that have been observed.

  The DSN personnel will provide instruction on the next action that is required to resolve this problem.

  STOP.

i02990250

MID 082 - CID 2203 - FMI 04

SMCS Code: 7610-038-II

S/N: B921–368

S/N: R9A1–Up

S/N: R9B1–Up

S/N: B9C1–Up

S/N: R9C1–Up

S/N: B9D1–4762

S/N: B9E1–1143

S/N: B9F1–Up

S/N: B9G1–Up

S/N: D9G1–1585

S/N: B9H1–Up

S/N: R9H1–Up

S/N: B9J1–Up

S/N: R9J1–Up

S/N: B9L1–Up

S/N: B9M1–Up

S/N: B9N1–Up

S/N: B9R1–Up

S/N: B9T1–Up

S/N: D9T1–1438

S/N: B9W1–Up

S/N: D9W1–Up

Conditions Which Generate This Code:

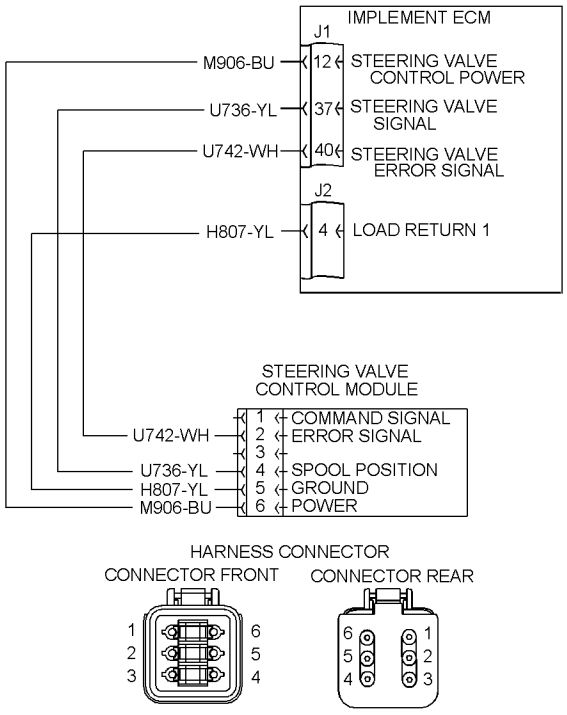


Illustration 390 g01271458

Connections of “Steering Valve Control Module Spool” position sensor

This diagnostic code is associated with the “steering valve control module spool” position sensor. The sensor provides an input to the Implement ECM. The position sensor is located in “steering valve” control module.

The FMI 04 means that the ECM has detected that the voltage of the signal circuit is below normal.

The “steering valve control module spool” position sensor supplies an analog voltage signal to the ECM modules in order to indicate the position of the valve spool. The voltage of the signal will range from 1.25 VDC to 3.75 VDC. When the joystick is stationary and the spool is in the center position, a signal of between 2.2 VDC to 2.8 VDC (approximately 2.5 VDC) will be supplied to the ECM.

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to a ground source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: The Implement ECM supplies 24 VDC power for the “steering valve” control module through an “ON/OFF” driver at contact J1-12. Before performing this procedure, check for an active CID 2650 diagnostic code from the output power of the Implement ECM for the control module of the steering valve . Correct any problem with the power supply before performing this procedure.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. The 70 pin connector that passes the chassis circuits through the bulkhead at the front of the cab should be inspected for poor connections. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: Certain conditions that can cause the Implement ECM to activate a CID 2203 diagnostic code can also cause the Implement ECM to activate a CID 2202 FMI 12 (Steering Valve Control Module - bad component). If this occurs, correct the problem that is causing the CID 2203 diagnostic code before investigating the CID 2202 FMI 12 diagnostic code.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE VOLTAGE OF THE SENSOR SIGNAL AT THE STEERING MODULE

Note: Certain conditions that cause the Implement ECM to activate the CID 2203 FMI 03 diagnostic code can also cause the Implement ECM to activate the CID 2202 FMI 12 (steering valve - bad component) diagnostic code. When this occurs, the ECM will turn OFF the output that supplies power to the “steering valve” control module at contact J1-12. If the CID 2202 FMI 12 diagnostic code is active, it is not possible to check the voltages of any of the control signals in order to verify that the voltage is correct. In this test step we will short the ECM error signal pin to ground in order to allow the ECM to supply power to the steering valve control module if the CID 2202 FMI 12 diagnostic code is active.

A. Verify that a CID 2202 FMI 12 diagnostic code is active. If a CID 2202 FMI 12 diagnostic code IS active, proceed to the next step. If the CID 2202 FMI 12 diagnostic code is NOT active, proceed to step “F” .

B. At the machine harness connector J1 for the Implement ECM, use a 151-6320 Removal Tool to remove the error signal wire U742-WH(White) and the socket at contact J1-40 from the harness connector. The J1 connector remains connected to the Implement ECM.

C. Using a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar jumper wire device, connect one end to the ECM pin at J1-40 through the empty space in the J1 connector.

D. Connect the other end of the jumper wire to frame ground. This probe or the jumper wire must remain connected during the rest of this procedure.

E. Turn the disconnect switch and the key start switch to the ON position. With the jumper wire connected to frame ground and the ECM pin J1-40, the CID 2202 FMI 12 diagnostic code should no longer be active.

F. At the machine harness connector for the “steering control module” , use a 151-6320 Removal Tool to remove the signal wire for the “spool position” module U736-YL(Yellow) and the socket at contact 4 from the harness connector. The machine harness connector remains connected to the “steering control module” .

G. Start the engine. Run the engine at low idle speed.

H. Enable the steering system. The steering system must be enabled in order to check the signal voltage.

I. At the harness connector for the control module, insert a 7X-1710 Multimeter Probe along return contact 5 (wire H807-YL(Yellow)). Insert the other multimeter probe through the empty space at contact 4 in order to contact the pin on the connector for the steering module.

J. While moving the left joystick to different steer positions, measure the voltage between contact 4 to contact 5.

Expected Result:

The voltage measurement is in the range that is described at the beginning of this procedure.

Results:

- OK – The voltage measurement is in the range that is described at the beginning of this

procedure. The signal voltage of the “spool position” sensor is correct. Before proceeding to the next test step, install the “spool position signal” wire U736-YL(Yellow) and the socket back into contact 4 of the harness connector for the steering control module. Before proceeding to the next test step, if a jumper wire was connected, remove the jumper wire and reconnect the error signal wire back to the correct location at the ECM connector J1-40.Proceed to Test Step 2.

- NOT OK – The voltage measurement is not in the range that is described at the beginning of this procedure. The signal voltage is not correct.

  Repair: Verify that there are no active CID 2202 or CID 2650 diagnostic codes and that the steering system is enabled.

  Verify that the multimeter probes are making good connections on return contact 5 and on spool position contact 4 at the module connector. Measure the voltage of the signal again.

  If the voltage measurement is not in the correct range, the steering control module may have failed.

  Prior to replacing the “steering valve” control module, contact your dealership's Technical Communicator for possible consultation with Caterpillar.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the “steering valve control” module.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

D. At the J1 machine harness connector for the Implement ECM, measure the resistance from the signal contact for the sensor J1-37 (wire U736-YL(Yellow)) to frame ground. Measure the resistance from the sensor signal contact J1-37 (wire U736-YL(Yellow)) to all of the other J1 and J2 contacts that are used on the connectors of the Implement ECM .

Expected Result:

Each measurement of the resistance is greater than 5000 ohms.

Results:

- OK – Each measurement of the resistance is greater than 5000 ohms. The signal circuit is not shorted.Proceed to Test Step 3.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal wire of the circuit U736-YL(Yellow) and the circuit with the low resistance measurement or frame ground.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in circuits for locations in the machine harness that indicate that the circuits could be shorted. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position.

A. Reconnect the machine harness connector to the “steering valve control” module.

B. Reconnect the connectors of the machine harness J1 and J2 to the Implement ECM.

C. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the signal wire of the “spool position” module U736-YL(Yellow) and the socket at contact J1-37 from the harness connector. The J1 connector remains connected to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Observe the status of the active CID 2203 FMI 04 diagnostic code.

Expected Result:

The CID 2203 FMI 04 diagnostic code is no longer active. A CID 2203 FMI 03 diagnostic code becomes active when circuit wire for the “spool position” module is disconnected from the ECM at J1-37.

Results:

- YES – The CID 2203 FMI 04 diagnostic code is no longer active. A CID 2203 FMI 03 diagnostic code has been activated after the circuit wire of the spool position module was removed from the ECM connector. The ECM has responded correctly to

the open circuit condition in the “spool position sensor” circuit. The ECM is not the most likely cause of the problem.Reinstall the disconnected circuit wire into the correct spot of the ECM connector before proceeding to the next test step. Proceed to Test Step 4.

- NO – The CID 2203 FMI 04 diagnostic code remains active. The status of the active diagnostic code does not change when the circuit wire of the “spool position” module is removed from the ECM connector.

  Repair: The ECM has not responded correctly to the condition of the open circuit in the “spool position” circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2203 FMI 04 diagnostic code is active.

Expected Result:

The CID 2203 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2203 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2203 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06684230

MID 082 - CID 2203 - FMI 04

SMCS Code: 7610-038-II

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

Conditions Which Generate This Code:

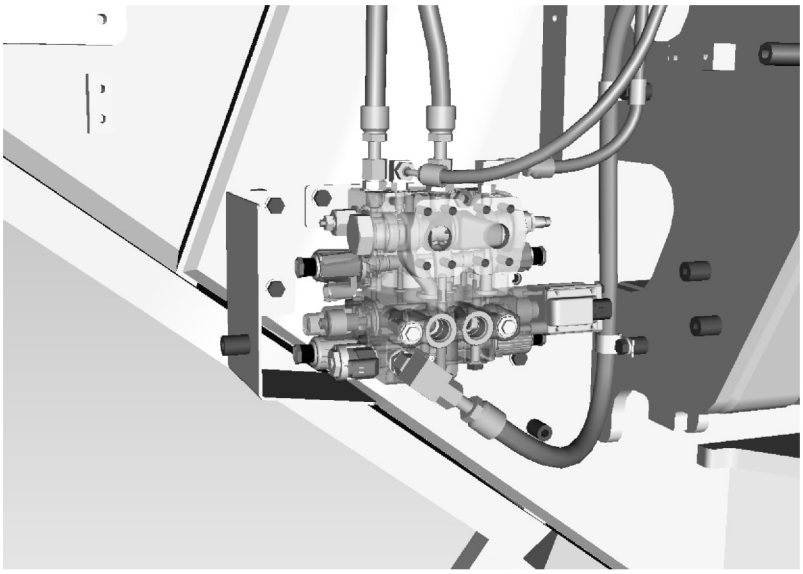


Illustration 391 g03379613

The steering valve which is located in front of the cab on the left-hand side of the machine.

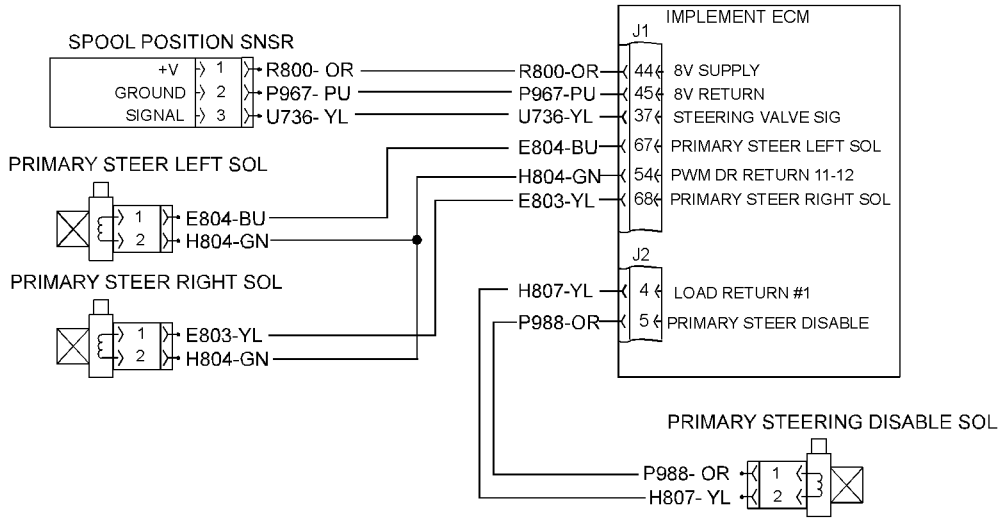


Illustration 392 g06075256

Primary Steering Valve Spool Displacement Line Sensor circuit connections

The CID 2203 diagnostic code is associated with the Primary Steering Valve Spool Displacement Line (steer valve spool position sensor). The Implement ECM will use the voltage input signal from the sensor to determine whether the steering control valve spool is operating as expected.

The FMI 04 indicates that the ECM has detected that the voltage of the input signal is below the low voltage threshold.

The Implement ECM monitors the signal circuit from the steer valve spool position sensor for diagnostics at all machine speeds.

At travel speeds below 7 km/h (4.3 mph), the ECM will use the valve spool position status to determine if the valve spool is responding as expected to the current commands that are being sent to the steer solenoid valves.

During steering operation, a probe on the end of the valve spool moves in and out of the position sensor. The sensor sends a voltage signal to the ECM on the signal circuit. As the position of the spool changes, the voltage of the signal changes.

When the sensor is powered, the ECM expects the voltage of the signal circuit to be in the range of 0.1 VDC to 4.9 VDC. When the left joystick is stationary in any position, the ECM expects the sensor signal voltage to be in the neutral range of 2.5 ± 0.3 VDC.

When the joystick is moved to the right on the steering axis, the voltage of the signal circuit will decrease toward the 0.1 VDC end of the range. When the joystick is moved to the left on the steering axis, the voltage of the signal circuit will increase toward the 4.9 VDC end of the range.

When the joystick is stationary in any position on the steering axis, the voltage of the signal should return to the neutral range of 2.5 ± 0.3 VDC.

The possible conditions that could cause the Implement ECM to activate the CID 2203 FMI 04 diagnostic code are listed:

- The sensor signal circuit is shorted to a ground source.
- The steer valve spool position sensor is faulty.
- The ECM has failed or the operating software is not the latest version. ECM failure is the least likely cause.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections or contamination in a connector can often be the cause of a problem in an electrical circuit. Ensure that the circuit connections are clean, dry, and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may cause other diagnostic codes to be activated. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected. Ensure that the CID 2203 FMI 04 diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE CIRCUIT FOR A SHORT TO GROUND

A. Disconnect the harness connector from the steer valve position sensor connector.

B. Turn the disconnect switch and the key start switch to the ON position.

C. Observe the status of the active CID 2203 FMI 04 diagnostic code.

Expected Result:

The CID 2203 FMI 04 diagnostic code is no longer active. A CID 2203 FMI 03 diagnostic code becomes active when the harness connector for the sensor is disconnected.

Results:

- OK – A CID 2203 FMI 03 diagnostic code becomes active when the harness connector for the sensor is disconnected. The ECM has correctly detected the open circuit condition in the sensor signal circuit. The signal circuit is not shorted to ground and the ECM is most likely not causing the problem.Proceed to Test Step 2.
- NOT OK – The CID 2203 FMI 04 diagnostic code remains active. The status of the active diagnostic code does not change when the signal circuit is open.

  Repair: The most likely cause of this condition is a short to ground in the signal circuit. Check the signal circuit for areas where the harness may be in contact with the frame. Check the condition of all of the harness connectors that are used for the circuit.

  If a short to ground is found in the machine harness, fix the signal circuit or replace the signal circuit in the machine harness.

  If a short to ground cannot be found in the machine harness, proceed to Test Step 3 in order to check the operation of the ECM.

Test Step 2. CHECK THE OPERATION OF THE STEER VALVE SPOOL POSITION SENSOR

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Reconnect the harness connector to the position sensor.

C. At the harness connector for the position sensor, use spoon type multimeter probes to check the DC voltage of the position sensor. At the back of the harness connector for the sensor, Insert the positive probe along the signal contact 3 wire U736-YL(Yellow). Insert the negative probe along the power supply return contact 2 wire P967-PU(Purple). Ensure that the probes are in good contact with the wire contacts.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Do not move the left steering joystick. Observe the sensor signal voltage.

Expected Result:

When the left joystick is stationary in any position, the sensor signal voltage measures in the range of 2.5 ± 0.3 VDC.

Results:

- YES – The voltage measurement is in the range of 2.5 ± 0.3 VDC. The position sensor signal voltage is correct.Proceed to Test Step 3.
- NO – With the steering joystick stationary, the voltage measurement is not in the range of 2.5 ± 0.3 VDC. The position sensor signal voltage is not correct.

  Repair: Replace the steer valve spool position sensor. After replacement of the sensor, verify that diagnostic code is no longer active. Verify that the steering system is correct before operating the machine.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The harness connector for the sensor remains disconnected.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the harness connector J1 for the Implement ECM, use a 151-6320 Removal Tool to remove the sensor signal circuit wire U736-YL(Yellow)and the socket at contact J1-37 from the harness connector. The J1 harness connector remains connected to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2203 FMI 04 diagnostic code.

Expected Result:

The CID 2203 FMI 04 diagnostic code is no longer active. A CID 2203 FMI 03 diagnostic code becomes active when the ECM pin at J1-37 is open.

Results:

- YES – A CID 2203 FMI 03 diagnostic code has been activated. The ECM has responded correctly to the open circuit condition in the sensor signal circuit. The ECM is most likely not the cause of the problem.

  Repair: Install the enable circuit wire and socket in the original location in the J1 harness connector.

  There is a short to ground condition in the steer valve spool position sensor signal circuit wire U736-YL(Yellow). The short circuit could be to another grounded circuit in the machine harness or the circuit could be grounded to the machine frame.

  Examine the connectors that are used to connect the signal circuit in the machine harness. Check for areas where the machine harness may be chafing against the frame.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness

  STOP.

- NO – The CID 2203 FMI 04 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the sensor signal circuit is open at the ECM connector.

  Repair: The ECM has not responded correctly to the open condition in the enable circuit. The operation of the ECM is not correct.

  Ensure that the latest version of software is loaded on the Implement ECM.

  If the software is not the latest version, flash the latest version of software to the Implement ECM.

  If the diagnostic code remains active after flashing the latest software version to the ECM, the ECM could be causing the problem.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  Proceed to Test Step 4.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and key start switch to the OFF position.

B. Reconnect any harness connectors that were disconnected in the procedure. Ensure that the connectors are securely locked in place.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Determine if the CID 2203 FMI 04 diagnostic code is active.

Expected Result:

The CID 2203 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2203 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code could have been caused by a poor connection or a momentary condition that reset when the machine was restarted. Resume normal operation

  STOP.

- NOT OK – The CID 2203 FMI 04 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Ensure that all possible causes of this diagnostic code have been investigated.

  If a cause of this problem cannot be found, contact the Dealer Solutions Network (DSN) for consultation with company personnel concerning this problem. Indicate the steps that have been taken and the results that have been observed.

  The DSN personnel will provide instruction on the next action that is required to resolve this problem.

  STOP.

i02990321

MID 082 - CID 2204 - FMI 03

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

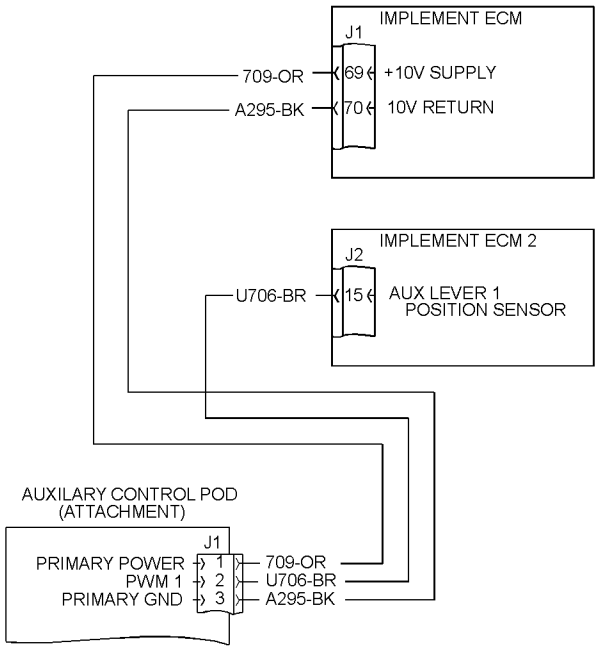


Illustration 393 g01271836

Connections of “Auxiliary Lever 1” position sensor

This diagnostic code is associated with the “auxiliary lever 1” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 03 means that the Implement ECM 2 has detected that the signal circuit voltage from the “auxiliary lever 1” position sensor is above normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to another voltage source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the J1 harness connector for the auxiliary control pod, insert 7X-1710 Multimeter Probes along the power supply contact 1 (wire 709-OR(Orange)) and along ground contact 3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

Expected Result:

The voltage measurement is approximately 10.0 ± 0.4 DCV.

Results:

- OK – The voltage measurement is approximately 10.0 ± 0.4 DCV. The power supply for the sensor is correct. Proceed to Test Step 2.
- NOT OK – The voltage measurement is less than 10.0 ± 0.4 DCV. The power supply for the sensor is not correct.

  Repair: Either the sensor ground circuit wire A295-BK(Black) or the supply wire 709-OR(Orange) has a bad connection or an open in the machine harness. Examine all of the connectors that are in the circuit. Ensure that the connections are clean, that all the connections are secure and that all connections are in good condition. Refer to the CID 1482 procedures in this manual for troubleshooting the 10 VDC power supply. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . At the machine harness connector J1 for the pod, connect a jumper wire between the return contact for sensor J1-3 (wire A295-BK(Black)) and the signal contact J1-2 (wire U706-BR(Brown)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from Implement ECM return contact J1-70 (wire A295-BK(Black)) to the Implement ECM 2 signal contact J2-15 (wire U706-BR(Brown)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The measurement of the resistance is less than 5 ohms at all times during the manipulation of the harness and the connectors.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The sensor circuit is not open. Proceed to Test Step 3.
- NOT OK – The measurement of the resistance is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire from the connector of the machine harness for the auxiliary pod that was installed in the last test step.

B. Disconnect any J1 and J2 machine harness connectors that are not already disconnected from the Implement ECM and from the Implement ECM 2.

C. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the contact of the sensor signal J2-15 (wire U706-BR(Brown)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

D. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-15 (wire U706-BR(Brown)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Inspect the connectors of the machine harness. Clean the connectors for the Implement ECM and for the Implement ECM 2. Reconnect the J1 and J2 harness connectors to both ECM modules before proceeding to the next test step. Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the sensor signal circuit (wire U706-BR(Brown)) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The machine harness connectors are reconnected to the Implement ECM and the Implement 2 ECM.

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the auxiliary control pod, use a 151-6320 Removal Tool to remove the signal wire U706-BR(Brown) and the socket at contact J1-2 from the harness connector. The machine harness connector J1 remains connected to the auxiliary control pod.

B. Turn the key start switch and the disconnect switch to the ON position.

C. At the connector J1 for the “auxiliary control pod” , insert a 7X-1710 Multimeter Probe along the return contact of the sensor J1-3 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 2” on the connector of the control pod .

E. Measure the duty cycle of the sensor signal between the connector contacts of the auxiliary control pod J1-2 and J1-3. Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The duty cycle of the “auxiliary lever 1” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the machine harness connector for the “auxiliary control pod” .Proceed to Test Step 5.

- NOT OK – The duty cycle of the “auxiliary lever 1” position sensor is NOT within the acceptable duty cycle range. The sensor has failed.

Repair: The operation of the “auxiliary lever 1” position sensor is not correct. Replace the assembly of the auxiliary pod. After replacement of the assembly of the pod, verify that the operation of the new “auxiliary lever 1” position sensor is correct before operating the machine.

STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2204 FMI 03 diagnostic code is active.

Expected Result:

The CID 2204 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2204 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2204 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02990529

MID 082 - CID 2204 - FMI 04

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

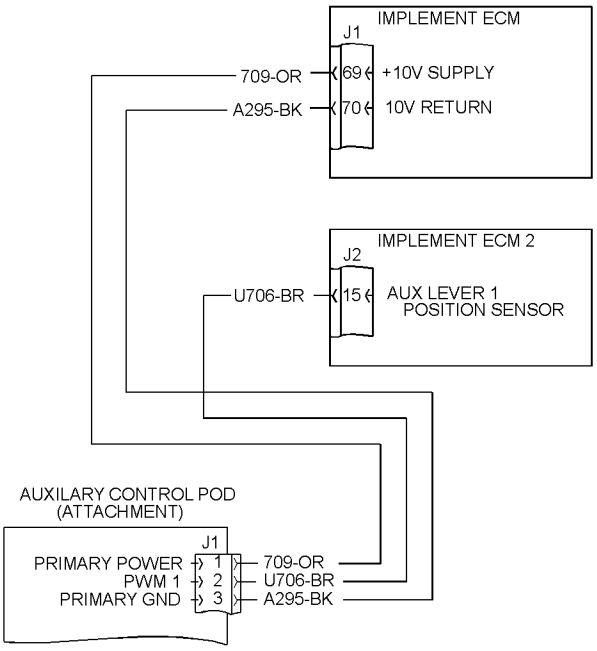


Illustration 394 g01271836

Connections of “Auxiliary Lever 1” position sensor

This diagnostic code is associated with the “auxiliary lever 1” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 04 indicates that the Implement ECM 2 has detected that the signal voltage from the “auxiliary lever 1” position sensor is below normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in the full rearward position to approximately 90% when the lever is in the full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The signal circuit is shorted to a ground source.
- The position sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . Observe the status of the diagnostic code.

Expected Result:

The FMI “04” diagnostic code will remain active if the sensor is not the cause of the problem. The sensor is the cause of the problem if the active FMI “04” diagnostic code changes to an active FMI “03” diagnostic code when the connector is disconnected.

Results:

- OK – The FMI “04” diagnostic code remains active. The sensor has not failed. Proceed to Test Step 2.
- NOT OK – The FMI “04” diagnostic code is NO longer active. An FMI “03” diagnostic code is active when the sensor is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the “auxiliary lever 1” position sensor is not correct. Replace the auxiliary control pod assembly. After replacement of the auxiliary control pod assembly, verify that the operation of the new “auxiliary lever 1” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector for the “auxiliary control pod” J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect any J1 and J2 machine harness connectors from the Implement ECM and from the Implement ECM 2.

D. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-15 (wire U706-BR(Brown)) to frame ground. Measure the resistance from the sensor signal contact J2-15 (wire U706-BR(Brown)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

E. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-15 (wire U706-BR(Brown)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 3.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the sensor signal

circuit (wire U706-BR(Brown)) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replacethe machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2204 FMI 04 diagnostic code is active.

Expected Result:

The CID 2204 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2204 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2204 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed. It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02990548

MID 082 - CID 2204 - FMI 08

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

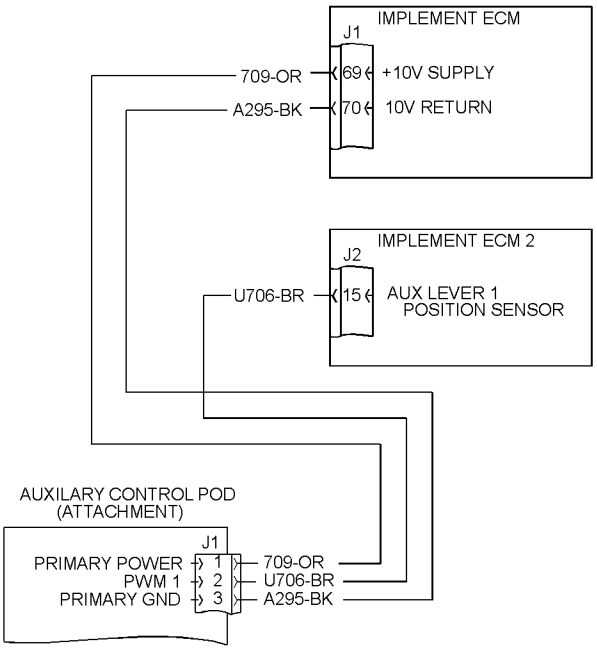


Illustration 395 g01271836

Connections of “Auxiliary Lever 1” position sensor

This diagnostic code is associated with the “auxiliary lever 1” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 08 means that the Implement ECM 2 has determined that the signal frequency of the sensor or the signal pulse width is not within the expected range.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed or a mechanical connection has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the auxiliary control pod, use a 151-6320 Removal Tool to remove the signal wire U706-BR(Brown) and the socket at contact J1-2 from the harness connector. The machine harness connector J1 remains connected to the auxiliary control pod.

B. Turn the disconnect switch and the key start switch to the ON position.

C. At the connector J1 for the “auxiliary control pod” , insert a 7X-1710 Multimeter Probe along the sensor return contact J1-3 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 2” on the control pod connector.

E. With the “auxiliary lever” stationary, measure the frequency of the signal from the sensor.

F. Measure the duty cycle of the sensor signal between the “auxiliary control pod” connector contacts J1-2 and J1-3. Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position while observing the duty cycle of the sensor signal.

Expected Result:

The frequency of the “auxiliary lever 1” position sensor signal is 500 ± 100 Hz. The duty cycle of the “auxiliary lever 1” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector J1 for the “auxiliary control pod” .Proceed to Test Step 2.
- NOT OK – The frequency of the signal or the duty cycle of the “auxiliary lever 1” position sensor is NOT correct according to the description at the beginning of this procedure. The position sensor has failed.

  Repair: The operation of the “auxiliary lever 1” position sensor is not correct. Replace the assembly of the “auxiliary control pod” . After replacement of the assembly of the pod, verify that the operation of the “auxiliary lever 1” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . At the connector of the machine harness, connect a jumper wire between the return contact of the sensor J1-3 (wire A295-BK(Black)) and the signal contact at J1-2 (wire U705-BR(Brown)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact of the Implement ECM 2 J2-15 (wire U706-BR(Brown)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The measurement of the resistance is less than 5 ohms at all times during the manipulation of the harness and the connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The measurement of the resistance is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2204 FMI 08.

Expected Result:

The CID 2204 FMI 08 is not active.

Results:

- OK – The CID 2204 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2204 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02990581

MID 082 - CID 2205 - FMI 03

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

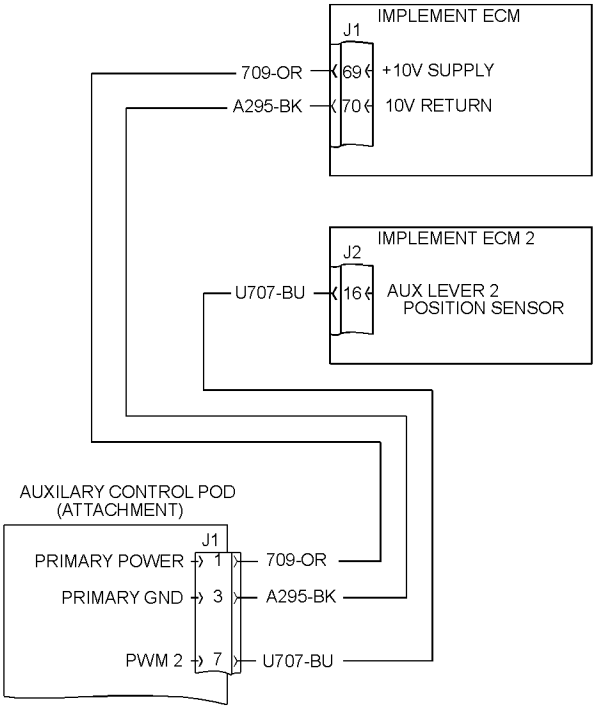


Illustration 396 g01272128

Connections of “Auxiliary Lever 2” position sensor

This diagnostic code is associated with the “auxiliary lever 2” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 03 means that the Implement ECM 2 has detected that signal circuit voltage from the “auxiliary lever 2” position sensor is above normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The circuit of the sensor power supply is open.
- The return circuit for the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to another voltage source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the J1 harness connector for the auxiliary control pod, insert 7X-1710 Multimeter Probes along the power supply contact 1 (wire 709-OR(Orange)) and along ground contact 3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the power supply for the sensor.

Expected Result:

The voltage measurement is approximately 10.0 ± 0.4 DCV.

Results:

- OK – The voltage measurement is approximately 10.0 ± 0.4 DCV. The power supply for the sensor is correct. Proceed to Test Step 2.
- NOT OK – The voltage measurement is less than 10.0 ± 0.4 DCV. The power supply for the sensor is not correct.

  Repair: Either the sensor ground circuit wire A295-BK(Black) or the supply wire

709-OR(Orange) has a bad connection or an open in the machine harness. Examine all of the connectors that are in the circuit. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition. Refer to the CID 1482 procedures in this manual for troubleshooting the 10 VDC power supply. Repair the machine harness or replace the machine harness.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . At the machine harness connector J1 for the pod, connect a jumper wire between the sensor return contact J1-3 (wire A295-BK(Black)) and the signal contact J1-7 (wire U707-BU(Blue)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact of the Implement ECM 2J2-16 (wire U707-BU(Blue)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The measurement of the resistance is less than 5 ohms at all times during the manipulation of the harness and the connectors.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The sensor circuit is not open. Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire from the machine harness connector for the auxiliary pod that was installed in the last test step.

B. Disconnect any J1 and J2 machine harness connectors that are not already disconnected from the Implement ECM and from the Implement ECM 2.

C. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-16 (wire U707-BU(Blue)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

D. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-16 (wire U707-BU(Blue)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Inspect the machine harness connectors. Clean the connectors for the Implement ECM and for the Implement ECM 2. Reconnect the J1 and J2 harness connectors to both ECM modules before proceeding to the next test step. Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the sensor signal circuit (wire U707-BU(Blue)) and the circuit with the low resistance measurement. For

information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The machine harness connectors are reconnected to the Implement ECM and the Implement 2 ECM.

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the “auxiliary control pod” , use a 151-6320 Removal Tool to remove the signal wire U707-BU(Blue) and the socket at contact J1-7 from the harness connector. The machine harness connector J1 remains connected to the “auxiliary control pod” .

B. Turn the key start switch and the disconnect switch to the ON position.

C. At the connector J1 for the “auxiliary control pod” , insert a 7X-1710 Multimeter Probe along the sensor return contact J1-3 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 7” on the connector for the control pod .

E. Measure the duty cycle of the sensor signal between the “auxiliary control pod” connector contacts J1-2 and J1-7. Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The duty cycle of the “auxiliary lever 2” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the machine harness connector for the auxiliary control pod.Proceed to Test Step 5.

- NOT OK – The duty cycle of the “auxiliary lever 2” position sensor is NOT within the acceptable duty cycle range. The sensor has failed.

  Repair: The operation of the “auxiliary lever 2” position sensor is not correct. Replace the assembly of the “auxiliary pod” . After replacement of the assembly of the pod , verify that the operation of the new “auxiliary lever 2” position sensor is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2205 FMI 03 diagnostic code is active.

Expected Result:

The CID 2205 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2205 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2205 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02990831

MID 082 - CID 2205 - FMI 04

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

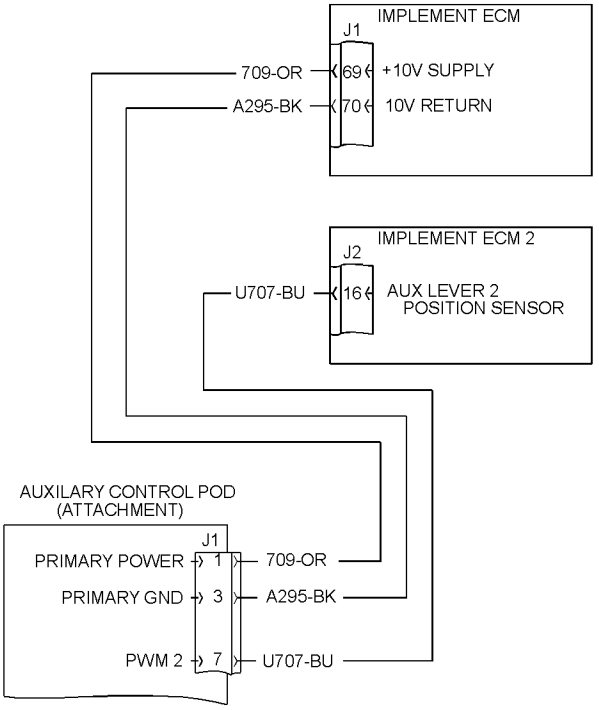


Illustration 397 g01272128

Connections of “Auxiliary Lever 2” position sensor

This diagnostic code is associated with the “auxiliary lever 2” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 04 means that the Implement ECM 2 has detected that signal circuit voltage from the “auxiliary lever 2” position sensor is below normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The signal circuit is shorted to a ground source.
- The position sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . Observe the status of the diagnostic code.

Expected Result:

The FMI “04” diagnostic code will remain active if the sensor is not the cause of the problem. The sensor is the cause of the problem if the active FMI “04” diagnostic code changes to an active FMI “03” diagnostic code when the connector is disconnected.

Results:

- OK – The FMI “04” diagnostic code remains active. The sensor has not failed. Proceed to Test Step 2.

- NOT OK – The FMI “04” diagnostic code is NO longer active. An FMI “03” diagnostic code is active when the sensor is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The “auxiliary lever 2” position sensor operation is not correct. Replace the “auxiliary control pod” assembly. After replacement of the “auxiliary control pod” assembly, verify that the operation of the new “auxiliary lever 2” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the “auxiliary control pod” J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM and from the Implement ECM 2.

D. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-16 (wire U707-BU(Blue)) to frame ground. Measure the resistance from the sensor signal contact J2-16 (wire U707-BU(Blue)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

E. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-16 (wire U707-BU(Blue)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 3.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the sensor signal circuit (wire U707-BU(Blue)) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2205 FMI 04 diagnostic code is active.

Expected Result:

The CID 2205 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2205 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2205 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02990843

MID 082 - CID 2205 - FMI 08

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

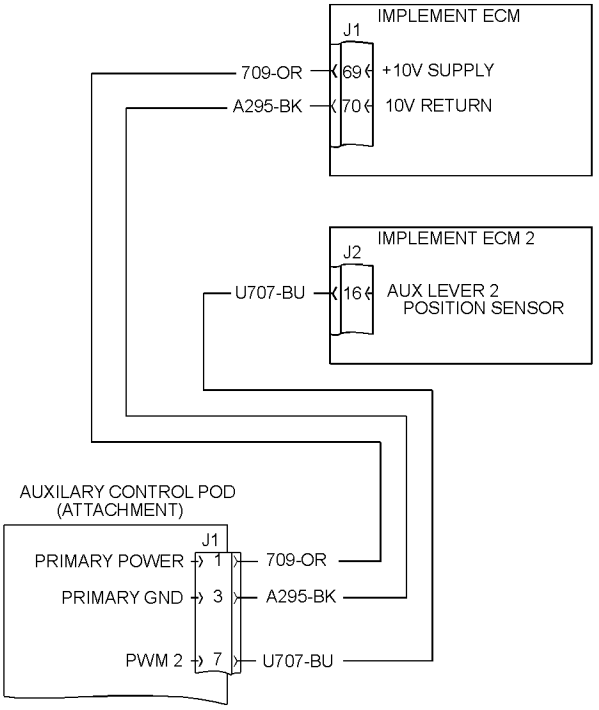


Illustration 398 g01272128

Connections of “Auxiliary Lever 2” position sensor

This diagnostic code is associated with the “auxiliary lever 2” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 08 means that the Implement ECM 2 has determined that the signal frequency of the sensor or the signal pulse width is not within the expected range.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed or a mechanical connection has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the “auxiliary control pod” , use a 151-6320 Removal Tool to remove the signal wire U707-BU(Blue) and the socket at contact J1-7 from the harness connector. The machine harness connector J1 remains connected to the “auxiliary control pod” .

B. Turn the disconnect switch and the key start switch to the ON position.

C. At the connector J1 for the auxiliary control pod, insert a 7X-1710 Multimeter Probe along the sensor return contact J1-3 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 7” on the connector for the control pod .

E. With the auxiliary lever stationary, measure the frequency of the signal from the sensor.

F. Measure the duty cycle of the sensor signal between the “auxiliary control pod” connector contacts J1-2 and J1-7. Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The frequency of the “auxiliary lever 2” position sensor is 500 ± 100 Hz. The duty cycle of the “auxiliary lever 2” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector J1 for the “auxiliary control pod” .Proceed to Test Step 2.
- NOT OK – The signal frequency or the duty cycle of the “auxiliary lever 2” position sensor is NOT correct according to the description at the beginning of this procedure. The position sensor has failed.

  Repair: The operation of the “auxiliary lever 2” position sensor is not correct. Replace the assembly of the “auxiliary control pod” . After replacement of the pod assembly, verify that the operation of the “auxiliary lever 2” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . At the connector of the machine harness, connect a jumper wire between the return contact of the sensor at J1-3 (wire A295-BK(Black)) and the signal contact at J1-7 (wire U707-BU(Blue)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact of the Implement ECM 2 J2-16 (wire U707-BU(Blue)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2205 FMI 08.

Expected Result:

The CID 2205 FMI 08 is not active.

Results:

- OK – The CID 2205 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2205 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02990862

MID 082 - CID 2206 - FMI 03

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

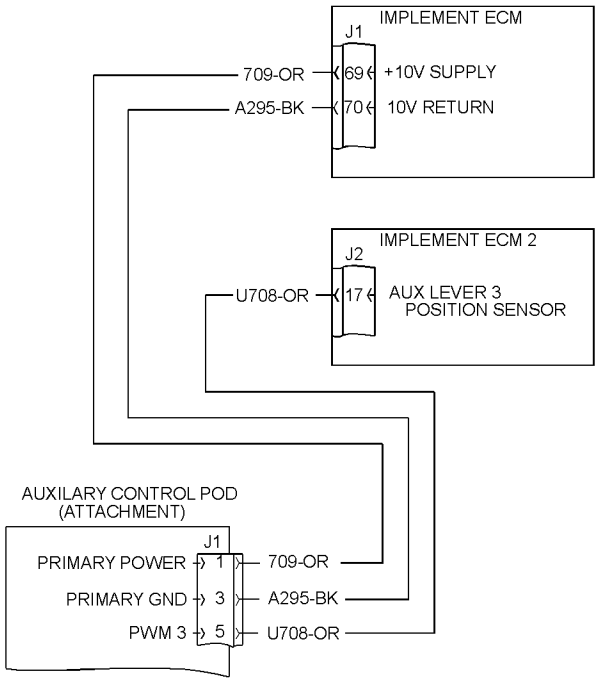


Illustration 399 g01272252

Connections of “Auxiliary Lever 3” position sensor

This diagnostic code is associated with the “auxiliary lever 3” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 03 means that the Implement ECM 2 has detected that signal circuit voltage from the “auxiliary lever 3” position sensor is above normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to another voltage source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the J1 harness connector for the “auxiliary control pod” , insert 7X-1710 Multimeter Probes along the contact for the power supply 1 (wire 709-OR(Orange)) and along contact for the ground 3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

Expected Result:

The voltage measurement is approximately 10.0 ± 0.4 VDC.

Results:

- OK – The voltage measurement is approximately 10.0 ± 0.4 VDC. The power supply for the sensor is correct. Proceed to Test Step 2.
- NOT OK – The voltage measurement is less than 10.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: Either the ground circuit wire for the sensor A295-BK(Black) or the supply wire 709-OR(Orange) has a bad connection or an open in the machine harness. Examine all of the connectors that are in the circuit. Ensure that the connections are clean, that the connections are secure and that the connections are in good condition. Refer to the CID 1482 procedures in this manual for troubleshooting the 10 VDC power supply. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . At the machine harness connector J1 for the pod, connect a jumper wire between the return contact for the sensor J1-3 (wire A295-BK(Black)) and the signal contact J1-5 (wire U708-OR(Orange)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact for the Implement ECM 2J2-17 (wire U708-OR(Orange)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The measurement of the resistance is less than 5 ohms at all times during the manipulation of the harness and the connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire from the connector of the machine harness for the auxiliary pod that was installed in the last test step.

B. Disconnect any J1 and J2 machine harness connectors that are not already disconnected from the Implement ECM and from the Implement ECM 2.

C. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-17 (wire U708-OR(Orange)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

D. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-17 (wire U708-OR(Orange)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Inspect the machine harness connectors and clean the connectors for the Implement ECM and for the Implement ECM 2. Reconnect the J1 and J2 harness connectors to both ECM modules before proceeding to the next test step. Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the sensor signal circuit wire U708-OR(Orange) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The connectors of the machine harness are reconnected to the Implement ECM and the Implement 2 ECM.

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the “auxiliary control pod” , use a 151-6320 Removal Tool to remove the signal wire U708-OR(Orange) and the socket at contact J1-5 from the harness connector. The machine harness connector J1 remains connected to the “auxiliary control pod” .

B. Turn the key start switch and the disconnect switch to the ON position.

C. At the connector J1 for the “auxiliary control pod” , insert a 7X-1710 Multimeter Probe along the return contact of the sensor J1-3 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 5” on the connector of the control pod.

E. Measure the duty cycle of the sensor signal between the “auxiliary control pod” connector contacts J1-2 and J1-5. Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The duty cycle of the “auxiliary lever 3” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the machine harness connector for the “auxiliary control pod” .Proceed to Test Step 5.

- NOT OK – The duty cycle of the “auxiliary lever 3” position sensor is NOT within the acceptable duty cycle range. The sensor has failed.

  Repair: The operation of the “auxiliary lever 3” position sensor is not correct. Replace the assembly of the auxiliary pod . After replacement of the pod assembly, verify that the operation of the new “auxiliary lever 3” position sensor is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2206 FMI 03 diagnostic code is active.

Expected Result:

The CID 2206 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2206 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2206 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02990898

MID 082 - CID 2206 - FMI 04

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

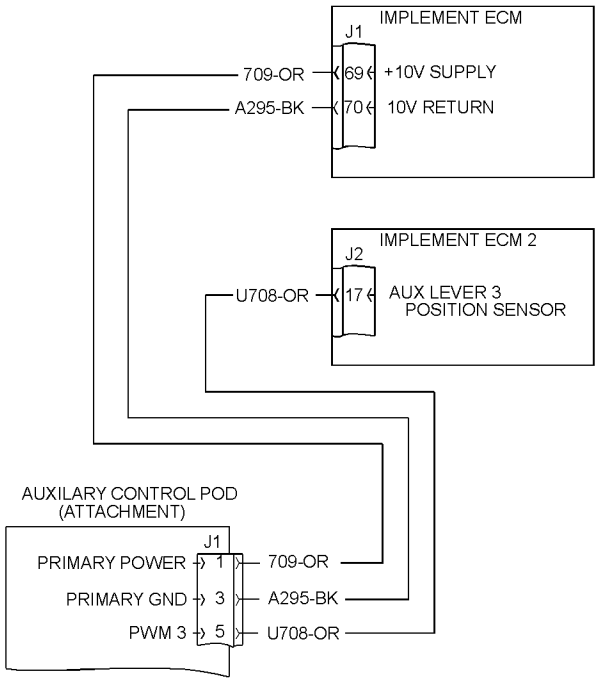


Illustration 400 g01272252

Connections of “Auxiliary Lever 3” position sensor

This diagnostic code is associated with the “auxiliary lever 3” position sensor. The position sensor is located in the attachment for the “auxiliary control pod” .

The FMI 04 means that the Implement ECM 2 has detected that signal circuit voltage from the “auxiliary lever 3” position sensor is below normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The signal circuit is shorted to a ground source.
- The position sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the auxiliary control pod. Observe the status of the diagnostic code.

Expected Result:

The FMI “04” diagnostic code will remain active if the sensor is not the cause of the problem. The sensor is causing the problem if the active FMI “04” diagnostic code changes to an active FMI “03” diagnostic code when the connector is disconnected.

Results:

- OK – The FMI “04” diagnostic code remains active. The sensor has not failed. Proceed to Test Step 2.
- NOT OK – The FMI “04” diagnostic code is NO longer active. An FMI “03” diagnostic code is active when the sensor is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the “auxiliary lever 3” position sensor is not correct. Replace the assembly of the “auxiliary control pod” . After replacement of the “auxiliary control pod” assembly, verify that the operation of the new “auxiliary lever 3” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The “auxiliary control pod” connector J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM and from the Implement ECM 2.

D. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-17 (wire U708-OR(Orange)) to frame ground. Measure the resistance from the sensor signal contact J2-17 (wire U708-OR(Orange)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

E. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-17 (wire U708-OR(Orange)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 3.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the sensor signal

circuit (wire U708-OR(Orange)) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2206 FMI 04 diagnostic code is active.

Expected Result:

The CID 2206 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2206 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2206 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed. It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02990910

MID 082 - CID 2206 - FMI 08

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

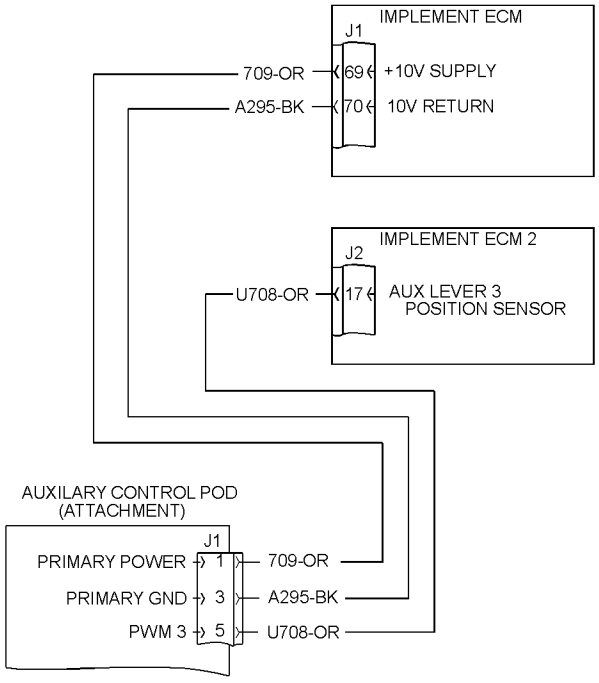


Illustration 401 g01272252

Connections of “Auxiliary Lever 3” position sensor

This diagnostic code is associated with the “auxiliary lever 3” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 08 means that the Implement ECM 2 has determined that the signal frequency of the sensor or the signal pulse width is not within the expected range.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed or a mechanical connection has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the “auxiliary control pod” , use a 151-6320 Removal Tool to remove the signal wire U708-OR(Orange) and the socket at contact J1-5 from the harness connector. The machine harness connector J1 remains connected to the “auxiliary control pod” .

B. Turn the disconnect switch and the key start switch to the ON position.

C. At the connector J1 for the “auxiliary control pod” , insert a 7X-1710 Multimeter Probe along the return contact of the sensor J1-3 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 5” on the connector of the control pod.

E. With the auxiliary lever stationary, measure the frequency of the signal from the sensor.

F. Measure the duty cycle of the sensor signal between the “auxiliary control pod” connector contacts J1-2 and J1-5. Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The frequency of the “auxiliary lever 3” position sensor is 500 ± 100 Hz. The duty cycle of the “auxiliary lever 3” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the connector of the machine harness J1 for the “auxiliary control pod” .Proceed to Test Step 2.
- NOT OK – The signal frequency or the duty cycle of the “auxiliary lever 3” position sensor is NOT correct according to the description at the beginning of this procedure. The position sensor has failed.

  Repair: The operation of the “auxiliary lever 3” position sensor is not correct. Replace the “auxiliary control pod” assembly. After replacement of the pod assembly, verify that the operation of the “auxiliary lever 3” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the auxiliary control pod. At the connector of the machine harness, connect a jumper wire between the return contact of the sensor at J1-3 (wire A295-BK(Black)) and the signal contact at J1-5 (wire U708-OR(Orange)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact of the Implement ECM 2 J2-17 (wire U708-OR(Orange)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the harness and the connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the signal circuit of the sensor. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2206 FMI 08.

Expected Result:

The CID 2206 FMI 08 is not active.

Results:

- OK – The CID 2206 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2206 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02990925

MID 082 - CID 2207 - FMI 03

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

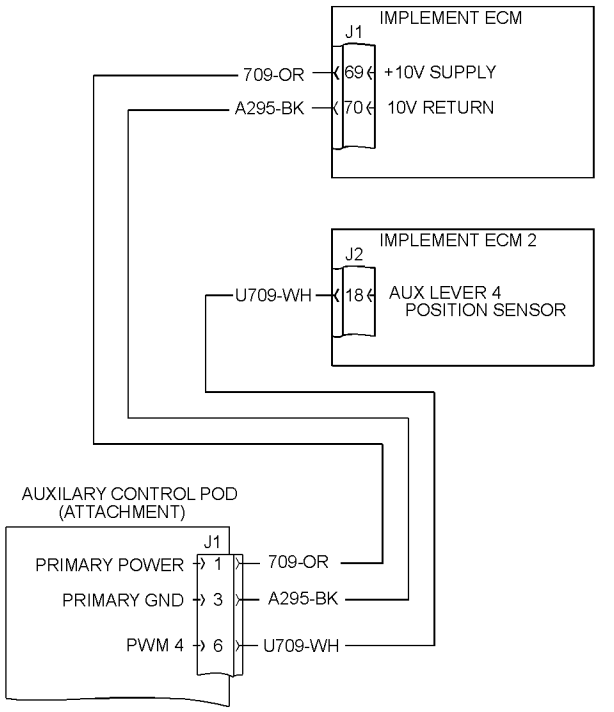


Illustration 402 g01272336

Connections of “Auxiliary Lever 4” position sensor

This diagnostic code is associated with the “auxiliary lever 4” position sensor. The position sensor is located in the attachment of the “auxiliary control pod” .

The FMI 03 means that the Implement ECM 2 has detected that signal circuit voltage from the “auxiliary lever 4” position sensor is above normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to another voltage source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the J1 harness connector for the “auxiliary control pod” , insert 7X-1710 Multimeter Probes along the contact for the power supply 1 (wire 709-OR(Orange)) and along the ground contact 3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

Expected Result:

The voltage measurement is approximately 10.0 ± 0.4 VDC.

Results:

- OK – The voltage measurement is approximately 10.0 ± 0.4 VDC. The power supply for the sensor is correct. Proceed to Test Step 2.
- NOT OK – The voltage measurement is less than 10.0 ± 0.4 VDC. The power supply for the sensor is not correct.

Repair: Either the ground circuit wire for the sensor A295-BK(Black) or the supply wire 709-OR(Orange) has a bad connection or an open in the machine harness. Examine all of the connectors that are in the circuit. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition. Refer to the CID 1482 procedures in this manual for troubleshooting the 10 VDC power supply. Repair the machine harness or replace the machine harness.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the auxiliary control pod. At the machine harness connector J1 for the pod, connect a jumper wire between the return contact of the sensor J1-3 (wire A295-BK(Black)) and the signal contact J1-6 (wire U709-WH(White)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact of the Implement ECM 2 J2-18 (wire U709-WH(White)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the harness and the connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the signal circuit of the sensor. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire from the machine harness connector for the auxiliary pod that was installed in the last test step.

B. Disconnect any J1 and J2 machine harness connectors that are not already disconnected from the Implement ECM and from the Implement ECM 2.

C. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the signal contact of the sensor J2-18 (wire U709-WH(White)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

D. At the J2 connector for the machine harness of the Implement ECM 2, measure the resistance from the signal contact of the sensor J2-18 (wire U709-WH(White)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Inspect the machine harness connectors. Clean the connectors for the Implement ECM and for the Implement ECM 2. Reconnect the J1 and J2 harness connectors to both ECM modules before proceeding to the next test step. Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

Repair: There is a short in the machine harness. The short is between the wire of the signal circuit of the sensor U709-WH(White) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The machine harness connectors are reconnected to the Implement ECM and the Implement 2 ECM.

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the “auxiliary control pod” , use a 151-6320 Removal Tool to remove the signal wire U709-WH(White) and the socket at contact J1-6 from the harness connector. The machine harness connector J1 remains connected to the “auxiliary control pod” .

B. Turn the key start switch and the disconnect switch to the ON position.

C. At the connector J1 for the “auxiliary control pod” , insert a 7X-1710 Multimeter Probe along the return contact of the sensor J1-3 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 6” on the connector of the control pod .

E. Measure the duty cycle of the sensor signal between the “auxiliary control pod” connector contacts J1-2 and J1-6. Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The duty cycle of the “auxiliary lever 4” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the machine harness connector for the “auxiliary control pod” .Proceed to Test Step 5.
- NOT OK – The duty cycle of the “auxiliary lever 4” position sensor is NOT within the acceptable duty cycle range. The sensor has failed.

  Repair: The operation of the “auxiliary lever 4” position sensor is not correct. Replace the assembly of the auxiliary pod . After replacement of the assembly of the pod, verify that the operation of the new “auxiliary lever 4” position sensor is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2207 FMI 03 diagnostic code is active.

Expected Result:

The CID 2207 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2207 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2207 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02990981

MID 082 - CID 2207 - FMI 04

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

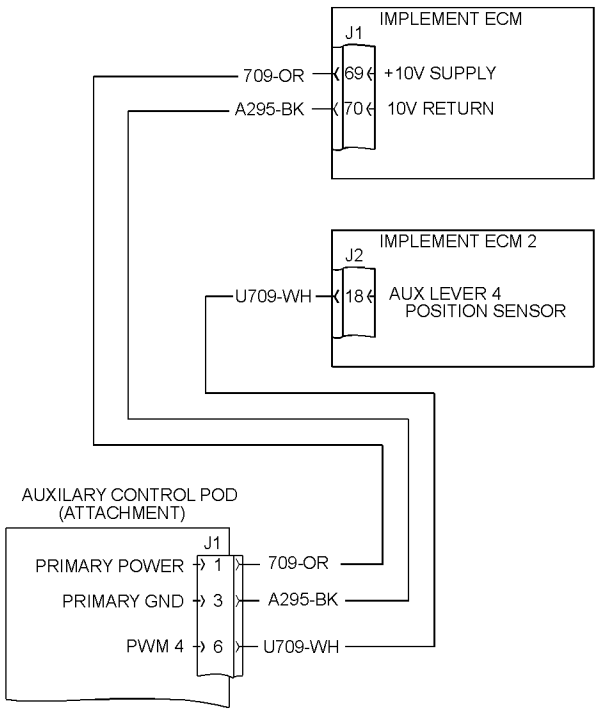


Illustration 403 g01272336

Connections of “Auxiliary Lever 4” position sensor

This diagnostic code is associated with the “auxiliary lever 4” position sensor. The position sensor is located in the attachment of the “auxiliary control pod” .

The FMI 04 means that the Implement ECM 2 has detected that signal circuit voltage from the “auxiliary lever 4” position sensor is below normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The signal circuit is shorted to a ground source.
- The position sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . Observe the status of the diagnostic code.

Expected Result:

The FMI “04” diagnostic code will remain active if the sensor is not the cause of the problem. The sensor is causing the problem if the active FMI “04” diagnostic code changes to an active FMI “03” diagnostic code when the connector is disconnected.

Results:

- OK – The FMI “04” diagnostic code remains active. The sensor has not failed. Proceed to Test Step 2.

- NOT OK – The FMI “04” diagnostic code is NO longer active. An FMI “03” diagnostic code is active when the sensor is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the “auxiliary lever 4” position sensor is not correct. Replace the “auxiliary control pod” assembly. After replacement of the “auxiliary control pod” assembly, verify that the operation of the new “auxiliary lever 4” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the “auxiliary control pod” J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM and from the Implement ECM 2.

D. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-18 (wire U709-WH(White)) to frame ground. Measure the resistance from the sensor signal contact J2-18 (wire U709-WH(White)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

E. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-18 (wire U709-WH(White)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 3.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit of the sensor (wire U709-WH(White)) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2207 FMI 04 diagnostic code is active.

Expected Result:

The CID 2207 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2207 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2207 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with “Caterpillar” . This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02991088

MID 082 - CID 2207 - FMI 08

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

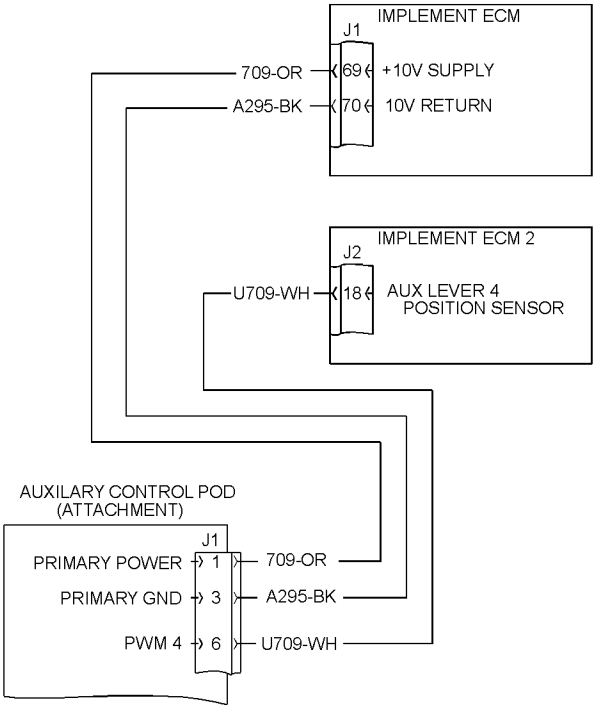


Illustration 404 g01272336

Connections of “Auxiliary Lever 4” position sensor

This diagnostic code is associated with the “auxiliary lever 4” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 08 means that the Implement ECM 2 has determined that the signal frequency of the sensor or the signal pulse width is not within the expected range.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed or a mechanical connection has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the connector of the machine harness J1 for the “auxiliary control pod” , use a 151-6320 Removal Tool to remove the signal wire U709-WH(White) and the socket at contact J1-6 from the harness connector. The machine harness connector J1 remains connected to the auxiliary control pod.

B. Turn the disconnect switch and the key start switch to the ON position.

C. At the connector J1 for the “auxiliary control pod” , insert a 7X-1710 Multimeter Probe along the return contact of the sensor J1-3 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 6” on the connector of the control pod.

E. With the auxiliary lever stationary, measure the frequency of the signal from the sensor.

F. Measure the duty cycle signal of the sensor between the “auxiliary control pod” connector contacts J1-2 and J1-6. Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The frequency of the “auxiliary lever 4” position sensor is 500 ± 100 Hz. The duty cycle of the “auxiliary lever 4” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the connector of the machine harness J1 for the “auxiliary control pod” .Proceed to Test Step 2.

- NOT OK – The signal frequency or the duty cycle of the “auxiliary lever 4” position sensor is NOT correct according to the description at the beginning of this procedure. The position sensor has failed.

  Repair: The operation of the “auxiliary lever 4” position sensor is not correct. Replace the “auxiliary control pod” assembly. After replacement of the pod assembly, verify that the operation of the “auxiliary lever 4” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . At the connector of the machine harness, connect a jumper wire between the return contact of the sensor at J1-3 (wire A295-BK(Black)) and the signal contact at J1-6 (wire U709-WH(White)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact of the Implement ECM 2 J2-18 (wire U709-WH(White)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the signal circuit of the sensor. Ensure that all connections are clean, that all connections are secure and that all the connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2207 FMI 08.

Expected Result:

The CID 2207 FMI 08 is not active.

Results:

- OK – The CID 2207 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2207 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02991206

MID 082 - CID 2208 - FMI 03

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

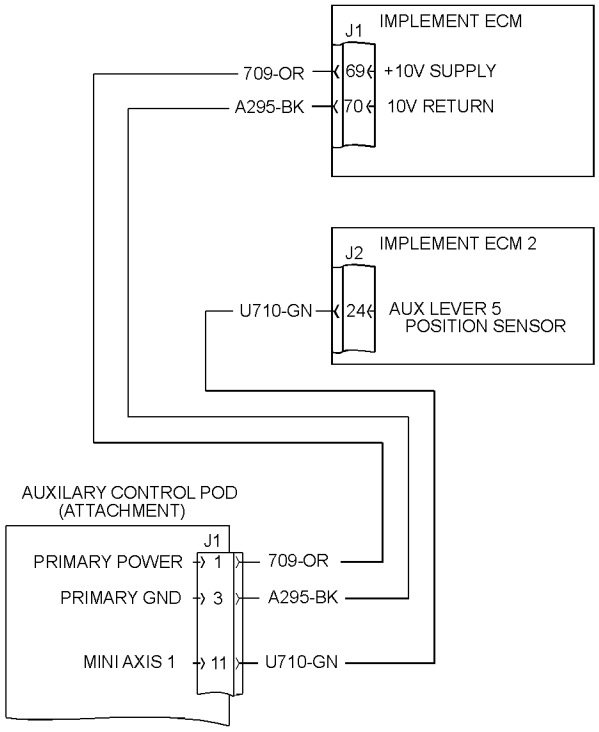


Illustration 405 g01272378

Connections of “Auxiliary Lever 5” position sensor

This diagnostic code is associated with the “auxiliary lever 5” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 03 means that the Implement ECM 2 has detected that signal circuit voltage from the “auxiliary lever 5” position sensor is above normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to another voltage source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the J1 harness connector for the “auxiliary control pod” , insert 7X-1710 Multimeter Probes along the contact of the power supply 1 (wire 709-OR(Orange)) and along the contact for the ground 3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the power supply for the sensor.

Expected Result:

The voltage measurement is approximately 10.0 ± 0.4 DCV.

Results:

- OK – The voltage measurement is approximately 10.0 ± 0.4 DCV. The power supply for the sensor is correct. Proceed to Test Step 2.
- NOT OK – The voltage measurement is less than 10.0 ± 0.4 DCV. The power supply for the sensor is not correct.

  Repair: Either the ground circuit wire for the sensor A295-BK(Black) or the supply wire for the sensor 709-OR(Orange) has a bad connection or an open in the machine harness. Examine all of the connectors that are in the circuit. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition. Refer to the CID 1482 procedures in this manual for troubleshooting the 10 VDC power supply. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . At the machine harness connector J1 for the pod, connect a jumper wire between the return contact for the sensor J1-3 (wire A295-BK(Black)) and the signal contact J1-11 (wire U710-GN(Green)).

C. Disconnect the harness connector of the machine J1 from the Implement ECM. Disconnect the harness connector of the machineJ2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact of the Implement ECM 2 J2-24 (wire U710-GN(Green)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the harness and the connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the signal circuit of the sensor. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire from the machine harness connector for the “auxiliary pod” that was installed in the last test step.

B. Disconnect any J1 and J2 machine harness connectors that are not already disconnected from the Implement ECM and from the Implement ECM 2.

C. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the signal contact of the sensor J2-24 (wire U710-GN(Green)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

D. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the signal contact of the sensor J2-24 (wire U710-GN(Green)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Inspect the machine harness connectors. Clean the connectors for the Implement ECM and for the Implement ECM 2. Reconnect the J1 and J2 harness connectors to both ECM modules before proceeding to the next test step. Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit wire of the sensor U710-GN(Green) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The machine harness connectors are reconnected to the Implement ECM and the Implement 2 ECM.

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the “auxiliary control pod” , use a 151-6320 Removal Tool to remove the signal wire U710-GN(Green) and the socket at contact J1-11 from the harness connector. The machine harness connector J1 remains connected to the “auxiliary control pod” .

B. Turn the key start switch and the disconnect switch to the ON position.

C. At the connector J1 for the “auxiliary control pod” , insert a 7X-1710 Multimeter Probe along the return contact of the sensor J1-3 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 11” on the connector of the control pod .

E. Measure the duty cycle of the sensor signal between the “auxiliary control pod” connector contacts J1-2 and J1-11. Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The duty cycle of the “auxiliary lever 5” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the machine harness connector for the “auxiliary control pod” .Proceed to Test Step 5.

- NOT OK – The duty cycle of the “auxiliary lever 5” position sensor is NOT within the acceptable duty cycle range. The sensor has failed.

  Repair: The operation of the “auxiliary lever 5” position sensor is not correct. Replace the auxiliary pod assembly. After replacement of the pod assembly, verify that the operation of the new “auxiliary lever 5” position sensor is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2208 FMI 03 diagnostic code is active.

Expected Result:

The CID 2208 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2208 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2208 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02991349

MID 082 - CID 2208 - FMI 04

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

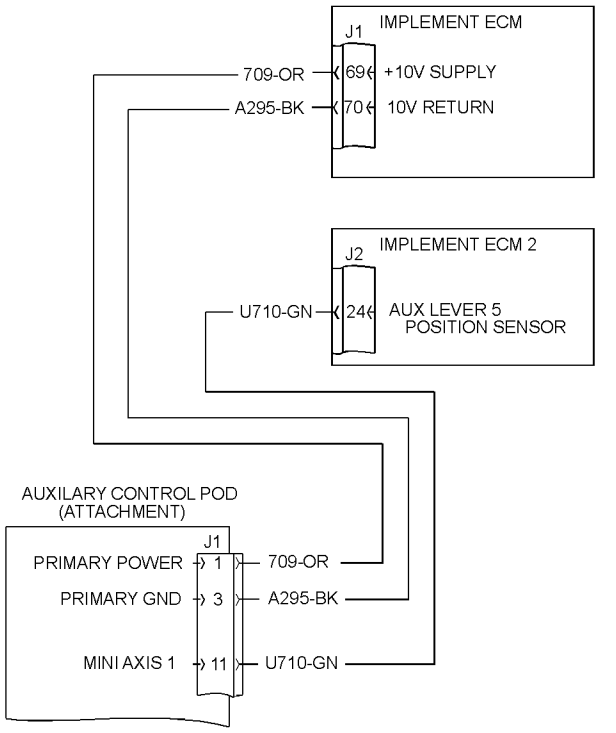


Illustration 406 g01272378

Connections of “Auxiliary Lever 5” position sensor

This diagnostic code is associated with the “auxiliary lever 5” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 04 means that the Implement ECM 2 has detected that signal circuit voltage from the “auxiliary lever 5” position sensor is below normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The signal circuit is shorted to a ground source.
- The position sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . Observe the status of the diagnostic code.

Expected Result:

The FMI “04” diagnostic code will remain active if the sensor is not the cause of the problem. The sensor is the cause of the problem if the active FMI “04” diagnostic code changes to an active FMI “03” diagnostic code when the connector is disconnected.

Results:

- OK – The FMI “04” diagnostic code remains active. The sensor has not failed. Proceed to Test Step 2.
- NOT OK – The FMI “04” diagnostic code is NO longer active. An FMI “03” diagnostic code is active when the sensor is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the “auxiliary lever 5” position sensor is not correct. Replace the “auxiliary control pod” assembly. After replacement of the “auxiliary control pod” assembly, verify that the operation of the new “auxiliary lever 5” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The “auxiliary control pod” connector J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM and from the Implement ECM 2.

D. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the signal contact of the sensor J2-24 (wire U710-GN(Green)) to frame ground. Measure the resistance from the signal contact of the sensor J2-24 (wire U710-GN(Green)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

E. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the signal contact of the sensor J2-24 (wire U710-GN(Green)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 3.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the circuit for the

signal wire of the sensor U710-GN(Green) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2208 FMI 04 diagnostic code is active.

Expected Result:

The CID 2208 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2208 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2208 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02991427

MID 082 - CID 2208 - FMI 08

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

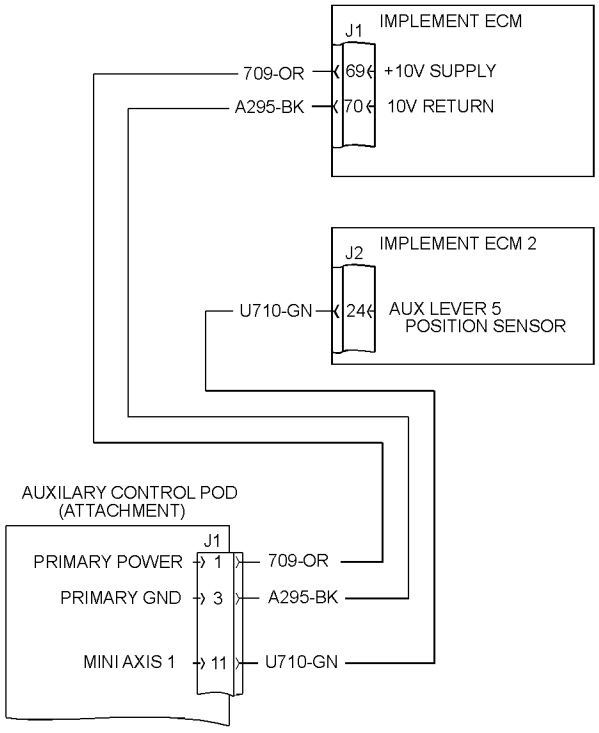


Illustration 407 g01272378

Connections of “Auxiliary Lever 5” position sensor

This diagnostic code is associated with the “auxiliary lever 5” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 08 means that the Implement ECM 2 has determined that the signal frequency of the sensor or the signal pulse width of the sensor is not within the expected range.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed or a mechanical connection has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the auxiliary control pod, use a 151-6320 Removal Tool to remove the signal wire U710-GN(Green) and the socket at contact J1-11 from the harness connector. The machine harness connector J1 remains connected to the “auxiliary control pod” .

B. Turn the disconnect switch and the key start switch to the ON position.

C. At the connector J1 for the “auxiliary control pod” , insert a 7X-1710 Multimeter Probe along the return contact of the sensor J1-3 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 11” on the connector of the control pod.

E. With the auxiliary lever stationary, measure the frequency of the signal from the sensor.

F. Measure the duty cycle of the sensor signal between the “auxiliary control pod” connector contacts J1-2 and J1-11. Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The frequency of the “auxiliary lever 5” position sensor is 500 ± 100 Hz. The duty cycle of the “auxiliary lever 5” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector J1 for the “auxiliary control pod” .Proceed to Test Step 2.
- NOT OK – The signal frequency or the duty cycle of the “auxiliary lever 5” position sensor is NOT correct according to the description at the beginning of this procedure. The position sensor has failed.

  Repair: The operation of the “auxiliary lever 5” position sensor is not correct. Replace the “auxiliary control pod” assembly. After replacement of the pod assembly, verify that the operation of the “auxiliary lever 5” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . At the machine harness connector, connect a jumper wire between the return contact of the sensor at J1-3 (wire A295-BK(Black)) and the signal contact at J1-11 (wire U710-GN(Green)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact of the Implement ECM 2 J2-24 (wire U710-GN(Green)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the harness and the connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2208 FMI 08.

Expected Result:

The CID 2208 FMI 08 is not active.

Results:

- OK – The CID 2208 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2208 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02991558

MID 082 - CID 2209 - FMI 03

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

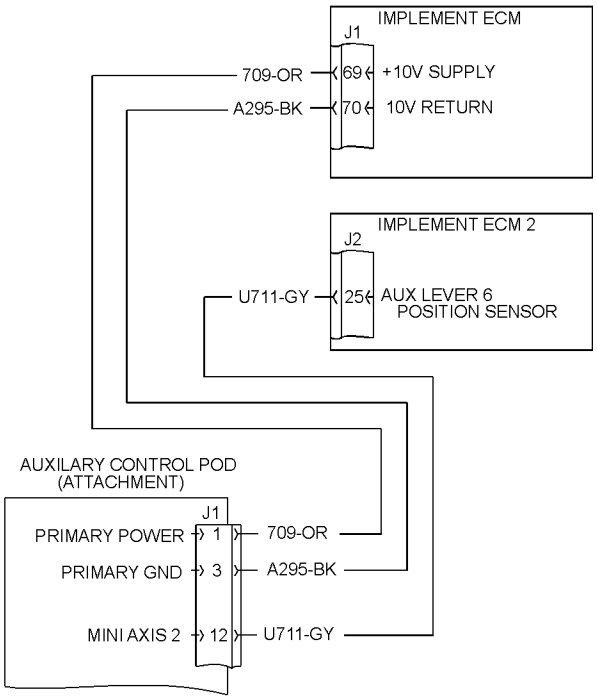


Illustration 408 g01272461

Connections of “Auxiliary Lever 6” position sensor with “Auxiliary Control Pod”

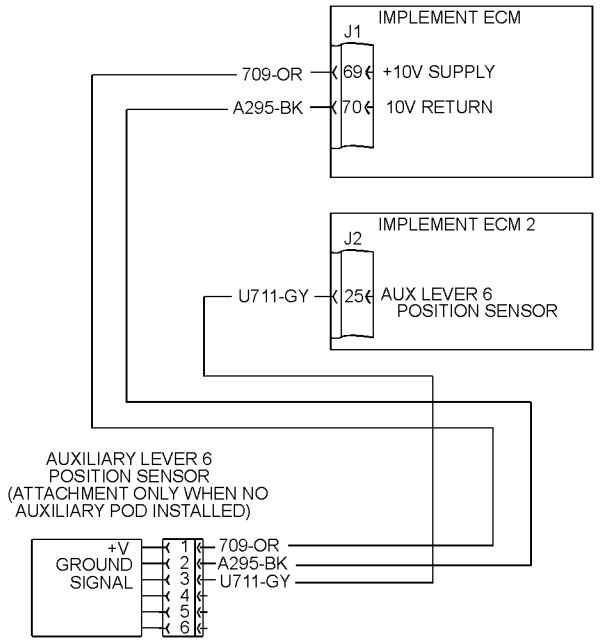


Illustration 409 g01272850

Connections of “Auxiliary Lever 6” Position Sensor with Stand-Alone lever

Note: The attachment “auxiliary lever 6” position sensor can be either part of the “auxiliary control pod” or can be a stand-alone actuator. The machine can not be equipped with two “auxiliary lever 6” components. The connections for the stand-alone actuator are in parenthesis in the following procedure.

This diagnostic code is associated with the “auxiliary lever 6” position sensor. The position sensor is located in the “auxiliary control pod” attachment or the position sensor can be a stand-alone lever that depends on the configuration of the machine.

The FMI 03 means that the Implement ECM 2 has detected that signal circuit voltage from the “auxiliary lever 6” position sensor is above normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to another voltage source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the J1 harness connector for the “auxiliary control pod” (stand-alone lever), insert 7X-1710 Multimeter Probes along the contact for the power supply1 (wire 709-OR(Orange)) and along the ground contact 3 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

Expected Result:

The voltage measurement is approximately 10.0 ± 0.4 DCV.

Results:

- OK – The voltage measurement is approximately 10.0 ± 0.4 DCV. The power supply for the sensor is correct. Proceed to Test Step 2.
- NOT OK – The voltage measurement is less than 10.0 ± 0.4 DCV. The power supply for the sensor is not correct.

  Repair: Either the sensor ground circuit wire A295-BK(Black) or the supply wire 709-OR(Orange) has a bad connection or an open connection in the machine harness. Examine all of the connectors that are in the circuit. Ensure that the connections are clean, that the connections are secure and that the connections are in good condition. Refer to the CID 1482 procedures in this manual for troubleshooting the 10 VDC power supply. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the “auxiliary control pod” . At the machine harness connector J1 for the pod or the stand-alone lever, connect a jumper wire between the return contact of the sensorJ1-3 (stand-alone connector contact 2) (wire A295-BK(Black)) and the signal contact J1-12 (stand-alone connector contact 3) (wire U711-GY(Grey)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact of the Implement ECM 2 J2-25 (wire U711-GY(Grey)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” (stand-alone lever). Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the harness and the connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the signal circuit of the sensor. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire from the connector of the machine harness for the “auxiliary pod ” (stand-alone lever) that was installed in the last test step.

B. Disconnect any J1 and J2 connectors of the machine harness that are not already disconnected from the Implement ECM and from the Implement ECM 2.

C. At the J2 connector of the machine harness for the Implement ECM 2, measure the resistance from the signal contact of the sensor J2-25 (wire U711-GY(Grey)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

D. At the J2 connector of the machine harness for the Implement ECM 2, measure the resistance from the sensor signal contact J2-25 (wire U711-GY(Grey)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Inspect the connectors of the machine harness and clean the connectors for the Implement ECM and for the Implement ECM 2. Reconnect the J1 and J2 harness connectors to both ECM modules before proceeding to the next test step. Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the circuit wire for the signal of the sensor U711-GY(Grey) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The connectors of the machine harness are reconnected to the Implement ECM and the Implement 2 ECM.

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector J1 for the auxiliary control pod, use a 151-6320 Removal Tool to remove the signal wire U711-GY(Grey) and the socket at contact J1-12 (stand-alone lever contact 3) from the harness connector. The machine harness connector J1 remains connected to the auxiliary control pod (actuator).

B. Turn the key start switch and the disconnect switch to the ON position.

C. At the connector J1 for the auxiliary control pod (actuator), insert a 7X-1710 Multimeter Probe along the return contact for the sensor J1-3 (stand-alone lever contact 2) (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the position sensor signal pin 12 (stand-alone connector contact 2) on the control pod connector.

E. Measure the duty cycle of the sensor signal between the auxiliary control pod connector contacts J1-2 and J1-12 (stand-alone connector contact 2). Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The duty cycle of the “auxiliary lever 6” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the connector of the machine harness for the “auxiliary control pod” .Proceed to Test Step 5.
- NOT OK – The duty cycle of the “auxiliary lever 6” position sensor is NOT within the acceptable duty cycle range. The sensor has failed.

  Repair: The operation of the “auxiliary lever 6” position sensor is not correct. Replace the assembly of the auxiliary pod (stand-alone lever position sensor). After replacement of the assembly of the pod (stand-alone lever position sensor), verify that the operation of the new “auxiliary lever 6” position sensor (stand-alone lever position sensor) is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2209 FMI 03 diagnostic code is active.

Expected Result:

The CID 2209 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2209 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.
- NOT OK – The CID 2209 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02991596

MID 082 - CID 2209 - FMI 04

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

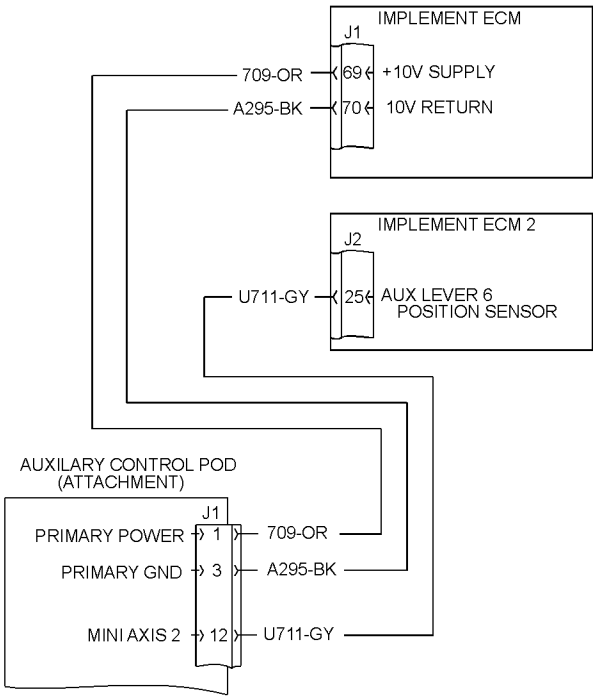


Illustration 410 g01272461

Connections of “Auxiliary Lever 6” position sensor with “Auxiliary Control Pod ”

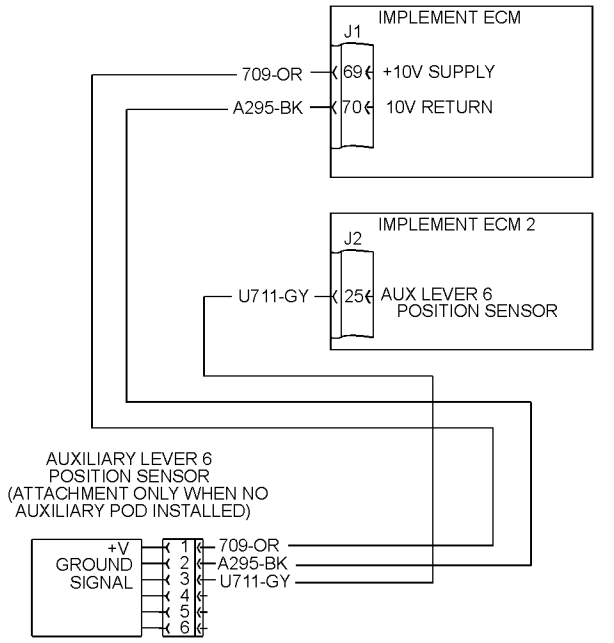


Illustration 411 g01272850

Connections of “Auxiliary Lever 6” position sensor with stand-alone actuator

Note: The attachment “auxiliary lever 6” position sensor can be either part of the “auxiliary control pod” or can be a stand-alone lever. The machine can not be equipped with two “auxiliary lever 6” components. The connections for the stand-alone lever are in parenthesis in the following procedure.

This diagnostic code is associated with the “auxiliary lever 6” position sensor. The position sensor is located in the “auxiliary control pod” attachment or the position sensor can be a stand-alone lever or an actuator, depending on the configuration of the machine.

The FMI 04 means that the Implement ECM 2 has detected that signal circuit voltage from the “auxiliary lever 6” position sensor is below normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The signal circuit is shorted to a ground source.
- The position sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the auxiliary control pod (stand-alone lever). Observe the status of the diagnostic code.

Expected Result:

The FMI “04” diagnostic code will remain active if the sensor is not the cause of the problem. The sensor is the cause of the problem if the active FMI “04” diagnostic code changes to an active FMI “03” diagnostic code when the connector is disconnected.

Results:

- OK – The FMI “04” diagnostic code remains active. The sensor has not failed. Proceed to Test Step 2.
- NOT OK – The FMI “04” diagnostic code is NO longer active. An FMI “03” diagnostic code is active when the sensor is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the “auxiliary lever 6” position sensor is not correct. Replace the “auxiliary control pod” assembly or the actuator. After replacement of the “auxiliary control pod” assembly (stand-alone lever), verify that the operation of the new “auxiliary lever 6” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the “auxiliary control pod” J1 (stand-alone lever connector) remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM and from the Implement ECM 2.

D. At the J2 connector of the machine harness for the Implement ECM 2, measure the resistance from the sensor signal contact J2-25 (wire U711-GY(Grey)) to frame ground. Measure the resistance from the sensor signal contact J2-25 (wire U711-GY(Grey)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

E. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-25 (wire U711-GY(Grey)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 3.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal wire of the sensor U711-GY(Grey) and the circuit with the low resistance measurement. For

information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2209 FMI 04 diagnostic code is active.

Expected Result:

The CID 2209 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2209 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2209 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed. It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02991604

MID 082 - CID 2209 - FMI 08

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

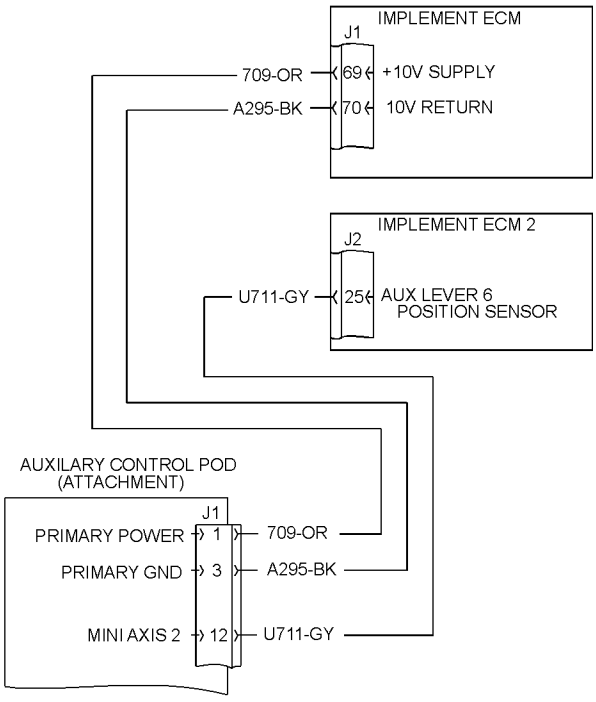


Illustration 412 g01272461

Connections of “Auxiliary Lever 6” position sensor with “Auxiliary Control Pod ”

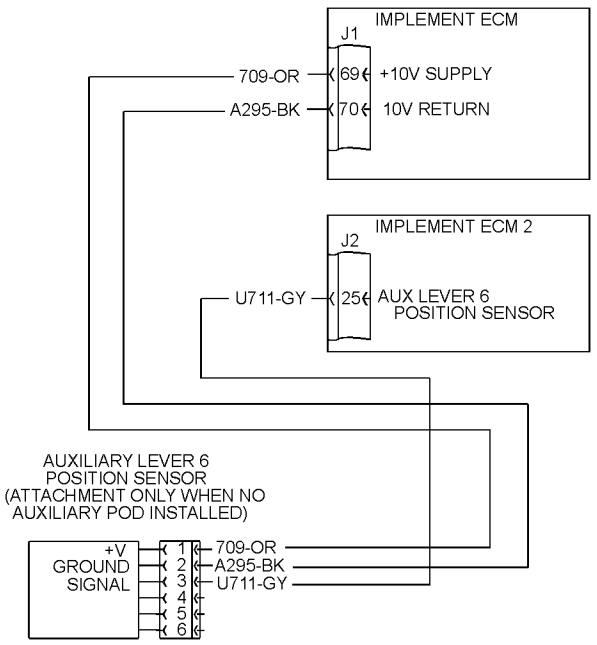


Illustration 413 g01272850

Connections of “Auxiliary Lever 6” position sensor with stand-alone lever

Note: The attachment “auxiliary lever 6” position sensor can be either part of the “auxiliary control pod” or can be a stand-alone lever. The machine can not be equipped with two “auxiliary lever 6” components. The connections for the stand-alone lever are in parenthesis in the following procedure.

This diagnostic code is associated with the “auxiliary lever 6” position sensor. The position sensor is located in the “auxiliary control pod” attachment.

The FMI 08 means that the Implement ECM 2 has determined that the signal frequency of the sensor or the signal pulse width is not within the expected range.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of approximately 500 ± 100 hertz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full rearward position to approximately 90% when the lever is in full forward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed or a mechanical connection has failed.
- Intermittent connections or poor connections
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 (actuator connector) for the “auxiliary control pod” (stand-alone lever), use a 151-6320 Removal Tool to remove the signal wire U711-GY(Grey) and the socket at contact J1-11 (stand-alone lever contact 3) from the harness connector. The machine harness connector J1 (connector of stand-alone lever) remains connected to the “auxiliary control pod” (stand-alone lever).

B. Turn the disconnect switch and the key start switch to the ON position.

C. At the connector J1 (actuator connector) for the “auxiliary control pod” (stand-alone lever), insert a 7X-1710 Multimeter Probe along the return contact of the sensor J1-3 (stand-alone lever contact 3) (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the “position sensor signal pin 11” (stand-alone lever contact 3) on the control pod connector (stand-alone lever).

E. With the auxiliary lever (stand-alone lever) stationary, measure the frequency of the signal from the sensor.

F. Measure the duty cycle of the sensor signal between the auxiliary control pod (actuator) connector contacts J1-2 (stand-alone lever connector 2) and J1-11 (stand-alone lever connector 3). Slowly move the lever to the full rearward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full forward position and observe the duty cycle of the sensor signal.

Expected Result:

The frequency of the “auxiliary lever 6” position sensor signal is 500 ± 100 Hz. The duty cycle of the “auxiliary lever 6” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector J1 for the “auxiliary control pod” (actuator).Proceed to Test Step 2.
- NOT OK – The signal frequency or the duty cycle of the “auxiliary lever 6” position sensor is NOT correct according to the description at the beginning of this procedure. The position sensor has failed.

  Repair: The operation of the “auxiliary lever 6” position sensor is not correct. Replace the “auxiliary control pod” assembly (stand-alone lever). After replacement of the pod assembly (stand-alone lever), verify that the operation of the “auxiliary lever 6” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 (actuator connector) from the “auxiliary control pod” (stand-alone lever). At the machine harness connector, connect a jumper wire between the return contact of the sensor at J1-3 (stand-alone lever contact 2) (wire A295-BK(Black)) and the signal contact at J1-11 (stand-alone lever contact 3) (wire U711-GY(Grey)).

C. Disconnect machine harness connector J1 from the Implement ECM. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connectors for the ECM modules, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact of the Implement ECM 2 J2-25 (wire U711-GY(Grey)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J1 for the “auxiliary control pod” . Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2209 FMI 08.

Expected Result:

The CID 2209 FMI 08 is not active.

Results:

- OK – The CID 2209 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2209 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05273978

MID 082 - CID 2210 - FMI 03

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

Auxiliary Lever #7 Position Sensor - Voltage Above Normal

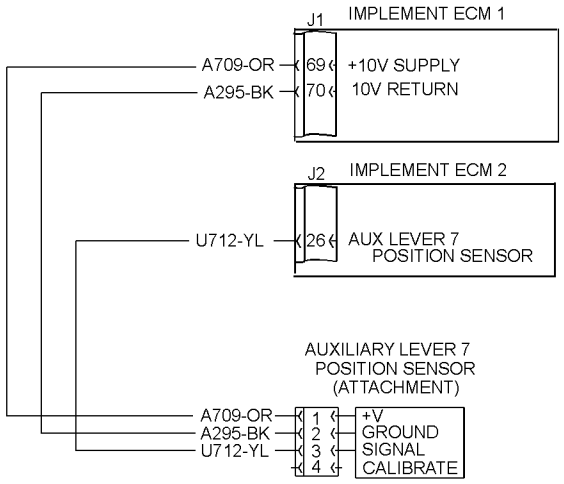


Illustration 414 g03354778

Connections of “Auxiliary Lever 7” Position Sensor

This diagnostic code is associated with the “auxiliary lever 7” position sensor (attachment). The FMI 03 means that the “Implement ECM 2” has detected that the voltage of the signal circuit from the “auxiliary lever 7” position sensor is above normal.

The “Implement ECM 2” communicates this condition to the Implement ECM over the SAE J1939 Data Link and the Implement ECM will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the “Implement ECM 2” . The duty cycle of the signal will vary from approximately 10% when the lever is in full upward position to approximately 90% when the lever is in full downward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to another voltage source.
- The sensor has failed.
- The ECM has failed. ECM failure is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections are often the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the harness connector for the “auxiliary lever 7” position sensor, insert 7X-1710 Multimeter Probes along the contact of the power supply 1 (wire A709-OR(Orange)) and along the ground contact 2 (wire A295-BK(Black)). Do not disconnect the machine harness from the “auxiliary lever 7” position sensor.

C. Measure the DC voltage of the sensor power supply.

Expected Result:

The voltage measurement is approximately 10.0 VDC (allowable tolerance between 7 VDC and 11 VDC).

Results:

- OK – The voltage measurement is approximately 10.0 VDC (allowable tolerance between 7 VDC and 11 VDC). The power supply for the sensor is correct. Proceed to Test Step 2.
- NOT OK – The voltage measurement is less than 7 VDC. The power supply for the sensor is not correct.

  Repair: Either the ground wire of the sensor circuit A295-BK(Black) or the supply wire A709-OR(Orange) has a bad connection or an open in the machine harness. Examine all of the connectors that are in the circuit. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition. Refer to the CID 0041 procedures in this manual for troubleshooting the 10 VDC power supply. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the “auxiliary lever 7” position sensor. At the machine harness connector for the sensor, connect a jumper wire between the contact of the sensor return 2 (A295-BK(Black)) and the contact of the signal wire U712-YL(Yellow)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM 2.

D. At the harness connectors for the ECM, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BK(Black)) to the signal contact J2-26 (wire U712-YL(Yellow)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connector J2 for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector for the “auxiliary lever 7” position sensor. Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open. Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire from the machine harness connector for the sensor that was installed in the last test step.

B. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-26 (wire U712-YL(Yellow)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Inspect the machine harness connectors. Clean the connectors for the Implement ECM 2. Reconnect the J1 and J2 harness connectors to the ECM before proceeding to the next test step. Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the circuit for the sensor signal U712-YL(Yellow) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The machine harness connectors are reconnected to the Implement ECM 2.

The key start switch and the disconnect switch remain in the OFF position.

A. At the machine harness connector for the “auxiliary lever 7” position sensor, use a 151-6320 Removal Tool to remove the signal wire U712-YL(Yellow) and the socket at contact 3 from the harness connector. The machine harness connector remains connected to the “auxiliary lever 7” position sensor.

B. Turn the key start switch and the disconnect switch to the ON position.

C. At the machine harness connector for the “auxiliary lever 7” position sensor, insert a 7X-1710 Multimeter Probe along the contact for the sensor return 2 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the signal pin 3 on the sensor connector for the position sensor.

E. Measure the duty cycle of the sensor signal between the connector contacts of position sensor 2 and 3. Slowly move the lever to the full upward position and observe the duty cycle of the sensor signal. Slowly move the lever to the full downward position and observe the duty cycle of the sensor signal.

Expected Result:

The duty cycle of the “auxiliary lever 7” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. Reconnect the signal wire and the socket in the machine harness connector for the position sensor. Proceed to Test Step 5.

- NOT OK – The duty cycle of the “auxiliary lever 7” position sensor is NOT within the acceptable duty cycle range. The sensor has failed.

  Repair: The operation of the “auxiliary lever 7” position sensor is not correct. Replace the position sensor. After replacement of the sensor, verify that the operation of the new “auxiliary lever 7” position sensor is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened completely.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2210 FMI 03 diagnostic code is active.

Expected Result:

The CID 2210 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2210 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2210 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  IECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05273989

MID 082 - CID 2210 - FMI 04

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

Auxiliary Lever #7 Position Sensor - Voltage Below Normal

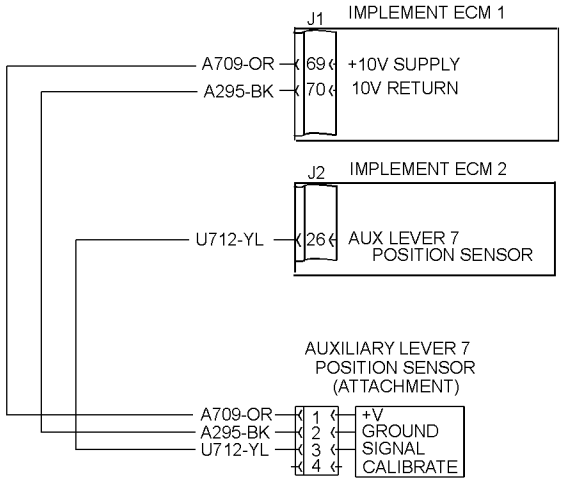


Illustration 415 g03354778

Connectors of the “Auxiliary Lever 7” position sensor

This diagnostic code is associated with the “auxiliary lever 7” position sensor. The FMI 04 means that the “Implement ECM 2” has detected that signal voltage from the “auxiliary lever 7” position sensor is below normal.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full upward position to approximately 90% when the lever is in full downward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The signal circuit is shorted to a ground source.
- The position sensor has failed.
- The ECM has failed. ECM failure is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector from the position sensor. Observe the status of the diagnostic code.

Expected Result:

The FMI “04” diagnostic code will remain active if the sensor is not the cause of the problem. The sensor is the cause of the problem if the active FMI “04” code changes to an active FMI “03” code when the connector is disconnected.

Results:

- OK – The FMI “04” diagnostic code remains active. The sensor has not failed. Proceed to Test Step 2.
- NOT OK – The FMI “04” diagnostic code is no longer active. An FMI “03” diagnostic code is active when the sensor is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The operation of the “auxiliary lever 7” position sensor is not correct. Replace the “auxiliary lever 7” position sensor. After replacement of the position sensor, verify that the operation of the new “auxiliary lever 7” position sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the position sensor J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM 2.

D. At the J2 machine harness connector for the Implement ECM 2, measure the resistance from the sensor signal contact J2-26 (wire U712-YL(Yellow)) to frame ground. Measure the resistance from the sensor signal contact J2-26 (wire U712-YL(Yellow)) to all of the other J1 and J2 contacts that are used in the connectors for the Implement ECM 2.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted in the machine harness.Proceed to Test Step 3.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal wire of the sensor circuit U712-YL(Yellow) and the circuit with the low resistance measurement. For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened completely.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2210 FMI 04 diagnostic code is active.

Expected Result:

The CID 2210 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2210 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2210 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed.

  ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05273995

MID 082 - CID 2210 - FMI 08

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

Auxiliary Lever #7 Position Sensor - Abnormal Frequency, Pulse Width, or Period

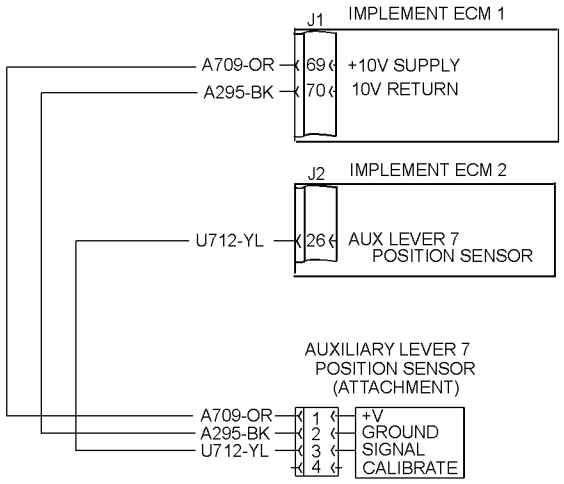


Illustration 416 g03354778

Connections of “Auxiliary Lever 7” position sensor

This diagnostic code is associated with the “auxiliary lever 7” position sensor. The FMI 08 means that the Implement ECM 2 has determined that the signal frequency of the sensor or the pulse width of the signal is not within the expected range.

The Implement ECM 2 communicates this condition to the Implement ECM over the SAE J1939 Data Link and will activate this diagnostic code.

The position sensor is a PWM sensor that operates at a frequency of 500 ± 100 Hz. The position sensor sends a PWM input signal to the Implement ECM 2. The duty cycle of the signal will vary from approximately 10% when the lever is in full upward position to approximately 90% when the lever is in full downward position. When the lever is in the center position, the duty cycle will be approximately 50%.

The possible causes of this diagnostic code are listed below:

- The sensor has failed or a mechanical connection has failed.
- Intermittent connections or poor connections
- The ECM has failed. ECM failure is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE SIGNAL FREQUENCY AT THE SENSOR

Turn the key start switch and the disconnect switch to the OFF position.

A. At the machine harness connector J1 for the position sensor, use a 151-6320 Removal Tool to remove the signal wire U712-YL(Yellow) and the socket at contact 3 from the harness connector. The machine harness connector remains connected to the position sensor.

B. Turn the disconnect switch and the key start switch to the ON position.

C. At the connector J1 for the position sensor, insert a 7X-1710 Multimeter Probe along the contact for the sensor return 2 (wire A295-BK(Black)).

D. Use the other multimeter probe to make contact through the harness connector with the signal pin 3 on the sensor connector of the position sensor.

E. With the auxiliary lever stationary, measure the frequency of the signal of the sensor.

F. Measure the duty cycle of the sensor signal between the connector contacts of the position sensor 2 and 3. Slowly move the lever to the full upward position while observing the duty cycle of the sensor signal. Slowly move the lever to the full downward position and observe the duty cycle of the sensor signal.

Expected Result:

The signal frequency of the “auxiliary lever 7” position sensor is 500 ± 100 Hz. The duty cycle of the “auxiliary lever 7” position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The signal frequency and the duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the position sensor. Proceed to Test Step 2.
- NOT OK – The signal frequency or the duty cycle of the “auxiliary lever 7” position sensor is not correct according to the description at the beginning of this procedure. The position sensor has failed.

  Repair: The operation of the “auxiliary lever 7” position sensor is not correct. Replace the position sensor. After replacement of the position sensor, verify that the operation of the “auxiliary lever 7” is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the position sensor. At the connector of the machine harness, connect a jumper wire between the contact for the sensor return 2 (wire A295-BK(Black)) and the signal contact 3 (wire U712-YL(Yellow)).

C. Disconnect machine harness connector J2 from the Implement ECM 2.

D. At the harness connector for the ECM, measure the resistance from return contact of the Implement ECM J1-70 (wire A295-BR(Brown)) to the signal contact J2-26 (wire U712-YL(Yellow)).

E. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the Implement ECM 2. Pull on the wires and wiggle the wires.

F. Observe the resistance measurement of the multimeter and wiggle the machine harness connector for the “auxiliary lever 7” position sensor. Pull on the wires and wiggle the wires. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the signal circuit of the sensor. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are fastened completely.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2210 FMI 08.

Expected Result:

The CID 2210 FMI 08 is not active.

Results:

- OK – The CID 2210 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2210 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the Implement ECM 2 may have failed. ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02539977

MID 082 - CID 2211 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

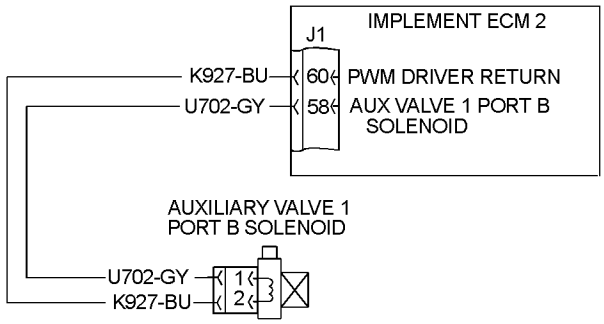


Illustration 417 g01271587

Auxiliary Valve 1 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 1 port B solenoid (attachment). The FMI 03 means that the Implement ECM 2 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-58 (wire U702-GY(Grey)) to all J1 and J2 contacts that are used on the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U702-GY(Grey) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U702-GY(Grey) and socket at contact J1-58 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2211 FMI 03 diagnostic code.

Expected Result:

The CID 2211 FMI 03 diagnostic code is no longer active. A CID 2211 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2211 FMI 03 diagnostic code is no longer active. A CID 2211 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2211 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2211 FMI 03 diagnostic code is active.

Expected Result:

The CID 2211 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2211 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2211 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02986485

MID 082 - CID 2211 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

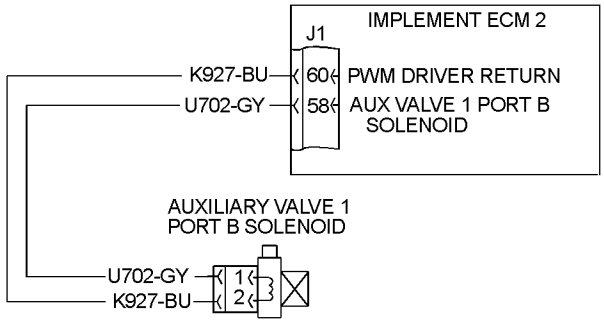


Illustration 418 g01271587

Connections of “Auxiliary Valve 1 Port B” solenoid

This diagnostic code is associated with the “auxiliary valve 1 port B” solenoid (attachment). The FMI 05 means that the Implement ECM 2 has determined that the current for the solenoid circuit is below normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U702-GY(Grey)) to contact 2 (wire K927-BU(Blue)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2211 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2211 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 2.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 2, measure the resistance from the return contact J1-60 (wire K927-BU(Blue)) to the energize contact J1-58 (wire U702-GY(Grey)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection in the machine or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good .

  Repair: The open connection or the possible poor connection is in the supply wire U702-GY(Grey) or in the return wire K927-BU(Blue) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U702-GY(Grey) and socket at contact J1-58 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-58 through the empty space in the J1 connector.

F. Observe the status of the active CID 2211 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2211 FMI 05 diagnostic code is no longer active. A CID 2211 FMI 06 diagnostic code becomes active when the ECM pin at J1-58 is grounded.

Results:

- YES – The CID 2211 FMI 05 diagnostic code is no longer active. A CID 2211 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid back into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2211 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2211 FMI 05 diagnostic code.

Expected Result:

The CID 2211 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2211 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. The ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.
- NO – The CID 2211 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540103

MID 082 - CID 2211 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

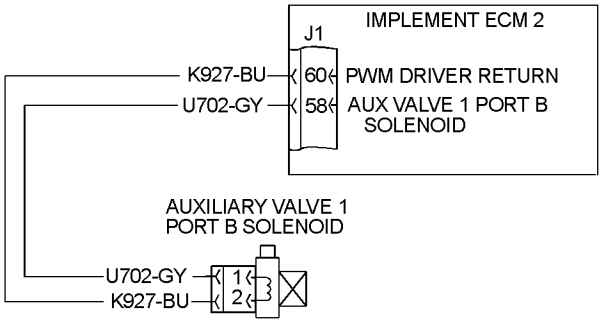


Illustration 419 g01271587

Auxiliary Valve 1 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 1 port B solenoid (attachment). The FMI 06 means that the Implement ECM 2 has determined that the current of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2211 FMI 06 diagnostic code changes to a CID 2211 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2211 FMI 06 diagnostic code changes to a CID 2211 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2211 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-58 (wire U702-GY(Grey)) to frame ground. Measure the resistance from the contact J1-58 (wire U702-GY(Grey)) to all of the other J1 and J2 contacts that are used in the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U702-GY(Grey) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2211 FMI 06 diagnostic code.

Expected Result:

The CID 2211 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2211 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2211 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540132

MID 082 - CID 2211 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 1 port B solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 2 detects that the solenoid needs calibration. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2211 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540147

MID 082 - CID 2212 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

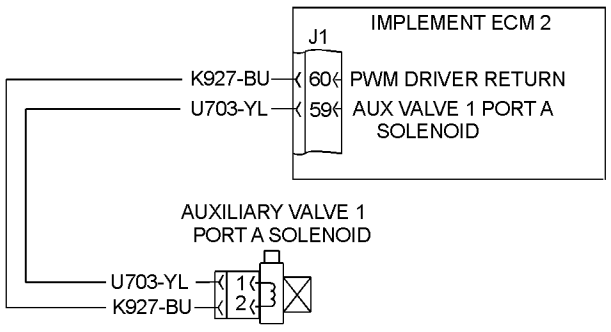


Illustration 420 g01271669

Auxiliary Valve 1 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 1 port A solenoid (attachment). The FMI 03 means that the Implement ECM 2 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-59 (wire U703-YL(Yellow)) to all J1 and J2 contacts that are used on the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U703-YL(Yellow) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U703-YL(Yellow) and socket at contact J1-59 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2212 FMI 03 diagnostic code.

Expected Result:

The CID 2212 FMI 03 diagnostic code is no longer active. A CID 2212 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2212 FMI 03 diagnostic code is no longer active. A CID 2212 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2212 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2212 FMI 03 diagnostic code is active.

Expected Result:

The CID 2212 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2212 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2212 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i02986460

MID 082 - CID 2212 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

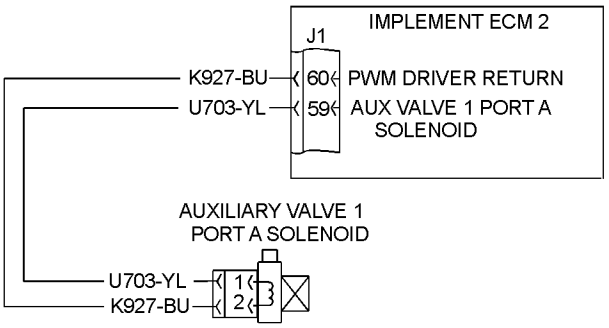


Illustration 421 g01271669

Connections of “Auxiliary Valve 1 Port A” solenoid

This diagnostic code is associated with the “auxiliary valve 1 port A” solenoid (attachment). The FMI 05 means that the Implement ECM 2 has determined that the current for the solenoid circuit is below normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U703-YL(Yellow)) to contact 2 (wire K927-BU(Blue)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2212 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2212 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 2.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 2, measure the resistance from the return contact J1-60 (wire K927-BU(Blue)) to the energize contact J1-59 (wire U703-YL(Yellow)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good .

  Repair: The open connection or the possible poor connection is in supply wire U702-GY(Grey) or in the return wire K927-BU(Blue) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U703-YL(Yellow) and the socket at contact J1-59 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-59 through the empty space in the J1 connector.

F. Observe the status of the active CID 2212 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2212 FMI 05 diagnostic code is no longer active. A CID 2212 FMI 06 diagnostic code becomes active when the ECM pin at J1-59 is grounded.

Results:

- YES – The CID 2212 FMI 05 diagnostic code is no longer active. A CID 2212 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2212 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2212 FMI 05 diagnostic code.

Expected Result:

The CID 2212 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2212 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. The ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2212 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540155

MID 082 - CID 2212 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

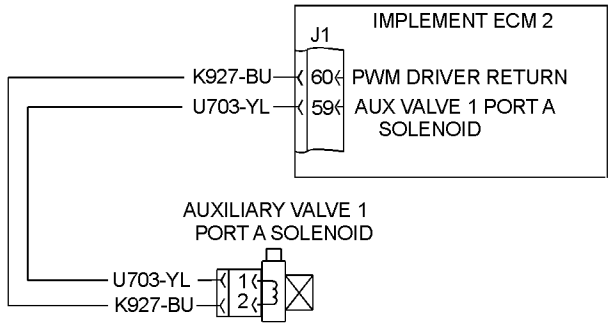


Illustration 422 g01271669

Auxiliary Valve 1 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 1 port A solenoid (attachment). The FMI 06 means that the Implement ECM 2 has determined that the current of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2212 FMI 06 diagnostic code changes to a CID 2212 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2212 FMI 06 diagnostic code changes to a CID 2212 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2212 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-59 (wire U703-YL(Yellow)) to frame ground. Measure the resistance from the contact J1-59 (wire U703-YL(Yellow)) to all of the other J1 and J2 contacts that are used in the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U703-YL(Yellow) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2212 FMI 06 diagnostic code.

Expected Result:

The CID 2212 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2212 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2212 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540157

MID 082 - CID 2212 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 1 port A solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 2 detects that the solenoid needs calibration. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2212 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540170

MID 082 - CID 2213 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

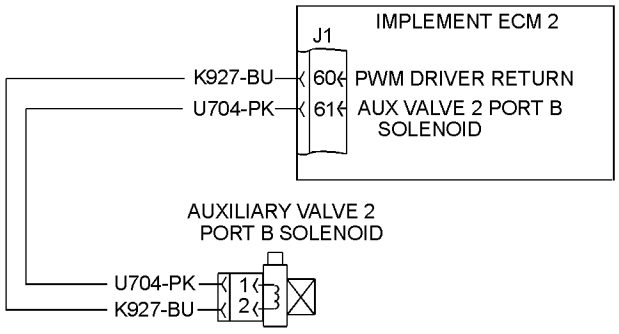


Illustration 423 g01271680

Auxiliary Valve 2 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 2 port B solenoid (attachment). The FMI 03 means that the Implement ECM 2 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-61 (wire U704-PK(Pink)) to all J1 and J2 contacts that are used on the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U704-PK(Pink) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U704-PK(Pink) and socket at contact J1-61 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2213 FMI 03 diagnostic code.

Expected Result:

The CID 2213 FMI 03 diagnostic code is no longer active. A CID 2213 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2213 FMI 03 diagnostic code is no longer active. A CID 2213 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2213 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2213 FMI 03 diagnostic code is active.

Expected Result:

The CID 2213 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2213 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2213 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i04776826

MID 082 - CID 2213 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

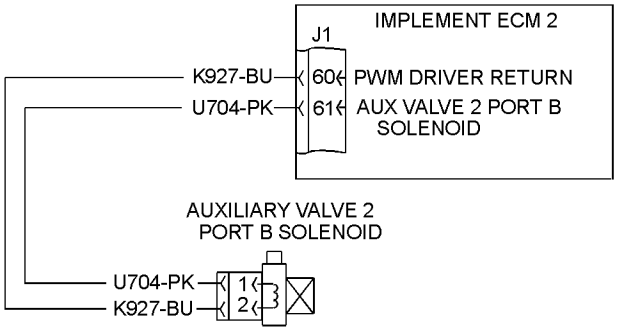


Illustration 424 g01271680

Connections of “Auxiliary Valve 2 Port B” solenoid

This diagnostic code is associated with the “auxiliary valve 2 port B” solenoid (attachment). The FMI 05 means that the Implement ECM 2 has determined that the current for the solenoid circuit is below normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U704-PK(Pink)) to contact 2 (wire K927-BU(Blue)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2213 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2213 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 2.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 2, measure the resistance from the return contact J1-60 (wire K927-BU(Blue)) to the energize contact J1-61 (wire U704-PK(Pink)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in supply wire U704-PK(Pink) or in the return wire K927-BU(Blue) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U704-PK(Pink) and the socket at contact J1-61 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-61 through the empty space in the J1 connector.

F. Observe the status of the active CID 2213 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2213 FMI 05 diagnostic code is no longer active. A CID 2213 FMI 06 diagnostic code becomes active when the ECM pin at J1-61 is grounded.

Results:

- YES – The CID 2213 FMI 05 diagnostic code is no longer active. A CID 2213 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid back in the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2213 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2213 FMI 05 diagnostic code.

Expected Result:

The CID 2213 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2213 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine . The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. The ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2213 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540175

MID 082 - CID 2213 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

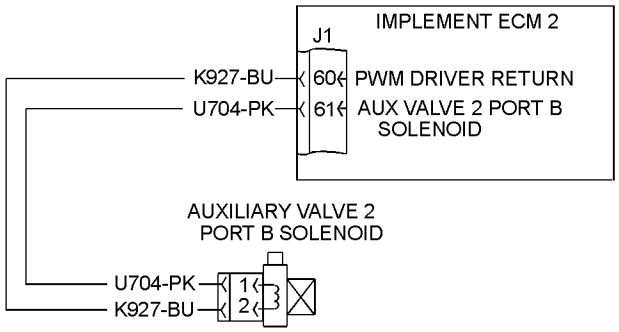


Illustration 425 g01271680

Auxiliary Valve 2 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 2 port B solenoid (attachment). The FMI 06 means that the Implement ECM 2 has determined that the current of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2213 FMI 06 diagnostic code changes to a CID 2213 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2213 FMI 06 diagnostic code changes to a CID 2213 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2213 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-61 (wire U704-PK(Pink)) to frame ground. Measure the resistance from the contact J1-61 (wire U704-PK(Pink)) to all of the other J1 and J2 contacts that are used in the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U704-PK(Pink) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2213 FMI 06 diagnostic code.

Expected Result:

The CID 2213 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2213 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2213 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540178

MID 082 - CID 2213 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 2 port B solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 2 detects that the solenoid needs calibration. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2213 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540180

MID 082 - CID 2214 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

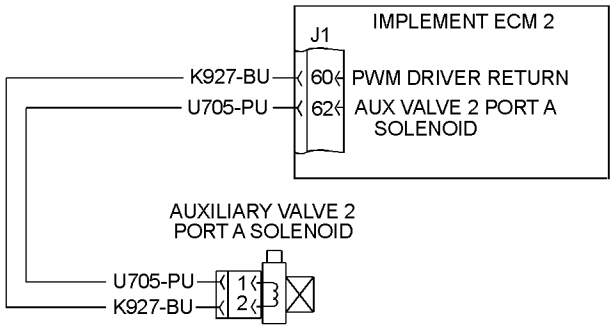


Illustration 426 g01271688

Auxiliary Valve 2 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 2 port A solenoid (attachment). The FMI 03 means that the Implement ECM 2 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-62 (wire U705-PU(Purple)) to all J1 and J2 contacts that are used on the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U705-PU(Purple) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U705-PU(Purple) and socket at contact J1-62 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2214 FMI 03 diagnostic code.

Expected Result:

The CID 2214 FMI 03 diagnostic code is no longer active. A CID 2214 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2214 FMI 03 diagnostic code is no longer active. A CID 2214 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2214 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2214 FMI 03 diagnostic code is active.

Expected Result:

The CID 2214 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2214 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2214 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i02985477

MID 082 - CID 2214 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

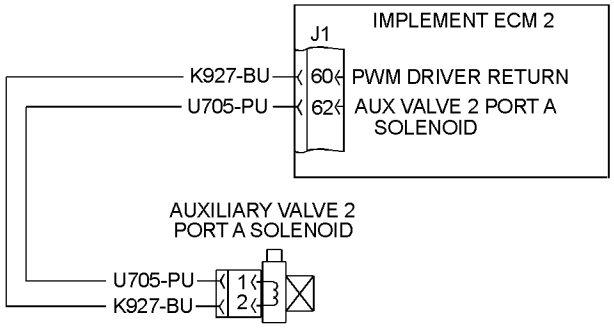


Illustration 427 g01271688

Connections of “Auxiliary Valve 2 Port A” solenoid

This diagnostic code is associated with the “auxiliary valve 2 port A” solenoid (attachment). The FMI 05 means that the Implement ECM 2 has determined that the current for the solenoid circuit is below normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U705-PU(Purple)) to contact 2 (wire K927-BU(Blue)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2214 FMI 05 diagnostic code.

Expected Result:

When the jumper wire is installed, the active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code.

Results:

- YES – When the jumper wire is installed, the active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code . The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2214 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 2.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 2, measure the resistance from the return contact J1-60 (wire K927-BU(Blue)) to the energize contact J1-62 (wire U705-PU(Purple)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The measurement of the resistance is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good .

  Repair: The open connection or the possible poor connection is in the supply wire U705-PU(Purple) or in the return wire K927-BU(Blue) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U705-PU(Purple) and the socket at contact J1-62 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-62 through the empty space in the J1 connector.

F. Observe the status of the active CID 2214 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2214 FMI 05 diagnostic code is no longer active. A CID 2214 FMI 06 diagnostic code becomes active when the ECM pin at J1-62 is grounded.

Results:

- YES – The CID 2214 FMI 05 diagnostic code is no longer active. A CID 2214 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid back into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2214 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2214 FMI 05 diagnostic code.

Expected Result:

The CID 2214 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2214 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. The ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2214 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540183

MID 082 - CID 2214 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

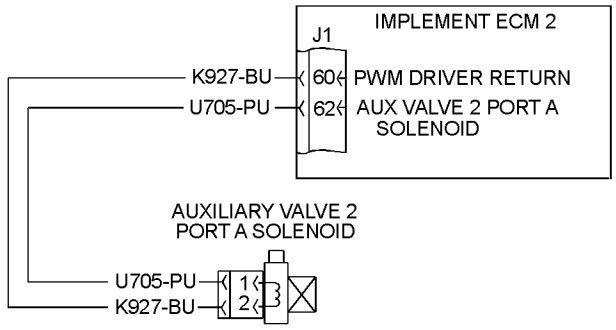


Illustration 428 g01271688

Auxiliary Valve 2 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 2 port A solenoid (attachment). The FMI 06 means that the Implement ECM 2 has determined that the current of the solenoid circuit is above normal. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2214 FMI 06 diagnostic code changes to a CID 2214 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2214 FMI 06 diagnostic code changes to a CID 2214 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2214 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-62 (wire U705-PU(Purple)) to frame ground. Measure the resistance from the contact J1-62 (wire U705-PU(Purple)) to all of the other J1 and J2 contacts that are used in the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U705-PU(Purple) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2214 FMI 06 diagnostic code.

Expected Result:

The CID 2214 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2214 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2214 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540184

MID 082 - CID 2214 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 2 port A solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 2 detects that the solenoid needs calibration. The Implement ECM 2 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2214 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 2. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540280

MID 082 - CID 2215 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

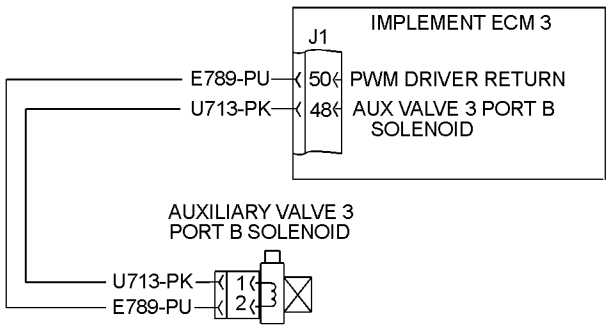


Illustration 429 g01271794

Auxiliary Valve 3 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 3 port B solenoid (attachment). The FMI 03 means that the Implement ECM 3 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-48 (wire U713-PK(Pink)) to all J1 and J2 contacts that are used on the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U713-PK(Pink) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U713-PK(Pink) and socket at contact J1-48 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2215 FMI 03 diagnostic code.

Expected Result:

The CID 2215 FMI 03 diagnostic code is no longer active. A CID 2215 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2215 FMI 03 diagnostic code is no longer active. A CID 2215 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2215 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2215 FMI 03 diagnostic code is active.

Expected Result:

The CID 2215 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2215 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2215 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02985360

MID 082 - CID 2215 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

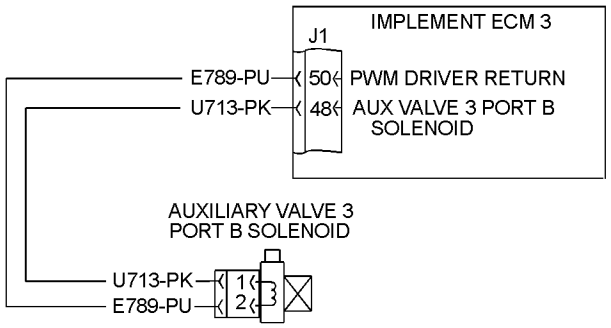


Illustration 430 g01271794

Connections of “Auxiliary Valve 3 Port B” solenoid

This diagnostic code is associated with the “auxiliary valve 3 port B” solenoid (attachment). The FMI 05 means that the Implement ECM 3 has determined that the current for the solenoid circuit is below normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U713-PK(Pink)) to contact 2 (wire E789-PU(Purple)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2215 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2215 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 3.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 3, measure the resistance from the return contact J1-50 (wire E789-PU(Purple)) to the energize contact J1-48 (wire U713-PK(Pink)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good .

  Repair: The open connection or the possible poor connection is in supply wire U713-PK(Pink) of the machine harness or in the return wire E789-PU(Purple) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U713-PK(Pink) and the socket at contact J1-48 from the harness connector.

C. Reconnect the machine harness J2 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-48 through the empty space in the J1 connector.

F. Observe the status of the active CID 2215 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2215 FMI 05 diagnostic code is no longer active. A CID 2215 FMI 06 diagnostic code becomes active when the ECM pin at J1-48 is grounded.

Results:

- YES – The CID 2215 FMI 05 diagnostic code is no longer active. A CID 2215 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid back into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2215 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the pin of the ECM for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2215 FMI 05 diagnostic code.

Expected Result:

The CID 2215 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2215 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine . The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed, as the ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2215 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540323

MID 082 - CID 2215 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

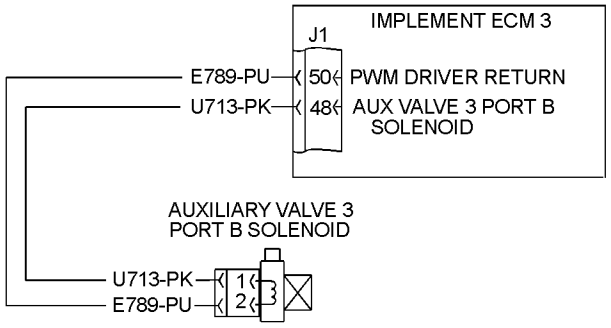


Illustration 431 g01271794

Auxiliary Valve 3 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 3 port B solenoid (attachment). The FMI 06 means that the Implement ECM 3 has determined that the current of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2215 FMI 06 diagnostic code changes to a CID 2215 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2215 FMI 06 diagnostic code changes to a CID 2215 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2215 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-48 (wire U713-PK(Pink)) to frame ground. Measure the resistance from the contact J1-48 (wire U713-PK(Pink)) to all of the other J1 and J2 contacts that are used in the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U713-PK(Pink) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2215 FMI 06 diagnostic code.

Expected Result:

The CID 2215 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2215 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2215 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540358

MID 082 - CID 2215 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 3 port B solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 3 detects that the solenoid needs calibration. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2215 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540476

MID 082 - CID 2216 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

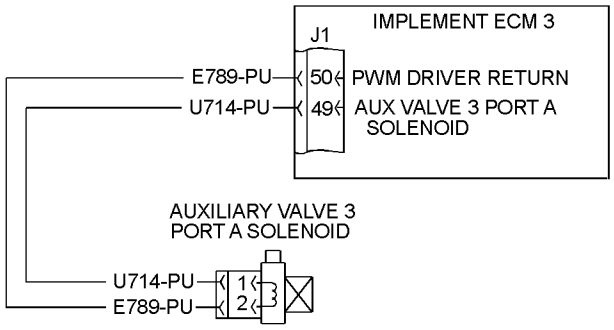


Illustration 432 g01271817

Auxiliary Valve 3 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 3 port A solenoid (attachment). The FMI 03 means that the Implement ECM 3 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-49 (wire U714-PU(Purple)) to all J1 and J2 contacts that are used on the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U714-PU(Purple) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U714-PU(Purple) and socket at contact J1-49 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2216 FMI 03 diagnostic code.

Expected Result:

The CID 2216 FMI 03 diagnostic code is no longer active. A CID 2216 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2216 FMI 03 diagnostic code is no longer active. A CID 2216 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2216 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2216 FMI 03 diagnostic code is active.

Expected Result:

The CID 2216 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2216 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2216 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i02985261

MID 082 - CID 2216 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

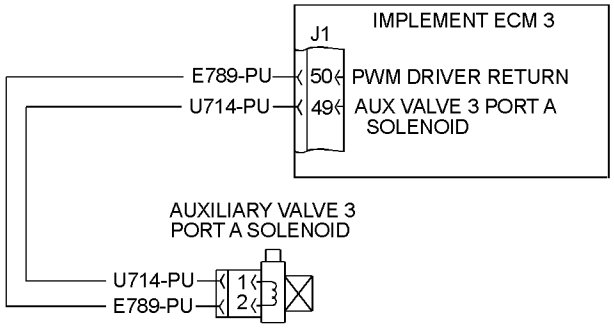


Illustration 433 g01271817

Connections of “Auxiliary Valve 3 Port A” solenoid

This diagnostic code is associated with the “auxiliary valve 3 port A” solenoid (attachment). The FMI 05 means that the Implement ECM 3 has determined that the current for the solenoid circuit is below normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U714-PU(Purple)) to contact 2 (wire E789-PU(Purple)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2216 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code after the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2216 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 3.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 3, measure the resistance from the return contact J1-50 (wire E789-PU(Purple)) to the energize contact J1-49 (wire U714-PU(Purple)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but that the connection is not good .

  Repair: The open connection or the possible poor connection is in supply wire U714-PU(Purple) of the machine harness or in return wire E789-PU(Purple) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U714-PU(Purple) and the socket at contact J1-49 from the harness connector.

C. Reconnect the machine harness J2 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-49 through the empty space in the J1 connector.

F. Observe the status of the active CID 2216 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2216 FMI 05 diagnostic code is no longer active. A CID 2216 FMI 06 diagnostic code becomes active when the ECM pin at J1-49 is grounded.

Results:

- YES – The CID 2216 FMI 05 diagnostic code is no longer active. A CID 2216 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2216 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2216 FMI 05 diagnostic code.

Expected Result:

The CID 2216 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2216 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed as the ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2216 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540479

MID 082 - CID 2216 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

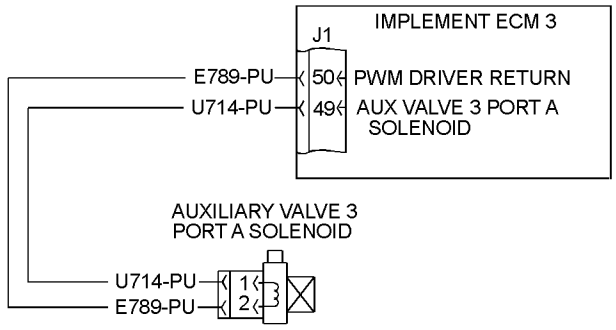


Illustration 434 g01271817

Auxiliary Valve 3 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 3 port A solenoid (attachment). The FMI 06 means that the Implement ECM 3 has determined that the current of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2216 FMI 06 diagnostic code changes to a CID 2216 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2216 FMI 06 diagnostic code changes to a CID 2216 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2216 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-49 (wire U714-PU(Purple)) to frame ground. Measure the resistance from the contact J1-49 (wire U714-PU(Purple)) to all of the other J1 and J2 contacts that are used in the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U714-PU(Purple) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2216 FMI 06 diagnostic code.

Expected Result:

The CID 2216 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2216 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2216 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540481

MID 082 - CID 2216 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 3 port A solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 3 detects that the solenoid needs calibration. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2216 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540535

MID 082 - CID 2217 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

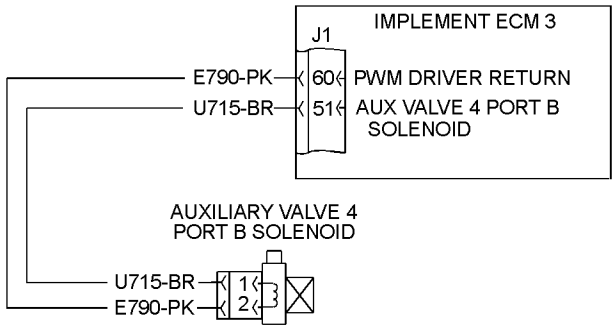


Illustration 435 g01271908

Auxiliary Valve 4 Port B connections

This diagnostic code is associated with the auxiliary valve 4 port B solenoid (attachment). The FMI 03 means that the Implement ECM 3 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-51 (wire U715-BR(Brown)) to all J1 and J2 contacts that are used on the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U715-BR(Brown) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J2 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire U715-BR(Brown) and socket at contact J1-51 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2217 FMI 03 diagnostic code.

Expected Result:

The CID 2217 FMI 03 diagnostic code is no longer active. A CID 2217 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2217 FMI 03 diagnostic code is no longer active. A CID 2217 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2217 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2217 FMI 03 diagnostic code is active.

Expected Result:

The CID 2217 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2217 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2217 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02985223

MID 082 - CID 2217 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

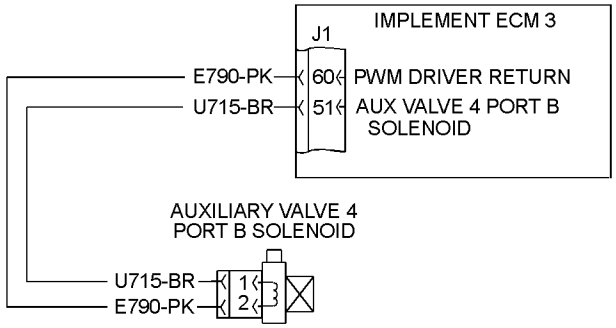


Illustration 436 g01271908

Connections of “Auxiliary Valve 4 Port B” solenoid

This diagnostic code is associated with the “auxiliary valve 4 port B” solenoid (attachment). The FMI 05 means that the Implement ECM 3 has determined that the current for the solenoid circuit is below normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U715-BR(Brown)) to contact 2 (wire E790-PK(Pink)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2217 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2217 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 3.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 3, measure the resistance from the return contact J1-60 (wire E790-PK(Pink)) to the energize contact J1-51 (wire U715-BR(Brown)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection or a bad connection in the machine harness. A measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good .

  Repair: The open connection or the possible poor connection is in supply wire U715-BR(Brown) or in the return wire E790-PK(Pink) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the energize wire of the solenoid U715-BR(Brown) and the socket at contact J1-51 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-51 through the empty space in the J1 connector.

F. Observe the status of the active CID 2217 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2217 FMI 05 diagnostic code is no longer active. A CID 2217 FMI 06 diagnostic code becomes active when the ECM pin at J1-51 is grounded.

Results:

- YES – The CID 2217 FMI 05 diagnostic code is no longer active. A CID 2217 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2217 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2217 FMI 05 diagnostic code.

Expected Result:

The CID 2217 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2217 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed as the ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2217 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540545

MID 082 - CID 2217 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

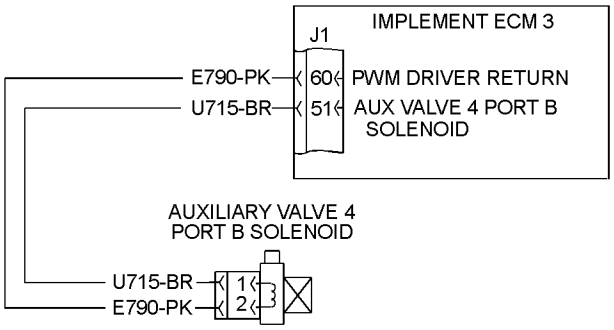


Illustration 437 g01271908

Auxiliary Valve 2 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 4 port B solenoid (attachment). The FMI 06 means that the Implement ECM 3 has determined that the current of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2217 FMI 06 diagnostic code changes to a CID 2217 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2217 FMI 06 diagnostic code changes to a CID 2217 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2217 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-51 (wire U715-BR(Brown)) to frame ground. Measure the resistance from the contact J1-51 (wire U715-BR(Brown)) to all of the other J1 and J2 contacts that are used in the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U715-BR(Brown) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2217 FMI 06 diagnostic code.

Expected Result:

The CID 2217 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2217 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2217 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540551

MID 082 - CID 2217 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 4 port B solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 3 detects that the solenoid needs calibration. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2217 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540559

MID 082 - CID 2218 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

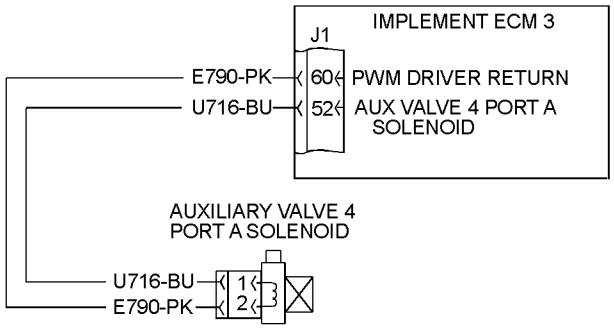


Illustration 438 g01271938

Auxiliary Valve 4 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 4 port A solenoid (attachment). The FMI 03 means that the Implement ECM 3 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-52 (wire U716-BU(Blue)) to all J1 and J2 contacts that are used on the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U716-BU(Blue) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U716-BU(Blue) and socket at contact J1-52 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2218 FMI 03 diagnostic code.

Expected Result:

The CID 2218 FMI 03 diagnostic code is no longer active. A CID 2218 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2218 FMI 03 diagnostic code is no longer active. A CID 2218 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2218 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2218 FMI 03 diagnostic code is active.

Expected Result:

The CID 2218 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2218 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2218 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i02985124

MID 082 - CID 2218 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

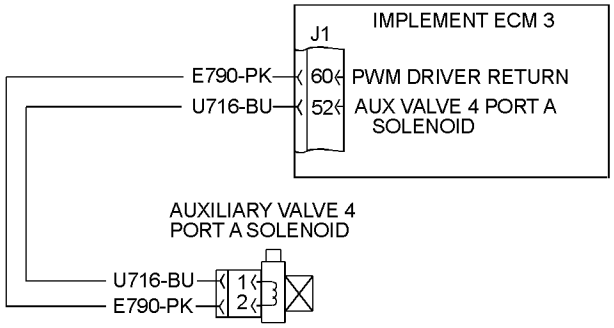


Illustration 439 g01271938

Connections of “Auxiliary Valve 4 Port A” solenoid

This diagnostic code is associated with the “auxiliary valve 4 port A” solenoid (attachment). The FMI 05 means that the Implement ECM 3 has determined that the current for the solenoid circuit is below normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U716-BU(Blue)) to contact 2 (wire E790-PK(Pink)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2218 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2218 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 3.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 3, measure the resistance from the return contact J1-60 (wire E790-PK(Pink)) to the energize contact J1-52 (wire U716-BU(Blue)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in supply wire U715-BR(Brown) or in the return wire E790-PK(Pink) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U716-BU(Blue) and the socket at contact J1-52 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-52 through the empty space in the J1 connector.

F. Observe the status of the active CID 2218 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2218 FMI 05 diagnostic code is no longer active. A CID 2218 FMI 06 diagnostic code becomes active when the ECM pin at J1-52 is grounded.

Results:

- YES – The CID 2218 FMI 05 diagnostic code is no longer active. A CID 2218 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2218 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2218 FMI 05 diagnostic code.

Expected Result:

The CID 2218 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2218 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine . The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed as the ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2218 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540563

MID 082 - CID 2218 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

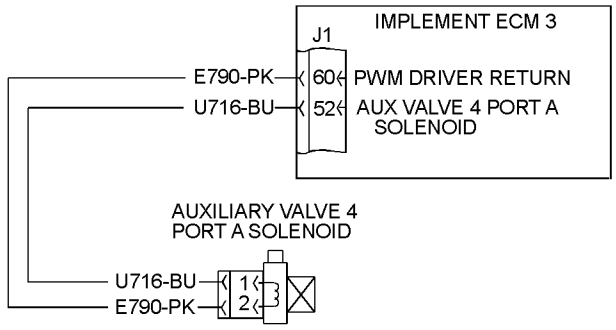


Illustration 440 g01271938

Auxiliary Valve 4 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 4 port A solenoid (attachment). The FMI 06 means that the Implement ECM 3 has determined that the current of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2218 FMI 06 diagnostic code changes to a CID 2218 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2218 FMI 06 diagnostic code changes to a CID 2218 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2218 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-52 (wire U716-BU(Blue)) to frame ground. Measure the resistance from the contact J1-52 (wire U716-BU(Blue)) to all of the other J1 and J2 contacts that are used in the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U716-BU(Blue) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2218 FMI 06 diagnostic code.

Expected Result:

The CID 2218 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2218 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2218 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540564

MID 082 - CID 2218 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 4 port A solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 3 detects that the solenoid needs calibration. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2218 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540488

MID 082 - CID 2219 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

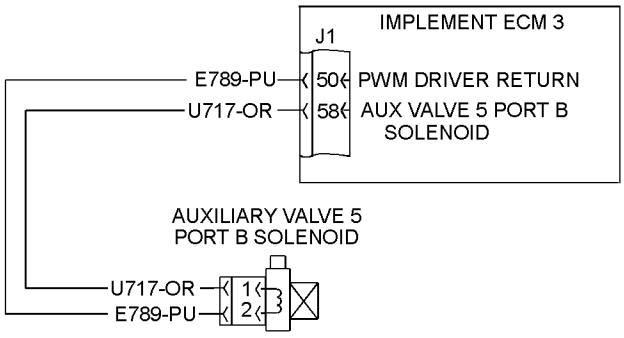


Illustration 441 g01271842

Auxiliary Valve 5 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 5 port B solenoid (attachment). The FMI 03 means that the Implement ECM 3 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-58 (wire U717-OR(Orange)) to all J1 and J2 contacts that are used on the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U717-OR(Orange) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U717-OR(Orange) and socket at contact J1-58 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2219 FMI 03 diagnostic code.

Expected Result:

The CID 2219 FMI 03 diagnostic code is no longer active. A CID 2219 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2219 FMI 03 diagnostic code is no longer active. A CID 2219 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2219 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2219 FMI 03 diagnostic code is active.

Expected Result:

The CID 2219 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2219 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2219 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02985084

MID 082 - CID 2219 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

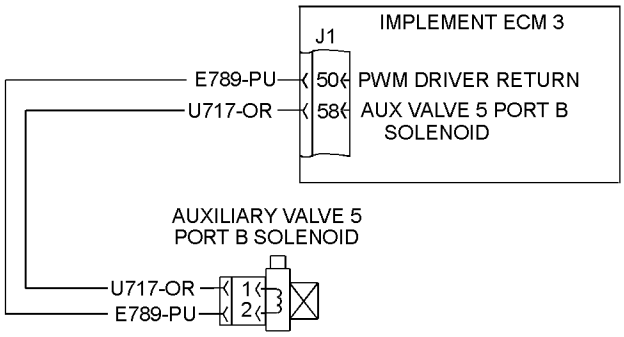


Illustration 442 g01271842

Connections of “Auxiliary Valve 5 Port B” solenoid

This diagnostic code is associated with the “auxiliary valve 5 port B” solenoid (attachment). The FMI 05 means that the Implement ECM 3 has determined that the current for the solenoid circuit is below normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U717-OR(Orange)) to contact 2 (wire E789-PU(Purple)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2219 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code after the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2219 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 3.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 3, measure the resistance from the return contact J1-50 (wire E789-PU(Purple)) to the energize contact J1-58 (wire U717-OR(Orange)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in the supply wire U717-OR(Orange) or in the return wire E789-PU(Purple) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U717-OR(Orange) and the socket at contact J1-58 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-58 through the empty space in the J1 connector.

F. Observe the status of the active CID 2219 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2219 FMI 05 diagnostic code is no longer active. A CID 2219 FMI 06 diagnostic code becomes active when the ECM pin at J1-58 is grounded.

Results:

- YES – The CID 2219 FMI 05 diagnostic code is no longer active. A CID 2219 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the likely cause of the problem.Reinstall the energize wire of the solenoid in the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2219 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2219 FMI 05 diagnostic code.

Expected Result:

The CID 2219 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2219 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed as the ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2219 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540490

MID 082 - CID 2219 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

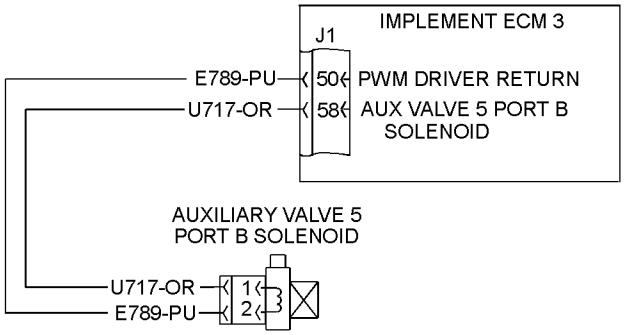


Illustration 443 g01271842

Auxiliary Valve 5 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 5 port B solenoid (attachment). The FMI 06 means that the Implement ECM 3 has determined that the current of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2219 FMI 06 diagnostic code changes to a CID 2219 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2219 FMI 06 diagnostic code changes to a CID 2219 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2219 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-58 (wire U717-OR(Orange)) to frame ground. Measure the resistance from the contact J1-58 (wire U717-OR(Orange)) to all of the other J1 and J2 contacts that are used in the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U717-OR(Orange) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2219 FMI 06 diagnostic code.

Expected Result:

The CID 2219 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2219 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2219 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540492

MID 082 - CID 2219 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 5 port B solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 3 detects that the solenoid needs calibration. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2219 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540517

MID 082 - CID 2220 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

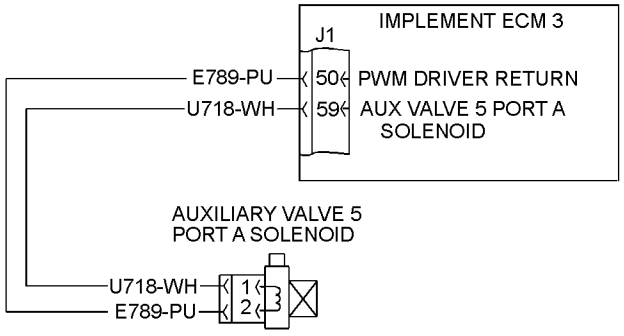


Illustration 444 g01271887

Auxiliary Valve 5 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 5 port A solenoid (attachment). The FMI 03 means that the Implement ECM 3 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-59 (wire U718-WH(White)) to all J1 and J2 contacts that are used on the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U718-WH(White) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U718-WH(White) and socket at contact J1-59 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2220 FMI 03 diagnostic code.

Expected Result:

The CID 2220 FMI 03 diagnostic code is no longer active. A CID 2220 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2220 FMI 03 diagnostic code is no longer active. A CID 2220 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2220 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2220 FMI 03 diagnostic code is active.

Expected Result:

The CID 2220 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2220 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2220 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i02984944

MID 082 - CID 2220 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

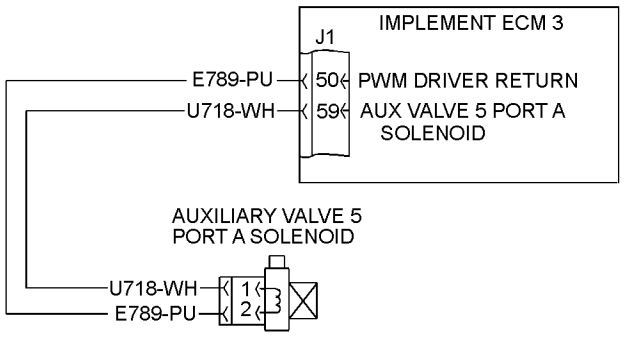


Illustration 445 g01271887

Connections of “Auxiliary Valve 5 Port A” solenoid

This diagnostic code is associated with the “auxiliary valve 5 port A” solenoid (attachment). The FMI 05 means that the Implement ECM 3 has determined that the current for the solenoid circuit is below normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U718-WH(White)) to contact 2 (wire E789-PU(Purple)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2220 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code after the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2220 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 3.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 3, measure the resistance from the return contact J1-50 (wire E789-PU(Purple)) to the energize contact J1-59 (wire U718-WH(White)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but that the connection is not good .

  Repair: The open connection or the possible poor connection is in supply wire U718-WH(White) or in the return wire E789-PU(Purple) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U718-WH(White) and the socket at contact J1-59 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-59 through the empty space in the J1 connector.

F. Observe the status of the active CID 2220 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2220 FMI 05 diagnostic code is no longer active. A CID 2220 FMI 06 diagnostic code becomes active when the ECM pin at J1-59 is grounded.

Results:

- YES – The CID 2220 FMI 05 diagnostic code is no longer active. A CID 2220 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the likely cause of the problem.Reinstall the energize wire of the solenoid in the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 2220 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2220 FMI 05 diagnostic code.

Expected Result:

The CID 2220 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2220 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed as the ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2220 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540521

MID 082 - CID 2220 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

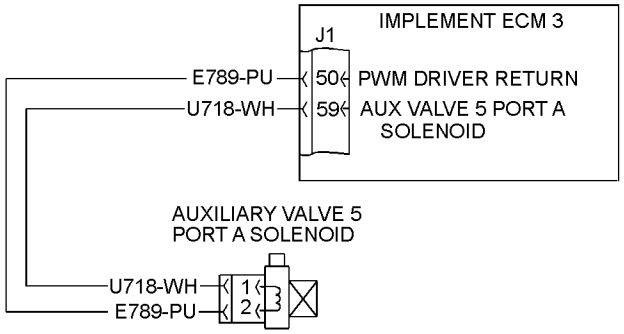


Illustration 446 g01271887

Auxiliary Valve 5 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 5 port A solenoid (attachment). The FMI 06 means that the Implement ECM 3 has determined that the current of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2220 FMI 06 diagnostic code changes to a CID 2220 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2220 FMI 06 diagnostic code changes to a CID 2220 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2220 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-59 (wire U718-WH(White)) to frame ground. Measure the resistance from the contact J1-59 (wire U718-WH(White)) to all of the other J1 and J2 contacts that are used in the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U718-WH(White) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2220 FMI 06 diagnostic code.

Expected Result:

The CID 2220 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2220 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2220 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540525

MID 082 - CID 2220 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 5 port A solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 3 detects that the solenoid needs calibration. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2220 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540580

MID 082 - CID 2221 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

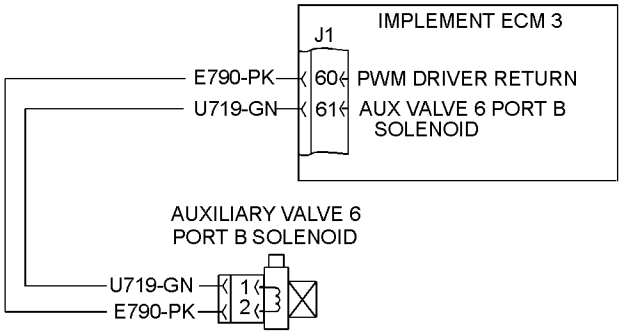


Illustration 447 g01271971

Auxiliary Valve 6 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 6 port B solenoid (attachment). The FMI 03 means that the Implement ECM 3 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-61 (wire U719-GN(Green)) to all J1 and J2 contacts that are used on the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U719-GN(Green) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire U719-GN(Green) and socket at contact J1-61 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2221 FMI 03 diagnostic code.

Expected Result:

The CID 2221 FMI 03 diagnostic code is no longer active. A CID 2221 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2221 FMI 03 diagnostic code is no longer active. A CID 2221 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2221 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2221 FMI 03 diagnostic code is active.

Expected Result:

The CID 2221 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2221 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2221 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02984901

MID 082 - CID 2221 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

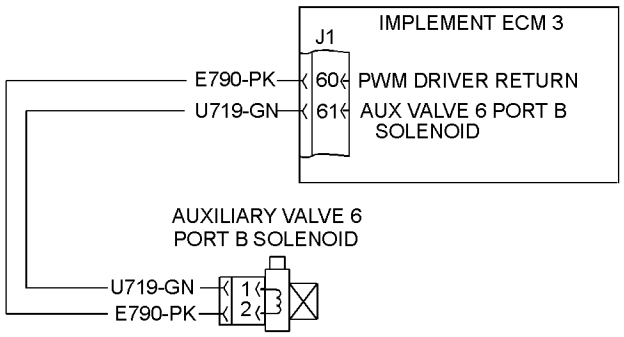


Illustration 448 g01271971

Connections of “Auxiliary Valve 6 Port B” solenoid

This diagnostic code is associated with the “auxiliary valve 6 port B” solenoid (attachment). The FMI 05 means that the Implement ECM 3 has determined that the current for the solenoid circuit is below normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U719-GN(Green)) to contact 2 (wire E790-PK(Pink)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2221 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2221 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 3.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 3, measure the resistance from the return contact J1-60 (wire E790-PK(Pink)) to the energize contact J1-61 (wire U719-GN(Green)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in supply wire U719-GN(Green) or in the return wire E790-PK(Pink) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U719-GN(Green) and the socket at contact J1-61 from the harness connector.

C. Reconnect the machine harness J2 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-61 through the empty space in the J1 connector.

F. Observe the status of the active CID 2221 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 2221 FMI 05 diagnostic code is no longer active. A CID 2221 FMI 06 diagnostic code becomes active when the ECM pin at J1-61 is grounded.

Results:

- YES – The CID 2221 FMI 05 diagnostic code is no longer active. A CID 2221 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is likely not the cause of the problem.Install the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 2221 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2221 FMI 05 diagnostic code.

Expected Result:

The CID 2221 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2221 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed as the ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2221 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540586

MID 082 - CID 2221 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

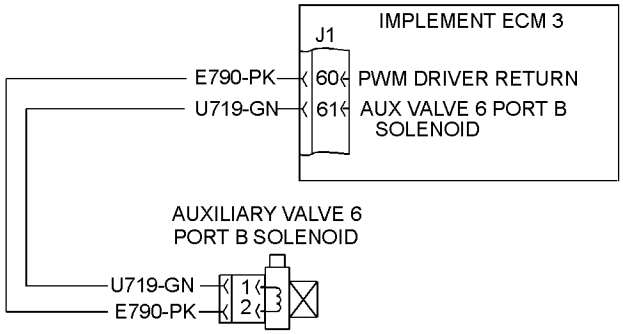


Illustration 449 g01271971

Auxiliary Valve 6 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 6 port B solenoid (attachment). The FMI 06 means that the Implement ECM 3 has determined that the current of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2221 FMI 06 diagnostic code changes to a CID 2221 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2221 FMI 06 diagnostic code changes to a CID 2221 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2221 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-61 (wire U719-GN(Green)) to frame ground. Measure the resistance from the contact J1-61 (wire U720-GY(Grey)) to all of the other J1 and J2 contacts that are used in the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U719-GN(Green) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2221 FMI 06 diagnostic code.

Expected Result:

The CID 2221 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2221 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2221 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540592

MID 082 - CID 2221 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 6 port B solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 3 detects that the solenoid needs calibration. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2221 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540593

MID 082 - CID 2222 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

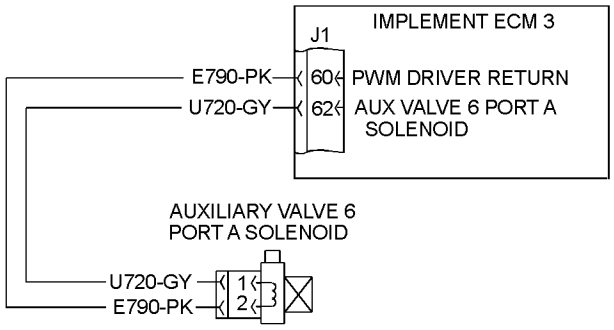


Illustration 450 g01271984

Auxiliary Valve 6 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 6 port A solenoid (attachment). The FMI 03 means that the Implement ECM 3 has determined that the voltage of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-62 (wire U720-GY(Grey)) to all J1 and J2 contacts that are used on the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U720-GY(Grey) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U720-GY(Grey) and socket at contact J1-62 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2222 FMI 03 diagnostic code.

Expected Result:

The CID 2222 FMI 03 diagnostic code is no longer active. A CID 2222 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2222 FMI 03 diagnostic code is no longer active. A CID 2222 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2222 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2222 FMI 03 diagnostic code is active.

Expected Result:

The CID 2222 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2222 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2222 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection

or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

i02984821

MID 082 - CID 2222 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

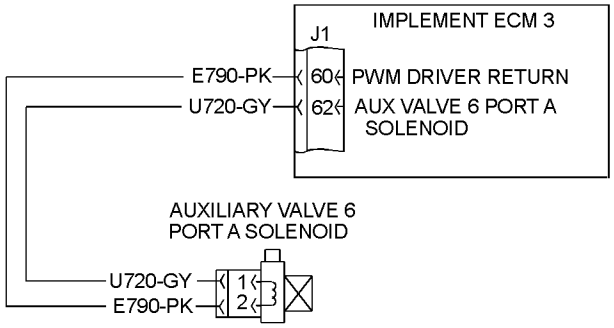


Illustration 451 g01271984

Connections of “Auxiliary Valve 6 Port A” solenoid

This diagnostic code is associated with the “auxiliary valve 6 port A” solenoid (attachment). The FMI 05 means that the Implement ECM 3 has determined that the current for the solenoid circuit is below normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U720-GY(Grey)) to contact 2 (wire E790-PK(Pink)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2222 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2222 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM 3.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the Implement ECM 3, measure the resistance from the return contact J1-60 (wire E790-PK(Pink)) to the for the energize wire J1-62 (wire U720-GY(Grey)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in supply wire U720-GY(Grey) or in the return wire E790-PK(Pink) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U720-GY(Grey) and the socket at contact J1-62 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-62 through the empty space in the connector.

F. Observe the status of the active CID 2222 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2222 FMI 05 diagnostic code is no longer active. A CID 2222 FMI 06 diagnostic code becomes active when the ECM pin at J1-62 is grounded.

Results:

- YES – The CID 2222 FMI 05 diagnostic code is no longer active. A CID 2222 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is likely not the cause of the problem.Reinstall the solenoid energize wire of the solenoid into the correct connector location of the ECM. Then proceed to the next test step. Proceed to Test Step 4.
- NO – The CID 2222 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2222 FMI 05 diagnostic code.

Expected Result:

The CID 2222 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2222 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed as the ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2222 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540601

MID 082 - CID 2222 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

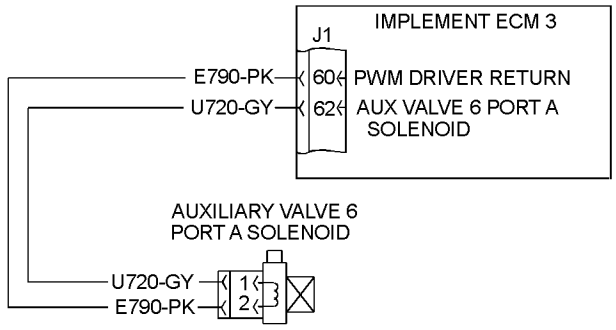


Illustration 452 g01271984

Auxiliary Valve 6 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 6 port A solenoid (attachment). The FMI 06 means that the Implement ECM 3 has determined that the current of the solenoid circuit is above normal. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2222 FMI 06 diagnostic code changes to a CID 2222 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2222 FMI 06 diagnostic code changes to a CID 2222 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2222 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 3.

D. At the machine harness ECM connectors, measure the resistance from the contact J1-62 (wire U720-GY(Grey)) to frame ground. Measure the resistance from the contact J1-62 (wire U720-GY(Grey)) to all of the other J1 and J2 contacts that are used in the Implement ECM 3 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire U720-GY(Grey) and the circuit with the low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2222 FMI 06 diagnostic code.

Expected Result:

The CID 2222 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2222 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2222 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540604

MID 082 - CID 2222 - FMI 13

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

This diagnostic code is associated with the auxiliary valve 6 port A solenoid (attachment). The FMI 13 diagnostic code is activated when the Implement ECM 3 detects that the solenoid needs calibration. The Implement ECM 3 communicates this condition to the Implement ECM over the J1939 data link and the Implement ECM will activate this diagnostic code.

Note: Before performing this procedure, verify that no other active CID 2222 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM 3. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02540621

MID 082 - CID 2223 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

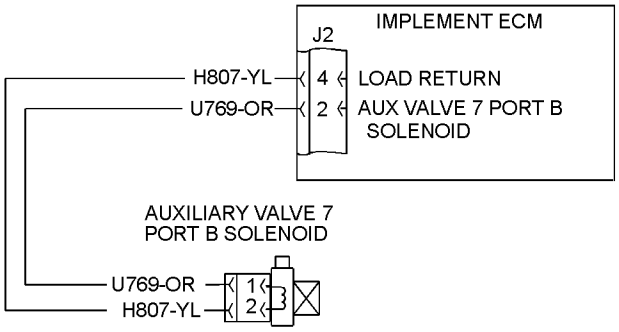


Illustration 453 g01272010

Auxiliary Valve 7 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 7 port B solenoid (attachment). The solenoid is an ON/OFF type of solenoid. The FMI 03 means that the Implement ECM has determined that voltage is present in the circuit when there should be no voltage.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

C. At the machine harness ECM connector J2, measure the resistance from contact J2-2 (wire U769-OR(Orange)) to all J1 and J2 contacts that are used on the Implement ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U769-OR(Orange) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire U769-OR(Orange) and socket at contact J2-2 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2223 FMI 03 diagnostic code.

Expected Result:

The CID 2223 FMI 03 diagnostic code is no longer active. A CID 2223 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2223 FMI 03 diagnostic code is no longer active. A CID 2223 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2223 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2223 FMI 03 diagnostic code is active.

Expected Result:

The CID 2223 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2223 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2223 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02984743

MID 082 - CID 2223 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

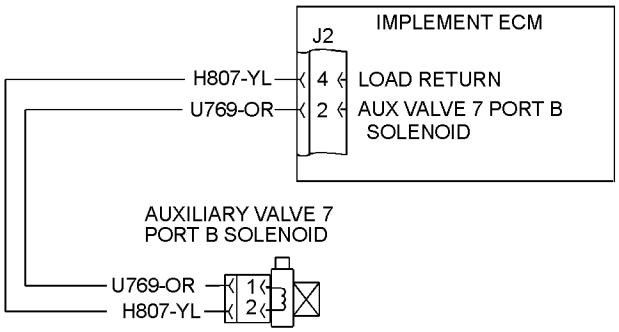


Illustration 454 g01272010

Connections of “Auxiliary Valve 7 Port B” solenoid

This diagnostic code is associated with the “auxiliary valve 7 port B” solenoid (attachment). The solenoid is an ON/OFF type of solenoid. The FMI 05 means that the Implement ECM has determined that the current for the solenoid circuit is below normal.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U769-OR(Orange)) to contact 2 (wire H807-YL(Yellow)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2223 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code after the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2223 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J2 for the Implement ECM, measure the resistance from the return contact J2-4 (wire H807-YL(Yellow)) to the energize contact J2-2 (wire U769-OR(Orange)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not a good connection.

  Repair: The open connection or the possible poor connection is in supply wire U769-OR(Orange) or in return wire H807-YL(Yellow) of the machine harness. Refer to the complete Electrical System Schematic of the machine . Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U769-OR(Orange) and the socket at contact J2-2 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J2-2 through the empty space in the J2 connector.

F. Observe the status of the active CID 2223 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2223 FMI 05 diagnostic code is no longer active. A CID 2223 FMI 06 diagnostic code becomes active when the ECM pin at J2-2 is grounded.

Results:

- YES – The CID 2223 FMI 05 diagnostic code is no longer active. A CID 2223 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the ground circuit condition in the solenoid circuit. The ECM is likely not the cause of the problem.Install the energize wire of the solenoid in the correct location of the ECM connector. Then proceed to the next test step. Proceed to Test Step 4.

- NO – The CID 2223 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2223 FMI 05 diagnostic code.

Expected Result:

The CID 2223 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2223 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed as the ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2223 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540624

MID 082 - CID 2223 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

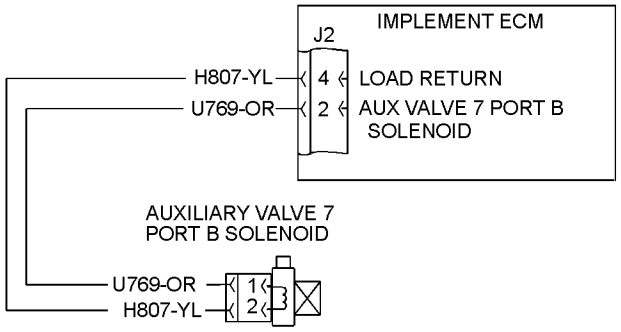


Illustration 455 g01272010

Auxiliary Valve 7 Port B Solenoid connections

This diagnostic code is associated with the auxiliary valve 7 port B solenoid (attachment). The solenoid is an ON/OFF type of solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2223 FMI 06 diagnostic code changes to a CID 2223 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2223 FMI 06 diagnostic code changes to a CID 2223 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2223 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

D. At the machine harness ECM connectors, measure the resistance from the contact J2-2 (wire U769-OR(Orange)) to frame ground. Measure the resistance from the contact J2-2 (wire U769-OR(Orange)) to all of the other J1 and J2 contacts that are used in the Implement ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a

short in the machine harness. The short is between wire U769-OR(Orange) and the circuit with the low resistance measurement.

Repair: Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2223 FMI 06 diagnostic code.

Expected Result:

The CID 2223 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2223 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2223 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540625

MID 082 - CID 2224 - FMI 03

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

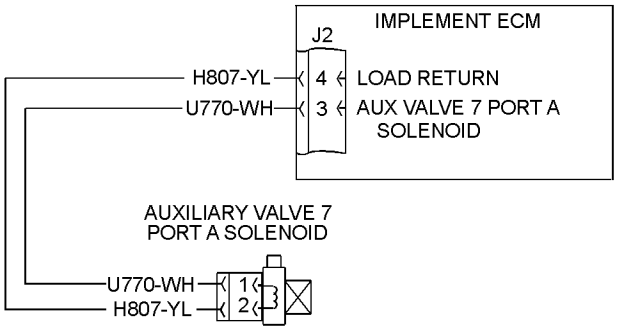


Illustration 456 g01272020

Auxiliary Valve 7 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 7 port A solenoid (attachment). The solenoid is an ON/OFF type of solenoid. The FMI 03 means that the Implement ECM has determined that voltage is present in the circuit when there should be no voltage.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.

- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

C. At the machine harness ECM connector J2, measure the resistance from contact J2-3 (wire U770-WH(White)) to all J1 and J2 contacts that are used on the Implement ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.

- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire U770-WH(White) and the circuit that has a low resistance measurement.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire U770-WH(White) and socket at contact J2-3 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2224 FMI 03 diagnostic code.

Expected Result:

The CID 2224 FMI 03 diagnostic code is no longer active. A CID 2224 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2224 FMI 03 diagnostic code is no longer active. A CID 2224 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2224 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2224 FMI 03 diagnostic code is active.

Expected Result:

The CID 2224 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2224 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2224 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02984663

MID 082 - CID 2224 - FMI 05

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

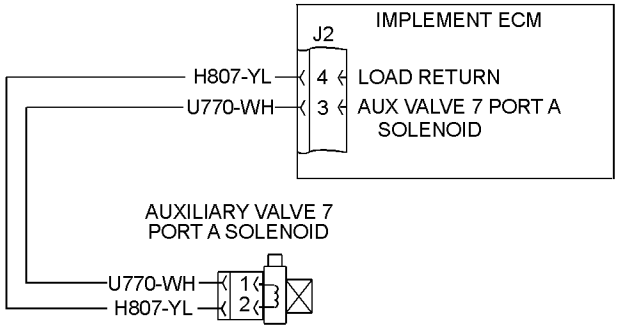


Illustration 457 g01272020

Connections of “Auxiliary Valve 7 Port A” solenoid

This diagnostic code is associated with the “auxiliary valve 7 port A” solenoid (attachment). The solenoid is an ON/OFF type of solenoid. The FMI 05 means that the Implement ECM has determined that the current for the solenoid circuit is below normal.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire U770-WH(White)) to contact 2 (wire H807-YL(Yellow)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2224 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2224 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the Implement ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J2 for the Implement ECM, measure the resistance from the contact of the return wire J2-4 (wire H807-YL(Yellow)) to the contact for the energize wire J2-3 (wire U770-WH(White)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open connection or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not a good connection.

  Repair: The open connection or the possible poor connection is in supply wire U769-OR(Orange) or in the return wire H807-YL(Yellow) of the machine harness. Refer to the complete Electrical System Schematic of the machine . Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid U770-WH(White) and the socket at contact J2-3 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J2-3 through the empty space in the J1 connector.

F. Observe the status of the active CID 0358 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2224 FMI 05 diagnostic code is no longer active. A CID 2224 FMI 06 diagnostic code becomes active when the ECM pin at J2-3 is grounded.

Results:

- YES – The CID 2224 FMI 05 diagnostic code is no longer active. A CID 2224 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is probably not the cause of the problem.Install the energize wire of the solenoid into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 4.
- NO – The CID 2224 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2224 FMI 05 diagnostic code.

Expected Result:

The CID 2224 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2224 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed as the ECM responded correctly to the grounded condition in the last test step.

  Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.
- NO – The CID 2224 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02540629

MID 082 - CID 2224 - FMI 06

SMCS Code: 5479-038-AX

Conditions Which Generate This Code:

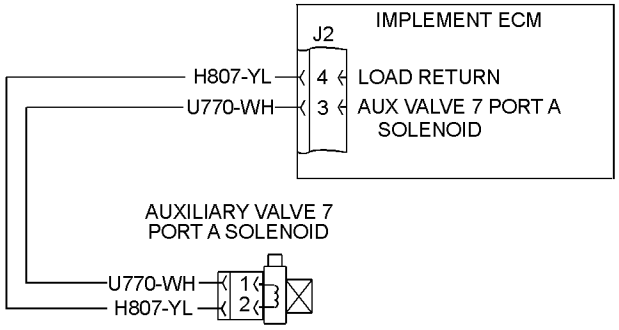


Illustration 458 g01272020

Auxiliary Valve 7 Port A Solenoid connections

This diagnostic code is associated with the auxiliary valve 7 port A solenoid (attachment). The solenoid is an ON/OFF type of solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2224 FMI 06 diagnostic code changes to a CID 2224 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2224 FMI 06 diagnostic code changes to a CID 2224 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2224 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

D. At the machine harness ECM connectors, measure the resistance from the contact J2-3 (wire U770-WH(White)) to frame ground. Measure the resistance from the contact J2-3 (wire U770-WH(White)) to all of the other J1 and J2 contacts that are used in the Implement ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a

short in the machine harness. The short is between wire U770-WH(White) and the circuit with the low resistance measurement.

Repair: Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2224 FMI 06 diagnostic code.

Expected Result:

The CID 2224 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2224 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the Implement ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2224 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i05761841

MID 082 - CID 2252 - FMI 02

SMCS Code: 4806-038

Conditions Which Generate This Code:

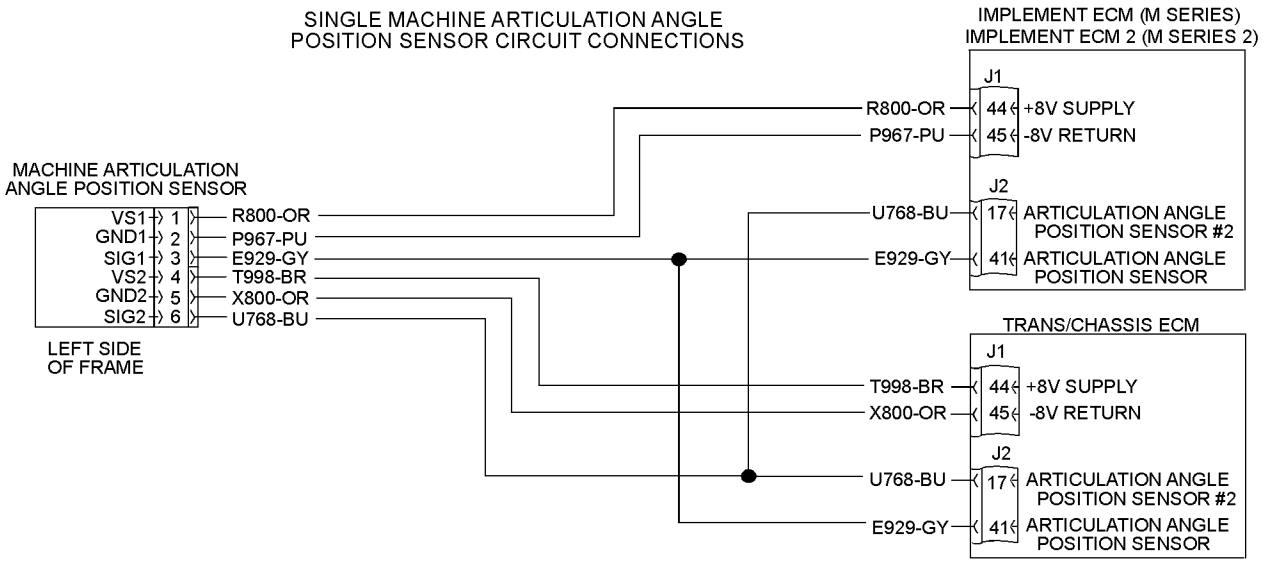


Illustration 459 g03656396

Connections for the Single Machine Articulation Angle Position Sensor 2 with two outputs

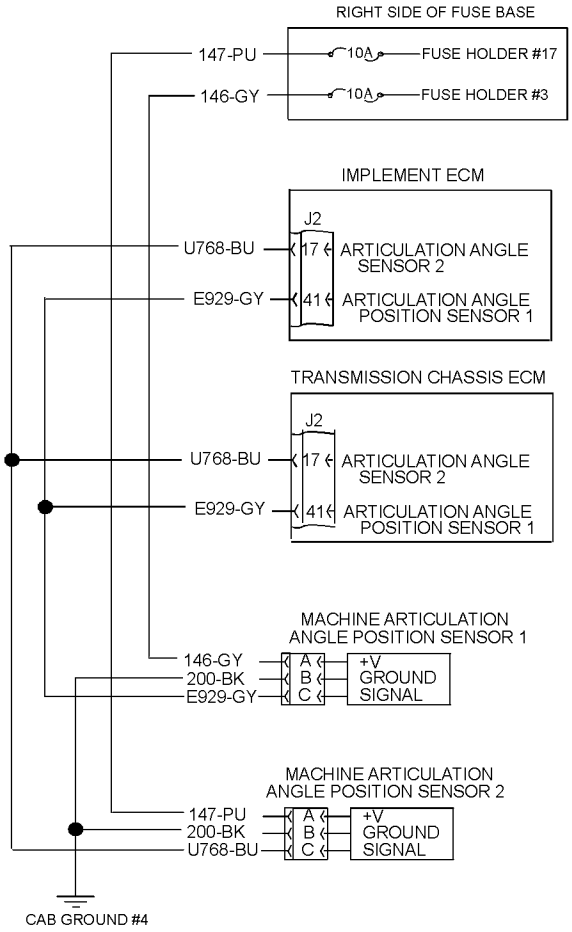


Illustration 460 g03665296

Connections of machine articulation angle position sensor 2

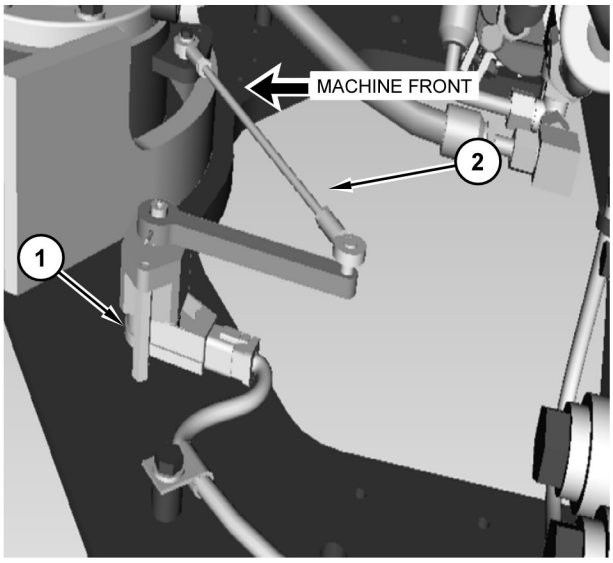


Illustration 461 g03236020

"Machine Articulation Angle Position" sensor location (View: From the left side of the machine at the articulation hitch)

(1) Machine "articulation angle sensor"
(2) Mechanical linkage

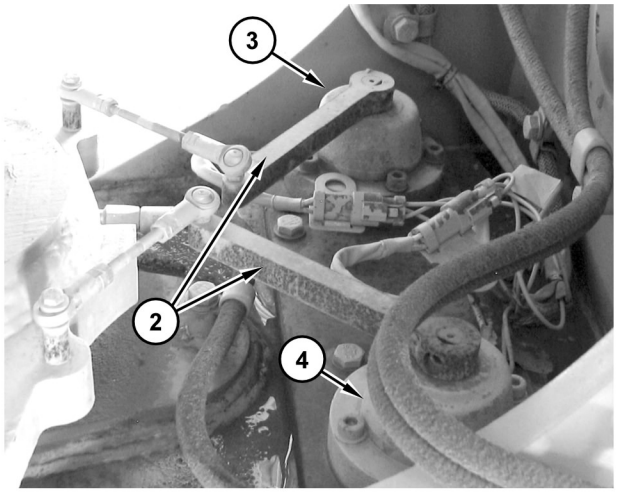


Illustration 462 g03665297

Location of the position sensor for the angle of the machine articulation

The view is from the left side of machine and the covers are removed.

(3) Articulation angle sensor 1
(4) Articulation angle sensor 2
(2) Mechanical linkage

Two articulation angle signals are required for correct operation of the articulation of the machine. Either the two separate sensors or the dual output sensor will provide a PWM input to the Implement ECM and the Transmission/Chassis ECM.

This diagnostic code is associated with the “machine articulation angle sensor signal 2” connected to each ECM at J2-17. The FMI 02 means that the ECM has determined that the input data from the sensor is erratic, intermittent, or incorrect. Either the Implement ECM or the Transmission/Chassis ECM or both ECM modules can activate this diagnostic code.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the input of the duty cycle from the sensor to the ECM is approximately 57% for the model 16M, approximately 54% for the model 14M and approximately 52% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 75% for all other models.

The possible causes of this diagnostic code are listed below:

- Mechanical devices are loose or mechanical devices are not adjusted correctly.
- There is an Intermittent connection or a poor connection in the circuit.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “articulation sensor signal 2” . Both ECM modules will activate a CID 2252 FMI 02 diagnostic code when an erratic signal or an intermittent signal is detected. If one ECM has activated a CID 2252 FMI 02 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor or a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Note: Use a digital multimeter for the measurements in this procedure.

Test Step 1. CHECK THE MECHANICAL LINKAGE

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight and that all components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and components for the adjustment of the articulation sensor(s) are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensor is correct. Proceed to Test Step 2.
- NOT OK – All mechanical linkage and adjustment for the articulation sensor is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensor(s). After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK FOR POWER AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Do not disconnect the harness connector from the sensor.

C. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along the contact for the supply 4 (wire T998-BR(Brown)) and along the contact for the return 5 (wire X800-OR(Orange)).

D. Turn the key start switch and the disconnect switch to the ON position.

E. Measure the voltage from contact 4 to contact 5.

Expected Result:

The voltage measurement is 8.0 ± 0.5 VDC.

Results:

- OK – The voltage measurement is 8.0 ± 0.5 VDC. The power supply circuit is correct.Proceed to Test Step 3.
- NOT OK – The voltage measurement is not 8.0 ± 0.5 VDC. The 8 VDC power supply circuit of the Transmission/Chassis ECM is not correct.

  Repair: There is a problem with the power supply circuit for the sensor. Refer to the complete Electrical System Schematic of the machine. Check all of the connections that are in the power supply circuit and the return circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL OF THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the back of the harness connector for the sensor, remove the multimeter probe from contact 4 (wire T998-BR(Brown)) and insert the probe along the signal contact 6 (wire U768-BU(Blue)).

C. The multimeter probe along return contact 5 (wire X800-OR(Orange)) remains in place.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Monitor the signal of the sensor with a digital multimeter. When possible monitor the signal from the cab of the machine in order to maintain a safe distance from the articulation point of the machine.

Note: The steering frame lock must be disconnected in order to articulate the machine. Ensure that all technicians at work in the immediate area are aware that the machine will be articulated during the check of the sensor.

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

F. Without disconnecting the sensor or the hardware that is associated with the sensor from the machine, take the sensor through the full operating range of the sensor.

G. Connect the steering frame lock link between the front and rear frames of the machine.

Expected Result:

The sensors signal responds in the manner that is described at the beginning of this procedure.

Results:

- OK – The sensors signal responds correctly. The sensor is operating correctly. Proceed to Test Step 4.

- NOT OK – The sensors signal does not respond correctly. The sensor is not operating correctly.

  Repair: Replace the “articulation angle 2” sensor. After the sensor is replaced, the sensor must be calibrated. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  STOP.

Test Step 4. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the sensor.

C. At the machine harness connector for the sensor, connector a jumper wire between a good frame ground contact and signal contact 6 (wire U768-BU(Blue)).

D. Disconnect the machine harness connector J2 from the Implement ECM.

E. At the Implement ECM machine harness connector, measure the resistance from a good frame ground contact to Implement ECM connector contact J2-17 (wire U768-BU(Blue)).

F. While observing the resistance measurement, wiggle the ECM connector and the sensor connector. Gently pull on the wires and move the wires around for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness.

Results:

- OK – The resistance measures less than 5 ohms. The resistance measurement is not indicating an open in the circuit.Proceed to Test Step 5.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: If both of the ECM modules have activated this diagnostic code, there is most likely an open or a bad connection on the sensor side of the machine harness splice connection for the signal wire.

  If only the Implement ECM has activated this diagnostic code, there is most likely an open or a bad connection on the ECM side of the machine harness splice connection for the signal wire.

  In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspected section of the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE OPERATION OF THE ECM

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors for the sensor and the J2 connector for the Implement ECM remain disconnected.

Note: This check should be performed on the ECM that has activated the diagnostic code. If both of the ECM modules have activated the diagnostic code, perform this check on both of the ECM modules.

A. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the sensor signal wire U768-BU(Blue) and the socket at contact J2-17 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Observe the status of the active CID 2252 FMI 02 diagnostic code.

Expected Result:

The CID 2252 FMI 02 diagnostic code is no longer active. A CID 2252 FMI 03 diagnostic code is now active.

Results:

- YES – The CID 2252 FMI 02 diagnostic code is no longer active. A CID 2252 FMI 03 diagnostic code has been activated after the sensor signal wire was disconnected. The ECM has responded correctly to the open circuit condition in the sensor circuit. Reinstall the disconnected sensor signal wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 6.

- NO – The CID 2252 FMI 03 diagnostic code remains active. The status of the active diagnostic code does not change when the sensor signal wire is disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the sensor circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 6. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) Pull Test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2252 FMI 02 diagnostic code.

Expected Result:

The CID 2252 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 2252 FMI 02 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2252 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the wiring harness of the machine. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, replace the sensor. After the replacement of the sensor, the sensor must be calibrated. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  If the problem is still present after the replacement of the sensor and the calibration of the sensor, the ECM may have failed. This is unlikely as the ECM responded correctly to the condition change in the previous test step.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM that activated the diagnostic code.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05761833

MID 082 - CID 2252 - FMI 03

SMCS Code: 4806-038

Conditions Which Generate This Code:

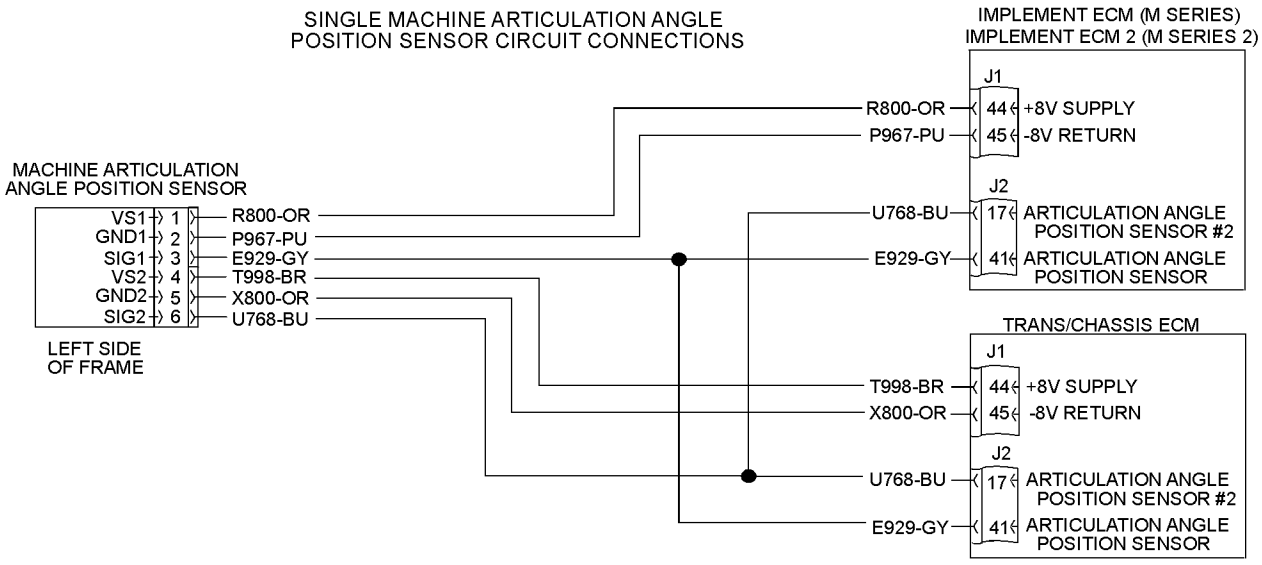


Illustration 463 g03656391

Connections for the Single Machine Articulation Angle Position Sensor 2 with two outputs

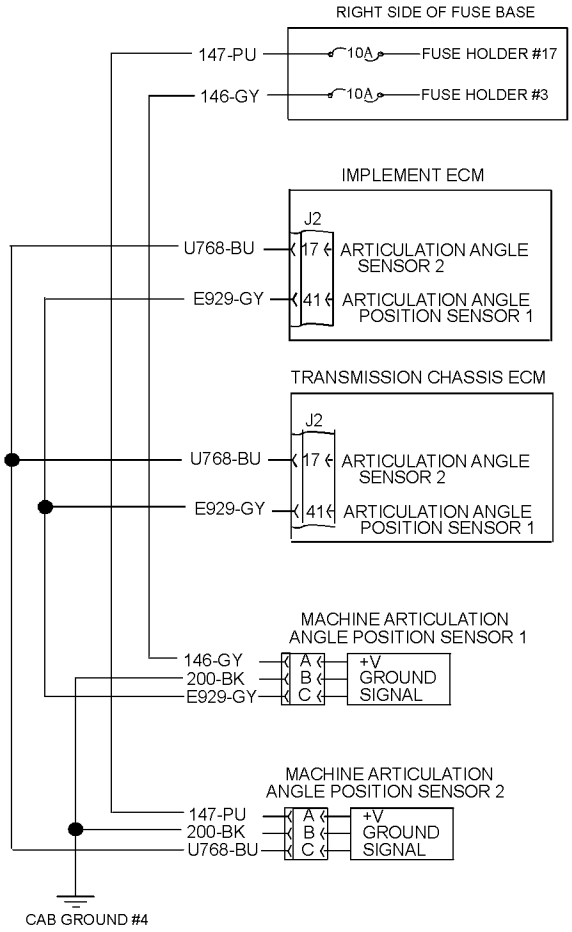


Illustration 464 g03665298

Connections of machine articulation angle position sensor 2

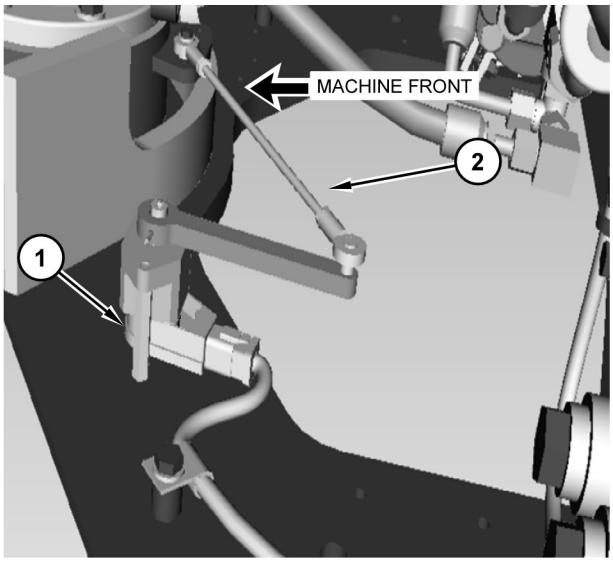


Illustration 465 g03236020

Machine “Articulation Angle Position” Sensor location (View: From the left side of the machine at the articulation hitch)

(1) “Articulation angle sensor”
(2) “Mechanical linkage”

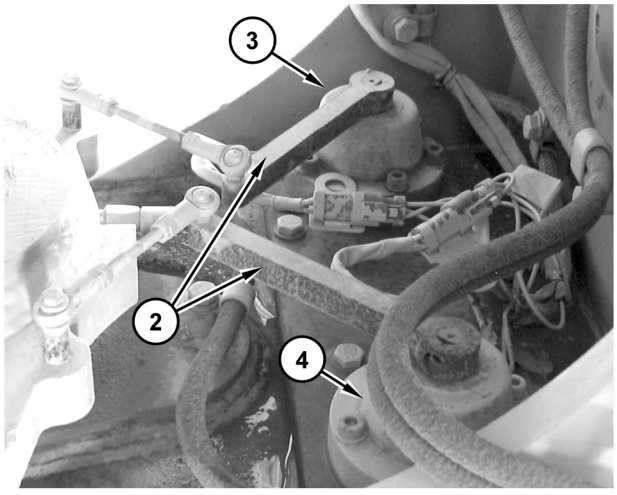


Illustration 466 g03665299

Location of the position sensor for the angle of the machine articulation

The view is from the left side of machine and the covers are removed.

(3) Articulation angle sensor 1
(4) Articulation angle sensor 2
(2) Mechanical linkage

Two articulation angle signals are required for correct operation of the articulation of the machine. Either the two separate sensors or the dual output sensor will provide a PWM input to the Implement ECM and the Transmission/Chassis ECM.

The FMI 03 diagnostic code is activated when the ECM reads the input signal from the machine “articulation angle sensor signal 2” connected to each ECM at J2-17 and the voltage of the signal is above normal. Either the Implement ECM or the Transmission/Chassis ECM or both ECM modules can activate this diagnostic code.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the input of the duty cycle from the sensor to the ECM is approximately 57% for the model 16M, approximately 54% for the model 14M and approximately 52% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models.

The possible causes of this diagnostic code are listed below:

- The power supply circuit of the sensor is open.
- The return circuit is open.
- The signal circuit is open or the sensor is disconnected.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, check for an active CID 0041 diagnostic code for the 8 VDC sensor power supply of the Transmission/Chassis ECM. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “articulation sensor signal 1” . Both ECM modules can activate a CID 2252 FMI 03 diagnostic code when an above normal signal is detected. If one ECM has activated a CID 2252 FMI 03 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor could be the cause or a problem with the wiring harness could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL LINKAGE

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight. Verify that all of the mechanical components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and components for the adjustment of the articulation sensor(s) are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensor is correct. Proceed to Test Step 2.
- NOT OK – All mechanical linkage and adjustment for the articulation sensors is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensor(s). After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SUPPLY VOLTAGE AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Do not disconnect the harness connector from the sensor.

C. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along the contact for the supply 4 (wire T998-BR(Brown)). Insert a multimeter probe along the contact for the return 5 (wire X800-OR(Orange)).

D. Turn the key start switch and the disconnect switch to the ON position.

E. Measure the voltage from contact 4 to contact 5.

Expected Result:

The voltage measurement is 8.0 ± 0.5 VDC.

Results:

- OK – The voltage measurement is 8.0 ± 0.5 VDC. The power supply circuit is correct.Proceed to Test Step 3.
- NOT OK – The voltage measurement is not 8.0 ± 0.5 VDC. The power supply circuit of the Transmission/Chassis ECM is not correct.

  Repair: There is a problem with the circuit of the 8 VDC power supply of the Transmission/Chassis ECM for the sensor. Refer to the complete Electrical System Schematic of the machine. Check all of the connections that are in the power supply circuit and all the connections in the return circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

The key start switch and the disconnect switch remain in the OFF position.

A. Disconnect the machine harness connector from the sensor.

B. At the machine harness connector for the sensor, connect a jumper wire between a good ground contact and the contact for the signal 6 (wire U768-BU(Blue)).

C. Disconnect the machine harness connector J2 from the Implement ECM.

D. At the machine harness connector of the Implement ECM, measure the resistance from a good contact of the frame ground to the contact for the connector of the Implement ECM J2-17 (wire U768-BU(Blue)).

E. Observe the resistance measurement of the multimeter and wiggle the ECM connector and the sensor connector. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness.

Results:

- OK – The resistance measures less than 5 ohms. The signal circuit is not open.Proceed to Test Step 4.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

Repair: If both of the ECM modules have activated this diagnostic code, there is most likely an open connection or a bad connection on the sensor side of the machine harness splice connection for the signal wire.

If only the Implement ECM has activated this diagnostic code, there is most likely an open connection or a bad connection on the ECM side of the machine harness splice connection for the signal wire.

In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspected section of the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The sensor connector and the Implement ECM J2 harness connector remain disconnected from the machine harness.

A. Remove the jumper wire that was installed in the last step.

B. Disconnect the J1 connector from the Implement ECM and disconnect the J1 and J2 connectors from the Transmission/Chassis ECM.

C. At the J1 and J2 machine harness connectors for the Implement ECM, measure the resistance from the sensor signal contact J2-17 (wire U768-BU(Blue)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

D. At the J1 and J2 machine harness connectors for the Transmission/Chassis ECM, measure the resistance from the sensor signal contact J2-17 (wire U768-BU(Blue)) to all of the other J1 and J2 contacts that are used for the Transmission/Chassis ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted. Proceed to Test Step 5.
- NOT OK – A resistance measurement is less than 5000 ohms.

Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connectors are secure and that all connectors are in good condition.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 5. CHECK THE SIGNAL OF THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Reconnect the harness connectors J1 and J2 to the connectors of the Transmission/Chassis ECM and the Implement ECM.

B. Reconnect the machine harness connector to the sensor.

C. At the back of the harness connector for the sensor, insert the multimeter probe along contact 5 (wire X800-OR(Orange)) and insert the probe along the signal contact 6 (wire U768-BU(Blue)).

D. Turn the disconnect switch and the key start switch to the ON position.

E. Monitor the signal of the sensor with a digital multimeter. When possible monitor the signal from the cab of the machine in order to maintain a safe distance from the articulation point of the machine.

Note: The steering frame lock must be disconnected in order to articulate the machine. Ensure that all technicians at work in the immediate area are aware that the machine will be articulated during the check of the sensor.

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

F. Without disconnecting the sensor or the hardware that is associated with the sensor from the machine, take the sensor through the full operating range of the sensor.

G. Connect the steering frame lock link between the front and rear frames of the machine.

Expected Result:

The sensors signal responds in the manner that is described at the beginning of this procedure.

Results:

- OK – The sensors signal responds correctly. The sensor is operating correctly. Proceed to Test Step 6.
- NOT OK – The sensors signal does not respond correctly. The sensor is not operating correctly.

  Repair: Replace the “articulation angle 2” sensor. After the replacement of the sensor, the sensor must be calibrated. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  STOP.

Test Step 6. CHECK THE OPERATION OF THE ECM

Note: This check should be performed on the ECM that has activated the diagnostic code. If both of the ECM modules have activated the diagnostic code, perform this check on both of the ECM modules.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the sensor signal U768-BU(Blue) and the socket at contact J2-17 from the harness connector.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J2-17 through the empty space in the J2 connector.

E. While observing the status of the active CID 2252 FMI 03 diagnostic code, ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2252 FMI 03 diagnostic code is no longer active. A CID 2252 FMI 04 diagnostic code becomes active when the ECM pin at J2-17 is grounded.

Results:

- YES – The CID 2252 FMI 03 diagnostic code is no longer active. A CID 2252 FMI 04 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the likely cause of the problem.Reinstall the disconnected sensor signal wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 7.
- NO – The CID 2252 FMI 03 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the sensor signal is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the sensor circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 7. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) Pull Test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2252 FMI 03 diagnostic code is active.

Expected Result:

The CID 2252 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2252 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2252 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, replace the sensor. After the replacement of the sensor, the sensor must be calibrated. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  If the problem is still present after the replacement of the sensor, the ECM may have failed. This is unlikely as the ECM responded correctly to the condition change in the previous test step.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05761834

MID 082 - CID 2252 - FMI 04

SMCS Code: 4806-038

Conditions Which Generate This Code:

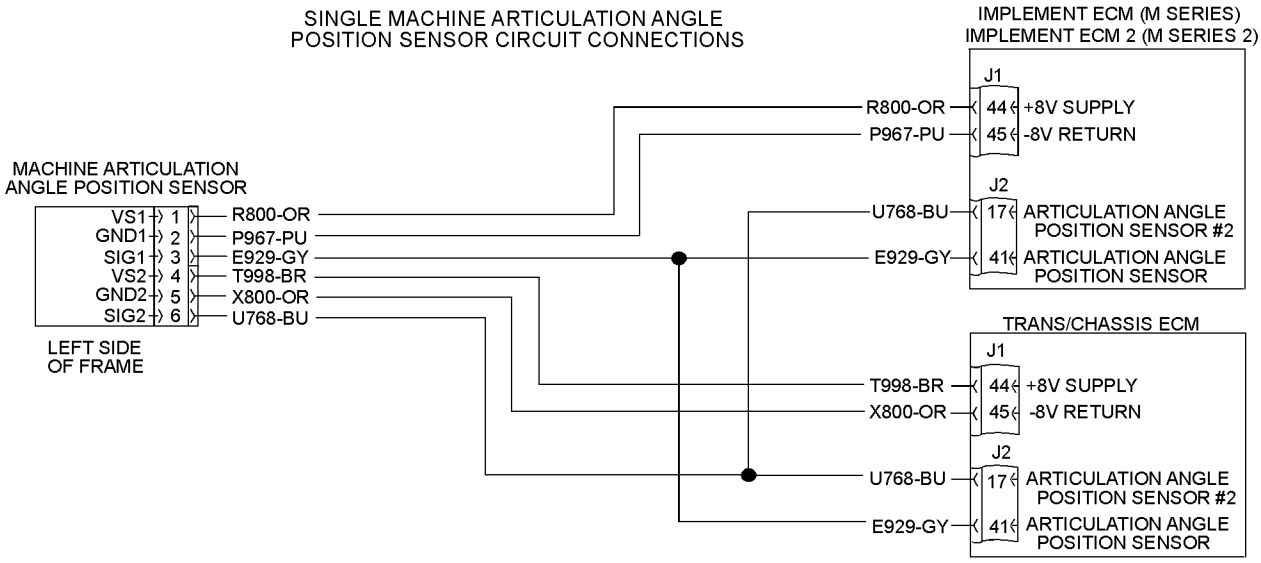


Illustration 467 g03656392

Connections for the single Machine Articulation Angle Position Sensor 2 with two outputs

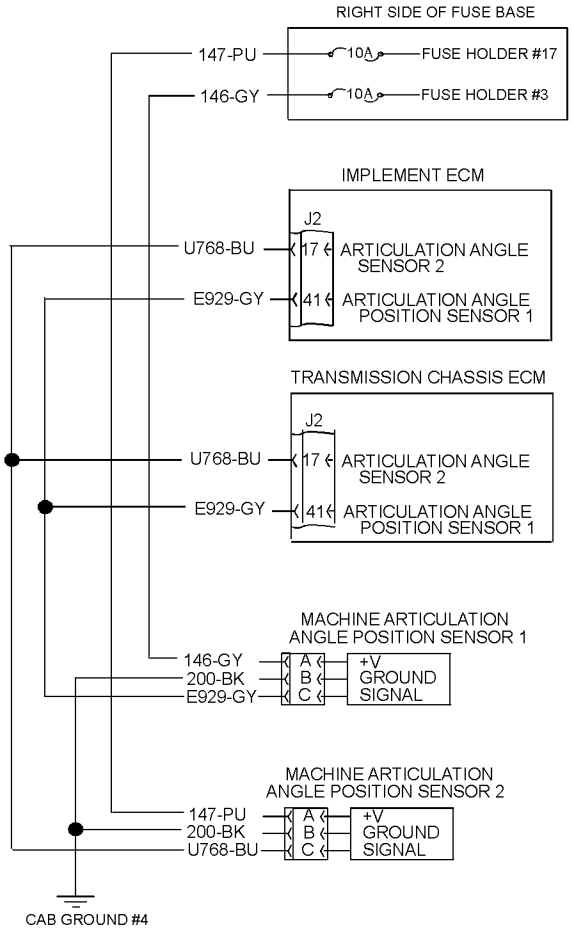


Illustration 468 g03665305

Connections of machine articulation angle position sensor 2

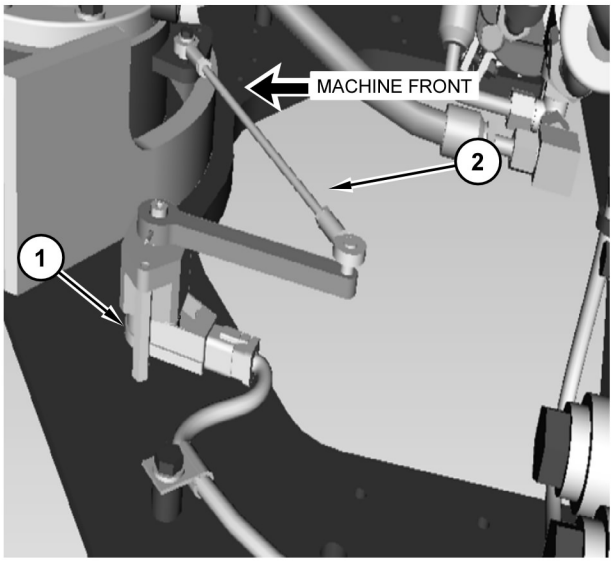


Illustration 469 g03236020

Locations of Machine “Articulation Angle” Position Sensor (View: From the left side of the machine at the articulation hitch)

(1) “Articulation angle sensor ”
(2) “Mechanical linkage”

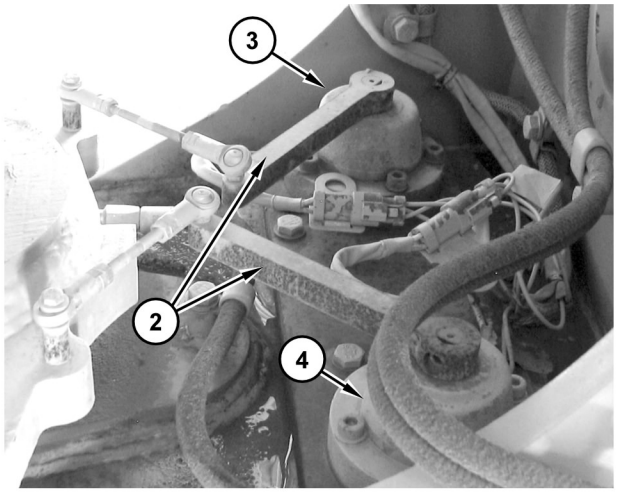


Illustration 470 g03665306

Location of the position sensor for the angle of the machine articulation

The view is from the left side of machine and the covers are removed.

(3) Articulation angle sensor 1
(4) Articulation angle sensor 2
(2) Mechanical linkage

Two articulation angle signals are required for correct operation of the articulation of the machine. Either the two separate sensors or the dual output sensor will provide a PWM input to the ECM.

This diagnostic code is recorded when the ECM reads the input signal from the machine “articulation angle sensor signal 2” connected to each ECM at J2-41 and the voltage of the signal is below normal. Either the Implement ECM or the Transmission/ Chassis ECM or both ECM modules can activate this diagnostic code.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the input of the duty cycle from the sensor to the ECM is approximately 57% for the model 16M, approximately 54% for the model 14M and approximately 52% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models.

The possible causes of this diagnostic code are listed below:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “articulation sensor signal 2” . Both ECM modules can activate a CID 2252 FMI 04 diagnostic code when a below normal voltage signal is detected. If one ECM has activated a CID 2252 FMI 04 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor OR a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL LINKAGE

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight and that all components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and components for the adjustment of the articulation sensor(s) are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensor is correct. Proceed to Test Step 2.
- NOT OK – All mechanical linkage and adjustment for the articulation sensors is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensor(s). After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Ensure that the diagnostic code is active.

C. Observe the status of the diagnostic code and disconnect the sensor from the machine harness.

Expected Result:

The CID 2252 FMI 04 diagnostic code is no longer active. A CID 2252 FMI 03 diagnostic code is now active.

Results:

- YES – The CID 2252 FMI 04 diagnostic code is no longer active. A CID 2252 FMI 03 diagnostic code is now active. The ECM and the circuit are correct. The position sensor is the cause of the problem.

  Repair: The sensor has failed. Replace the “articulation angle 2” sensor. After the replacement of the sensor, the sensor must be calibrated. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  STOP.

- NO – The CID 2252 FMI 04 diagnostic code remains active. Disconnecting the sensor did not affect the status of the active diagnostic code. The position sensor is not causing the problem. Proceed to Test Step 3.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The sensor remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM and the Transmission/Chassis ECM.

D. At machine harness connector J2 for the Implement ECM, measure the resistance from contact J2-17 (wire U768-BU(Blue)) to frame ground. Measure the resistance to all of the contacts that are used on the connectors of the Implement ECM.

E. At machine harness connector J2 for the Transmission/Chassis ECM, measure the resistance from contact J2-17 (wire U768-BU(Blue)) to frame ground. Measure the resistance to all of the contacts that are used on the connectors of the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 4.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: There is a short in the machine harness between the signal circuit and the circuit with the low resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE OPERATION OF THE ECM

The key start switch and the disconnect switch remain in the OFF position. The connectors of the machine harness for the sensor and both the Implement ECM and the Transmission/Chassis ECM remain disconnected.

Note: This check should be performed on the ECM that has activated the diagnostic code. If both of the ECM modules have activated the diagnostic code, perform this check on both of the ECM modules.

A. At the machine harness connector J2 for the ECM, use a 151 - 6320 Removal Tool to remove the sensor signal wire U768-BU(Blue) and the socket at contact J2-17 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Observe the status of the active CID 2252 FMI 04 diagnostic code.

Expected Result:

The CID 2252 FMI 04 diagnostic code is no longer active. A CID 2252 FMI 03 diagnostic code is now active.

Results:

- YES – The CID 2252 FMI 04 diagnostic code is no longer active. A CID 2252 FMI 03 diagnostic code is active after the wire for the sensor signal is disconnected. The ECM has responded correctly to the open circuit condition in the sensor circuit. Reinstall the disconnected sensor signal wire back into the correct spot of the ECM connector before proceeding to the next test step. Proceed to Test Step 5.

- NO – The CID 2252 FMI 04 diagnostic code remains active. The status of the active diagnostic code does not change when the sensor signal wire is disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the sensor circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) Pull Test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2252 FMI 04 diagnostic code is active.

Expected Result:

The CID 2252 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2252 FMI 04 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2252 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem is still present, the ECM may have failed. This is unlikely as the ECM responded correctly to the condition change in the previous test step.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05761836

MID 082 - CID 2252 - FMI 08

SMCS Code: 4806-038

Conditions Which Generate This Code:

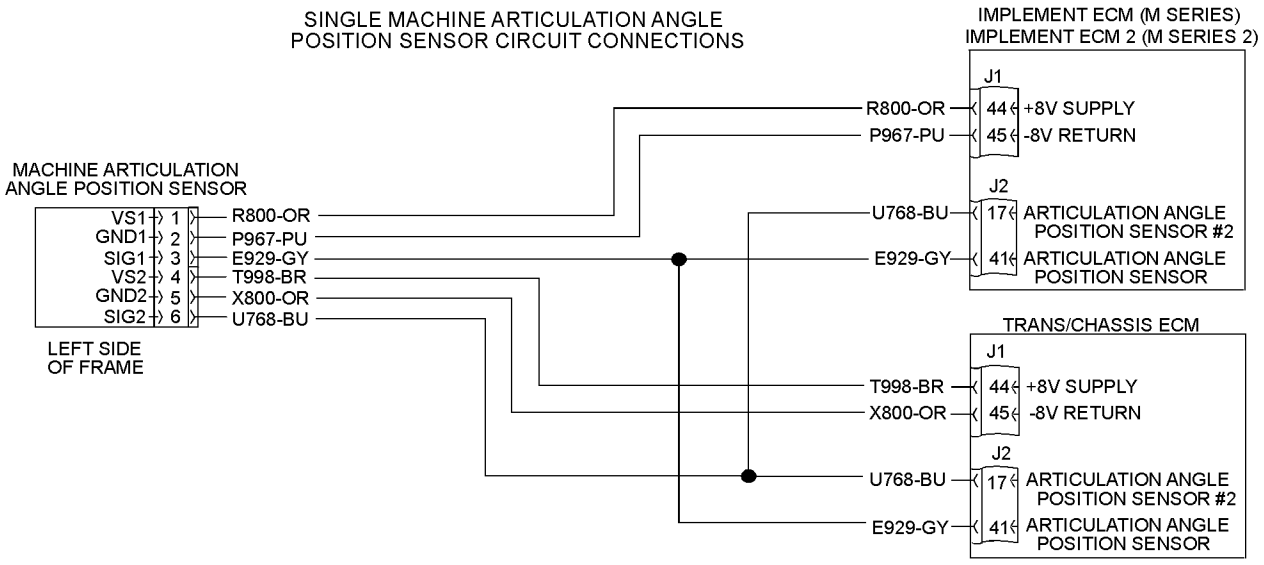


Illustration 471 g03656394

Connections for the Single Machine Articulation Angle Position Sensor 2 with two outputs

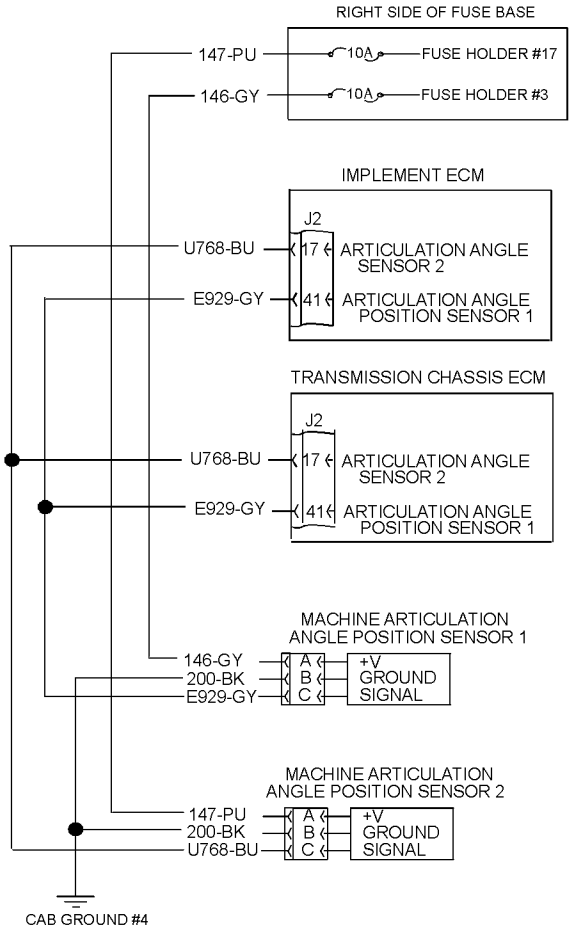


Illustration 472 g03665302

Connections of machine articulation angle position sensor 2

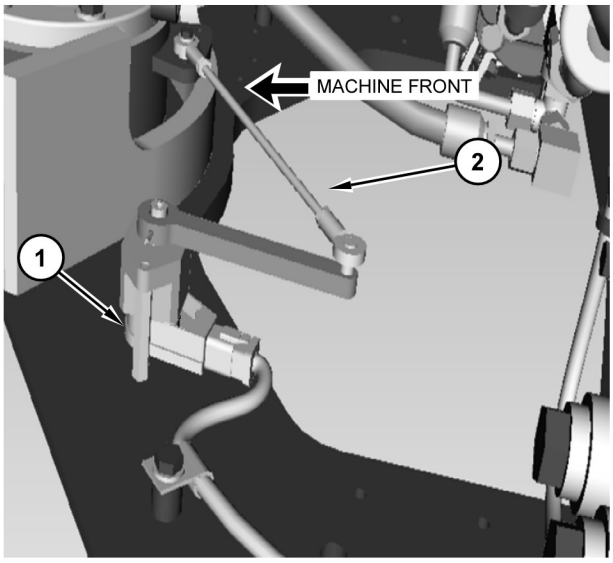


Illustration 473 g03236020

Machine “Articulation Angle Position” Sensor location (View: From the left side of the machine at the articulation hitch)

(1) “Articulation angle sensor”
(2) “Mechanical linkage”

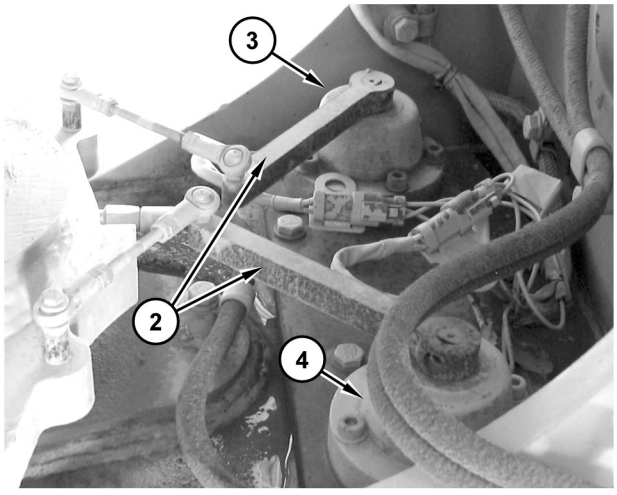


Illustration 474 g03665303

Location of the position sensor for the angle of the machine articulation

The view is from the left side of machine and the covers are removed.

(1) Articulation angle sensor 1
(2) Articulation angle sensor 2
(3) Mechanical linkage

Two articulation angle signals are required for correct operation of the articulation of the machine. Either the two separate sensors or the dual output sensor will provide a PWM input to the ECM.

This diagnostic code is associated with the machine “articulation angle sensor signal 2” connected to each ECM at J2-17 The FMI 08 means that the ECM has determined that the signal frequency or the signal pulse width is not within the expected range. The Implement ECM or the Transmission/Chassis ECM or both ECM modules can activate this diagnostic code.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the input of the duty cycle from the sensor to the ECM is approximately 57% for the model 16M, approximately 54% for the model 14M and approximately 52% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models.

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- Mechanical devices are loose.
- The ECM has failed. An ECM failure is unlikely.

Before performing this procedure, check for an active CID 0041 diagnostic code for the 8 VDC sensor power supply of the ECM. Correct any problem with the 8 VDC power supply before performing this procedure.

Note: The Transmission/Chassis ECM (MID 027) and the Implement ECM (MID 082) receive an input signal from the “articulation sensor signal 2” . Both ECM modules can activate a CID 2252 FMI 08 diagnostic code when the signal frequency or the signal pulse width is not within the expected range. If one ECM has activated a CID 2252 FMI 08 diagnostic code and the other ECM has not, it is likely that the sensor is operating correctly. When this occurs, a poor connection in the machine harness would be suspected. When both ECM modules have activated the diagnostic code, either the sensor or a harness problem could be the cause. If both ECM modules have activated the diagnostic code, it is very unlikely that either ECM is causing the problem. For either condition, proceed with this procedure in order to verify the cause of the problem.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL LINKAGE

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight and that all components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and components for the adjustment of the articulation sensor(s) are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensor is correct. Proceed to Test Step 2.

- NOT OK – All mechanical linkage and adjustment for the articulation sensors is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensor(s). After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SIGNAL OF THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along return contact B (wire X800-OR(Orange)) and insert a probe along the signal contact C (wire U768-BU(Blue)).

C. Turn the disconnect switch and the key start switch to the ON position.

D. Monitor the signal of the sensor with a digital multimeter. When possible monitor the signal from the cab of the machine in order to maintain a safe distance from the articulation point of the machine.

Note: The steering frame lock must be disconnected in order to articulate the machine. Ensure that all technicians at work in the immediate area are aware that the machine will be articulated during the check of the sensor.

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

E. Without disconnecting the sensor or the hardware that is associated with the sensor from the machine, take the sensor through the full operating range of the sensor.

F. Connect the steering frame lock link between the front and rear frames of the machine.

Expected Result:

The sensors signal responds in the manner that is described at the beginning of this procedure.

Results:

- OK – The sensors signal responds correctly. The sensor is operating correctly. Proceed to Test Step 3.

- NOT OK – The sensors signal does not respond correctly. The sensor is not operating correctly.

  Repair: Replace the “articulation angle 2” sensor. After the replacement of the sensor , the sensor must be calibrated. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  STOP.

Test Step 3. CHECK FOR AN OPEN IN THE SIGNAL CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the sensor.

C. At the machine harness connector for the sensor, connect a jumper wire between a good contact at the frame ground and signal contact C (wire U768-BU(Blue)).

D. Disconnect the machine harness connectors J2 from the Implement ECM.

E. At the machine harness connector of the Implement ECM, measure the resistance from a good contact on the frame ground to the connector contact of the Implement ECM J2-17 (wire U768-BU(Blue)).

F. Observe the resistance measurement of the multimeter and wiggle the ECM connector and the sensor connector. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness.

Results:

- OK – The resistance measurement is less than 5 ohms. The resistance measurement is not indicating an open in the circuit.Proceed to Test Step 5.

- NOT OK – One or both of the resistance measurements is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: If both of the ECM modules have activated this diagnostic code, there is most likely an open connection or a bad connection on the splice connection on the sensor side of the machine harness for the signal wire.

  If only the Implement ECM has activated this diagnostic code, there is most likely an open connection or a bad connection on the ECM side of the machine harness at the splice connection for the signal wire.

  In either case, refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspected section of the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE OPERATION OF THE ECM

The key start switch and the disconnect switch remain in the OFF position. The machine harness connector for the sensor and the Implement ECM remain disconnected.

Note: This check should be performed on the ECM that has activated the diagnostic code. If both of the ECM modules have activated the diagnostic code, perform this check on both of the ECM modules.

A. Remove the jumper wire that was connected in the previous test step.

B. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the sensor signal wire U768-BU(Blue) and the socket at contact J2-17 from the harness connector.

C. Reconnect any disconnected harness connectors to the ECM.

D. Turn the key start switch and the disconnect switch to the ON position.

E. Observe the status of the active CID 2252 FMI 08 diagnostic code.

Expected Result:

The CID 2252 FMI 08 diagnostic code is no longer active. A CID 2252 FMI 03 diagnostic code is now active.

Results:

- YES – The CID 2252 FMI 08 diagnostic code is no longer active. A CID 2252 FMI 03 diagnostic code is active after the sensor signal wire is disconnected. The ECM has responded correctly to the open circuit condition in the sensor circuit. Reinstall the disconnected wire for the sensor signal into the correct spot of the ECM connector before proceeding to the next test step. Proceed to Test Step 5.

- NO – The CID 2252 FMI 08 diagnostic code remains active. The status of the active diagnostic code does not change when the sensor signal wire is disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the sensor circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) Pull Test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2252 FMI 08.

Expected Result:

The CID 2252 FMI 08 is not active.

Results:

- OK – The CID 2252 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a

poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

STOP.

- NOT OK – The CID 2252 FMI 08 is active. The active diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, replace the sensor. After the replacement of the sensor, verify that the new sensor corrected the problem. If the problem is still present after the replacement of the sensor, the ECM may have failed. This is unlikely as the ECM responded correctly to the condition change in the previous test step.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05040529

MID 082 - CID 2252 - FMI 13

SMCS Code: 4806-038

Conditions Which Generate This Code:

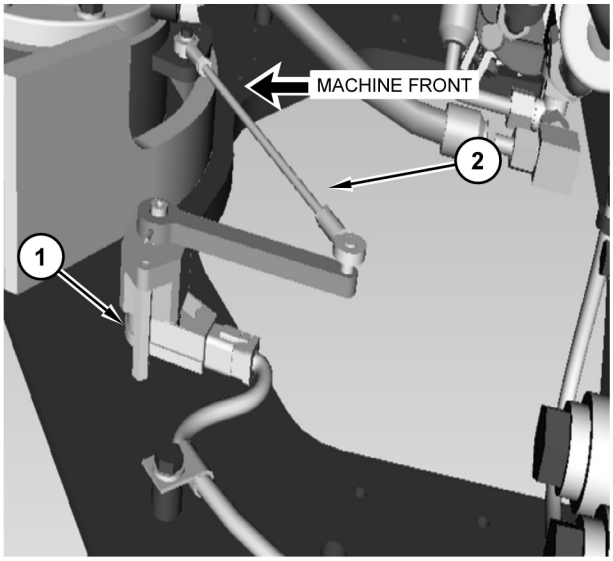


Illustration 475 g03236020

Machine “Articulation Angle Position” Sensor location (View: From the left side of the machine at the articulation hitch)

(1) “Articulation angle sensor ”
(2) “Mechanical linkage”

Two articulation angle sensors are required for correct operation of the articulation of the machine. Each sensor will provide a PWM input to the Implement ECM and the Transmission/Chassis ECM.

This diagnostic code is recorded when the ECM detects that the signal from the machine “articulation angle sensor 2” is out of calibration. The Implement ECM and the Transmission/Chassis ECM can activate this diagnostic code.

Inspect the mechanical linkage of the articulation joint prior to calibration. Correct any problems with the linkage.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the input of the duty cycle from the sensor to the ECM is approximately 57% for the model 16M, approximately 54% for the model 14M and approximately 52% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models.

Note: Verify that no other CID 2252 diagnostic codes are active. Any other active CID 2252 diagnostic codes must be investigated and the diagnostic codes cleared before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the sensor. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the sensor.

  If the second calibration procedure is not successful, replace the position sensor. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new sensor, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealerships Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05761838

MID 082 - CID 2252 - FMI 14

SMCS Code: 4806-038

Conditions Which Generate This Code:

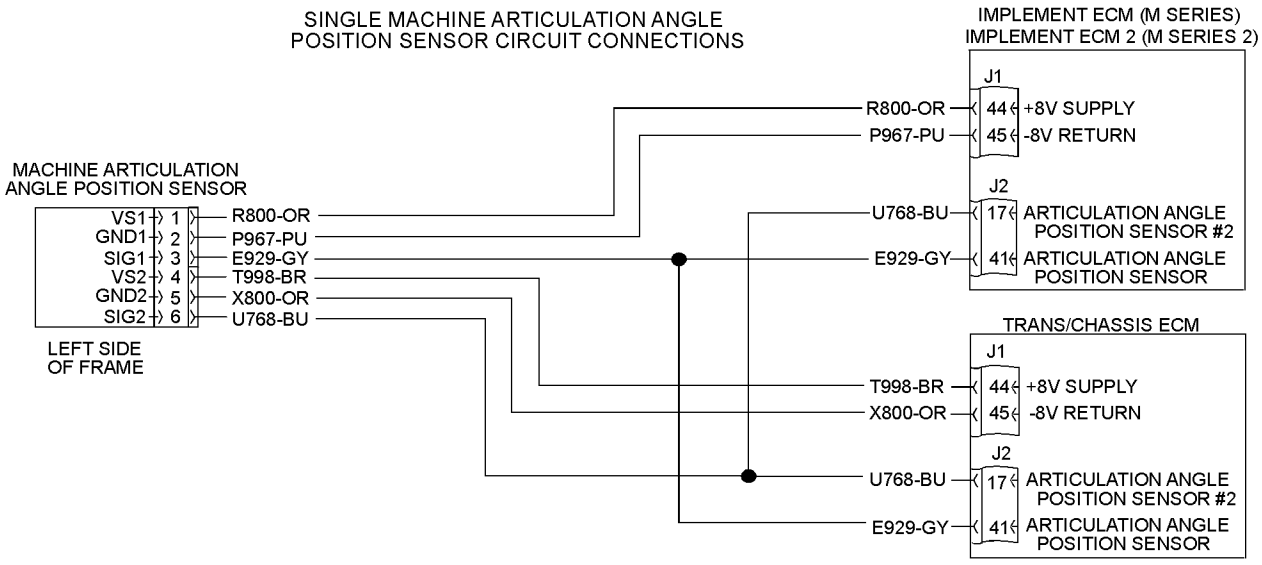


Illustration 476 g03656395

Connections for the Single Machine Articulation Angle Position Sensor 2 with two outputs

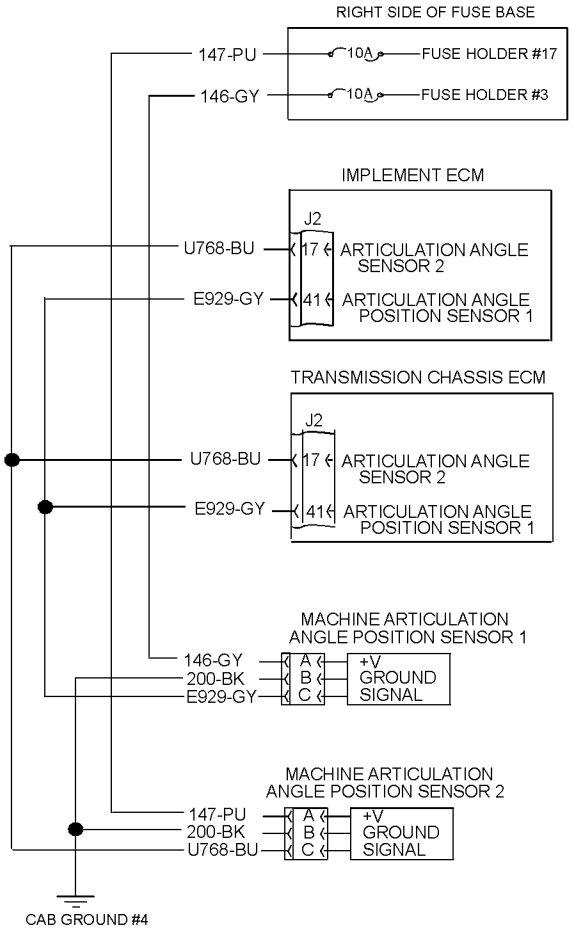


Illustration 477 g03665300

Connections of machine articulation angle position sensor 2

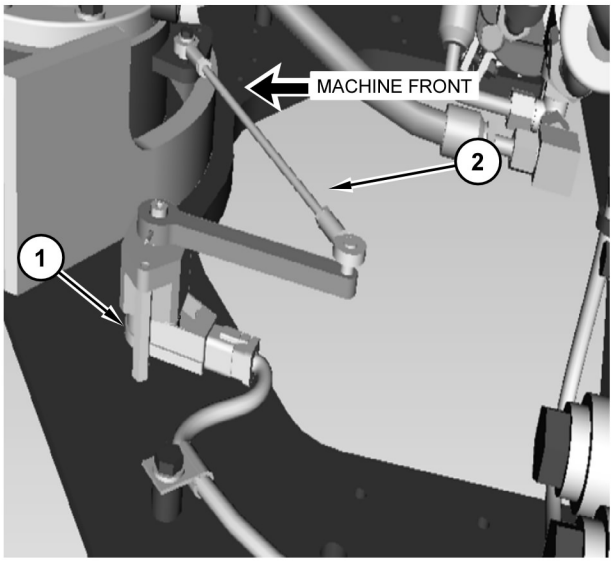


Illustration 478 g03236020

Machine “Articulation Angle Position” Sensor location (View: From the left side of the machine at the articulation hitch)

(1) “Articulation angle sensor ”
(2) “Mechanical linkage”

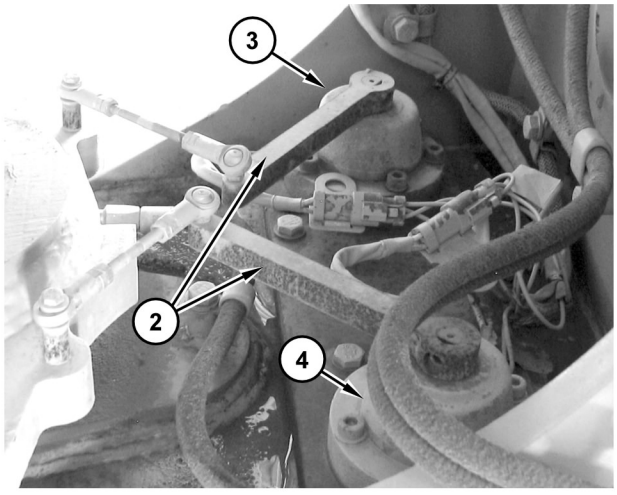


Illustration 479 g03665301

Location of the position sensor for the angle of the machine articulation

The view is from the left side of machine and the covers are removed.

(3) Articulation angle sensor 1
(4) Articulation angle sensor 2
(2) Mechanical linkage

Two articulation angle signals are required for correct operation of the articulation of the machine. Either the two separate sensors or the dual output sensor will provide a PWM input to the ECM.

This diagnostic code is associated with the machine “articulation angle sensor signal 2” connected to each ECM at J2-17. The FMI 14 diagnostic code is recorded when the ECM determines that the signal from articulation angle sensor 1 does not match the signal from articulation angle sensor 2. The technician should use Caterpillar Electronic Technician (CAT ET) to monitor the signals of both sensors to check for a mismatch in the output of the sensors.

The sensor is a PWM sensor that operates at a frequency of approximately 500 Hz. When the machine is in the neutral position, the input of the duty cycle from the sensor to the ECM is approximately 57% for the model 16M, approximately 54% for the model 14M and approximately 52% for all other models. When the machine is articulated to the full left position, the duty cycle will be approximately 29% for the model 14M and approximately 33% for all other models. When the machine is articulated to the full right position, the duty cycle will be approximately 75% for the model 16M, approximately 79% for the model 14M and approximately 74% for all other models.

The possible causes of this diagnostic code are listed below:

- The mechanical linkage for the position sensor is not functioning correctly.
- The sensor needs calibrated.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, ensure that there are no active CID 0041 diagnostic codes for the 8 VDC sensor power supply. Ensure that the power supply for the angle sensor is correct.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE MECHANICAL LINKAGE

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Remove any guards or shielding for the articulation sensors.

C. Check the mounting bolts for the articulation sensors. Ensure that the sensors are securely mounted.

D. Visually inspect the mechanical linkage for the articulation sensors. Verify that all mechanical components are tight and that all components are in good condition. Verify that the adjustment of the linkage is correct.

Expected Result:

All mechanical linkage and components for the adjustment of the articulation sensor(s) are in good condition and no mechanical connections are loose.

Results:

- OK – All mechanical linkage and adjustment for the articulation sensor is correct. Proceed to Test Step 2.
- NOT OK – All mechanical linkage and adjustment for the articulation sensors is not correct.

  Repair: Perform the maintenance that is required in order to correct the problem with the mechanical connections for the articulation sensor(s). After the problem has been corrected, verify that this diagnostic code is still active before proceeding with this procedure.

  STOP.

Test Step 2. CALIBRATE THE POSITION SENSOR

A. After the linkage for the sensor is verified to be correct, use the Caterpillar Electronic Technician (ET) service tool to perform the calibration procedure for the “articulation angle sensor 2” . Refer to Testing and Adjusting, “Calibrations” for information on how to access the calibration procedure for the articulation sensor.

Expected Result:

The calibration procedure has been performed for the machine “articulation sensor 2” and the FMI 14 diagnostic code is no longer active.

Results:

- OK – The calibration procedure has been performed for the machine “articulation sensor 2” and the FMI 14 diagnostic code is no longer active. NOTE: If the position sensor has been calibrated recently and the FMI 14 diagnostic code becomes active again after a short time, the linkage for the articulation position sensor is most likely causing the problem. Repair the linkage or replace the linkage for the sensor.

  STOP.

- NOT OK – The calibration procedure has been performed for the machine “articulation sensor 2” , however, the FMI 14 diagnostic code is still active. The problem has not been corrected.Proceed to Test Step 3.

Test Step 3. CHECK THE SIGNAL CIRCUIT OF THE SENSOR

A. The key start switch and the disconnect switch remain in the OFF position.

B. Do not disconnect the harness connector from the sensor.

C. At the back of the harness connector for the sensor, insert 7X-1710 Multimeter Probes along return contact B (wire X800-OR(Orange)) and insert a multimeter probe along the contact for the signal wire C (wire U768-BU(Blue)).

D. Turn the disconnect switch and the key start switch to the ON position.

E. Monitor the signal of the sensor with a digital multimeter. When possible monitor the signal from the cab of the machine in order to maintain a safe distance from the articulation point of the machine.

Note: The steering frame lock must be disconnected in order to articulate the machine. Ensure that all technicians at work in the immediate area are aware that the machine will be articulated during the check of the sensor.

⚠ WARNING

Personal injury or death can result from machine articulation or movement.

Machine frames can move and a person can be crushed.

Connect the steering frame lock link between the front and rear frames before working on machine.

Do not disconnect the lock link until the machine is made operational and the commissioning procedure is completed.

F. Without disconnecting the sensor or the hardware that is associated with the sensor from the machine, articulate the machine through the full range of operation.

Expected Result:

The sensors signal responds in the manner that is described at the beginning of this procedure.

Results:

- OK – The sensors signal responds correctly. The sensor is operating correctly. Proceed to Test Step 4.

- NOT OK – The sensors signal does not respond correctly. The sensor is NOT operating correctly.

  Repair: Replace the “articulation angle 2” sensor. After the replacement of the sensor, the sensor must be calibrated. Refer to the Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and the key start switch to the ON position.

B. Operate the machine.

C. Check the status of the CID 2252 FMI 14 diagnostic code.

Expected Result:

The CID 2252 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 2252 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably

caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

STOP.

- NOT OK – The CID 2252 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM that activated the diagnostic code. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05946229

MID 082 - CID 2258 - FMI 03

SMCS Code: 7332-038

Conditions Which Generate This Code:

This procedure applies to machines that have the Advanced Control Joysticks installed. If the Grade Control Push Button pods are installed on the machine, go to the prior CID 2258 procedure

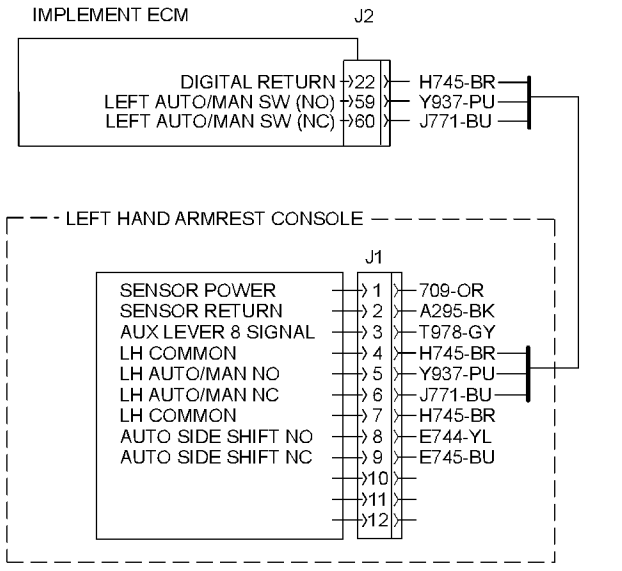


Illustration 480 g03818158

Connections of the left Auto/Manual switch on the left Advanced Control Joystick

This diagnostic will only be used when the Advanced Control Joystick is configured for grade control.

This diagnostic code is associated with the Auto/Manual switch on the left Advanced Control Joystick. The FMI 03 diagnostic code is activated when the Implement ECM detects an above normal voltage of the circuit.

The following conditions could cause this diagnostic code to be activated:

- The switch has failed.
- The normally closed circuit of the switch is open.
- The ground circuit of the switch is open.
- The ECM has failed. ECM failure is unlikely.

Note: The following test procedure may create other diagnostic codes. Clear these created diagnostic codes when the original diagnostic code has been corrected. Verify that the diagnostic code of CID 2258 FMI 03 is active before performing this procedure.

Note: Use a 146-4080 Digital Multimeter for the measurements in this procedure.

System Response:

When this diagnostic code is active, the hydraulic control system will default to the “Auto Not Allowed” state.

Test Step 1. CHECK THE SWITCH

A. Turn the disconnect switch to the OFF position.

B. Turn the key start switch to the OFF position.

C. Disconnect the machine harness connector from the switch.

D. Use the Multimeter to verify the proper operation of the switch. Refer to Table 23 for the switch operation.

Table 23

(NC) J771 to -H745	(NO) Y937 to H745
Less than 5 ohms (switch not depressed)	Less than 5 ohms (switch depressed)
Greater than 5000 ohms (switch depressed)	Greater than 5000 ohms (switch not depressed)

Expected Result:

The switch is operating correctly.

Results:

- OK – The switch is operating correctly.Proceed to Test Step 2.
- NOT OK – The switch is not functioning correctly. There is an internal failure in the switch.

Repair: Replace the switch.

STOP.

Test Step 2. CHECK THE NORMALLY OPEN CONTACTS AND NORMALLY CLOSED CONTACTS OF THE SWITCH CIRCUITS IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness connectors from the ECM.

Note: The switch remains disconnected.

C. At the connector for the switch, connect a jumper wire between contact “6” and contact “5” .

D. At the machine harness connector for the ECM, measure the resistance from contact J2-60 (wire J771-BU(Blue)) and contact J2- 59 (wire Y937-PU(Purple)).

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The machine harness is correct.Proceed to Test Step 3.
- NOT OK – The resistance is greater than 5000 ohms. The circuit is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE GROUND CIRCUIT OF THE SWITCH IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. The machine harness connectors remain disconnected from the ECM and the switch.

C. Remove the jumper that was installed in the previous step.

D. At the connector for the switch, place a jumper between contact “6” and contact “4” .

E. At the machine harness connector for the ECM, measure the resistance from contact J2-60 (wire J771-BU(Blue)) and contact J2- 22 (wire H745-BR(Brown)).

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The machine harness is correct.Proceed to Test Step 4.
- NOT OK – The resistance is greater than 5000 ohms. There is a circuit that is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.

A. Perform the following:

- Visually inspect the harness connectors.
- Clean the contacts of the harness connectors.

B. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are fastened.

C. Turn the disconnect switch to the ON position.

D. Turn the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2258 FMI 03 is active.

Expected Result:

The CID 2258 FMI 03 is not active.

Results:

- OK – The CID 2258 FMI 03 is not active. The problem has not been corrected. The ECM may have failed.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

- NOT OK – The CID 2258 FMI 03 is active. The problem has not been corrected.

  Repair: The ECM may have failed. However, ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, contact your local Caterpillar Dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to the Testing and Adjusting, “Electronic Control Module (ECM) - Replace” Story in this manual for additional information.

  STOP.

i05946233

MID 082 - CID 2258 - FMI 04

SMCS Code: 7332-038

Conditions Which Generate This Code:

The diagnostic will only be used when the Advanced Control Joystick is configured for grade control.

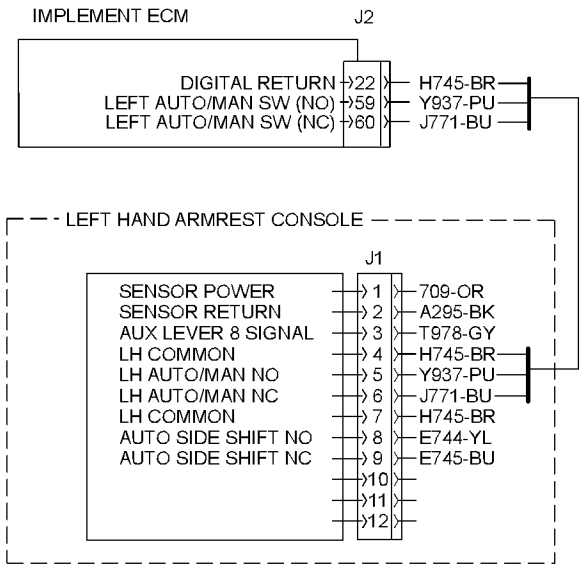


Illustration 481 g03817449

Connections of the left Auto/Manual switch on the left Advanced Control Joystick

This diagnostic code is associated with the Auto/Manual Switch on the left Advanced Control Joystick. The FMI 04 diagnostic code is activated when the Implement ECM detects both the normally open contacts and normally closed contacts in a closed state.

The following conditions could cause this diagnostic code to be activated:

- The switch has failed.
- The normally open circuit of the switch is shorted to ground.
- The ECM has failed. A failure in the ECM is unlikely.

Note: The following test procedure may create other diagnostic codes. Clear these created diagnostic codes when the original diagnostic code has been corrected. Verify that the diagnostic code of CID 2258 FMI 04 is active before performing this procedure.

Note: Use a 146-4080 Digital Multimeter for the measurements in this procedure.

System Response:

When this diagnostic code is active, the hydraulic control system will default to the “Auto Not Allowed” state.

Test Step 1. CHECK THE SWITCH

A. Turn the disconnect switch to the OFF position.

B. Turn the key start switch to the OFF position.

C. Disconnect the machine harness connector from the switch.

D. Use the Multimeter to verify the proper operation of the switch. Refer to Table 24 for the switch operation.

Table 24

(NC) J771 to H745	(NO) Y937 to H745
Less than 5 ohms (switch not depressed)	Greater than 5000 ohms (switch depressed)
Greater than 5000 ohms (switch depressed)	Less than 5 ohms (switch not depressed)

Expected Result:

The switch is operating correctly.

Results:

- OK – The switch is operating correctly.Proceed to Test Step 2.
- NOT OK – The switch is not functioning correctly. There is an internal failure in the switch.

  Repair: Replace the switch.

  STOP.

Test Step 2. CHECK THE NORMALLY OPEN CONTACT OF THE SWITCH CIRCUIT IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness connectors from the ECM.

Note: The switch remains disconnected.

C. At the machine harness connector for the ECM, measure the resistance from contact J2-59 (wire Y937-PU(Purple)) and contact J2-22 (wire H745-BR(Brown)).

Expected Result:

The resistance is greater than 5000 ohms.

Results:

- OK – The resistance is greater than 5000 ohms. The machine harness is correct.Proceed to Test Step 3.
- NOT OK – The resistance is less than 5 ohms. The circuit is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.

A. Perform the following:

- Visually inspect the harness connectors.
- Clean the contacts of the harness connectors.

B. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are fastened completely.

C. Turn the disconnect switch to the ON position.

D. Turn the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2258 FMI 04 is active.

Expected Result:

The CID 2258 FMI 04 is not active.

Results:

- OK – The CID 2258 FMI 04 is not active. The problem has not been corrected. The ECM may have failed.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2258 FMI 04 is active. The problem has not been corrected. The ECM may have failed.

  Repair: An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, contact the Technical Communicator at your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, see theTesting and Adjusting, “Electronic Control Module (ECM) - Replace” Story in this manual for additional information.

  STOP.

i05946243

MID 082 - CID 2258 - FMI 07

SMCS Code: 7332-038

Conditions Which Generate This Code:

This procedure applies to machines that have the Advanced Control Joysticks installed. If the Grade Control Push Button pods are installed on the machine, go to the prior CID 2258 procedure.

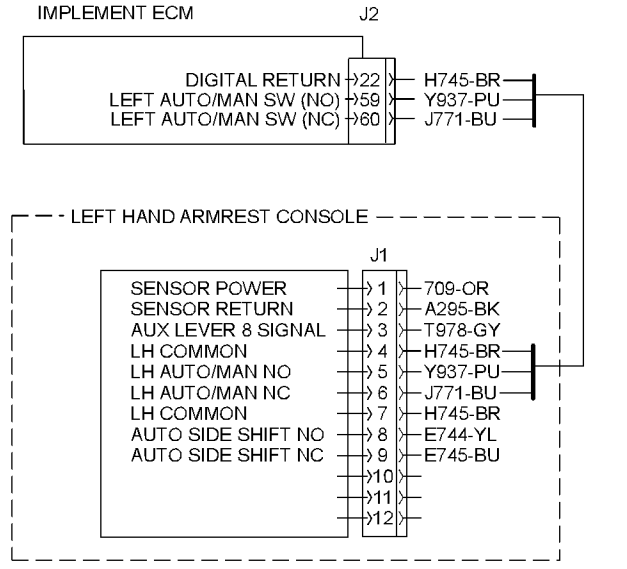


Illustration 482 g03818134

Connections of the left Auto/Manual switch on the left Advanced Control Joystick

This diagnostic will only be used when the Advanced Control Joystick is configured for grade control.

This diagnostic code is associated with the “Auto/ Manual Switch” on the left Advanced Control Joystick. The FMI 07 diagnostic code means that the ECM has determined that the switch has been in the CLOSED position for greater than fifteen seconds. The switch is probably stuck.

The possible causes of this diagnostic code are listed below:

- The switch has failed.
- The switch circuits in the harness have failed.
- The ECM has failed. An ECM failure is unlikely.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected. **Ensure that the diagnostic code of CID 2258 FMI 07 is active before performing this procedure.**

Note: Use the 146-4080 Digital Multimeter for the measurements in this procedure.

System Response:

When this diagnostic code is active the hydraulic control system will default to the “Auto Not Allowed” state.

Test Step 1. CHECK THE SWITCH

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the switch.

C. Use a Multimeter to verify the proper operation of the switch. Refer to Table 25 for the switch operation.

Table 25

(NC) J771 to H745	(NO) Y937 to H745
Less than 5 ohms (switch not depressed)	Greater than 5000 ohms (switch depressed)
Greater than 5000 ohms (switch depressed)	Less than 5 ohms (switch not depressed)

Expected Result:

The switch is operating correctly.

Results:

- OK – The switch is operating correctly.Proceed to Test Step 2.
- NOT OK – The switch is not functioning correctly. There is an internal failure in the switch.

  Repair: Replace the switch.

  STOP.

Test Step 2. CHECK THE N/O SWITCH CIRCUIT IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness connectors from the ECM.

The switch remains disconnected.

C. At the machine harness connector for the ECM, measure the resistance from contact “J2-59 (wire Y937-PU)” to contact “J2- 60 wire (J771-BU)” .

Expected Result:

The resistance is greater than 5000 ohms.

Results:

- OK – The resistance is greater than 5000 ohms. The machine harness is correct.Proceed to Test Step 4.
- NOT OK – The resistance is less than 5 ohms. The circuit is open.

Repair: Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE N/O AND GROUND CIRCUIT OF THE SWITCH IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. The machine harness connectors remain disconnected from the ECM and the switch.

C. At the connector for the switch, place a jumper between pin 4 and 5.

D. At the machine harness connector for the ECM, measure the resistance from contact “J2-59 (wire Y937-PU)” to contact “J2- 22 wire (H745-BR)” .

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The machine harness is correct.Proceed to Test Step 4.
- NOT OK – The resistance is greater than 5000 ohms. The circuit is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.

A. Inspect the contacts and clean the contacts of the harness connectors.

B. Reconnect all harness connectors.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 2258 FMI 07 diagnostic code is active.

Expected Result:

The CID 2258 FMI 07 diagnostic code is not active.

Results:

- YES – The CID 2258 FMI 07 diagnostic code is not active. The problem has not been corrected. The ECM may have failed.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NO – The CID 2258 FMI 07 diagnostic code is active. The problem has not been corrected. The ECM may have failed.

  Repair: It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Module - Replace”

  STOP.

i05946249

MID 082 - CID 2259 - FMI 03

SMCS Code: 7332-038

Conditions Which Generate This Code:

This procedure applies to machines that have the Advanced Control Joysticks installed. If the Grade Control Push Button pods are installed on the machine, go to the prior CID 2259 procedure.

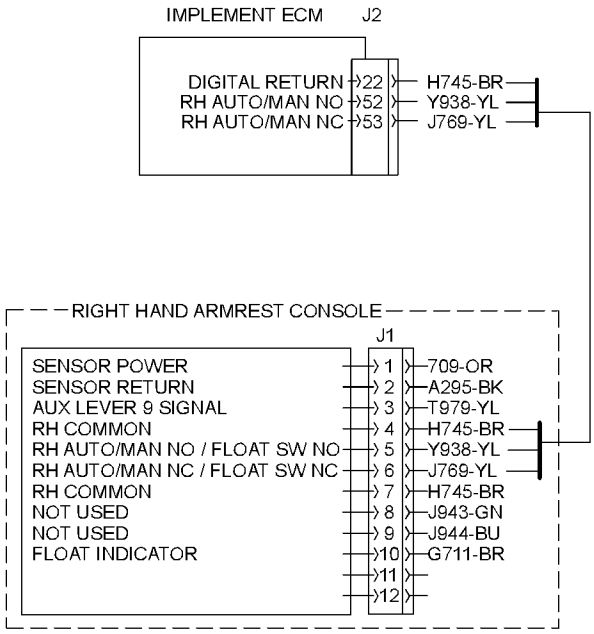


Illustration 483 g03818210

Connections of the right Auto/Manual switch on the right Advanced Control Joystick

This diagnostic will only be used when the Advanced Control Joystick is configured for grade control.

This diagnostic code is associated with the Auto/ Manual Switch on the right Advanced Control Joystick. The FMI 03 diagnostic code is activated when the Implement ECM detects an above normal voltage of the circuit.

The following conditions could cause this diagnostic code to be activated:

- The switch has failed.
- The normally closed circuit of the switch is open.
- The ground circuit of the switch is open.
- The ECM has failed. An ECM failure is unlikely.

Note: The following test procedure may create other diagnostic codes. Clear these created diagnostic codes when the original diagnostic code has been corrected. Verify that the diagnostic code of CID 2259 FMI 03 is active before performing this procedure.

Note: Use a 146-4080 Digital Multimeter for the measurements in this procedure.

System Response:

When this diagnostic code is active the hydraulic control system will default to the “Auto Not Allowed” state.

Test Step 1. CHECK THE SWITCH

A. Turn the disconnect switch to the OFF position.

B. Turn the key start switch to the OFF position.

C. Disconnect the machine harness connector from the switch.

D. Use the Multimeter to verify the proper operation of the switch. Refer to Table 26 for the switch operation.

Table 26

(NC) J769 to -H745	(NO) Y938 to H745
Less than 5 ohms (switch not depressed)	Less than 5 ohms (switch depressed)
Greater than 5000 ohms (switch depressed)	Greater than 5000 ohms (switch not depressed)

Expected Result:

The switch is operating correctly.

Results:

- OK – The switch is operating correctly.Proceed to Test Step 2.
- NOT OK – The switch is not functioning correctly. There is an internal failure in the switch.

  Repair: Replace the switch.

  STOP.

Test Step 2. CHECK THE NORMALLY OPEN CONTACTS AND NORMALLY CLOSED CONTACTS OF THE SWITCH CIRCUITS IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness connectors from the ECM.

Note: The switch remains disconnected.

C. At the connector for the switch, connect a jumper wire between pin 6 and pin 5.

D. At the machine harness connector for the ECM, measure the resistance from contact J2-52 (wire Y938-YL(Yellow)) and contact J2-53 (wire J769-YL(Yellow)).

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The machine harness is correct.Proceed to Test Step 3.
- NOT OK – The resistance is greater than 5000 ohms. The circuit is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE GROUND CIRCUIT OF THE SWITCH IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness connectors from the ECM.

Note: The switch remains disconnected.

C. Remove the jumper that was installed in the previous step.

D. At the connector for the switch, connect a jumper wire between pin 6 and pin 4.

E. At the machine harness connector for the ECM, measure the resistance from contact J2-22 (wire H745-BR(Brown)) and contact J2-53 (wire J769-YL(Yellow)).

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The machine harness is correct.Proceed to Test Step 4.
- NOT OK – The resistance is greater than 5000 ohms. The circuit is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.

A. Perform the following:

- Visually inspect the harness connectors.
- Clean the contacts of the harness connectors.

B. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are fastened.

C. Turn the disconnect switch to the ON position.

D. Turn the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2259 FMI 03 is active.

Expected Result:

The CID 2259 FMI 03 is not active.

Results:

- OK – The CID 2259 FMI 03 is not active. The problem has not been corrected. The ECM may have failed.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2259 FMI 03 is active. The problem has not been corrected. The ECM may have failed.

  Repair: An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, contact your dealership Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, see the Testing and Adjusting, “Electronic Control Module (ECM) - Replace” Story in this manual for additional information.

  STOP.

i05946287

MID 082 - CID 2259 - FMI 04

SMCS Code: 7332-038

Conditions Which Generate This Code:

This procedure applies to machines that have the Advanced Control Joysticks installed. If the Grade Control Push Button pods are installed on the machine, go to the prior CID 2259 procedure.

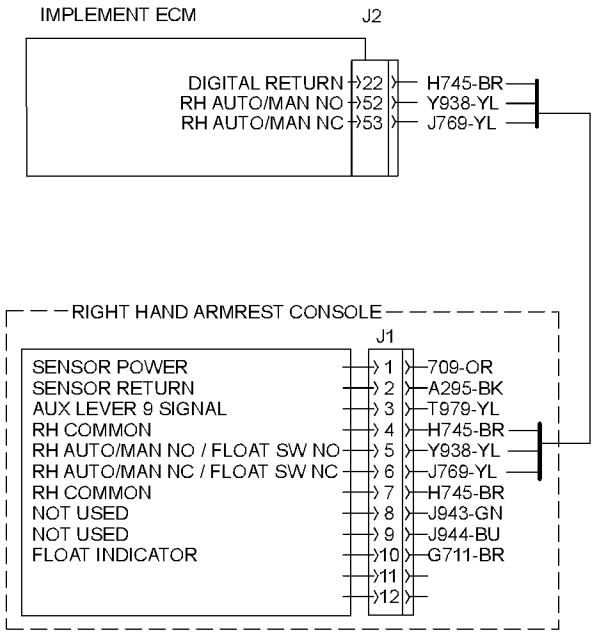


Illustration 484 g03740450

Connections of the right Auto/Manual switch on the right Advanced Control Joystick

This diagnostic will only be used when the Advanced Control Joystick is configured for grade control.

This diagnostic code is associated with the Auto/ Manual Switch on the right Advanced Control Joystick. The FMI 04 diagnostic code is activated when the Implement ECM detects both the normally open contacts and normally closed contacts are in a closed state.

The following conditions could cause this diagnostic code to be activated:

- The switch has failed.
- The normally open circuit of the switch is shorted to ground.
- The ECM has failed. An ECM failure is unlikely.

Note: The following test procedure may create other diagnostic codes. Clear these created diagnostic codes when the original diagnostic code has been corrected. Verify that the diagnostic code of CID 2259 FMI 04 is active before performing this procedure.

Note: Use a 146-4080 Digital Multimeter for the measurements in this procedure.

System Response:

When this diagnostic code is active, the hydraulic control system will default to the “Auto Not Allowed” state.

Test Step 1. CHECK THE SWITCH

A. Turn the disconnect switch to the OFF position.

B. Turn the key start switch to the OFF position.

C. Disconnect the machine harness connector from the switch.

D. Use the Multimeter to verify the proper operation of the switch. Refer to Table 27 for the switch operation.

Table 27

(NC) J769 to -H745	(NO) Y938 to H745
Less than 5 ohms (switch not depressed)	Less than 5 ohms (switch depressed)
Greater than 5000 ohms (switch depressed)	Greater than 5000 ohms (switch not depressed)

Expected Result:

The switch is operating correctly.

Results:

- OK – The switch is operating correctly.Proceed to Test Step 2.
- NOT OK – The CID 2259 FMI 04 diagnostic code is NO longer active. A CID 2259 FMI 03 diagnostic code becomes active when the connector of the switch is disconnected. The machine harness and the ECM are operating correctly. The switch has failed.

  Repair: Replace the “Operator Present” switch. After replacement of the switch, verify that the operation of the new switch is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE NORMALLY OPEN CONTACT OF THE SWITCH CIRCUIT IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness connectors from the ECM.

Note: The switch remains disconnected.

C. At the machine harness connector for the ECM, measure the resistance from contact J2-52 (wire Y938-YL(Yellow)) and contact J2-22 (wire H745-BR(Brown)).

Expected Result:

The resistance is greater than 5000 ohms.

Results:

- OK – The resistance is greater than 5000 ohms. The machine harness is correct.Proceed to Test Step 3.
- NOT OK – The resistance is less than 5 ohms. The circuit is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.

A. Perform the following:

- Visually inspect the harness connectors.
- Clean the contacts of the harness connectors.

B. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are fastened.

C. Turn the disconnect switch to the ON position.

D. Turn the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2259 FMI 04 is active.

Expected Result:

The CID 2259 FMI 04 is not active.

Results:

- OK – The CID 2259 FMI 04 is not active. The problem has not been corrected. The ECM may have failed.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2259 FMI 04 is active. The problem has not been corrected. The ECM may have failed.

  Repair: It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, contact the Technical Communicator at your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, see the Testing and Adjusting, “Electronic Control Module (ECM) - Replace” Story in this manual for additional information.

  STOP.

i05946294

MID 082 - CID 2259 - FMI 07

SMCS Code: 7332-038

Conditions Which Generate This Code:

This procedure applies to machines that have the Advanced Control Joysticks installed. If the Grade Control Push Button pods are installed on the machine, go to the prior CID 2259 procedure.

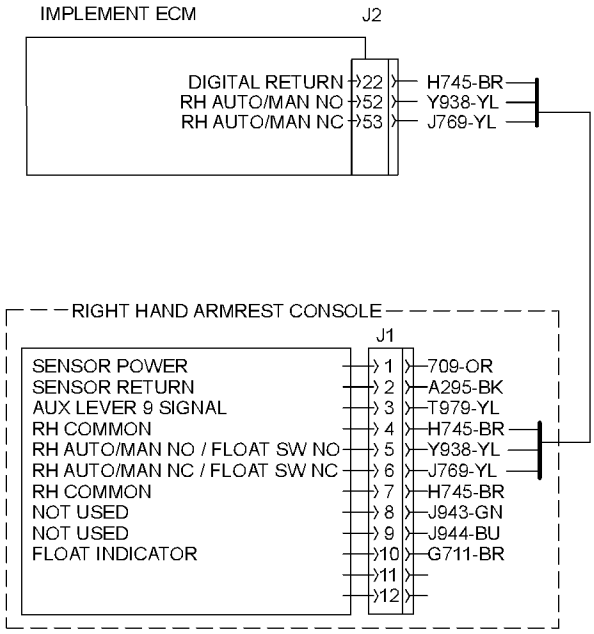


Illustration 485 g03740450

Connections of the right Auto/Manual switch on the right Advanced Control Joystick

This diagnostic will only be used when the Advanced Control Joystick is configured for grade control.

This diagnostic code is associated with the “Auto/ Manual Switch” on the right Advanced Control Joystick. The FMI 07 diagnostic code is displayed when the ECM determines that the switch is ACTIVE for more than fifteen seconds. The switch is probably stuck.

The possible causes of this diagnostic code are listed below:

- The switch has failed.
- The switch circuits in the harness have failed.
- The ECM has failed. An ECM failure is unlikely.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected. **Ensure that the diagnostic code of CID 2259 FMI 07 is active before performing this procedure.**

Note: Use the 146-4080 Digital Multimeter for the measurements in this procedure.

System Response:

When this diagnostic code is active the hydraulic control system will default to the “Auto Not Allowed” state.

Test Step 1. CHECK THE SWITCH

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the switch.

C. Use a Multimeter to verify the proper operation of the switch. Refer to Table 28 for the switch operation.

Table 28

(NC) J769 to -H745	(NO) Y938 to H745
Less than 5 ohms (switch not depressed)	Less than 5 ohms (switch depressed)
Greater than 5000 ohms (switch depressed)	Greater than 5000 ohms (switch not depressed)

Expected Result:

The switch is operating correctly.

Results:

- OK – The switch is operating correctly.Proceed to Test Step 2.
- NOT OK – The switch is not functioning correctly. There is an internal failure in the switch.

  Repair: Replace the switch.

  STOP.

Test Step 2. CHECK THE N/O and N/C SWITCH CIRCUIT IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness connectors from the ECM.

The switch remains disconnected.

C. At the machine harness connector for the ECM, measure the resistance from contact “J2-52 (wire Y938-YL)” to contact “J2- 53 wire (J769-YL)” .

Expected Result:

The resistance is greater than 5000 ohms.

Results:

- OK – The resistance is greater than 5000 ohms. The machine harness is correct.Proceed to Test Step 4.
- NOT OK – The resistance is less than 5 ohms. The circuit is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE N/C AND GROUND CIRCUIT OF THE SWITCH IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. The machine harness connectors remain disconnected from the ECM and the switch.

C. At the connector for the switch, place a jumper between pin 6 and 4.

D. At the machine harness connector for the ECM, measure the resistance from contact “J2-53 (wire J769-YL)” to contact “J2- 22 wire (H745-BR)” .

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The machine harness is correct.Proceed to Test Step 4.
- NOT OK – The resistance is greater than 5000 ohms. The circuit is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.

A. Inspect the contacts and clean the contacts of the harness connectors.

B. Reconnect all harness connectors.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 2259 FMI 07 diagnostic code is active.

Expected Result:

The CID 2259 FMI 07 diagnostic code is not active.

Results:

- YES – The CID 2259 FMI 07 diagnostic code is not active. The problem has not been corrected. The ECM may have failed.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.
- NO – The CID 2259 FMI 07 diagnostic code is active. The problem has not been corrected. The ECM may have failed.

  Repair: It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Module - Replace”

  STOP.

i05946300

MID 082 - CID 2260 - FMI 03

SMCS Code: 7332-038

Conditions Which Generate This Code:

This procedure applies to machines that have the Advanced Control Joysticks installed. If the Grade Control Push Button pods are installed on the machine, go to the prior CID 2260 procedure

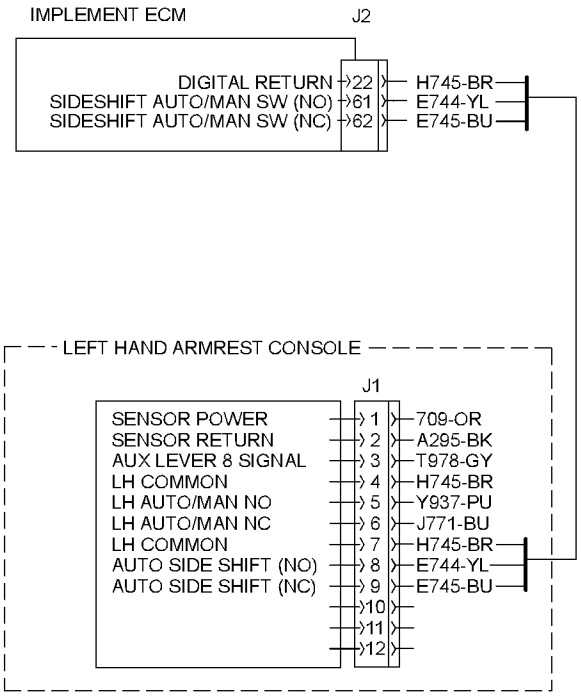


Illustration 486 g03819119

Connections of side shift control mode switch on the left Advanced Control Joystick

This diagnostic will only be used when the Advanced Control Joystick is configured for grade control.

This diagnostic code is associated with the Side Shift Blade Control Mode Switch on the left Advanced Control Joystick. The FMI 03 diagnostic code is activated when the Implement ECM detects an above normal voltage of the circuit.

The following conditions could cause this diagnostic code to be activated:

- The switch has failed.
- The normally closed circuit of the switch is open.
- The ground circuit of the switch is open.
- The ECM has failed. An ECM failure is unlikely.

Note: The following test procedure may create other diagnostic codes. Clear these created diagnostic codes when the original diagnostic code has been corrected. Verify that the diagnostic code of CID 2260 FMI 03 is active before performing this procedure.

Note: Use a 146-4080 Digital Multimeter for the measurements in this procedure.

System Response:

When this diagnostic code is active, the hydraulic control system will default to the “Auto Not Allowed” state.

Test Step 1. CHECK THE SWITCH

A. Turn the disconnect switch to the OFF position.

B. Turn the key start switch to the OFF position.

C. Disconnect the machine harness connector from the switch.

D. Use the Multimeter to verify the proper operation of the switch. Refer to Table 29 for the switch operation.

Table 29

(NC) J771 to -H745	(NO) Y937 to H745
Less than 5 ohms (switch not depressed)	Less than 5 ohms (switch depressed)
Greater than 5000 ohms (switch depressed)	Greater than 5000 ohms (switch not depressed)

Expected Result:

The switch is operating correctly.

Results:

- OK – The switch is operating correctly.Proceed to Test Step 2.
- NOT OK – The switch is not functioning correctly. There is an internal failure in the switch.

  Repair: Replace the switch. After replacement of the switch, verify that the operation of the new switch is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE NORMALLY OPEN CONTACTS AND NORMALLY CLOSED CONTACTS OF THE SWITCH CIRCUITS IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness connectors from the ECM.

Note: The switch remains disconnected.

C. At the connector for the switch, connect a jumper wire between pin 8 and pin 9.

D. At the machine harness connector for the ECM, measure the resistance from contact J2-61 (wire E744-YL(Yellow)) and contact J2-62 (wire E745-BU(Blue)).

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The machine harness is correct.Proceed to Test Step 3.
- NOT OK – The resistance is greater than 5000 ohms. The circuit is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE GROUND CIRCUIT OF THE SWITCH IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness connectors from the ECM.

Note: The switch remains disconnected.

C. Remove the jumper that was installed in the previous step.

D. At the connector for the switch, connect a jumper wire between pin 7 and pin 9.

E. At the machine harness connector for the ECM, measure the resistance from contact J2-61 (wire H745-YL(Yellow)) and contact J2-22 (wire H745-BR(Brown)).

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The machine harness is correct.Proceed to Test Step 4.
- NOT OK – The resistance is greater than 5000 ohms. The circuit is open.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.

A. Perform the following:

- Visually inspect the harness connectors.
- Clean the contacts of the harness connectors.

B. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are fastened.

C. Turn the disconnect switch to the ON position.

D. Turn the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2260 FMI 03 is active.

Expected Result:

The CID 2260 FMI 03 is not active.

Results:

- OK – The CID 2260 FMI 03 is not active. The problem has not been corrected. The ECM may have failed.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2260 FMI 03 is active. The problem has not been corrected. The ECM may have failed.

  Repair: ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, contact your dealership Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, see the Testing and Adjusting, “Electronic Control Module (ECM) - Replace” Story in this manual for additional information.

  STOP.

i05946302

MID 082 - CID 2260 - FMI 04

SMCS Code: 7332-038

Conditions Which Generate This Code:

This procedure applies to machines that have the Advanced Control Joysticks installed. If the Grade Control Push Button pods are installed on the machine, go to the prior CID 2260 procedure

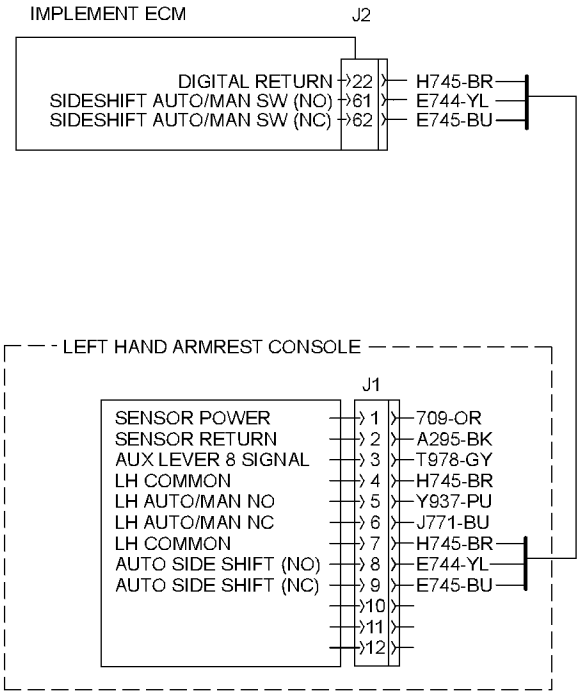


Illustration 487 g03819150

Connections of side shift control mode switch on the left Advanced Control Joystick

This diagnostic will only be used when the Advanced Control Joystick is configured for grade control.

This diagnostic code is associated with the Side Shift Blade Control Mode Switch on the left Advanced Control Joystick. The FMI 04 diagnostic code is activated when the Implement ECM detects both the normally open contacts are in a normally closed state.

The following conditions could cause this diagnostic code to be activated:

- The switch has failed.
- The normally open circuit of the switch is shorted to ground.
- The ECM has failed. An ECM failure is unlikely.

Note: The following test procedure may create other diagnostic codes. Clear these created diagnostic codes when the original diagnostic code has been corrected. Verify that the diagnostic code of CID 2260 FMI 04 is active before performing this procedure.

Note: Use a 146-4080 Digital Multimeter for the measurements in this procedure.

System Response:

When this diagnostic code is active, the hydraulic control system will default to the “Auto Not Allowed” state.

Test Step 1. CHECK THE SWITCH

A. Turn the disconnect switch to the OFF position.

B. Turn the key start switch to the OFF position.

C. Disconnect the machine harness connector from the switch.

D. Use the Multimeter to verify the proper operation of the switch. Refer to Table 30 for the switch operation.

Table 30

(NC) J771 to -H745	(NO) Y937 to H745
Less than 5 ohms (switch not depressed)	Less than 5 ohms (switch depressed)
Greater than 5000 ohms (switch depressed)	Greater than 5000 ohms (switch not depressed)

Expected Result:

The switch is operating correctly.

Results:

- OK – The switch is operating correctly.Proceed to Test Step 2.
- NOT OK – The switch is not functioning correctly. There is an internal failure in the switch.

  Repair: Replace the switch.

  STOP.

Test Step 2. CHECK THE NORMALLY OPEN CONTACT OF THE SWITCH CIRCUIT IN THE HARNESS

A. The key start switch and the disconnect switch remain in the OFF position.

B. Disconnect the machine harness connectors from the ECM.

Note: The switch remains disconnected.

C. At the machine harness connector for the ECM, measure the resistance from contact J2-62 (wire E745-BU(Blue)) and contact J2-22 (wire H745-BR(Brown)).

Expected Result:

The resistance is greater than 5000 ohms.

Results:

- OK – The resistance is greater than 5000 ohms. The machine harness is correct.Proceed to Test Step 3.
- NOT OK – The resistance is less than 5 ohms.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.

A. Perform the following:

- Visually inspect the harness connectors.
- Clean the contacts of the harness connectors.

B. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are fastened.

C. Turn the disconnect switch to the ON position.

D. Turn the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2260 FMI 04 is active.

Expected Result:

The CID 2260 FMI 04 is not active.

Results:

- OK – The CID 2260 FMI 04 is not active. The problem has not been corrected. The ECM may have failed.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2260 FMI 04 is active. The problem has not been corrected. The ECM may have failed.

  Repair: ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, contact the Technical Communicator at your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, see the Testing and Adjusting, “Electronic Control Module (ECM) - Replace” Story in this manual for additional information.

  STOP.

i06507077

MID 082 - CID 2261 - FMI 02

SMCS Code: 7332-038

Conditions Which Generate This Code:

This procedure applies to machines that have the Advanced Control Joysticks (ACJ) installed. If the Grade Control Push-Button pods are installed on the machine, go to the prior CID 2261 procedure

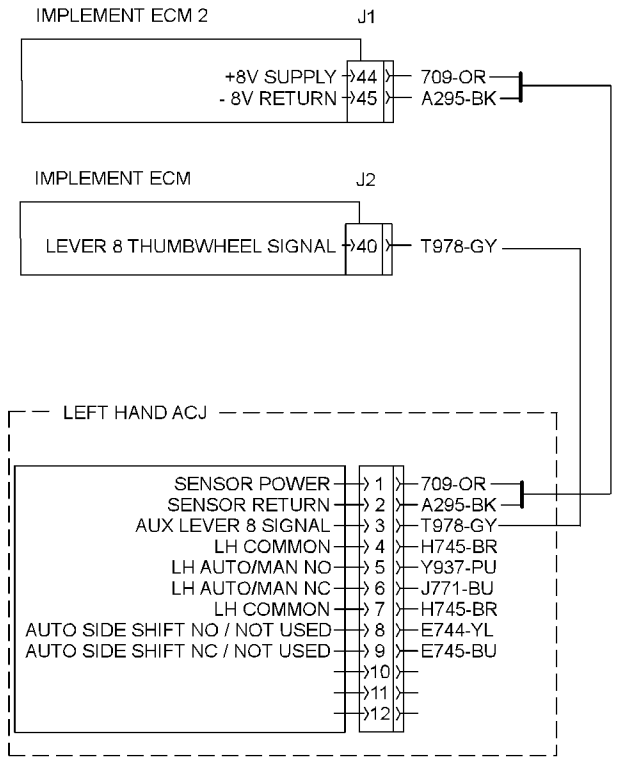


Illustration 488 g06000367

This diagnostic code is recorded when the ECM records an erratic signal or an intermittent signal from the Left-Hand ACJ.

The possible causes for this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections exist in the sensor circuit.
- The signal circuit is shorted to another circuit in the machine harness.
- The ECM has failed. An ECM failure is unlikely.

Note: Ensure that CID 2261 FMI 02 diagnostic code is active and that the diagnostic code indicator is active.

Table 31

Duty Cycles for ACJ Thumbwheels When Used For Grade Control	
0 - 5%	Shorted Low
5 - 20%	No Command
20 - 45%	Decrement
45 - 55%	Center Position - No Command
55 - 95%	Increment
95 - 100%	Shorted High/Open Circuit

Test Step 1. CHECK THE SENSOR POWER SUPPLIES

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left ACJ, insert 7X-1710 Multimeter Probes along the +8V power supply contact J1-44 (wire 709-OR(Orange)) and along ground contact J1-45 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

D. At the harness connector for the left ACJ, insert 7X-1710 Multimeter Probes along the +8V power supply contact J1-1 (wire 709-OR(Orange)) and along ground contact J1-2 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

E. Measure the DC voltage of the sensor power supply.

Expected Result:

Each voltage measurement is approximately 8.0 ± 0.4 VDC.

Results:

- OK – Each voltage measurement is approximately 8.0 ± 0.4 VDC. The power supplies for the sensor are correct.Proceed to Test Step 2.
- NOT OK – One or both of the voltage measurements are less than 8.0 ± 0.4 VDC. The power supplies for the sensor are not correct.

  Repair: Either one or both of the ground wires of the sensor circuit or one or both of the sensor supply circuits are an open connection or a poor connection.

  Refer to the complete Electrical System Schematic of the machine. Examine all the connectors that are in the circuits. Ensure that the connections are clean, that the connections are secure, and that the connections are in good condition.

  For troubleshooting one or both of the separate ECM power supplies that provide power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Transmission/Chassis ECM or the Implement ECM.

  Repair the faulty power supply circuit before proceeding with this procedure.

  STOP.

Test Step 2. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Inspect all the harness connectors for the ACJ and the ECM. Clean the contacts of the harness connectors and check the wires for damage to the insulation. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

B. At the machine harness connector J2 for the left ACJ, use a 151-6320 Removal Tool to remove the signal wire T978-GY(Grey)and socket at contact J1-3 from the harness connector. The machine harness connector J2 remains connected to the left connector of the ACJ.

C. At the back of the ACJ connectors J1 and J2, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-3 and the ground contact at J1-2.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor between the connector contacts of the ACJ J1-2 and J1-3. Rotate the ACJ through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the ACJ .Proceed to Test Step 3.
- NOT OK – The duty cycle of the sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again to verify that the sensor signal is not correct.

  If the sensor signal is not correct according to the description at the beginning of this procedure, replace the left assembly of the ACJ. After replacement of the assembly of the ACJ, verify that the operation of the new assembly of the ACJ is correct before operating the machine.

  STOP.

Test Step 3. CHECK THE SIGNAL AT THE ECM

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the machine harness connector J1 for the Implement ECM, insert a multimeter probe along return contact J1-45 (wire A295-BK(Black)). At the machine harness connector J2 for the Implement ECM, insert a multimeter probe along signal contact J2-40 (wire T978-GY(Grey)). The machine harness connectors remain connected to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Measure the duty cycle of the sensor between the connector contacts of the ECM J1-45 and J2-40. Move the ACJ through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct at the ECM. The machine harness does not appear to be the cause of the problem. An intermittent open or a short could still be causing the problem.Proceed to Test Step 4.
- NOT OK – The duty cycle of the sensor is NOT correct at the ECM connector according to the description at the beginning of this procedure. There is a problem in the machine harness.

  Repair: The sensor signal circuit in the machine harness is not correct. Refer to the complete Electrical System Schematic of the machine. Examine all the connectors that are in the sensor signal circuit. Verify that the connections are clean, that the connections are secure, and that the connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors for the ACJ remain disconnected.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-40 (wire T978-GY(Grey)) to all the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurements do not indicate a short in the circuit.Proceed to Test Step 5.
- NOT OK – A resistance measurement is less than 5000 ohms.

Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low-resistance measurement.

Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP. .

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2261 FMI 02 diagnostic code is active.

Expected Result:

The CID 2261 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 2261 FMI 02 diagnostic code is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation

  STOP. .

- NOT OK – The CID 2261 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP. .

i06504482

MID 082 - CID 2261 - FMI 03

SMCS Code: 7332-038

Conditions Which Generate This Code:

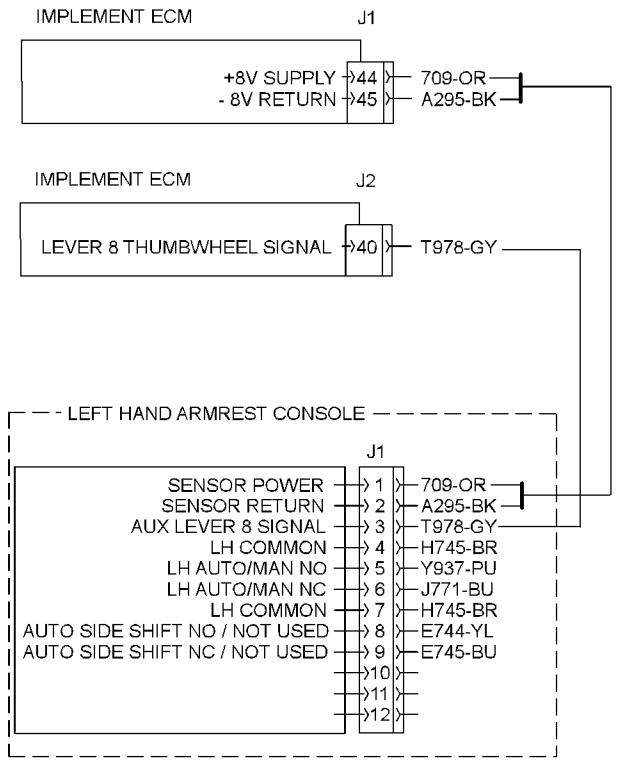


Illustration 489 g06000885

Connections of the left Increment/Decrement on the left Advanced Control Joystick (ACJ)

This diagnostic code is recorded when the ECM records an erratic signal or an intermittent signal from the LH ACJ.

The possible causes for this diagnostic code are listed below:

- The circuit for the sensor power supply is open.
- The circuit for the sensor return is open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Ensure that CID 2261 FMI 03 diagnostic code is active and that the diagnostic code indicator is active.

Table 32

Duty Cycles for ACJ Thumbwheels When Used For Grade Control	
0 - 5%	Shorted Low
5 - 20%	No Command
20 - 45%	Decrement
45 - 55%	Center Position - No Command
55 - 95%	Increment
95 - 100%	Shorted High/Open Circuit

Test Step 1. CHECK THE SENSOR POWER SUPPLY CIRCUIT

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left ACJ, insert 7X-1710 Multimeter Probes along the +V power supply contact J1-1 (wire 709-OR(Orange)) and along ground contact J1-2 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

Expected Result:

Each voltage measurement is approximately 8.0 ± 0.4 VDC.

Results:

- OK – The voltage measurement is approximately 8.0 ± 0.4 VDC. The power supply for the sensor is correct.Proceed to Test Step 2.
- NOT OK – The voltage measurement is less than 8.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: If the voltage measurement is not correct, the problem is most likely in the power circuit wire. This condition will cause multiple diagnostic codes to activate.

  Refer to the complete Electrical System Schematic of the machine. Examine all the connectors that are in the circuits. Ensure that the connections are clean, that all connections are secure, and that all connections are in good condition.

  For troubleshooting the ECM power supply that is providing power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Implement ECM.

  Repair the defective power supply circuit before proceeding with this procedure.

  STOP. .

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the left ACJ. At the harness connectors for the ACJ, place a jumper wire between the ground contact J1-2 (wire A295-BK(Black)) and the signal contact J1-3 (wire T978-GY(Grey)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connector for the Implement ECM, measure the resistance from return contact J1-45 (wire A295-BK(Black)) to signal contact J2-40 (wire T978-GY(Grey)).

E. While observing the resistance measurement, wiggle the ECM connector and the sensor connector. Gently pull on the wires and move the wires around for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms always during the manipulation of the wiring harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The signal circuit of the sensor and the ground circuits of the sensor are not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement for the signal circuit is greater than 5 ohms. There is an open or a bad connection in the circuit.

  Repair: Check the signal circuit for opens or for a bad connection.

  A resistance measurement that is greater than 5 ohms but less than 5000 ohms would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5000 ohms would indicate an open in the circuit.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP. .

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors for the ACJ remain disconnected.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-40 (wire T978-GY(Grey)) to all the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurements do not indicate a short in the circuit.Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low-resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP. .

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Inspect all the harness connectors for the ACJ and the ECM. Clean the contacts of the harness connectors and check the wires for damage to the insulation. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

B. At the machine harness connector J1 for the left ACJ, use a 151-6320 Removal Tool to remove the signal wire T978-GY(Grey)and the socket at contact J1-3 from the harness connector. The machine harness connector J2 remains connected to the connector of the left ACJ.

C. At the back of the ACJ connectors J1 and J2, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-3 and the ground contact at J1-2.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor between the connector contacts of the ACJ J1-2 and J1-3. Rotate the ACJ through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the ACJ.Proceed to Test Step 5.

- NOT OK – The duty cycle of the sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again to verify that the sensor signal is not correct.

  If the sensor signal is not correct according to the description at the beginning of this procedure, replace the left ACJ assembly. After replacement of the assembly of the ACJ, verify that the operation of the new assembly of the ACJ is correct before operating the machine.

  STOP. .

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2261 FMI 03 diagnostic code is active.

Expected Result:

The CID 2261 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2261 FMI 03 diagnostic code is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation

  STOP. .

- NOT OK – The CID 2261 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP. .

i06507082

MID 082 - CID 2261 - FMI 04

SMCS Code: 7332-038

Conditions Which Generate This Code:

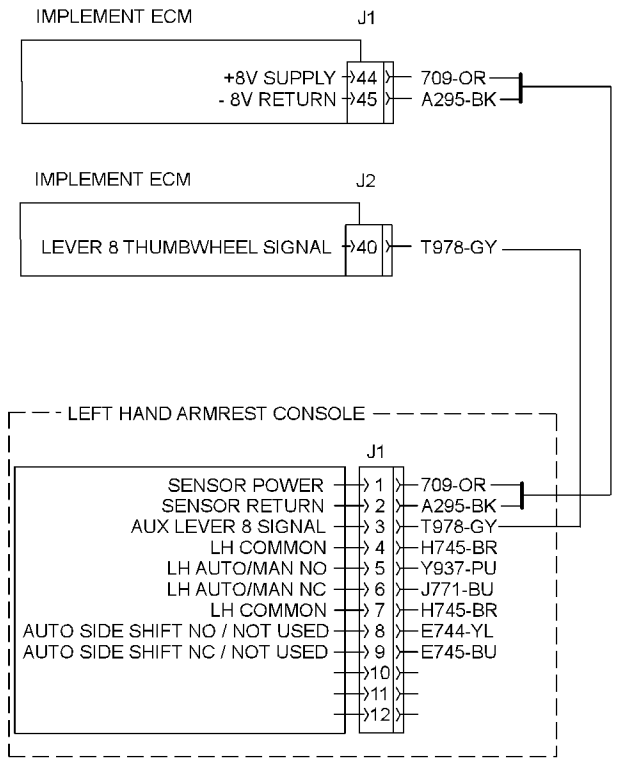


Illustration 490 g06001630

Connections of the left Increment/Decrement on the left Advanced Control Joystick (ACJ)

This diagnostic code is recorded when the ECM records an erratic signal or an intermittent signal from the LH ACJ.

The possible causes for this diagnostic code are listed below:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Ensure that CID 2261 FMI 04 diagnostic code is active and that the diagnostic code indicator is active.

Table 33

Duty Cycles for ACJ Thumbwheels When Used For Grade Control	
0 - 5%	Shorted Low
5 - 20%	No Command
20 - 45%	Decrement
45 - 55%	Center Position - No Command
55 - 95%	Increment
95 - 100%	Shorted High/Open Circuit

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J2 from the left ACJ. Observe the status of the active CID 2261 FMI 04 diagnostic code.

Expected Result:

The status of the CID 2261 FMI 04 diagnostic code did not change when the joystick connector was disconnected. A CID 2261 FMI 03 diagnostic code has NOT been activated the ECM. The CID 2261 FMI 04 diagnostic code remains active when the ACJ connector is disconnected.

Results:

- YES – The CID 2261 FMI 04 diagnostic code remains active when the ACJ connector is disconnected. The sensor is not causing the problem.Proceed to Test Step 2.
- NO – The CID 2261 FMI 04 diagnostic code is no longer active when the ACJ connector is disconnected. A CID 2261 FMI 03 diagnostic code has been activated by the ECM when the ACJ connector is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The sensor is causing the problem. There is an internal short to ground in the left ACJ. Replace the assembly of the left ACJ. After replacement of the assembly of the ACJ, verify that the operation of the assembly of the new ACJ is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the ACJ J2 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J2 for the Implement ECM, measure the resistance from contact J2-40 (wire T978-GY(Grey)) to frame ground. Measure the resistance to all the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements are less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and either the frame ground or the circuit with the low-resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2261 FMI 04 diagnostic code is active.

Expected Result:

The CID 2261 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2261 FMI 04 diagnostic code is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation

  STOP.

- NOT OK – The CID 2261 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact your Cat Dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06508495

MID 082 - CID 2261 - FMI 07

SMCS Code: 7332-038

Conditions Which Generate This Code:

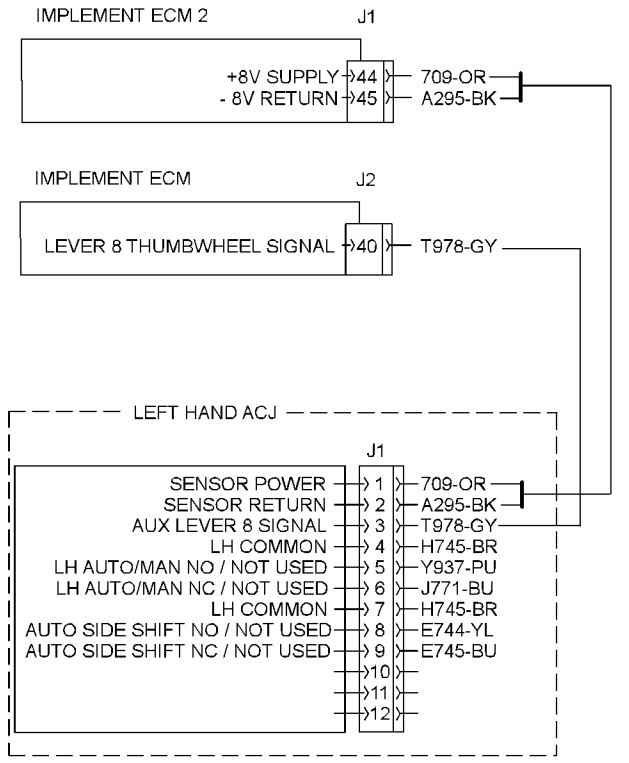


Illustration 491 g06002306

Connections of the left Increment/Decrement on the left Advanced Control Joystick (ACJ)

This diagnostic code is recorded when the ECM records an erratic signal or an intermittent signal from the LH Offset Switch.

The possible causes for this diagnostic code are listed below:

- The switch has failed.
- The signal circuit is open.
- A signal circuit is shorted to the +battery circuit.
- The signal circuit is shorted to ground.
- The signal circuits may be shorted together.
- The ECM has failed.

Note: Ensure that CID 2261 FMI 07 diagnostic code is active and that the diagnostic code indicator is active.

Table 34

Duty Cycles for ACJ Thumbwheels When Used For Grade Control	
0 - 5%	Shorted Low
5 - 20%	No Command
20 - 45%	Decrement
45 - 55%	Center Position - No Command
55 - 95%	Increment
95 - 100%	Shorted High/Open Circuit

Test Step 1. CHECK THE OPERATION OF THE SWITCH.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the Switch.

Table 35

Contacts	State of Switch		
	Increment	Neutral	Decrement
Contacts 1 to 2	Less than 5 ohms	Greater than 5000 ohms	Greater than 5000 ohms
Contacts 2 to 4	Greater than 5000 ohms	Less than 5 ohms	Greater than 5000 ohms
Contacts 2 to 6	Greater than 5000 ohms	Greater than 5000 ohms	Less than 5 ohms

C. Measure the resistance of each set of contact points. Refer to the list of contact points in the table above. Note the resistance values.

Expected Result:

The measurements agree with the values that are listed in Table 35 .

Results:

- YES – The resistances that were measured agree with the expected measurements that are listed in the table.Proceed to Test Step 2.
- NO – The resistance measurements do not reflect the expected measurements that are listed in the table. The switch has failed.

  Repair: Replace the switch.

  STOP.

Test Step 2. CHECK FOR A SHORTED HARNESS.

A. The “LH Offset Switch” remains disconnected.

B. Turn the disconnect switch and the key start switch to the OFF position.

C. Disconnect the harness connectors (J1) and (J2) from the ECM.

D. At the harness connector for the ECM (J1), measure the resistance between contact J1-44 (wire 709-OR(Orange)) and ALL other J1 connector contacts.

E. Measure the resistance at the harness connector for the ECM (J1). Measure the resistance between contact J1-45 (wire A295-BK(Black)) and ALL other J1 connector contacts.

F. Measure the resistance at the harness connector for the ECM (J2), Measure the resistance between contact J2-40 (wire T978-GY(Grey)) and ALL other J2 connector contacts.

Expected Result:

The resistance is greater than 5000 Ohms.

Results:

- YES – The resistance is greater than 5000 Ohms. The harness resistance is correct.Proceed to Test Step 3.
- NO – Resistance is less than 5000 Ohms.

  Repair: The harness has failed. Repair the harness or replace the harness.

  STOP.

Test Step 3. CHECK FOR AN OPEN HARNESS.

A. The “LH Offset Switch” remains disconnected from the harness.

B. The key start switch and the disconnect switch are in the OFF position.

C. NOT SURE HOW TO DO THESE STEPS :At the harness connector for the “LH Offset Switch” , place a jumper wire between the following contacts:

- Contact 1 (wire Y934-WH(White)) and Contact 2 (wire H745-BR(Brown))
- Contact 4 (wire Y936-PK(Pink)) and contact 6 (wire Y933-YL(Yellow))

D. The J2 connectors remain disconnected from the ECM.

E. Measure the resistance at the harness connector for the ECM. Measure the resistance between contact J2-58 (wire Y933-YL(Yellow)) and contact J2-22 (wire H745-BR(Brown)). Make a note of the resistance that was measured.

F. Measure the resistance at the harness connector for the ECM Measure the resistance between contact J2-55 (wire Y934-WH(White)) and contact J2-54 (wire Y936-PK(Pink)). Make a note of the resistance that was measured.

Expected Result:

The resistance is less than 5 Ohms for all the measurements.

Results:

- YES – The resistance is less than 5 Ohms for all the measurements.Proceed to Test Step 4.
- NO – Resistance is greater than 5000 Ohms for one or more of the measurements.

  Repair: The harness has failed. Repair the harness or replace the harness.

  STOP.

Test Step 4. CHECK THE ECM.

A. Reconnect all connectors to the Implement ECM.

B. Turn the disconnect switch and the key start switch to the ON position.

C. The harness remains disconnected from the switch.

D. At the harness connector of the switch, measure the voltage between each of the following contacts:

- Contact 2 (wire A295-BK(Black)) and contact 1 (wire 709-OR(Orange))
- Contact 2 (wire A295-BK(Black)) and contact 3 (wire T978-GY(Grey))

Expected Result:

The voltage measures approximately 8.0 ± 0.5 DCV.

Results:

- YES – The voltage measures approximately 8.0 ± 0.5 DCV.Proceed to Test Step 5.
- NO – The voltage is NOT approximately 8.0 ± 0.5 DCV.

  Repair: The voltage from the ECM is incorrect. An ECM failure is unlikely. Exit this procedure and perform this troubleshooting procedure again. If the diagnostic code is not found, then replace the ECM. See Testing and Adjusting, “Module - Replace”.

  STOP.

Test Step 5. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.

A. Inspect the contacts and clean the contacts of the harness connectors.

B. Reconnect all harness connectors.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 2261 FMI 07 diagnostic code is active.

Expected Result:

The CID 2261 FMI 07 diagnostic code is no longer active.

Results:

- YES – The CID 2261 FMI 07 diagnostic code is not active. The problem does not exist currently.

  Repair: The initial diagnostic code was most likely caused by a poor electrical connection or a short at one of the harness connectors. The result could have been caused by the disconnecting or reconnecting of the wire harness. Resume normal machine operation.

  STOP.

- NO – The CID 2261 FMI 07 diagnostic code is active. The problem has not been corrected. The ECM may have failed.

  Repair: An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Module - Replace”.

  STOP.

i06507201

MID 082 - CID 2262 - FMI 02

SMCS Code: 7332-038

Conditions Which Generate This Code:

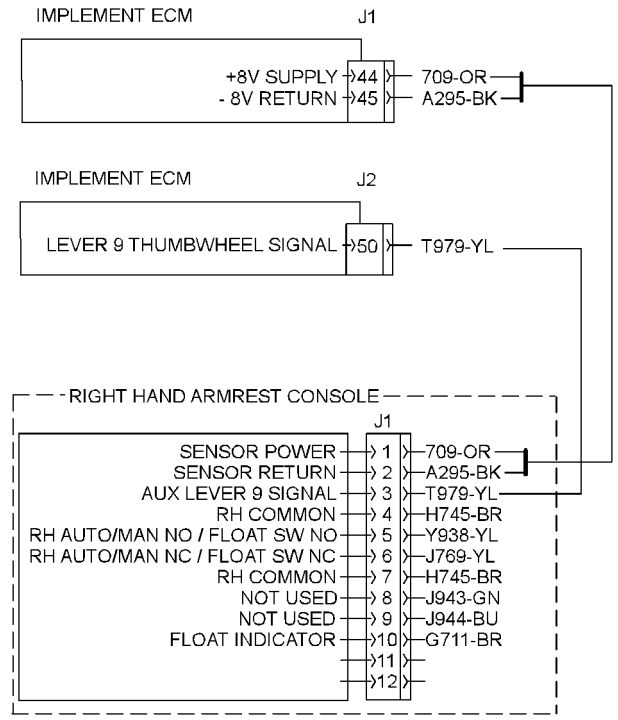


Illustration 492 g06001757

Connections of the right Increment/Decrement on the Right Advanced Control Joystick (ACJ)

This diagnostic code is recorded when the ECM records an erratic signal or an intermittent signal from the “RH Offset Switch” .

The possible causes for this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections exist in the sensor circuit.
- The signal circuit is shorted to another circuit in the machine harness.
- The ECM has failed. An ECM failure is unlikely.

Note: Ensure that CID 2262 FMI 02 diagnostic code is active and that the diagnostic code indicator is active.

Table 36

Duty Cycles for ACJ Thumbwheels When Used For Grade Control	
0 - 5%	Shorted Low
5 - 20%	No Command
20 - 45%	Decrement
45 - 55%	Center Position - No Command
55 - 95%	Increment
95 - 100%	Shorted High/Open Circuit

Test Step 1. CHECK THE SENSOR POWER SUPPLIES

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the right ACJ, insert 7X-1710 Multimeter Probes along the +8V power supply contact J1-44 (wire 709-OR(Orange)) and along ground contact J1-45 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

D. At the harness connector for the right ACJ, insert 7X-1710 Multimeter Probes along the +8V power supply contact J1-1 (wire 709-OR(Orange)) and along ground contact J1-2 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

E. Measure the DC voltage of the sensor power supply.

Expected Result:

Each voltage measurement is approximately 8.0 ± 0.4 VDC.

Results:

- OK – Each voltage measurement is approximately 8.0 ± 0.4 VDC. The power supplies for the sensor are correct.Proceed to Test Step 2.
- NOT OK – One or both of the voltage measurements are less than 8.0 ± 0.4 VDC. The power supplies for the sensor are not correct.

  Repair: Either one or both of the ground wires of the sensor circuit or one or both of the sensor supply circuits are an open connection or a poor connection.

Refer to the complete Electrical System Schematic of the machine. Examine all the connectors that are in the circuits. Ensure that the connections are clean, that the connections are secure, and that the connections are in good condition.

For troubleshooting one or both of the separate ECM power supplies that provide power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Transmission/Chassis ECM or the Implement ECM.

Repair the faulty power supply circuit before proceeding with this procedure.

STOP.

Test Step 2. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Inspect all the harness connectors for the ACJ and the ECM. Clean the contacts of the harness connectors and check the wires for damage to the insulation. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

B. At the machine harness connector J2 for the right ACJ, use a 151-6320 Removal Tool to remove the signal wire T979-YL(Yellow)and socket at contact J1-3 from the harness connector. The machine harness connector J2 remains connected to the right connector of the ACJ.

C. **At the back of the ACJ connectors J1 and J2**, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-3 and the ground contact at J1-2.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor between the connector contacts of the ACJ J1-2 and J1-3. Rotate the ACJ through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the ACJ.Proceed to Test Step 3.
- NOT OK – The duty cycle of the sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again to verify that the sensor signal is not correct.

  If the sensor signal is not correct according to the description at the beginning of this procedure, replace the right assembly of the ACJ. After replacement of the assembly of the ACJ, verify that the operation of the new assembly of the ACJ is correct before operating the machine.

  STOP.

Test Step 3. CHECK THE SIGNAL AT THE ECM

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the machine harness connector J1 for the Implement ECM, insert a multimeter probe along return contact J1-45 (wire A295-BK(Black)). At the machine harness connector J2 for the Implement ECM, insert a multimeter probe along signal contact J2-50 (wire T979-YL(Yellow)). The machine harness connectors remain connected to the ECM.

C. Turn the key start switch and the disconnect switch to the ON position.

D. Measure the duty cycle of the sensor between the connector contacts of the ECM J1-45 and J2-50. Move the ACJ through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct at the ECM. The machine harness does not appear to be the cause of the problem. An intermittent open or a short could still be causing the problem.Proceed to Test Step 4.
- NOT OK – The duty cycle of the sensor is NOT correct at the ECM connector according to the description at the beginning of this procedure. There is a problem in the machine harness.

Repair: The sensor signal circuit in the machine harness is not correct. Refer to the complete Electrical System Schematic of the machine. Examine all the connectors that are in the sensor signal circuit. Verify that the connections are clean, that the connections are secure, and that the connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors for the ACJ remain disconnected.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-50 (wire T979-YL(Yellow)) to all the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurements do not indicate a short in the circuit.Proceed to Test Step 5.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low-resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2262 FMI 02 diagnostic code is active.

Expected Result:

The CID 2262 FMI 02 diagnostic code is not active.

Results:

- OK – The CID 2262 FMI 02 diagnostic code is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2262 FMI 02 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i06507465

MID 082 - CID 2262 - FMI 03

SMCS Code: 7332-038

Conditions Which Generate This Code:

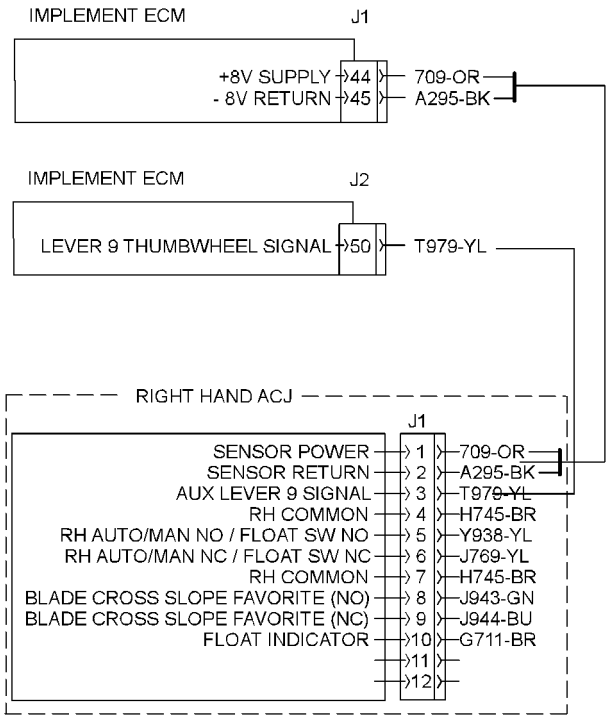


Illustration 493 g06001864

Connections of the right Increment/Decrement on the right Advanced Control Joystick (ACJ)

This diagnostic code is recorded when the ECM records an erratic signal or an intermittent signal from the RH ACJ.

The possible causes for this diagnostic code are listed below:

- The circuit for the sensor power supply is open.
- The circuit for the sensor return is open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Ensure that CID 2262 FMI 03 diagnostic code is active and that the diagnostic code indicator is active.

Table 37

Duty Cycles for ACJ Thumbwheels When Used For Grade Control	
0 - 5%	Shorted Low
5 - 20%	No Command
20 - 45%	Decrement
45 - 55%	Center Position - No Command
55 - 95%	Increment
95 - 100%	Shorted High/Open Circuit

Test Step 1. CHECK THE SENSOR POWER SUPPLY CIRCUIT

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the right ACJ, insert 7X-1710 Multimeter Probes along the +8V power supply contact J1-1 (wire 709-OR(Orange)) and along ground contact J1-2 (wire A295-BK(Black)). Do not disconnect the machine harness from the J1 connector.

C. Measure the DC voltage of the sensor power supply.

Expected Result:

Each voltage measurement is approximately 8.0 ± 0.4 VDC.

Results:

- OK – The voltage measurement is approximately 8.0 ± 0.4 VDC. The power supply for the sensor is correct.Proceed to Test Step 2.
- NOT OK – The voltage measurements are less than 8.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: If the voltage measurement is not correct, the problem is most likely in the power circuit wire. This condition will cause multiple diagnostic codes to activate.

  Refer to the complete Electrical System Schematic of the machine. Examine all the connectors that are in the circuits. Ensure that the connections are clean, that all connections are secure, and that all connections are in good condition.

  For troubleshooting the ECM power supply that is providing power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Implement ECM.

Repair the defective power supply circuit before proceeding with this procedure.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the right ACJ. At the harness connectors for the ACJ, place a jumper wire between the ground contact J1-2 (wire A295-BK(Black)) and the signal contact J1-3 (wire T979-YL(Yellow)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connector for the Implement ECM, measure the resistance from return contact J1-45 (wire A295-BK(Black)) to signal contact J2-50 (wire T979-YL(Yellow)).

E. Observe the resistance measurement while you wiggle the ECM connector and the sensor connector. Gently pull on the wires and move the wires around for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms always during the manipulation of the wiring harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The signal circuit of the sensor and the ground circuits of the sensor are not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement for the signal circuit is greater than 5 ohms. There is an open or a bad connection in the circuit.

  Repair: Check the signal circuit for opens or for a bad connection.

  A resistance measurement that is greater than 5 ohms but less than 5000 ohms would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5000 ohms would indicate an open in the circuit.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position. The machine harness connectors for the ACJ remain disconnected.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the Implement ECM, measure the resistance from the sensor signal contact J2-50 (wire T979-YL(Yellow)) to all the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurements do not indicate a short in the circuit.Proceed to Test Step 4.
- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low-resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Inspect all the harness connectors for the ACJ and the ECM. Clean the contacts of the harness connectors and check the wires for damage to the insulation. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

B. At the machine harness connector J1 for the right ACJ, use a 151-6320 Removal Tool to remove the signal wire T979-YL(Yellow)and the socket at contact J1-3 from the harness connector. The machine harness connector J2 remains connected to the connector of the right ACJ.

C. At the back of the ACJ connectors J1 and J2, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-3 and the ground contact at J1-2.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor between the connector contacts of the ACJ J1-2 and J1-3. Rotate the ACJ through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the ACJ.Proceed to Test Step 5.

- NOT OK – The duty cycle of the sensor is NOT correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again to verify that the sensor signal is not correct.

  If the sensor signal is not correct according to the description at the beginning of this procedure, replace the right ACJ assembly. After replacement of the assembly of the ACJ, verify that the operation of the new assembly of the ACJ is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2262 FMI 03 diagnostic code is active.

Expected Result:

The CID 2262 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2262 FMI 03 diagnostic code is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2262 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contactCat Dealership Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06507769

MID 082 - CID 2262 - FMI 04

SMCS Code: 7332-038

Conditions Which Generate This Code:

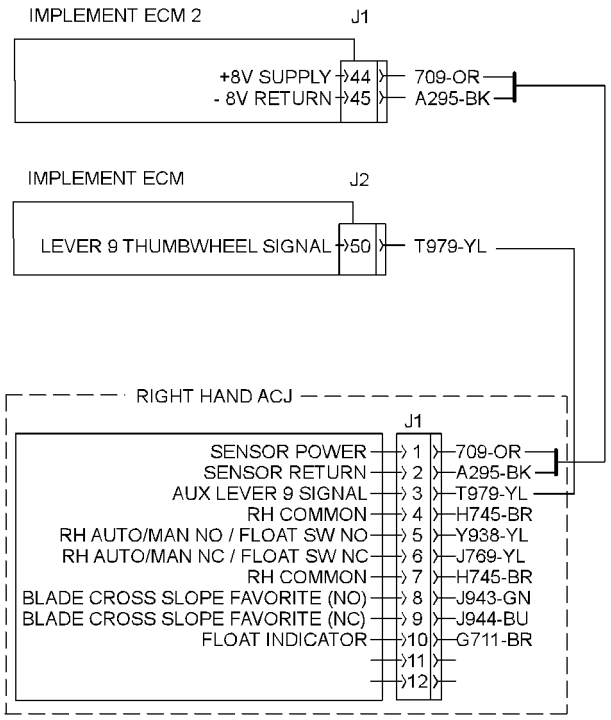


Illustration 494 g06002179

Connections of the right Increment/Decrement on the right Advanced Control Joystick (ACJ)

This diagnostic code is recorded when the ECM records an erratic signal or an intermittent signal from the RH ACJ.

The possible causes for this diagnostic code are listed below:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Ensure that CID 2262 FMI 04 diagnostic code is active and that the diagnostic code indicator is active.

Table 38

Duty Cycles for ACJ Thumbwheels When Used For Grade Control	
0 - 5%	Shorted Low

(continued)

(Table 38, contd)

5 - 20%	No Command
20 - 45%	Decrement
45 - 55%	Center Position - No Command
55 - 95%	Increment
95 - 100%	Shorted High/Open Circuit

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J2 from the right ACJ. Observe the status of the active CID 2262 FMI 04 diagnostic code.

Expected Result:

The status of the CID 2262 FMI 04 diagnostic code did not change when the ACJ connector was disconnected. A CID 2262 FMI 03 diagnostic code has NOT been activated the ECM. The CID 2262 FMI 04 diagnostic code remains active when the ACJ connector is disconnected.

Results:

- YES – The CID 2262 FMI 04 diagnostic code remains active when the ACJ connector is disconnected. The sensor is not causing the problem.Proceed to Test Step 2.
- NO – The CID 2262 FMI 04 diagnostic code is no longer active when the ACJ connector is disconnected. A CID 2262 FMI 03 diagnostic code has been activated by the ECM when the ACJ connector is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The sensor is causing the problem. There is an internal short to ground in the right ACJ. Replace the assembly of the right ACJ. After replacement of the assembly of the ACJ, verify that the operation of the assembly of the new ACJ is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector of the ACJ J2 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. Measure the resistance at machine harness connector J2 for the Implement ECM, from contact J2-50 (wire T979-YL(Yellow)) to frame ground. Measure the resistance to all the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements are less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and either the frame ground or the circuit with the low-resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2262 FMI 04 diagnostic code is active.

Expected Result:

The CID 2262 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 2262 FMI 04 diagnostic code is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.
- NOT OK – The CID 2262 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator of your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i05946333

MID 082 - CID 2262 - FMI 07

SMCS Code: 7332-038

Conditions Which Generate This Code:

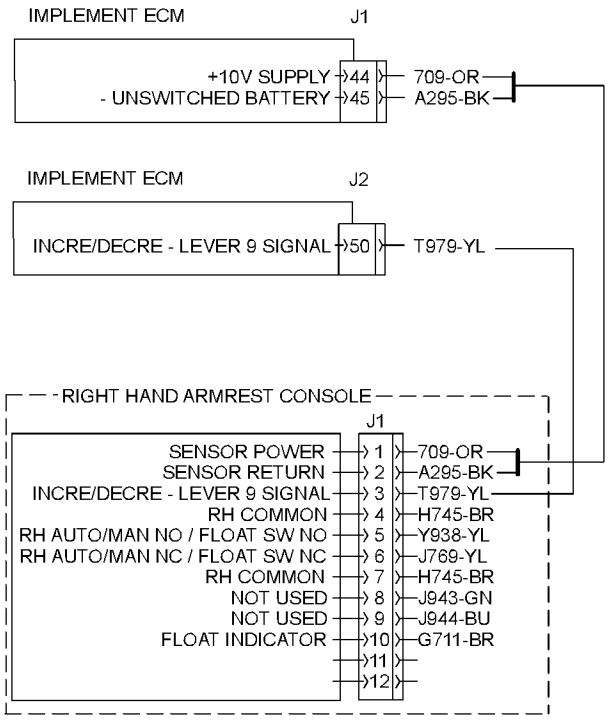


Illustration 495 g03819567

Connections of the right Increment/Decrement on the right Advanced Control Joystick

This diagnostic code is recorded when the ECM records an erratic signal or an intermittent signal from the RH Offset Switch.

The possible causes for this diagnostic code are listed below:

- The switch has failed.
- The signal circuit is open.
- A signal circuit is shorted to the +battery circuit.
- The signal circuit is shorted to ground.
- The signal circuits may be shorted together.
- The ECM has failed. An ECM failure is unlikely.

Note: Ensure that CID 2262 FMI 07 diagnostic code is active and that the diagnostic code indicator is active.

Table 39

Duty Cycles for ACJ Thumbwheels When Used For Grade Control	
0 - 5%	Shorted Low
5 - 20%	No Command
20 - 45%	Decrement
45 - 55%	Center Position - No Command
55 - 95%	Increment
95 - 100%	Shorted High/Open Circuit

Test Step 1. CHECK THE OPERATION OF THE SWITCH.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the switch.

Table 40

Contacts	State of Switch		
	Increment	Neutral	Decrement
Contacts 1 to 2	Less than 5 ohms	Greater than 5000 ohms	Greater than 5000 ohms
Contacts 2 to 4	Greater than 5000 ohms	Less than 5 ohms	Greater than 5000 ohms
Contacts 2 to 6	Greater than 5000 ohms	Greater than 5000 ohms	Less than 5 ohms

C. Measure the resistance between the contact points of each connector. Refer to the list in the table above. Note the resistance values.

Expected Result:

The measurements agree with the values that are listed in Table 40 .

Results:

- YES – The resistance measurements agree with the list of values from the table.Proceed to Test Step 2.
- NO – The resistance measurements do not reflect the expected measurements that are listed in the table. The switch has failed.

  Repair: Replace the switch.

  STOP.

Test Step 2. CHECK FOR A SHORTED HARNESS.

A. The “RH Offset Switch” remains disconnected.

B. Turn the disconnect switch and the key start switch to the OFF position.

C. Disconnect the harness connector (J2) from the ECM.

D. NEED HELP WITH STEPS :At the harness connector for the ECM (J2), measure the resistance between contact J2-47 (wire K722-YL(Yellow)) and ALL other J2 contacts.

E. At the harness connector for the ECM (J2), measure the resistance between contact J2-46 (wire K723-PU(Purple)) and ALL other J2 connector contacts.

F. At the harness connector for the ECM (J2), measure the resistance between contact J2-45 (wire Y935-OR(Orange)) and all other J2 connector contacts.

G. At the harness connector for the ECM (J2), measure the resistance between contact J2-22 (wire H745-BK(Black)) and ALL other J2 connector contacts.

Expected Result:

The resistance is greater than 5000 Ohms.

Results:

- YES – The resistance is greater than 5000 Ohms. The harness resistance is correct.Proceed to Test Step 3.
- NO – Resistance is less than 5000 Ohms.

  Repair: The harness has failed. Repair the harness or replace the harness.

  STOP.

Test Step 3. CHECK FOR AN OPEN HARNESS.

A. The “RH Offset Switch” remains disconnected from the harness.

B. The key start switch and the disconnect switch are in the OFF position.

C. At the harness connector for the “RH Offset Switch” , place a jumper wire between the following contacts:

- Contact 1 (wire K723-PU(Purple)) and Contact 2 (wire H745-BR(Brown))
- Contact 4 (wire Y935-OR(Orange)) and contact 6 (wire K722-YL(Yellow))

D. The J2 connectors remain disconnected from the ECM.

E. At the harness connector for the ECM, measure the resistance between contact J2-46 (wire K723-PU(Purple)) and contact J2-22 (wire H745-BR(Brown)). Make a note of the resistance that was measured.

F. At the harness connector for the ECM, measure the resistance between contact J2-45 (wire Y935-OR(Orange)) and contact J2-47 (wire K722-YL(Yellow)). Make a note of the resistance that was measured.

Expected Result:

The resistance is less than 5 Ohms for all of the measurements.

Results:

- YES – The resistance is less than 5 Ohms for all of the measurements.Proceed to Test Step 4.
- NO – Resistance is greater than 5000 Ohms for one or more of the measurements.

  Repair: The harness has failed. Repair the harness or replace the harness.

  STOP.

Test Step 4. CHECK THE ECM.

A. Reconnect all connectors to the Implement ECM.

B. Turn the disconnect switch and the key start switch to the ON position.

C. The harness remains disconnected from the switch.

D. At the harness connector for the switch, measure the voltage between each of the following contacts:

- Contact 2 (wire H745-BR(Brown)) and contact 1 (wire K723-PU(Purple))
- Contact 2 (wire H745-BR(Brown)) and contact 4 (wire Y935-OR(Orange))
- Contact 2 (wire H745-BR(Brown)) and contact 6 (wire K722-YL(Yellow))

Expected Result:

The voltage measures approximately 12.0 ± 0.5 DCV.

Results:

- YES – The voltage measures approximately 12.0 ± 0.5 DCV.Proceed to Test Step 5.
- NO – The voltage is NOT approximately 12.0 ± 0.5 DCV.

  Repair: The voltage from the ECM is incorrect. An ECM failure is unlikely. Exit this procedure and perform this troubleshooting procedure again. If the diagnostic code is not found, then replace the ECM. See Testing and Adjusting, “Module - Replace”.

  STOP.

Test Step 5. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE.

A. Inspect the contacts and clean the contacts of the harness connectors.

B. Reconnect all harness connectors.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 2262 FMI 07 diagnostic code is active.

Expected Result:

The CID 2262 FMI 07 diagnostic code is no longer active.

Results:

- YES – The CID 2262 FMI 07 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NO – The CID 2262 FMI 07 diagnostic code is active. The problem has not been corrected. The ECM may have failed.

  Repair: Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Module - Replace”.

  STOP.

i02505719

MID 082 - CID 2650 - FMI 03

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

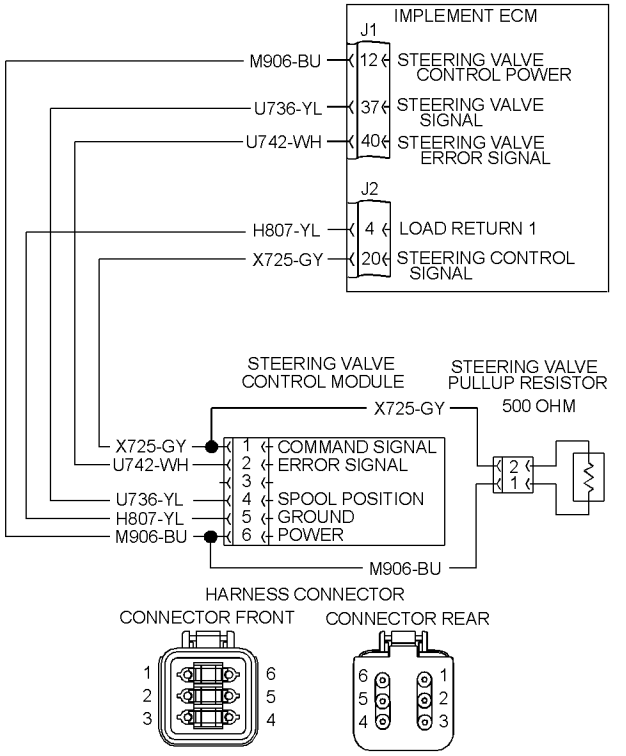


Illustration 496 g01315411

Steering Valve Control Module connections

The ECM supplies system power for the steering valve control module through an ON/OFF driver at contact J1-12. The CID 2650 FMI 03 diagnostic code is activated when the ECM detects that voltage is present in the circuit when no voltage should be present.

The following conditions could cause the ECM to activate this diagnostic code:

- The power supply circuit for the steering valve control module is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. The 70 pin connector that passes the chassis circuits through the bulkhead at the front of the cab should be inspected for poor connections. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: If a CID 2202 FMI 12 diagnostic code is active for the steering valve control module, the Implement ECM will turn OFF the power output for the steering valve control module. Verify that a CID 2202 FMI 12 diagnostic code is not active before proceeding with this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected. Verify that the CID 2650 FMI 03 diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE HARNESS FOR A SHORT CIRCUIT

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the machine harness connector from the steering valve control module.

C. Disconnect the machine harness connector from the steering valve pull up resistor.

D. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

E. At the harness connector J1, measure the resistance from supply contact J1-12 (wire M906-BU(Blue)) to all of the other ECM contact that are used in connectors J1 and J2 for the ECM.

Expected Result:

Each resistance measurement at the ECM connectors is greater than 5000 ohms.

Results:

- OK – Each resistance measurement at the ECM connectors is greater than 5000 ohms. The resistor is correct and the supply circuit is not shorted in the machine harness. Proceed to Test Step 2.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The power supply circuit wire M906-BU(Blue) is shorted to another circuit in the machine harness.

  Refer to the complete machine Electrical System Schematic. Examine the supply circuit in order to determine where the short circuit could occur. Check all connectors that are in the power supply circuit for the steering control module. Ensure that all of the connectors in the circuit are clean and the contacts are securely connected.

  Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK FOR VOLTAGE IN THE CIRCUIT

This test step checks for short circuit voltage in the circuit from possible sources other than the ECM harness.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the machine harness connector J1 for the Implement ECM, use a 151-6320 Removal Tool to remove the supply wire M906-BU(Blue) and socket at contact J1-12 from the J1 harness connector. The machine harness connector J1 remains connected to the ECM.

C. At the machine harness connector J2 for the ECM, insert a 7X-1710 Multimeter Probe along the return circuit wire at contact J2-4 (wire H807-YL(Yellow)). Use the other multimeter probe to make contact with the now disconnected supply wire M906-BU(Blue).

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the voltage between the return circuit at contact J2-4 (wire H807-YL(Yellow)) and the disconnected supply wire M906-BU(Blue).

F. While observing the voltage measurement, wiggle the wiring harness for the steering module. Gently move the harness and move the wires.

Expected Result:

The voltage measurement is less than 0.5 VDC at all times during the manipulation of the harness.

Results:

- OK – The voltage measurement is less than 0.5 VDC. During the manipulation of the harness, the voltage measurement does not change. The voltage measurement does not indicate that the supply circuit is shorted in the harness. Reinstall the signal wire M906-BU(Blue) and socket back to the original location at contact J1-12 in the machine harness connector ECM. Proceed to Test Step 3.
- NOT OK – The voltage measurement is greater than 0.5 VDC at all times or during the manipulation of the harness, the voltage measurement did spike above 0.5 VDC. The voltage measurement is indicating that the supply circuit wire M906-BU(Blue) for the steering control module is shorted to another circuit in the machine harness.

  Repair: Refer to the complete machine Electrical System Schematic. Examine the supply circuit in order to determine where the short circuit could occur. Check all connectors that are in the power supply circuit for the steering control module. Ensure that all of the connectors in the circuit are clean and the contacts are securely connected.

  Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2650 FMI 03 diagnostic code is active.

Expected Result:

The CID 2650 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2650 FMI 03 diagnostic code is active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2650 FMI 03 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02984612

MID 082 - CID 2650 - FMI 05

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

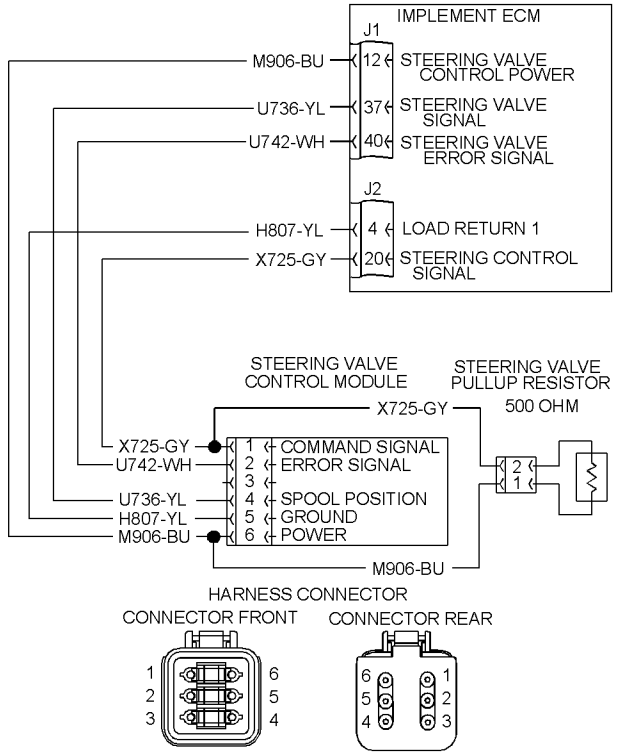


Illustration 497 g01315411

Connectors of “Steering Valve Control” module

The ECM supplies system power for the steering valve control module through an ON/OFF driver at contact J1-12.

The CID 2650 FMI 05 diagnostic code is activated when the ECM detects that the current of power supply circuit is lower than the normal.

The following conditions could cause this diagnostic code:

- The power supply circuit is open in the machine harness.
- The control module of the steering valve has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. The 70 pin connector that passes the chassis circuits through the bulkhead at the front of the cab should be inspected for poor connections. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected. Verify that the CID 2650 FMI 05 diagnostic code is active before performing this procedure.

Note: If a CID 2202 FMI 12 diagnostic code is active for the steering valve control module, the Implement ECM will turn OFF the power output for the steering valve control module. Verify that a CID 2202 FMI 12 diagnostic code is not active before proceeding with this procedure.

Test Step 1. CHECK THE HARNESS FOR AN OPEN CIRCUIT

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the machine harness connector from the control module of the steering valve.

C. At the machine harness connector from the steering valve control module, place a jumper wire between the supply contact 6 (wire M906-BU(Blue)) and the return contact 5 (wire H807-YL(Yellow)).

D. Disconnect the machine harness connectors J1 and J2 from the ECM.

E. Measure the resistance from signal contact J1-12 (wire M906-BU(Blue)) to return contact J2-4 (wire H807-YL(Yellow)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The power supply circuit is not open in the machine harness. Proceed to Test Step 2.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open connection or a bad connection in the machine harness.

  Repair: Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the power supply circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE ECM OUTPUT SUPPLY VOLTAGE

The disconnect switch and the key start switch remain in the OFF position.

A. Reconnect the machine harness connectors J1 and J2 to the ECM connectors.

B. At the machine harness connector for the steering control module, use a 151-6320 Removal Tool, or a similar removal tool, to remove the supply wire and socket at contact 6 (wire M906-BU(Blue)) from the harness connector. Use the removal tool to remove the return circuit wire and the socket at contact 5 (wire H807-YL(Yellow)) from the harness connector. The machine harness connector remains connected to the steering valve control module.

C. In this step and the next step, the steering module error signal circuit must be grounded to prevent an error signal to the ECM which will turn OFF the power output. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar jumper wire device for this step. At the back of the harness connector for the steering control module, insert the multimeter probe along error signal contact 2 (wire U742-WH(White)).

D. Connect the other end of the jumper wire to frame ground. This probe or jumper wire must remain connected during the rest of this procedure.

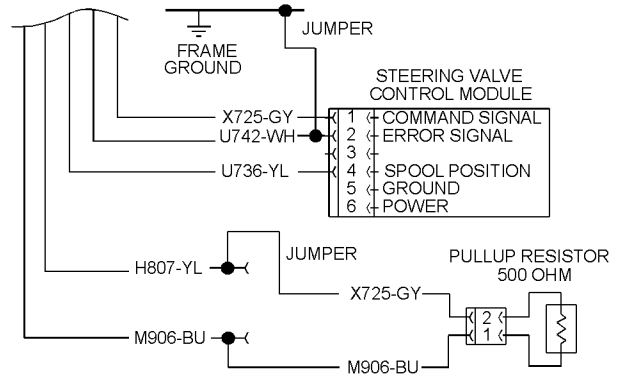


Illustration 498 g01316140

Steps “C” , “D” , “E” - error signal jumpered to ground, pull up resistor connected to power circuit and jumpered to ground circuit in order to “load” the circuit

E. In this step, we will use the pull up resistor to load the ECM power supply output circuit. If the ECM does not detect a load on the circuit, the ECM will turn OFF the output. At the harness connector for the steering control module, contact 1, disconnect the wire of the pull up resistor X725-GY(Grey). Use a jumper wire to connect the pull up resistor wire X725-GY(Grey) to the disconnected return circuit wire H807-YL(Yellow). The other pull up resistor wire M906-BU(Blue) remains connected to the disconnected power wire M906-BU(Blue). Note the illustration above.

F. Turn the disconnect switch and the key start switch to the ON position.

G. Verify that there is not an active CID 2202 FMI 12 diagnostic code for the steering valve control module error signal. If this diagnostic code is active, ensure that the error signal circuit is grounded. Do not proceed to the next step if the CID 2202 FMI 12 diagnostic code is active.

H. Measure the voltage between the disconnected supply wire M906-BU(Blue) and the disconnected return circuit wire H807-YL(Yellow).

Expected Result:

The voltage is between 18.0 VDC and 32.0 VDC.

Results:

- OK – The voltage is between 18.0 VDC and 32.0 VDC. The supply voltage is correct. At the machine harness connector for the steering control module, reinstall the supply wire and the socket at contact 6 (wire M906-BU(Blue)) to the original location in the harness connector. Reinstall the return circuit wire and the socket at contact 5 (wire H807-YL(Yellow)) in the original

location the harness connector. Reconnect the pull up resistor to the original connection with the command signal circuit. Proceed to Test Step 3.

- NOT OK – The voltage is not between 18.0 VDC and 32.0 VDC. The supply voltage is not correct.

  Repair: The ECM may not be supplying the correct output supply voltage to the steering valve control module. Repeat this procedure. Ensure that the error signal circuit is grounded and the CID 2202 FMI 12 diagnostic code is not active.

  If the same result is found after repeating this procedure, the Implement ECM may have failed.

  Contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2650 FMI 05 diagnostic code is active.

Expected Result:

The CID 2650 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2650 FMI 05 diagnostic code is active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  Repeat this procedure in order to verify the result. If the cause of the problem is not found, the module of the steering valve control may have failed.

  Prior to replacing the module of the steering valve control, contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  STOP.

- NO – The CID 2650 FMI 05 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02506287

MID 082 - CID 2650 - FMI 06

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

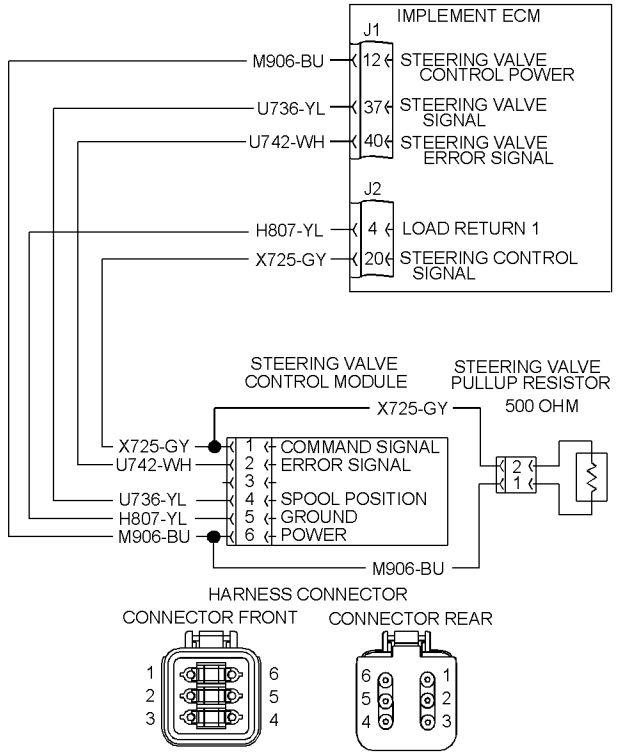


Illustration 499 g01315411

Steering Valve Control Module connections

The ECM supplies system power for the steering valve control module through an ON/OFF driver at contact J1-12.

The CID 2650 FMI 06 diagnostic code is activated when the ECM detects that the current of power supply circuit is higher than normal.

The following conditions could cause this diagnostic code:

- The power supply circuit is shorted to a ground source in the machine harness.
- The steering valve control module has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. The 70 pin connector that passes the chassis circuits through the bulkhead at the front of the cab should be inspected for poor connections. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected. Verify that the CID 2650 FMI 06 diagnostic code is active before performing this procedure.

Note: If a CID 2202 FMI 12 diagnostic code is active for the steering valve control module, the Implement ECM will turn OFF the power output for the steering valve control module. Verify that a CID 2202 FMI 12 diagnostic code is not active before preceeding wiht this procedure.

Test Step 1. CHECK THE CONTROL MODULE

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the machine harness connector from the steering valve control module.

Expected Result:

The CID 2650 FMI 06 code changes to a CID 2650 FMI 05 when the control module is disconnected.

Results:

- YES – CID 2650 FMI 06 changes to CID 2650 FMI 05 when the steering control module is disconnected. The circuit is correct.

  Repair: The steering valve control module has failed. Repeat this test step “CHECK THE CONTROL MODULE” in order to verify the failure of the control module. Replace the steering valve control module.

  STOP.

- NO – The status of the CID 2650 FMI 06 diagnostic code did not change when the control module was disconnected.Proceed to Test Step 2.

Test Step 2. CHECK THE POWER SUPPLY CIRCUIT FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The steering valve control module remains disconnected from the machine harness.

C. Disconnect the machine harness connector from the steering valve pull up resistor.

D. Disconnect the machine harness connectors from the Implement ECM.

E. At the machine harness connectors for the ECM, measure the resistance from the supply contact J1-12 (wire M906-BU(Blue)) to frame ground. Measure the resistance from the supply contact J1-12 (wire M906-BU(Blue)) to all of the other J1 and J2 contacts that are used for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire M906-BU(Blue) and the circuit with the low resistance measurement.

  Repair: Refer to the complete machine Electrical System Schematic. Examine the supply circuit in order to determine where the problem could be. Check all connectors that are in the power supply circuit for the steering control module.

  Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2650 FMI 06 diagnostic code is active.

Expected Result:

The CID 2650 FMI 06 diagnostic code is active.

Results:

- YES – The CID 2650 FMI 06 diagnostic code is active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may be faulty.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM requires replacement, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2650 FMI 06 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02991688

MID 082 - CID 2746 - FMI 03

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

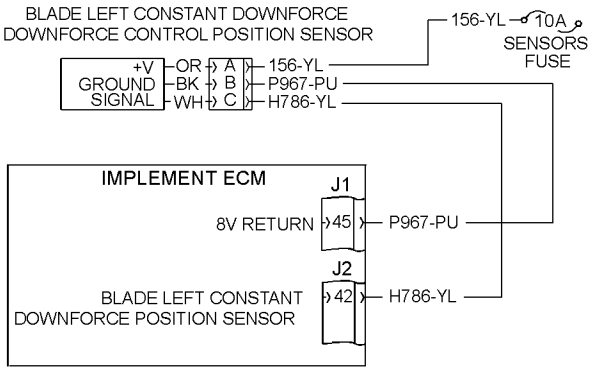


Illustration 500 g01334039

Connections of “Blade Left Constant Downforce Control” position sensor

This diagnostic code is associated with the “blade left constant downforce control” position sensor. The FMI 03 means that the Implement ECM has detected that the voltage or the duty cycle of the signal circuit for the position sensor is above normal.

The position sensor is connected to the “left downforce operator” control dial. The position sensor will supply a PWM duty cycle (input signal) to the Implement ECM in order to indicate the position of the dial.

The position sensor operates in a frequency range of approximately 400 hertz to 600 hertz. When the “blade downforce” dial is moved to the full clockwise position (no downforce), the PWM duty cycle of the signal is approximately 93 percent. When the dial is moved through a detent to the full left counterclockwise position (maximum downforce), the PWM duty cycle of the signal is approximately 10.6 percent.

System voltage for the operation of the sensor is supplied through the power fuse for the sensor (10 amp). A condition that involves an open fuse will cause multiple diagnostic codes to be activated.

The conditions that could cause this diagnostic code to be activated are listed below:

- There is a problem with the sensor power supply.
- The signal circuit for the sensor has an open or a bad connection.
- The signal circuit for the sensor is shorted to a voltage source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

Note: Before performing this test step, verify that the power fuse for the sensor is not open. If the fuse is open, replace the fuse and verify that this diagnostic code is still active before proceeding.

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the machine harness connector for the sensor, insert 7X-1710 Multimeter Probes along the power supply contact A (wire 156-YL(Yellow)) and along ground contact B (wire P967-PU(Purple)).

C. Measure the system voltage.

D. Remove the multimeter probe from along the ground contact and make a good contact with the frame ground.

E. Measure the system voltage.

Expected Result:

Both of the voltage measurements are at the voltage level for the system.

Results:

- OK – Both of the voltage measurements are at the voltage level for the system. The sensor is receiving system voltage. Proceed to Test Step 2.
- NOT OK – One or both of the voltage measurements are not at voltage levels of the system. The sensor is not receiving system voltage.

  Repair: If both of the voltage measurements are not measuring system voltage, it is likely

that the power circuit between the fuse and the position sensor is open an open connection or a poor connection in the machine harness.

If the voltage measurement between the power circuit and the ground circuit is not measuring system voltage and the voltage measurement between the power circuit and frame ground is measuring system voltage, the ground circuit between the ECM and the position sensor is most likely open connection or a poor connection.

Refer to the complete Electrical System Schematic of the machine. Examine all of the connections and wires that are in the suspect circuit for opens or poor connections. Repair the machine harness or replace the machine harness.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the position sensor.

C. At the machine harness connector for the sensor, place a jumper wire between the return contact for the sensor B (wire P967-PU(Purple)) and the signal contact C (wire H786-YL(Yellow)) .

D. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

E. At the harness connectors for the ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-42 (wire H786-YL(Yellow)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is not connected or that a wire is open. A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT OF THE SENSOR FOR A SHORT

The sensor remains disconnected from the machine harness. The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors remain disconnected from the ECM.

A. Remove the jumper wire that was used in the last test step.

B. At the harness connector J2 for the ECM, measure the resistance from signal contact J2-42 (wire H786-YL(Yellow)) to all of the other contacts that are used for the J1 and J2 connectors on the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted to another circuit in the machine harness.Proceed to Test Step 4.
- NOT OK – One or more resistance of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The signal circuit wire for the sensor H786-YL(Yellow)is shorted to the circuit with the low resistance measurement in the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in the circuits for points in the machine harness where a short could occur.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Reconnect the machine harness connectors to the position sensor and to the ECM.

B. At the sensor connector for the machine harness, use a 151-6320 Removal Tool to remove the signal wire H786-YL(Yellow) and the socket at contact C from the harness connector. The machine harness connector remains connected to the position sensor connector.

C. At the back of the sensor connector, insert 7X-1710 Multimeter Probes along the sensor signal contact C and the return contact at B.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor at the connector contacts of the sensor C and B. Move the downforce control dial through the full range of movement.

Expected Result:

For dial operation, the position sensor duty cycle is in the range of 10.6 percent when the dial is in the full counterclockwise position to 93 percent when the dial is in the full clockwise position. The duty cycle of the sensor is never above 94%.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the problem. Reconnect the wire and the the socket that were removed from the harness connector for the sensor. Proceed to Test Step 5.
- NOT OK – The duty cycle of the sensor is NOT correct according to the description above. The sensor has failed.

  Repair: The blade left constant downforce control position sensor operation is not correct. Replace the blade left constant downforce control position sensor. After replacement of the sensor, verify that the operation of the new sensor is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2746 FMI 03 diagnostic code is active.

Expected Result:

The CID 2746 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2746 FMI 03 diagnostic code is not active. The problem has been corrected.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2746 FMI 03 diagnostic code is still active. The problem has not been corrected.

  Repair: Perform this test step again. If the problem has not been corrected, Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the sensor circuit in the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If a problem is not found in the machine harness, the Implement ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02991708

MID 082 - CID 2746 - FMI 04

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

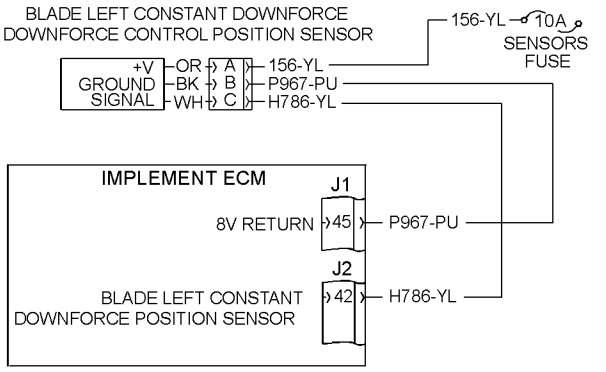


Illustration 501 g01334039

Connections of “Blade Left Constant Downforce Control” position sensor

This diagnostic code is associated with the “blade left constant downforce control” position sensor. The FMI 04 means that the Implement ECM has detected that the voltage or duty cycle of the position sensor signal circuit is below normal.

The position sensor is connected to the “left downforce operator” control dial. The position sensor will supply a PWM duty cycle input signal to the Implement ECM in order to indicate the position of the dial.

The position sensor operates in a frequency range of approximately 400 hertz to 600 hertz. When the “blade downforce” dial is moved to the full clockwise position (no downforce), the PWM duty cycle of the signal is approximately 93 percent. When the dial is moved through a detent to the full left counterclockwise position (maximum downforce), the PWM duty cycle of the signal is approximately 10.6 percent.

System voltage for the operation of the sensor is supplied through the 10 amp sensor power fuse. An open condition of the fuse will cause multiple diagnostic codes to be activated.

The possible conditions that can cause this diagnostic code to activate are listed below:

- The sensor has failed.
- The signal circuit for the sensor is shorted to a ground source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: This procedure can cause new diagnostic codes to be activated. Ignore these created diagnostic codes. When the problem has been corrected, clear the created diagnostic codes.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Observe the status of the diagnostic code and disconnect the machine harness connector from the “blade left constant downforce control” position sensor.

Expected Result:

The FMI 04 diagnostic code will remain active if the sensor is not the cause of the problem. The sensor is internally shorted if the FMI 04 diagnostic code changes to an active FMI 03 diagnostic code when the sensor is disconnected from the machine harness.

Results:

- OK – The FMI 04 diagnostic code remains active. The sensor has not failed. Proceed to Test Step 2.
- NOT OK – The FMI 04 diagnostic code changes to an FMI 03 diagnostic code when the sensor is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The “blade left constant downforce control” position sensor has failed. Replace the sensor. After replacement of the sensor, verify that the operation of the new sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SENSOR CIRCUIT FOR A SHORT

The position sensor remains disconnected from the machine harness.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 and J2 from the Implement ECM.

C. At the machine harness connector J2 for the ECM, measure the resistance from the signal contact J2-42 (wire H786-YL(Yellow)) to frame ground. Measure the resistance from the signal contact J2-42 (wire H786-YL(Yellow)) to all of the contacts that are used in the machine harness connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more resistance measurements is not correct. There is a short in the machine harness.

  Repair: The short is between the signal wire H786-YL(Yellow) and the circuit with the low resistance measurement or frame ground.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in circuits for points in the machine harness where a short circuit could occur.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2746 FMI 04 diagnostic code.

Expected Result:

The CID 2746 FMI 04 diagnostic code is active.

Results:

- YES – The CID 2746 FMI 04 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Perform this procedure again. If the problem has not been corrected, Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the sensor circuit in the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2746 FMI 04 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02957514

MID 082 - CID 2746 - FMI 08

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

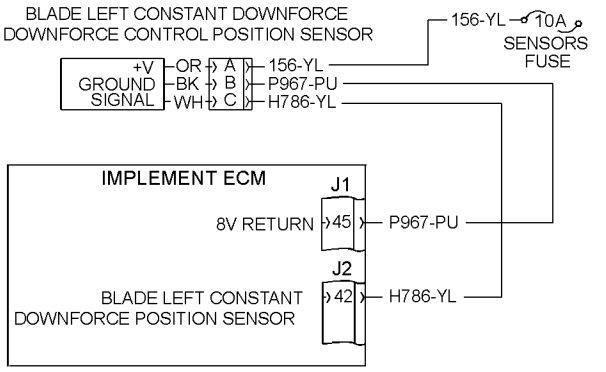


Illustration 502 g01334039

Connections of Blade “Left Constant Downforce Control Position” sensor

This diagnostic code is associated with the blade “left constant downforce control position” sensor. The FMI 08 means that the Implement ECM has detected that the voltage or the duty cycle of the position sensor signal frequency or the signal pulse width is not within the expected range.

The position sensor is connected to the “left downforce operator control dial” . The position sensor will supply a PWM duty cycle input to the Implement ECM in order to indicate the position of the dial.

The position sensor operates in a frequency range of approximately 400 hertz to 600 hertz. When the “blade downforce dial” is moved to the full clockwise position (no downforce), the PWM duty cycle of the signal is approximately 93 percent. When the dial is moved through a detent to the full left counterclockwise position (maximum downforce), the PWM duty cycle of the signal is approximately 10.6 percent.

The conditions that could cause this diagnostic code to activate are listed below:

- The sensor has failed.
- Intermittent connections or poor connections in the circuit of the sensor signal.
- The ECM has failed. This is unlikely.

Note:

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE FREQUENCY OF THE SIGNAL AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the connector for the sensor of the machine harness, use a 151-6320 Removal Tool to remove the signal wire H786-YL(Yellow) and the socket at contact C from the harness connector. The machine harness connector remains connected to the connector for the position sensor.

C. At the back of the sensor connector, insert 7X-1710 Multimeter Probes along the sensor signal contact C and the return contact at B.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle and the frequency of the sensor at the contact for the sensor connector C and B. Move the “downforce control dial” through the full range of movement.

Expected Result:

For dial operation, the position sensor duty cycle is in the range of 10.6 percent when the dial is in the full counterclockwise position to 93 percent when the dial is in the full clockwise position (the frequency of the sensor is expected to be approximately 500 hertz).

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the problem. Reconnect the wire and the socket that were removed from the harness connector for the sensor.Proceed to Test Step 2.
- NOT OK – The duty cycle of the sensor is NOT correct according to the description above. The sensor has failed.

Repair: The operation of “blade left constant downforce control” position sensor is not correct. Replace the “blade left constant downforce control” position sensor. After replacement of the sensor, verify that the operation of the new sensor is correct before operating the machine.

STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the position sensor.

C. At the machine harness connector for the sensor, place a jumper wire between the contact of the sensor return B (wire P967-PU(Purple)) and the signal contact C (wire F786-YL(Yellow)) .

D. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

E. At the harness connectors for the ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-42 (wire F786-YL(Yellow)).

F. Observe the resistance measurement and wiggle the machine harness at the ECM connector. Observe the resistance measurement and wiggle the machine wiring harness at the sensor connector. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the machine harness.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is not connected or that a wire is open. A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT OF THE SENSOR FOR A SHORT

The sensor remains disconnected from the machine harness. The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors remain disconnected from the ECM.

A. Remove the jumper wire that was used in the last test step.

B. At the harness connector J2 for the ECM, measure the resistance from signal contact J2-42 (wire F786-YL(Yellow)) to all of the other contacts that are used for the J1 and J2 connectors on the Implement ECM.

C. Observe the resistance measurements and wiggle the machine harness at the ECM connector. Observe the resistance measurement and wiggle the machine wiring harness at the sensor connector.

Expected Result:

Each resistance measurement is greater than 5000 ohms at all times during the manipulation of the machine harness.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted to another circuit in the machine harness.Proceed to Test Step 4.
- NOT OK – One or more resistance of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The wire for the sensor signal F786-YL(Yellow) is shorted to the circuit with the low resistance measurement in the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in the circuits for points in the machine harness where a short could occur.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2746 FMI 08.

Expected Result:

The CID 2746 FMI 08 is not active.

Results:

- OK – The CID 2746 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2746 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the diagnostic code is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02992085

MID 082 - CID 2747 - FMI 03

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

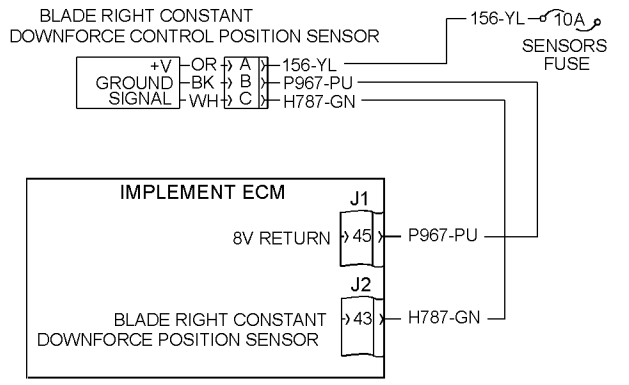


Illustration 503 g01334125

Connections of “Blade Right Constant Downforce Control” position sensor

This diagnostic code is associated with the “blade right constant downforce control” position sensor. The FMI 03 means that the Implement ECM has detected that the voltage or the duty cycle of the position sensor signal circuit is above normal.

The position sensor is connected to the “right downforce operator” control dial. The position sensor will supply an input signal (PWM duty cycle) to the Implement ECM in order to indicate the position of the dial.

The position sensor operates in a frequency range of approximately 400 hertz to 600 hertz. When the “blade downforce” dial is moved to the full clockwise position (no downforce), the PWM duty cycle of the signal is approximately 93 percent. When the dial is moved through a detent to the full counterclockwise position (maximum downforce), the PWM duty cycle of the signal is approximately 10.6 percent.

System voltage for the operation of the sensor is supplied through the 10 amp sensor power fuse. A fuse in an open condition will cause multiple diagnostic codes to be activated.

The conditions that could cause this diagnostic code to be active are listed below:

- There is a problem with the sensor power supply.
- The signal circuit for the sensor has an open or a bad connection.
- The signal circuit for the sensor is shorted to a voltage source.
- The sensor has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SENSOR POWER SUPPLY

Note: Before performing this test step, verify that the power fuse for the sensor is not open. If the fuse is open, replace the fuse and verify that this diagnostic code is still active before proceeding.

A. Turn the key start switch and the disconnect switch to the ON position.

B. At the machine harness connector for the sensor, insert 7X-1710 Multimeter Probes along the contact for the power supply A (wire 156-YL(Yellow)) and along ground contact B (wire P967-PU(Purple)).

C. Measure the system voltage.

D. Remove the multimeter probe from along the ground contact and make a good contact with frame ground.

E. Measure the system voltage.

Expected Result:

Both of the voltage measurements are at the system voltage level.

Results:

- OK – Both of the voltage measurements are at the system voltage level. The sensor is receiving system voltage. Proceed to Test Step 2.
- NOT OK – One of the voltage measurements or both of the voltage measurements are not at the voltage level of the system. The sensor is not receiving system voltage.

  Repair: If both of the voltage measurements are not measuring system voltage, it is likely that the power circuit between the fuse and the position sensor is an open connection or that the sensor has a poor connection in the machine harness.

  If the voltage measurement between the power circuit and the ground circuit is not measuring system voltage and the voltage measurement between the power circuit and frame ground is measuring system voltage, the ground circuit between the ECM and the position sensor is most likely an open connection or the sensor has a poor connection.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connections and the wires that are in the suspect circuit for open connections or poor connections. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the position sensor.

C. At the machine harness connector for the sensor, place a jumper wire between the return contact of the sensor B (wire P967-PU(Purple)) and the signal contact C (wire H787-GN(Green)) .

D. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

E. At the harness connectors for the ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-43 (wire H787-GN(Green)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open connection or a bad connection in the signal circuit.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is not connected or that a wire is open. A resistance measurement that is greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that connection is not good.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT OF THE SENSOR FOR A SHORT

The sensor remains disconnected from the machine harness. The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors remain disconnected from the ECM.

A. Remove the jumper wire that was used in the last test step.

B. At the harness connector J2 for the ECM, measure the resistance from signal contact J2-43 (wire H787-GN(Green)) to all of the other contacts that are used for the J1 and J2 connectors on the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted to another circuit in the machine harness.Proceed to Test Step 4.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The signal wire of the sensor circuit H787-GN(Green) is shorted to the circuit with the low resistance measurement in the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in the circuits for points in the machine harness that indicate a potential short.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Reconnect the machine harness connectors to the position sensor and to the ECM.

B. At the sensor connector of the machine harness, use a 151-6320 Removal Tool to remove the signal wire H787-GN(Green) and the socket at contact C from the harness connector. The machine harness connector remains connected to the connector of the position sensor.

C. At the back of the sensor connector, insert 7X-1710 Multimeter Probes along the sensor signal contact C and the return contact at B.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor at the connector contacts for the sensor C and B. Move the “downforce control” dial through the full range of movement.

Expected Result:

For dial operation, the position sensor duty cycle is in the range of 10.6 percent when the dial is in the full counterclockwise position to 93 percent when the dial is in the full clockwise position. The duty cycle of the sensor is never above 94%.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the problem. Reconnect the wire and the socket that were removed from the harness connector for the sensor.Proceed to Test Step 5.

- NOT OK – The duty cycle of the sensor is NOT correct according to the description above. The sensor has failed.

Repair: The operation of the “blade right constant downforce control” position sensor is not correct. Replace the “blade right constant downforce control” position sensor. After replacement of the sensor, verify that the operation of the new sensor is correct before operating the machine.

STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2746 FMI 03 diagnostic code is active.

Expected Result:

The CID 2746 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2746 FMI 03 diagnostic code is not active. The problem has been corrected.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2746 FMI 03 diagnostic code is still active. The problem has not been corrected.

  Repair: Perform this test step again. If the problem has not been corrected, Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the sensor circuit in the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If a problem is not found in the machine harness, the Implement ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02992142

MID 082 - CID 2747 - FMI 04

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

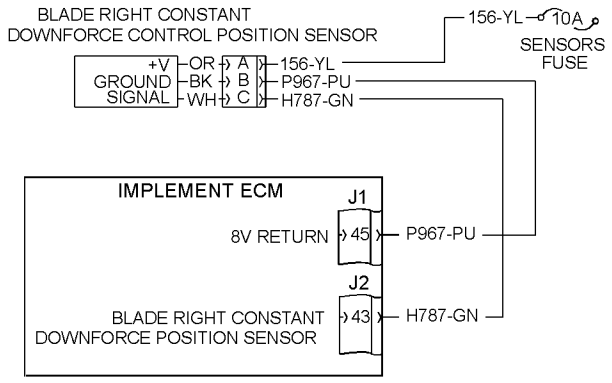


Illustration 504 g01334125

Connections of “Blade Right Constant Downforce Control” position sensor

This diagnostic code is associated with the “blade right constant downforce control” position sensor. The FMI 04 means that the Implement ECM has detected that the voltage or the duty cycle of the signal circuit for the position sensor is below normal.

The position sensor is connected to the “right downforce operator” control dial. The position sensor will supply a input signal (PWM duty cycle) to the Implement ECM in order to indicate the position of the dial.

The position sensor operates in a frequency range of approximately 400 hertz to 600 hertz. When the “blade downforce dial” is moved to the full clockwise position (no downforce), the PWM duty cycle of the signal is approximately 93 percent. When the dial is moved through a detent to the full counterclockwise position (maximum downforce), the PWM duty cycle of the signal is approximately 10.6 percent.

The conditions that could cause this diagnostic code to be activated are listed below:

- The sensor has failed.

- The signal circuit for the sensor is shorted to a ground source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: This procedure can cause new diagnostic codes to be activated. Ignore these created diagnostic codes. When the problem has been corrected, clear the created diagnostic codes.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Observe the status of the diagnostic code and disconnect the machine harness connector from the “blade right constant downforce control” position sensor.

Expected Result:

The FMI 04 diagnostic code will remain active if the sensor is not the cause of the problem. The sensor is internally shorted if the FMI 04 diagnostic code changes to an active FMI 03 diagnostic code when the sensor is disconnected from the machine harness.

Results:

- OK – The FMI 04 diagnostic code remains active. The sensor has not failed. Proceed to Test Step 2.
- NOT OK – The FMI 04 diagnostic code changes to an FMI 03 diagnostic code when the sensor is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The “blade right constant downforce control” position sensor has failed. Replace the sensor. After replacement of the sensor, verify that the operation of the new sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SENSOR CIRCUIT FOR A SHORT

The position sensor remains disconnected from the machine harness.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

C. At the machine harness connector J2 for the ECM, measure the resistance from the signal contact J2-43 (wire H787-GN(Green)) to frame ground. Measure the resistance from the signal contact J2-43 (wire H787-GN(Green)) to all of the contacts that are used in the machine harness connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more resistance measurements is not correct. There is a short in the machine harness.

  Repair: The short is between the signal wire H787-GN(Green) and the circuit with the low resistance measurement or frame ground.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in circuits for points in the machine harness where a short circuit could occur.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2747 FMI 04 diagnostic code.

Expected Result:

The CID 2747 FMI 04 diagnostic code is active.

Results:

- YES – The CID 2747 FMI 04 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Perform this procedure again. If the problem has not been corrected, Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the sensor circuit in the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2747 FMI 04 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02992184

MID 082 - CID 2747 - FMI 08

SMCS Code: 5737-038-BG

Conditions Which Generate This Code:

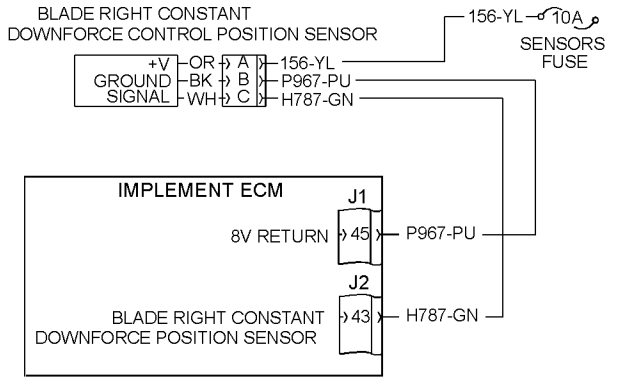


Illustration 505 g01334125

Connections of “Blade Right Constant Downforce Control” position sensor

This diagnostic code is associated with the “blade right constant downforce control” position sensor. The FMI 08 means that the Implement ECM has detected that the frequency (signal) of the position sensor or the pulse width (signal) of the position sensor is not within the expected range.

The position sensor is connected to the “right downforce operator” control dial. The position sensor will supply a PWM duty cycle (input signal) to the Implement ECM in order to indicate the position of the dial.

The position sensor operates in a frequency range of approximately 400 hertz to 600 hertz. When the “blade downforce dial” is moved to the full clockwise position (no downforce), the PWM duty cycle of the signal is approximately 93 percent. When the dial is moved through a detent to the full counterclockwise position (maximum downforce), the PWM duty cycle of the signal is approximately 10.6 percent.

The conditions that could cause this diagnostic code to activate are listed below:

- The sensor has failed.
- Intermittent connections or poor connections in the sensor signal circuit.
- The ECM has failed. This is unlikely.

Note:

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE DUTY CYCLE AND THE FREQUENCY OF THE SIGNAL AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the sensor connector of the machine harness, use a 151-6320 Removal Tool to remove the signal wire H787-GN(Green) and the socket at contact C from the harness connector. The machine harness connector remains connected to the connector for the position sensor.

C. At the back of the sensor connector, insert 7X-1710 Multimeter Probes along the sensor signal contact C and the return contact at B.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor at the connector contacts of the sensor C and B. Move the “downforce control dial” through the full range of movement.

Expected Result:

For dial operation, the position sensor duty cycle is in the range of 10.6 percent when the dial is in the full counterclockwise position to 93 percent when the dial is in the full clockwise position at a frequency of approximately 500 hertz.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the problem. Reconnect the wire and reconnect the socket that were removed from the harness connector of the sensor.Proceed to Test Step 2.

- NOT OK – The duty cycle of the sensor is NOT correct according to the description above. The signal of the position sensor, frequency or pulse width, is not within the expected range. The sensor has failed.

  Repair: The operation of the “blade left constant downforce control” position sensor is not correct. Replace the “blade left constant downforce control” position sensor. After replacement of the sensor, verify that the operation of the new sensor is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the position sensor.

C. At the machine harness connector for the sensor, place a jumper wire between the return contact of the sensor B (wire P967-PU(Purple)) and the signal contact C (wire F787-GN(Green)) .

D. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

E. At the harness connectors for the ECM, measure the resistance from return contact J1-45 (wire P967-PU(Purple)) to signal contact J2-43 (wire F787-GN(Green)).

F. Observe the resistance measurement and wiggle the machine harness at the ECM connector. Observe the resistance measurement and wiggle the machine wiring harness at the sensor connector. Do not disconnect the jumper wire.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the machine harness.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is not connected or that a wire is open. A resistance measurement that is greater than 5

ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the sensor signal circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT OF THE SENSOR FOR A SHORT

The sensor remains disconnected from the machine harness. The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors remain disconnected from the ECM.

A. Remove the jumper wire that was used in the last test step.

B. At the harness connector J2 for the ECM, measure the resistance from signal contact J2-43 (wire F787-GN(Green)) to all of the other contacts that are used for the J1 and J2 connectors on the Implement ECM.

C. Observe the resistance measurements and wiggle the machine harness at the ECM connector. Observe the resistance measurements and wiggle the machine wiring harness at the sensor connector.

Expected Result:

Each resistance measurement is greater than 5000 ohms at all times during the manipulation of the machine harness.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The signal circuit is not shorted to another circuit in the machine harness.Proceed to Test Step 4.
- NOT OK – One or more resistance of the resistance measurements is less than 5000 ohms. There is a short in the machine harness.

  Repair: The signal wire for the sensor circuit F78&-GN(Green) is shorted to the circuit with the low resistance measurement in the machine harness.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in the circuits for points in the machine harness that indicate that a short could occur.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors in order to make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2747 FMI 08.

Expected Result:

The CID 2747 FMI 08 is not active.

Results:

- OK – The CID 2747 FMI 08 is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 2747 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the diagnostic code is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02957527

MID 082 - CID 2748 - FMI 03

SMCS Code: 7332-038-BG

Conditions Which Generate This Code:

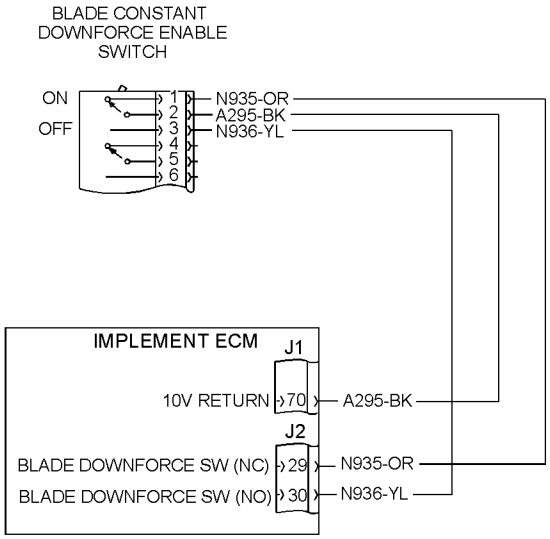


Illustration 506 g01473897

“Blade Constant Downforce Enable” Switch

The “blade constant downforce enable” switch is a two pole, double-throw switch. One pole is used to provide two switch-to-ground inputs to the Implement ECM in order to indicate the status of the switch. During normal operation, one of the inputs is open. The other input is closed to an ECM return (ground) circuit.

During normal operation, one of the inputs is not connected to ground and the other input is connected to ground through the switch contacts. An internal pull-up voltage is present at the ECM switch inputs. When the input is grounded through the switch, the ECM detects the ground signal.

The ECM expects one of the switch circuits to be grounded at all times. The FMI 03 diagnostic code is activated when both of the switch inputs are open at the same time.

The possible causes of this diagnostic code are listed below:

- The switch has failed.
- The return circuit for the ECM has failed.
- One of the input circuits of the switch is shorted to a ground source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Table 41

Blade Constant Downforce Enable Switch Contact Status		
Switch Position	N/O Contact (Wire N935-OR(Orange) - J2-29	N/C Contact (Wire N936-YL(Yellow) - J2-30
ON	Closed(1)	Open (2)
OFF	Open	Closed

(1) Closed to ECM ground - wire A295-BK(Black) - Sw. contact 2.
(2) Open to ECM ground - wire A295-BK(Black) - Sw. contact 2.

Test Step 1. CHECK THE SWITCH

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the switch.

C. With the switch in the OFF position, measure the resistance from switch contact 1 to the common contact of the switch 2. Record this measurement.

D. With the switch in the OFF position, measure the resistance from switch contact 3 to switch contact 2. Record this measurement.

E. Move the switch to the ON position and repeat Steps “C” and “D” .

Expected Result:

The contact status of the switch is correct according to the table at the beginning of this procedure with the switch in the ON position and with the switch in the OFF position.

Results:

- OK – All of the resistance checks for the switch contacts are correct in both of the switch positions. The switch is working correctly.Proceed to Test Step 2.

- NOT OK – The switch contact states are not correct according to the table at the beginning of this procedure. The switch operation is not correct.

  Repair: Replace the “blade constant downforce enable” switch. After the switch is replaced, verify that the operation of the switch is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE RETURN CIRCUIT FOR AN OPEN

The disconnect switch and the key start switch remain in the OFF position. The machine harness remains disconnected from the switch.

A. At the machine harness connector from the switch, connect a jumper wire between the common return contact 2 (wire A295-BK(Black)) and input contact 3 (wire N935-OR(Orange)).

B. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. Measure the resistance from common return contact J1-70 (wire A295-BK(Black)) to the input contact of the switch J2-29 (wire N935-OR(Orange)).

D. At the machine harness connector from the switch, move the end of the jumper wire that is connected to input contact 3 (wire N935-OR(Orange)) to input contact 1 (wire N936-YL(Yellow)). The other end of the jumper wire remains connected to common return contact 2 (wire A295-BK(Black)).

E. Measure the resistance from common return contact J1-70 (wire A295-BK(Black)) to switch input contact J2-30 (wire N936-YL(Yellow)).

Expected Result:

Both of the resistance measurements are less than 5 ohms.

Results:

- OK – Both of the resistance measurements are less than 5 ohms. The common return circuit is not open in the machine harness. Proceed to Test Step 3.

- NOT OK – One or both of the resistance measurements is greater than 5 ohms. There is an open or a bad connection in the machine harness.

  Repair: If both of the resistance measurements are greater than 5 ohms. there is an open or a bad connection in the common return circuit.

  If one of the resistance measurements is less than 5 ohms and the other measurement is greater than 5 ohms there is an open connection or a bad connection in the input circuit of the switch that was connected for the measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the suspect circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK FOR A SHORT TO A GROUND SOURCE

The key start switch and the disconnect switch remain in the OFF position. The machine harness remains disconnected from the switch.

A. At the machine harness connector for the switch, connect the jumper wire that was used in the last step between contact 3 (wire N935-OR(Orange)) and contact 1 (wire N936-YL(Yellow)).

B. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

C. At the machine harness connector of the ECM J2, measure the resistance from input contact of the switch J2-29 (wire N935-OR(Orange)) to the frame ground. Measure the resistance from input contact of the switch J2-29 (wire N935-OR(Orange)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

D. While observing the resistance measurement, wiggle the wires and move the machine harness around at the ECM connectors and at the switch connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms at all times during the manipulation of the machine harness wires and the machine harness connectors.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is not indicating a short to ground or to another circuit in the machine harness.Proceed to Test Step 4.

- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between either the switch input circuit wire N935-OR(Orange) or the switch input circuit wire N936-YL(Yellow) and frame ground or the circuit with the low resistance measurement.

  Repair: Remove the jumper wire and check each input individually in order to isolate the circuit that is shorted.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors in the faulty circuit for points in the machine harness where a short could occur. Check for areas where the machine harness could be making contact with the machine frame.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2748 FMI 03 diagnostic code.

Expected Result:

The CID 2748 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 2748 FMI 03 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2748 FMI 03 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the input circuits of the switch again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause can not be found, the ECM may have failed. Verify that all possible causes of the diagnostic code have been investigated before replacement of the ECM.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02957547

MID 082 - CID 2748 - FMI 04

SMCS Code: 7332-038-BG

Conditions Which Generate This Code:

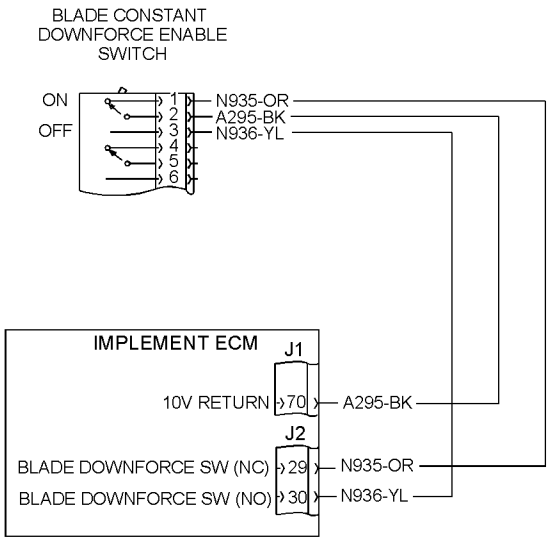


Illustration 507 g01473897

Blade Constant Downforce Enable Switch

The blade constant downforce enable switch is a two pole double throw switch. One pole is used to provide two switch to ground inputs to the Implement ECM in order to indicate the status of the switch. During normal operation, one of the inputs is open. The other input is closed to an ECM return (ground) circuit.

During normal operation, one of the inputs is not connected to ground and the other input is connected to ground through the switch contacts. An internal pull-up voltage is present at the ECM switch inputs. When the input is grounded through the switch, the ECM detects the ground signal.

The FMI 04 diagnostic code is activated by the ECM when both of the inputs are showing a ground signal at the same time.

The conditions that could cause the ECM to activate this diagnostic code are listed below:

- The switch has failed.
- There is a short to a ground source in one or both of the switch input circuits.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may cause other diagnostic codes to be activated. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SWITCH

Table 42

Blade Constant Downforce Enable Switch Contact Status		
Switch Position	N/O Contact (Wire N935-OR(Orange) - J2-29	N/C Contact (Wire N936-YL(Yellow) - J2-30
ON	Closed(1)	Open (2)
OFF	Open	Closed

(1) Closed to ECM ground - wire A295-BK(Black) - Sw. contact 2.
(2) Open to ECM ground - wire A295-BK(Black) - Sw. contact 2.

A. Turn the key switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the switch.

C. With the switch in the ON position, measure the resistance from switch common contact 2 to switch input contact 1. Compare the measurement to the switch contact status table above.

D. With the switch in the ON position, measure the resistance from switch common contact 2 to switch input contact 3. Compare the measurement to the switch contact status table above.

E. Move the switch to the OFF position and repeat Steps “C” and “D” .

Expected Result:

The resistance measurements in each switch position agree with the switch contact status table at the beginning of this test step.

Results:

- YES – All of the resistance checks for the switch are correct in each switch position according to the contact status table. The switch is working correctly.Proceed to Test Step 2.

- NO – The switch states are not correct according to the switch contact status table. The switch has failed.

  Repair: Replace the blade constant downforce enable switch. After the switch is replaced, verify that the switch operation is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SWITCH INPUT CIRCUITS FOR A SHORT

The key switch and the disconnect switch remain in the OFF position. The machine harness remains disconnected from the switch.

A. Disconnect the machine harness connectors J1 and J2 from the Implement ECM.

B. At the machine harness connector J2 for the ECM, measure the resistance between switch input contact J2-29 (wire N935-OR(Orange)) and frame ground. Measure the resistance between switch input contact J2-29 (wire N935-OR(Orange)) and all of the other contacts that are used in the J1 and J2 harness connectors for the ECM.

C. At the machine harness connector J2 for the ECM, measure the resistance between switch input contact J2-30 (wire N936-YL(Yellow)) and frame ground. Measure the resistance between switch input contact J2-30 (wire N936-YL(Yellow)) and all of the other contacts that are used in the J1 and J2 harness connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The switch input circuits are not shorted to ground or to another circuit in the machine harness.Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short to ground or to another circuit in the machine harness.

  Repair: The input circuit that checks the low resistance to frame ground or to another circuit is causing the problem.

  Refer to the complete machine Electrical System Schematic. Check all of the connectors that are in the defective input circuit. Ensure that all connections are clean, secure and in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2748 FMI 04 diagnostic code.

Expected Result:

The CID 2748 FMI 04 diagnostic code is active.

Results:

- YES – The CID 2748 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the switch input circuits again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause can not be found, the ECM may have failed. Verify that all possible causes of the diagnostic code have been investigated before replacement of the ECM.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2748 FMI 04 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02655689

MID 082 - CID 2749 - FMI 03

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

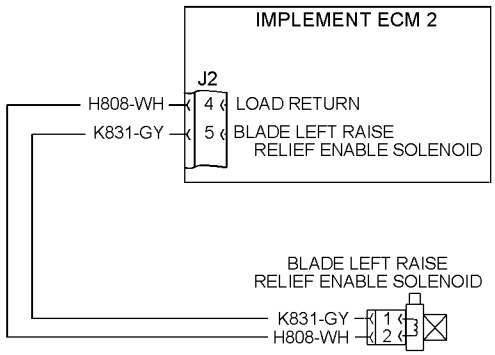


Illustration 508 g01334367

Blade Left Raise Relief Enable Solenoid connections

This diagnostic code is associated with the blade left raise relief enable solenoid. The solenoid is connected to an Implement ECM 2 ON/OFF output. The FMI 03 means that the ECM has detected that the voltage of the solenoid circuit is above normal or that the ECM has detected voltage in the circuit when no voltage should be present. The Implement 2 ECM will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

During operation of the blade downforce system, the blade left raise relief enable solenoid is used to enable the blade left raise downforce system.

Conditions that could causes this diagnostic code to be activated are:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connectors, measure the resistance from contact J2-5 (wire K831-GY(Grey)) to all of the other contacts that are used in the J1 and J2 connectors for the Implement ECM 2.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- YES – Each resistance measurement is greater than 5000 ohms. The resistance measurement does not indicate a short in the machine harness. Proceed to test step 2.
- NO – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness.

  Repair: The short is between wire K831-GY(Grey) and the circuit that has a low resistance measurement.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire K831-GY(Grey) and socket at contact J2-5 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2749 FMI 03 diagnostic code.

Expected Result:

The CID 2749 FMI 03 diagnostic code is no longer active. A CID 2749 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2749 FMI 03 diagnostic code is no longer active. A CID 2749 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2749 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2749 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2749 FMI 03 diagnostic code is not active.

Results:

- OK – The diagnostic code is not active at this time. The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2749 FMI 03 diagnostic code remains active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02983669

MID 082 - CID 2749 - FMI 05

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

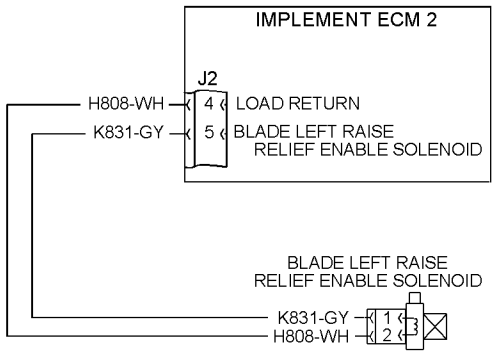


Illustration 509 g01334367

Connections of “Blade Left Raise Relief Enable” solenoid

This diagnostic code is associated with the “blade left raise relief enable” solenoid. The solenoid is connected to an Implement ECM 2 ON/OFF output. The FMI 05 means that the ECM has detected that the current for the solenoid circuit is below normal. The Implement ECM 2 will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

During operation of the blade downforce system, the blade left raise relief enable solenoid is used to enable the “blade left raise downforce” system.

Conditions that could cause this diagnostic code to be activated are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire K831-GY(Grey)) to contact 2 (wire H808-WH(White)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2749 FMI 05 diagnostic code.

Expected Result:

The CID 2749 FMI 05 diagnostic code is no longer active. A CID 2749 FMI 06 diagnostic code becomes active when the jumper wire is connected.

Results:

- YES – The CID 2749 FMI 05 diagnostic code is no longer active. A CID 2749 FMI 06 diagnostic code becomes active when the jumper wire is connected. The solenoid has failed.

  Repair: Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2749 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the active diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

The jumper wire that was installed in the previous test step remains in place.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the ECM connector for the machine harness J2 from the Implement ECM 2.

C. At the machine harness connector J2 for the ECM, measure the resistance from contact J2-5 (wire K831-GY(Grey)) to contact J2-4 (wire H808-WH(White)).

D. Observe the resistance measurement of the multimeter and wiggle the machine harness connectors for the ECM. Observe the resistance measurement of the multimeter and wiggle the machine harness connector for the solenoid. Gently pull on the wires and wiggle the wires.

Expected Result:

Each resistance measurement is less than 5.0 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – The resistance measurements are less than 5.0 ohms. The resistance measurements are not indicating an open or a bad connection in the circuit.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5.0 ohms. The resistance measurement is indicating an open circuit or a bad connection in the machine harness.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is either not connected or that a wire is open. A resistance measurement that is greater than 5.0 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but is not a good connection.

  The open connection or the possible bad connection is in the energize wire K831-GY(Grey) or in the return wire H808-WH(White) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J2 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire K831-GY(Grey) and the socket at contact J2-5 from the harness connector.

C. Reconnect the machine harness J2 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J2-5 through the empty space in the J2 connector.

F. Observe the status of the active CID 2749 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2749 FMI 05 diagnostic code is no longer active. A CID 2749 FMI 06 diagnostic code becomes active when the ECM pin at J2-5 is grounded.

Results:

- YES – The CID 2749 FMI 05 diagnostic code is no longer active. A CID 2749 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Install the energize wire of the solenoid in the correct spot of the ECM connector. Then proceed to the next test step. Proceed to Test Step 4.

- NO – The CID 2749 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2749 FMI 05 diagnostic code.

Expected Result:

The CID 2749 FMI 05 diagnostic code is not active.

Results:

- OK – The CID 2749 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2749 FMI 05 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02655695

MID 082 - CID 2749 - FMI 06

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

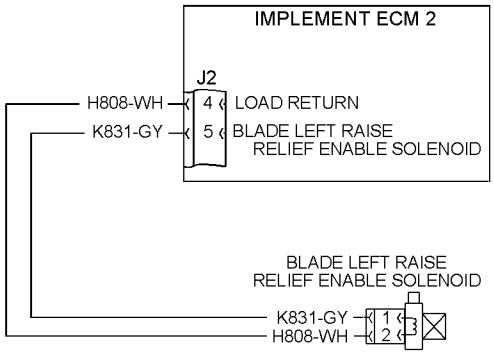


Illustration 510 g01334367

Blade Left Raise Relief Enable Solenoid connections

This diagnostic code is associated with the blade left raise relief enable solenoid. The solenoid is connected to an Implement ECM 2 ON/OFF output. The FMI 06 means that the ECM has detected that the current for the solenoid circuit is above normal. The Implement 2 ECM will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

During operation of the blade downforce system, the blade left raise relief enable solenoid is used to enable the blade left raise downforce system.

Conditions that could causes this diagnostic code to be activated are:

- The energize circuit of the solenoid is shorted to a ground source.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2749 FMI 06 diagnostic code changes to a CID 2749 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2749 FMI 06 diagnostic code changes to a CID 2749 FMI 05 diagnostic code when the solenoid is disconnected. The solenoid circuit in the machine harness is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2749 FMI 06 diagnostic code remains active. Disconnecting the solenoid did not change the status of the active diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

The solenoid remains disconnected from the machine harness.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

C. At the machine harness ECM connectors, measure the resistance from the signal contact J2-5 (wire K831-GY(Grey)) to frame ground. Measure the resistance from the signal contact J2-5 (wire K831-GY(Grey)) to all of the other contacts that are used in J1 and J2 ECM connectors.

D. While observing the multimeter resistance measurements, wiggle the machine harness connectors for the ECM and the solenoid. Gently pull on the wires and move the wires around.

Expected Result:

Each resistance measurement is greater than 5000 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. The resistance measurement is indicating that a short is present in the machine harness. The short is between wire K831-GY(Grey) and either frame ground or the circuit with the low resistance measurement.

  Repair: For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2749 FMI 06 diagnostic code.

Expected Result:

The CID 2749 FMI 06 diagnostic code not active.

Results:

- OK – The CID 2749 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2749 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause of the problem is not found, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02655698

MID 082 - CID 2750 - FMI 03

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

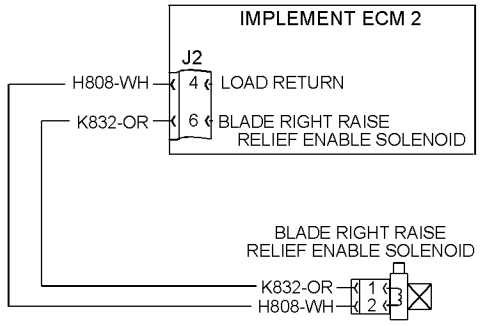


Illustration 511 g01334371

Blade Right Raise Relief Enable Solenoid connections

This diagnostic code is associated with the blade right raise relief enable solenoid. The solenoid is connected to an Implement ECM 2 ON/OFF output. The FMI 03 means that the ECM has detected that the voltage of the solenoid circuit is above normal or that the ECM has detected voltage in the circuit when no voltage should be present. The Implement 2 ECM will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

During operation of the blade downforce system, the blade right raise relief enable solenoid is used to enable the blade right raise downforce system.

Conditions that could causes this diagnostic code to be activated are:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connectors, measure the resistance from contact J2-6 (wire K832-OR(Orange)) to all of the other contacts that are used in the J1 and J2 connectors for the Implement ECM 2.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- YES – Each resistance measurement is greater than 5000 ohms. The resistance measurement does not indicate a short in the machine harness. Proceed to test step 2.
- NO – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness.

  Repair: The short is between wire K832-OR(Orange) and the circuit that has a low resistance measurement.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire K832-OR(Orange) and socket at contact J2-6 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2750 FMI 03 diagnostic code.

Expected Result:

The CID 2750 FMI 03 diagnostic code is no longer active. A CID 2750 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2750 FMI 03 diagnostic code is no longer active. A CID 2750 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2750 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2750 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2750 FMI 03 diagnostic code is not active.

Results:

- OK – The diagnostic code is not active at this time. The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2750 FMI 03 diagnostic code remains active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02655740

MID 082 - CID 2750 - FMI 05

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

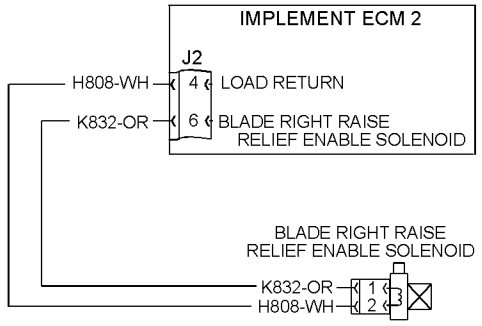


Illustration 512 g01334371

Blade Right Raise Relief Enable Solenoid connections

This diagnostic code is associated with the blade right raise relief enable solenoid. The solenoid is connected to an Implement ECM 2 ON/OFF output. The FMI 05 means that the ECM has detected that the current for the solenoid circuit is below normal. The Implement 2 ECM will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

During operation of the blade downforce system, the blade right raise relief enable solenoid is used to enable the blade right raise downforce system.

Conditions that could causes this diagnostic code to be activated are:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire K832-OR(Orange)) to contact 2 (wire H808-WH(White)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2750 FMI 05 diagnostic code.

Expected Result:

The CID 2750 FMI 05 diagnostic code is no longer active. A CID 2750 FMI 06 diagnostic code becomes active when the jumper wire is connected.

Results:

- YES – The CID 2750 FMI 05 diagnostic code is no longer active. A CID 2750 FMI 06 diagnostic code becomes active when the jumper wire is connected. The solenoid has failed.

  Repair: Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2750 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the active diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

The jumper wire that was installed in the previous test step remains in place.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Disconnect the machine harness ECM connector J2 from the Implement ECM 2.

C. At the machine harness connector J2 for the ECM, measure the resistance from contact J2-6 (wire K832-OR(Orange)) to contact J2-4 (wire H808-WH(White)).

D. While observing the multimeter resistance measurement, wiggle the machine harness connectors for the ECM and wiggle the machine harness connector for the solenoid. Gently pull on the wires and move the wires around.

Expected Result:

Each resistance measurement is less than 5.0 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – The resistance measurements are less than 5.0 ohms. The resistance measurements are not indicating an open or a bad connection in the circuit.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5.0 ohms. The resistance measurement is indicating an open circuit or a bad connection in the machine harness.

  Repair: A resistance measurement that is greater than 5000 ohms could indicate that a wire is either not connected or is open. A resistance measurement that is greater than 5.0 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but is not a good connection.

  The open or possible bad connection is in energize wire K832-OR(Orange) or in return wire H808-WH(White) of the machine harness. Refer to the complete machine Electrical System Schematic. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J2 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J2 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire K832-OR(Orange) and socket at contact J2-6 from the harness connector.

C. Reconnect the machine harness J2 connector to the ECM.

D. Turn the disconnect switch and the key start to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J2-5 through the vacant space in the J2 connector.

F. While observing the status of the active CID 2750 FMI 05 diagnostic code, ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2750 FMI 05 diagnostic code is no longer active. A CID 2750 FMI 06 diagnostic code becomes active when the ECM pin at J2-6 is grounded.

Results:

- YES – The CID 2750 FMI 05 diagnostic code is no longer active. A CID 2750 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is most likely not causing the problem.Reinstall the disconnected solenoid energize wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 4.

- NO – The CID 2750 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2750 FMI 05 diagnostic code.

Expected Result:

The CID 2750 FMI 05 diagnostic code is not active.

Results:

- OK – The CID 2750 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2750 FMI 05 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02655776

MID 082 - CID 2750 - FMI 06

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

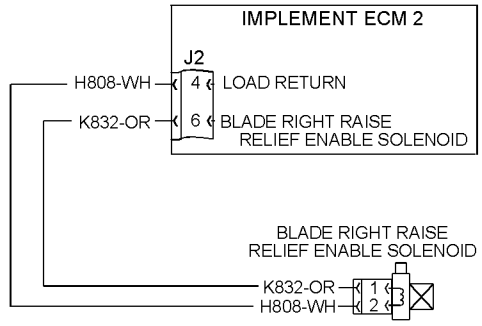


Illustration 513 g01334371

Blade Right Raise Relief Enable Solenoid connections

This diagnostic code is associated with the blade left raise relief enable solenoid. The solenoid is connected to an Implement ECM 2 ON/OFF output. The FMI 06 means that the ECM has detected that the current for the solenoid circuit is above normal. The Implement 2 ECM will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

During operation of the blade downforce system, the blade right raise relief enable solenoid is used to enable the blade right raise downforce system.

Conditions that could causes this diagnostic code to be activated are:

- The energize circuit of the solenoid is shorted to a ground source.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2750 FMI 06 diagnostic code changes to a CID 2750 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2750 FMI 06 diagnostic code changes to a CID 2750 FMI 05 diagnostic code when the solenoid is disconnected. The solenoid circuit in the machine harness is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2750 FMI 06 diagnostic code remains active. Disconnecting the solenoid did not change the status of the active diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

The solenoid remains disconnected from the machine harness.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

C. At the machine harness ECM connectors, measure the resistance from the signal contact J2-6 (wire K832-OR(Orange)) to frame ground. Measure the resistance from the signal contact J2-6 (wire K832-OR(Orange)) to all of the other contacts that are used in J1 and J2 ECM connectors.

D. While observing the multimeter resistance measurements, wiggle the machine harness connectors for the ECM and the solenoid. Gently pull on the wires and move the wires around.

Expected Result:

Each resistance measurement is greater than 5000 ohms at all times during the manipulation of the harness and connectors.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. The resistance measurement is indicating that a short is present in the machine harness. The short is between wire K832-OR(Orange) and either frame ground or the circuit with the low resistance measurement.

  Repair: For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2750 FMI 06 diagnostic code.

Expected Result:

The CID 2750 FMI 06 diagnostic code not active.

Results:

- OK – The CID 2750 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2750 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause of the problem is not found, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02655789

MID 082 - CID 2751 - FMI 03

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

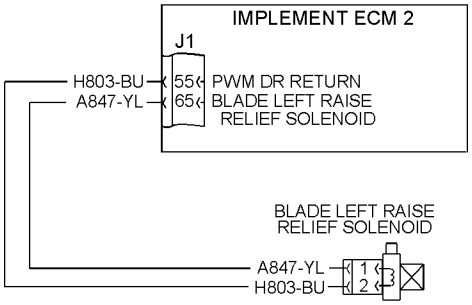


Illustration 514 g01334493

Blade Left Raise Relief Solenoid connections

This diagnostic code is associated with the blade left raise relief solenoid. The FMI 03 means that the Implement ECM 2 has determined that the voltage of the solenoid circuit is above normal. The Implement 2 ECM will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that the Implement ECM is receiving from the left constant downforce control dial.

During operation of the blade downforce system, the blade left raise relief solenoid is used to control the amount of hydraulic oil that is returned to the hydraulic tank through the left raise relief valve.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-65 (wire A847-YL(Yellow)) to all J1 and J2 contacts that are used on the Implement ECM 2 connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire A847-YL(Yellow) and the circuit that has a low resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire A847-YL(Yellow) and socket at contact J1-65 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2751 FMI 03 diagnostic code.

Expected Result:

The CID 2751 FMI 03 diagnostic code is no longer active. A CID 2751 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2751 FMI 03 diagnostic code is no longer active. A CID 2751 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 2751 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2751 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2751 FMI 03 diagnostic code is active.

Results:

- YES – The CID 2751 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2751 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02983883

MID 082 - CID 2751 - FMI 05

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

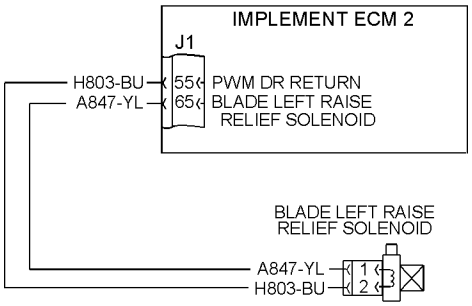


Illustration 515 g01334493

Connections of “Blade Left Raise Relief” solenoid connections

This diagnostic code is associated with the “blade left raise relief” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal. The Implement ECM 2 will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that the Implement ECM is receiving from the left constant downforce control dial.

During operation of the blade downforce system, the “blade left raise relief” solenoid is used to control the amount of hydraulic oil that is returned to the hydraulic tank through the “left raise” relief valve.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire A847-YL(Yellow)) to contact 2 (wire H803-BU(Blue)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2751 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2751 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the Implement ECM 2.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-55 (wire H803-BU(Blue)) to the energize contact J1-65 (wire A847-YL(Yellow)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but is not a good connection.

  Repair: The open connection or the possible poor connection is in supply wire A847-YL(Yellow) or in return wire H803-BU(Blue) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire A847-YL(Yellow) and the socket at contact J1-65 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-65 through the empty space in the J1 connector.

F. Observing the status of the active CID 2751 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2751 FMI 05 diagnostic code is no longer active. A CID 2751 FMI 06 diagnostic code becomes active when the ECM pin at J1-65 is grounded.

Results:

- YES – The CID 2751 FMI 05 diagnostic code is no longer active. A CID 2751 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM likely is not the cause of the problem.Reinstall the disconnected solenoid energize wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 4.

- NO – The CID 2751 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2751 FMI 05 diagnostic code.

Expected Result:

The CID 2751 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2751 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2751 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02655792

MID 082 - CID 2751 - FMI 06

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

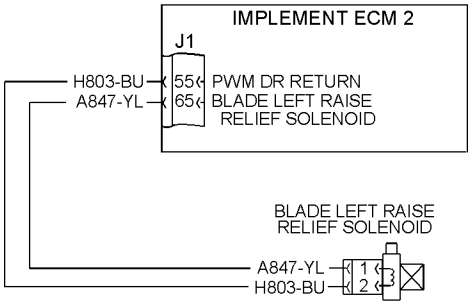


Illustration 516 g01334493

Blade Left Raise Relief Solenoid connections

This diagnostic code is associated with the blade left raise relief solenoid. The FMI 06 indicates that the Implement ECM 2 has determined that the current of the solenoid circuit is above normal. The Implement 2 ECM will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that the Implement ECM is receiving from the left constant downforce control dial.

During operation of the blade downforce system, the blade left raise relief solenoid is used to control the amount of hydraulic oil that is returned to the hydraulic tank through the left raise relief valve.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2751 FMI 06 diagnostic code changes to a CID 2751 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2751 FMI 06 diagnostic code changes to a CID 2751 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2751 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the Implement ECM 2.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-65 (wire A847-YL(Yellow)) to frame ground. Measure the resistance from the signal contact J1-65 (wire A847-YL(Yellow)) to all of the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire A847-YL(Yellow) and the circuit with the low resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2751 FMI 06 diagnostic code.

Expected Result:

The CID 2751 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2751 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2751 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02655878

MID 082 - CID 2752 - FMI 03

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

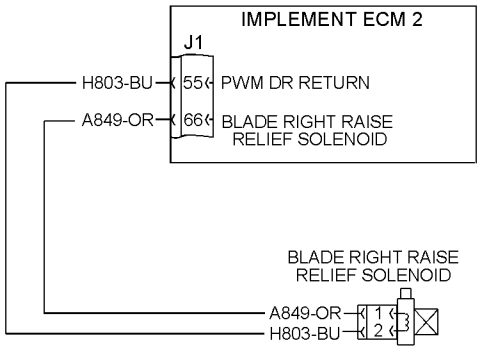


Illustration 517 g01334526

Blade Right Raise Relief Solenoid connections

This diagnostic code is associated with the blade right raise relief solenoid. The FMI 03 means that the Implement ECM 2 has determined that the voltage of the solenoid circuit is above normal. The Implement 2 ECM will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that the Implement ECM is receiving from the right constant downforce control dial.

During operation of the blade downforce system, the blade right raise relief solenoid is used to control the amount of hydraulic oil that is returned to the hydraulic tank through the right raise relief valve.

Conditions that could causes this diagnostic code to be activated are:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the Implement ECM 2.

C. At the machine harness ECM connectors, measure the resistance from contact J1-66 (wire A849-OR(Orange)) to all of the other contacts that are used in the J1 and J2 connectors for the Implement ECM 2.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- YES – Each resistance measurement is greater than 5000 ohms. The resistance measurement does not indicate a short in the machine harness. Proceed to test step 2.
- NO – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness.

  Repair: The short is between wire A849-OR(Orange) and the circuit that has a low resistance measurement.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J2 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire A849-OR(Orange) and socket at contact J2-66 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 2752 FMI 03 diagnostic code.

Expected Result:

The CID 2752 FMI 03 diagnostic code is no longer active. A CID 2752 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 2752 FMI 03 diagnostic code is no longer active. A CID 2752 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit. Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 2752 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 2752 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 2752 FMI 03 diagnostic code is not active.

Results:

- OK – The diagnostic code is not active at this time. The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

- NOT OK – The CID 2752 FMI 03 diagnostic code remains active. The problem has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i02983861

MID 082 - CID 2752 - FMI 05

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

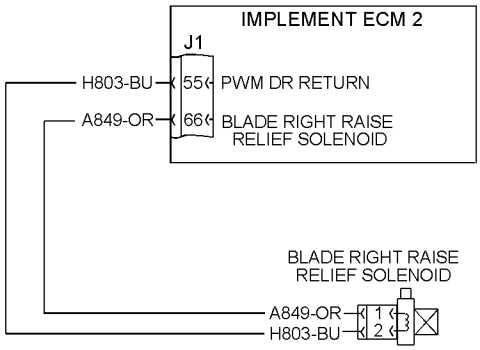


Illustration 518 g01334526

Connections of “Blade Right Raise Relief” solenoid connections

This diagnostic code is associated with the “blade right raise relief” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal. The Implement ECM 2 will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that the Implement ECM is receiving from the right constant downforce control dial.

During operation of the blade downforce system, the blade right raise relief solenoid is used to control the amount of hydraulic oil that is returned to the hydraulic tank through the right raise relief valve.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, place a jumper wire from contact 1 (wire A849-OR(Orange)) to contact 2 (wire H803-BU(Blue)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 2752 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 2752 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector for the machine harness J1 from the Implement ECM 2.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-55 (wire H803-BU(Blue)) to the energize contact J1-66 (wire A849-OR(Orange)).

Expected Result:

The resistance measurement is less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5000 ohms. The resistance measurement is not correct. There is an open or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not open but is not a good connection.

  Repair: The open or the possible poor connection is in supply wire A849-OR(Orange) or in return wire H803-BU(Blue) of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all of the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the solenoid energize wire A849-OR(Orange) and socket at contact J1-66 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-66 through the empty space in the J1 connector.

F. Observe the status of the active CID 2752 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to frame ground.

Expected Result:

The CID 2752 FMI 05 diagnostic code is no longer active. A CID 2752 FMI 06 diagnostic code becomes active when the ECM pin at J1-66 is grounded.

Results:

- YES – The CID 2752 FMI 05 diagnostic code is no longer active. A CID 2752 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM likely is not the cause of the problem.Reinstall the disconnected solenoid energize wire back into the correct spot in the ECM connector before proceeding to the next test step. Proceed to Test Step 4.
- NO – The CID 2752 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2752 FMI 05 diagnostic code.

Expected Result:

The CID 2752 FMI 05 diagnostic code is active.

Results:

- YES – The CID 2752 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 2752 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02655914

MID 082 - CID 2752 - FMI 06

SMCS Code: 5479-038-BG

Conditions Which Generate This Code:

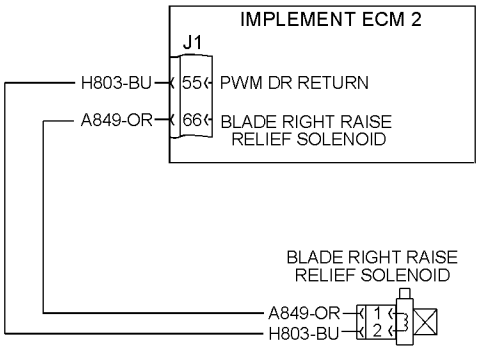


Illustration 519 g01334526

Blade Right Raise Relief Solenoid connections

This diagnostic code is associated with the blade right raise relief solenoid. The FMI 06 indicates that the Implement ECM 2 has determined that the current of the solenoid circuit is above normal. The Implement 2 ECM will notify the Implement ECM of this condition over the J1939 Data Link. The Implement ECM will activate this diagnostic code.

The Implement ECM 2 provides a PWM output signal to the solenoid in order to provide proportional control of the solenoid. The ECM will vary the electrical current of the PWM output signal based on the input command that the Implement ECM is receiving from the right constant downforce control dial.

During operation of the blade downforce system, the blade right raise relief solenoid is used to control the amount of hydraulic oil that is returned to the hydraulic tank through the right raise relief valve.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 2752 FMI 06 diagnostic code changes to a CID 2752 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 2752 FMI 06 diagnostic code changes to a CID 2752 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” in order to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 2752 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the Implement ECM 2.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-66 (wire A849-OR(Orange)) to frame ground. Measure the resistance from the signal contact J1-66 (wire A849-OR(Orange)) to all of the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements is less than 5000 ohms. There is a short in the machine harness. The short is between wire A849-OR(Orange) and the circuit with the low resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 2752 FMI 06 diagnostic code.

Expected Result:

The CID 2752 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 2752 FMI 06diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 2752 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02676380

MID 082 - CID 2954 - FMI 14

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

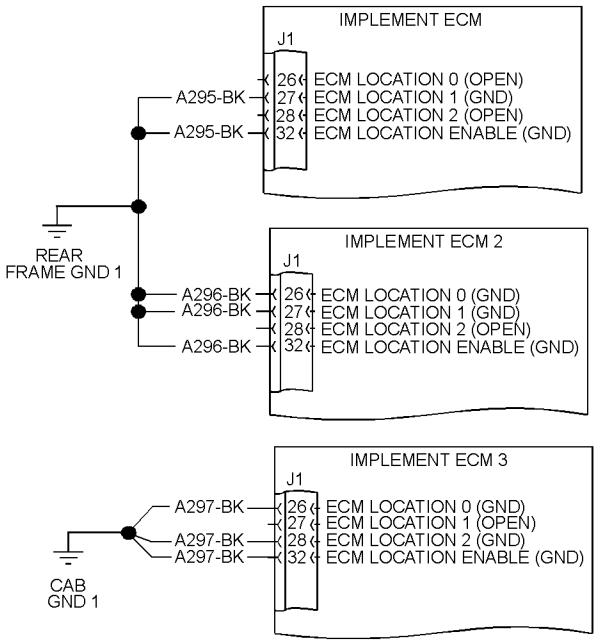


Illustration 520 g01301801

Location Code connections

This diagnostic code is activated by the Implement ECM when the Implement ECM 2 location code is not correct **AND** the Implement ECM 2 has detected an FMI 03 (voltage above normal) condition for a solenoid output at the same time. This diagnostic code can also be activated by the Implement ECM when the Implement ECM 3 location code is not correct **AND** the Implement ECM 3 has detected an FMI 03 (voltage above normal) condition for a solenoid output at the same time.

The probable cause of this diagnostic code is a problem with the hard wired location code connections for the involved ECM **AND** a solenoid output from the involved ECM is shorted to another voltage source **at the same time.**

In order to troubleshoot the active CID 2954 FMI 14 diagnostic code, the cause of the incorrect location code must be found and repaired first. Once the location code problem is corrected, the CID 2954 FMI 14 diagnostic code will no longer be active. The Implement ECM will then activate an FMI 03 diagnostic code for the specific solenoid that has the voltage above normal fault condition. When this occurs, refer to the diagnostic code troubleshooting procedure for the specific solenoid that has the fault.

An open circuit, or a poor connection in the circuit could cause the Implement ECM to detect an incorrect location code.

Note: For help with verification of correct location codes, in the Cat ET status screen, the “actual” location code and the “desired” location code for each ECM on the machine can be displayed.

Test Step 1. CHECK THE LOCATION CODE IN THE ET STATUS SCREEN

A. Check the ET status screen in order to determine which location code is not correct for the assigned control. The location codes for each implement control are listed below:

Implement ECM 2
Implement ECM 2 3
Implement ECM 3 5

Expected Result:

One of the location codes is not correct.

Results:

- YES – One of the location codes is not correct. Proceed to Test Step 2.
- NO – The location codes that are listed in the Cat ET status screen for the implement controls are correct.

  Repair: Repeat this test step in order to verify that the location codes are correct for the listed Implement Controls.

  If the location codes that are listed in Cat ET match the Implement Control location codes that are listed above, proceed to Test Step 4.

Test Step 2. INSPECT HARNESS CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the affected Implement ECM.

C. Inspect the harness connections that are related to the location codes for the Implement ECM that is involved. Make sure that the connectors are clean. Make sure that the connectors are tight.

D. Check for the proper mating of the connector.

E. Check all wires at the connector.

F. Check each wire for nicks. Check each wire for signs of abrasion in the insulation.

G. Check for moisture at the connector.

H. Check for dirty contacts or corroded contacts.

I. Check each pin and check each socket.

Expected Result:

The machine harness connectors are tight and the machine harness connectors are free of corrosion.

Results:

- OK – The machine harness connectors are tight and the machine harness connectors are free from corrosion.Proceed to Test Step 3.
- NOT OK – One or more of the machine harness connectors are in need of repair.

  Repair: Repair the connector and verify that all connections are correct before reconnecting to the mating connector. After the connector is repaired, verify that the problem has been corrected before operating the machine.

  STOP.

Test Step 3. CHECK FOR AN OPEN IN THE LOCATION CODE CIRCUITS

A. The disconnect switch and the key start switch remain in the OFF position. The machine harness connector J1 remains disconnected from the ECM.

B. Refer to the connection diagram at the beginning of this procedure. At the machine harness connector J1 for the affected ECM, measure the resistance between a good frame ground contact and the location code contacts that are connected to ground.

Expected Result:

Each of the resistance measurements is less than 5 ohms.

Results:

- OK – Each of the resistance measurements are less than 5 ohms. The location code circuits are correct.Proceed to Test Step 4.

- NOT OK – The resistance measurement for one or more of the circuits is greater than 5 ohms. One of the ground circuits is faulty.

  Repair: There is an open or a poor connection in the ground circuit that checked the high resistance.

  Refer to the complete machine Electrical System Schematic. Check all of the connectors that are in suspected ground circuit. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Determine if the CID 2954 FMI 14 diagnostic code is active.

Expected Result:

The CID 2954 FMI 14 diagnostic code is not active.

Results:

- OK – The CID 2954 FMI 14 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Once the CID 2954 FMI 14 diagnostic code is no longer active, the Implement ECM will activate an FMI 03 diagnostic code for the specific solenoid that has the voltage above normal fault condition. When this occurs, refer to the diagnostic code troubleshooting procedure for the specific solenoid that has the fault. Perform the procedure and repair the problem.

  STOP.

- NOT OK – The CID 2954 FMI 14 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06679987

MID 082 - CID 3284 - FMI 03

SMCS Code: 5479-038-ZH

Conditions Which Generate This Code:

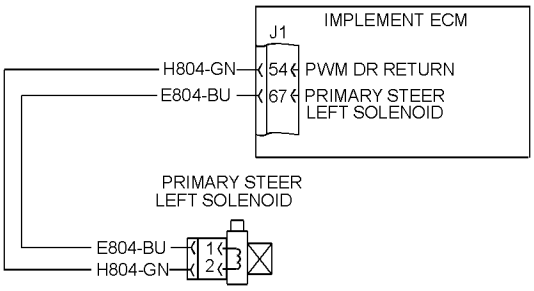


Illustration 521 g06072470

Primary Steer Left Solenoid connections

This diagnostic code is associated with the left primary steer solenoid. The FMI 03 diagnostic code is activated when the ECM detects an above normal voltage of the solenoid circuit.

The following conditions could cause this diagnostic code to be activated:

- The energize circuit of the solenoid is shorted to another voltage source.

- The ECM has failed. This condition is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-67 (wire E804-BU(Blue)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire E804-BU(Blue)and the circuit that has a low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire E804-BU(Blue)and socket at contact J1-67 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 3284 FMI 03 diagnostic code.

Expected Result:

The CID 3284 FMI 03 diagnostic code is no longer active. A CID 3284 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 3284 FMI 03 diagnostic code is no longer active. A CID 3284 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit.Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.
- NO – The CID 3284 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 3284 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 3284 FMI 03 diagnostic code is active.

Results:

- YES – The CID 3284 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This condition is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 3284 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06679990

MID 082 - CID 3284 - FMI 05

SMCS Code: 5479-038-ZH

Conditions Which Generate This Code:

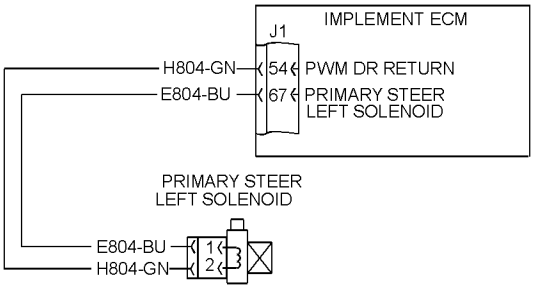


Illustration 522 g06072470

Connections of “Primary Steer Left” solenoid

This diagnostic code is associated with the “Primary Steer Left” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

The following conditions that cause this diagnostic code to be activated are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This condition is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure, and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, connect a jumper wire from contact 1 (wire E804-BU(Blue)) to contact 2 (wire H804-GN(Green)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 3284 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 3284 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-54 (wire H804-GN(Green)) to the energize contact J1-67 (wire E804-BU(Blue)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in the energize wire E804-BU(Blue)of the machine harness or in the return wire H804-GN(Green)of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid E804-BU(Blue)and the socket at contact J1-67 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-67 through the empty space in the J1 connector.

F. Observe the status of the active CID 3284 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 3284 FMI 05 diagnostic code is no longer active. A CID 3284 FMI 06 diagnostic code becomes active when the ECM pin at J1-67 is grounded.

Results:

- YES – The CID 3284 FMI 05 diagnostic code is no longer active. A CID 3284 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.
- NO – The CID 3284 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 3284 FMI 05 diagnostic code.

Expected Result:

The CID 3284 FMI 05 diagnostic code is active.

Results:

- YES – The CID 3284 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This condition is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 3284 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06679992

MID 082 - CID 3284 - FMI 06

SMCS Code: 5479-038-ZH

Conditions Which Generate This Code:

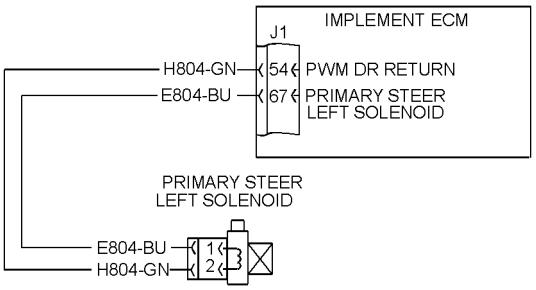


Illustration 523 g06072470

Primary Steer Left Solenoid connections

This diagnostic code is associated with the Primary Steer Left solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

The following conditions that cause the diagnostic code to be active are listed below:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This condition is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 3284 FMI 06 diagnostic code changes to a CID 3284 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 3284 FMI 06 diagnostic code changes to a CID 3284 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 3284 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-67 (wire E804-BU(Blue)) to frame ground. Measure the resistance from the signal contact J1-67 (wire E804-BU(Blue)) to all the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements are less than 5000 ohms. There is a short in the machine harness. The short is between wire E804-BU(Blue)and the circuit with the low-resistance measurement.

Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 3284 FMI 06 diagnostic code.

Expected Result:

The CID 3284 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 3284 FMI 06 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 3284 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06679994

MID 082 - CID 3284 - FMI 13

SMCS Code: 5479-038-ZH

Conditions Which Generate This Code:

This diagnostic code is associated with the Primary Steer Left solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

Note: Before performing this procedure, verify that no other active CID 3284 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i06679995

MID 082 - CID 3285 - FMI 03

SMCS Code: 5479-038-ZH

Conditions Which Generate This Code:

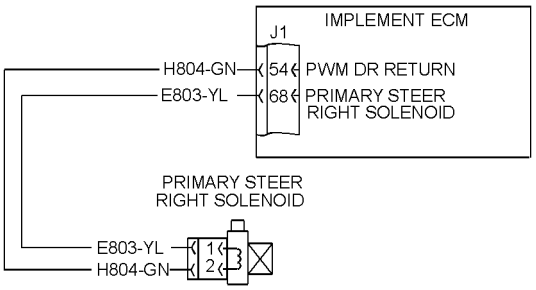


Illustration 524 g06073055

Primary Steer Right Solenoid connections

This diagnostic code is associated with the Primary Steer Right solenoid. The FMI 03 means that the Implement ECM has determined that the voltage of the solenoid circuit is above normal.

Conditions that can cause this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to another voltage source.
- The ECM has failed. This condition is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector from the solenoid. Disconnect the machine harness connectors J1 and J2 from the ECM.

C. At the machine harness ECM connector J1, measure the resistance from contact J1-68 (wire E803-YL(Yellow)) to all J1 and J2 contacts that are used on the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 2.
- NOT OK – Each resistance measurement is not greater than 5000 ohms. There is a short in the machine harness. The short is between wire E803-YL(Yellow)and the circuit that has a low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 2. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connectors for the solenoid and the ECM remain disconnected.

A. At the machine harness connector J1 for the ECM, use a 151 - 6320 Removal Tool to remove the solenoid energize wire E803-YL(Yellow)and socket at contact J1-68 from the harness connector.

B. Reconnect the machine harness J1 and J2 connectors to the ECM.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Observe the status of the active CID 3285 FMI 03 diagnostic code.

Expected Result:

The CID 3285 FMI 03 diagnostic code is no longer active. A CID 3285 FMI 05 diagnostic code is now active.

Results:

- YES – The CID 3285 FMI 03 diagnostic code is no longer active. A CID 3285 FMI 05 diagnostic code has been activated after the solenoid energize circuit was disconnected. The ECM has responded correctly to the open circuit condition in the solenoid circuit.Reinstall the disconnected solenoid energize wire back into the correct space in the ECM connector before proceeding to the next test step. Proceed to Test Step 3.

- NO – The CID 3285 FMI 03 diagnostic code remains active. The status of the active diagnostic code did not change when the solenoid energize wire was disconnected from the ECM.

  Repair: The ECM has not responded correctly to the open condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 3285 FMI 03 diagnostic code is active.

Expected Result:

The CID CID 3285 FMI 03 diagnostic code is active.

Results:

- YES – The CID 3285 FMI 03 diagnostic code is active.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the problem remains, the ECM may have failed. This condition is unlikely because the ECM detected the open circuit condition in the solenoid circuit and activated the FMI 05 diagnostic code when the solenoid energize wire was disconnected.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 3285 FMI 03 code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06680000

MID 082 - CID 3285 - FMI 05

SMCS Code: 5479-038-ZH

Conditions Which Generate This Code:

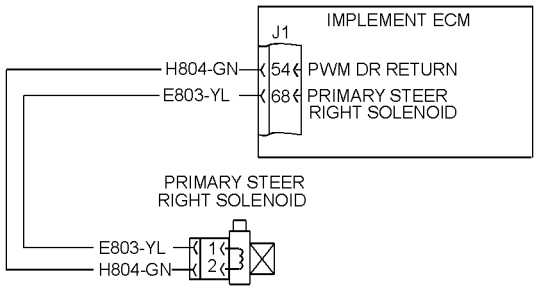


Illustration 525 g06073055

Connections of “Primary Steer Right” solenoid

This diagnostic code is associated with the “Primary Steer Right” solenoid. The FMI 05 means that the ECM has determined that the current for the solenoid circuit is below normal.

Some possible causes of this diagnostic code are listed below:

- The energize circuit of the solenoid is open.
- The return circuit of the solenoid is open.
- The solenoid has failed.
- The ECM has failed. This situation is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure, and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Disconnect the solenoid from the machine harness.

B. At the machine harness connector for the solenoid, connect a jumper wire from contact 1 (wire E803-YL(Yellow)) to contact 2 (wire H804-GN(Green)).

C. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

D. Observe the status of the CID 3285 FMI 05 diagnostic code.

Expected Result:

The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed.

Results:

- YES – The active diagnostic code changes from an FMI “05” diagnostic code to an FMI “06” diagnostic code when the jumper wire is installed. The solenoid has failed.

  Repair: The solenoid has failed. Repeat this Test Step “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid. Verify that the new solenoid corrects the problem.

  STOP.

- NO – The CID 3285 FMI 05 diagnostic code remains active. The jumper wire does not affect the status of the diagnostic code. The solenoid is not the cause of the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE CIRCUIT FOR AN OPEN

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the ECM connector of the machine harness J1 from the ECM.

C. The jumper wire that was installed in the previous Test Step remains in place.

D. At the machine harness connector J1 for the ECM, measure the resistance from the return contact J1-54 (wire H804-GN(Green)) to the energize contact J1-68 (wire E803-YL(Yellow)).

Expected Result:

The measurement of the resistance is less than 5 ohms.

Results:

- OK – The measurement of the resistance is less than 5 ohms. The circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The measurement of the resistance is greater than 5000 ohms. The measurement of the resistance is not correct. There is an open connection in the machine harness or a bad connection in the machine harness. A resistance measurement that is much greater than 5 ohms but less than 5000 ohms could indicate that one of the connection points in the circuit is not an open connection but that the connection is not good.

  Repair: The open connection or the possible poor connection is in the energize wire E803-YL(Yellow)of the machine harness or in the return wire H804-GN(Green)of the machine harness. Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the solenoid circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE OPERATION OF THE ECM

The disconnect switch and the key start switch remain in the OFF position. The machine harness connector for the solenoid and the ECM J1 connector remain disconnected.

A. Remove the jumper wire that was installed in the last test step.

B. At the machine harness connector J1 for the ECM, use a 151-6320 Removal Tool to remove the energize wire of the solenoid E803-YL(Yellow)and the socket at contact J1-68 from the harness connector.

C. Reconnect the machine harness J1 connector to the ECM.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Use a 7X-1710 Multimeter Probe that is not connected to a multimeter or a similar device to make contact with the ECM pin at J1-68 through the empty space in the J1 connector.

F. Observe the status of the active CID 3285 FMI 05 diagnostic code and ground the other end of the 7X-1710 Multimeter Probe to the frame ground.

Expected Result:

The CID 3285 FMI 05 diagnostic code is no longer active. A CID 3285 FMI 06 diagnostic code becomes active when the ECM pin at J1-68 is grounded.

Results:

- YES – The CID 3285 FMI 05 diagnostic code is no longer active. A CID 3285 FMI 06 diagnostic code has been activated after the ECM pin is grounded. The ECM has responded correctly to the grounded circuit condition in the solenoid circuit. The ECM is not the most likely cause of the problem.Reinstall the energize wire of the solenoid into the correct connector of the ECM. Proceed to Test Step 4.

- NO – The CID 3285 FMI 05 diagnostic code remains active. The status of the active diagnostic code does not change when the ECM pin for the solenoid is grounded.

  Repair: The ECM has not responded correctly to the grounded condition in the solenoid circuit. The operation of the ECM is not correct.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

Test Step 4. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 3285 FMI 05 diagnostic code.

Expected Result:

The CID 3285 FMI 05 diagnostic code is active.

Results:

- YES – The CID 3285 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found in the machine harness, the ECM may have failed. This condition is unlikely as the ECM responded correctly to the grounded condition in the previous test step.

  Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the active diagnostic code is not found and the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 3285 FMI 05 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06680002

MID 082 - CID 3285 - FMI 06

SMCS Code: 5479-038-ZH

Conditions Which Generate This Code:

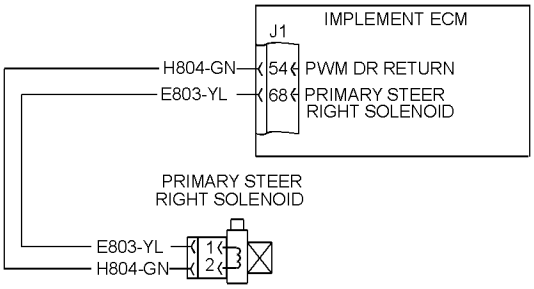


Illustration 526 g06073055

Primary Steer Right Solenoid connections

This diagnostic code is associated with the Primary Steer Right solenoid. The FMI 06 means that the Implement ECM has determined that the current of the solenoid circuit is above normal.

Some possible causes of this diagnostic code are listed:

- The energize circuit of the solenoid is shorted to ground.
- The solenoid has failed.
- The ECM has failed. This condition is unlikely.

Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure and in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.

Note: The resistance of the solenoid coil should be 8.7 ± .4 ohms at 25 °C (77.0 °F).

Test Step 1. CHECK THE SOLENOID

A. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

B. Observe the status of the diagnostic code.

C. Disconnect the solenoid with the active diagnostic code from the machine harness.

Expected Result:

The active CID 3285 FMI 06 diagnostic code changes to a CID 3285 FMI 05 diagnostic code when the solenoid is disconnected.

Results:

- YES – The active CID 3285 FMI 06 diagnostic code changes to a CID 3285 FMI 05 diagnostic code when the solenoid is disconnected. The circuit is correct.

  Repair: The solenoid has failed. Repeat this test “CHECK THE SOLENOID” to verify the solenoid failure. Replace the solenoid.

  STOP.

- NO – The CID 3285 FMI 06 remains active when the solenoid is disconnected. The solenoid is not causing the problem.Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE SOLENOID FOR A SHORT TO GROUND

A. Turn the key start switch and the disconnect switch to the OFF position.

B. The solenoid remains disconnected from the machine harness.

C. Disconnect the machine harness ECM connectors J1 and J2 from the ECM.

D. At the machine harness ECM connectors, measure the resistance from the signal contact J1-68 (wire E803-YL(Yellow)) to frame ground. Measure the resistance from the signal contact J1-68 (wire E803-YL(Yellow)) to all the other J1 and J2 contacts that are used in the ECM connectors.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements are less than 5000 ohms. There is a short in the machine harness. The short is between wire E803-YL(Yellow)and the circuit with the low-resistance measurement.

  Repair: Refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test” for more information on finding and correcting a short circuit. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors and clean the contacts of the harness connectors and check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 3285 FMI 06 diagnostic code.

Expected Result:

The CID 3285 FMI 06 diagnostic code is still active.

Results:

- YES – The CID 3285 FMI 06 diagnostic code is still active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, to perform a "Wiggle Test" on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem is not found, the ECM may have failed.

  It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that is controlling the solenoid. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 3285 FMI 06 is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i06680006

MID 082 - CID 3285 - FMI 13

SMCS Code: 5479-038-ZH

Conditions Which Generate This Code:

This diagnostic code is associated with the Primary Steer Right solenoid. The FMI 13 diagnostic code is activated when the ECM detects that the solenoid needs calibration.

Note: Before performing this procedure, verify that no other active CID 3285 diagnostic codes exist for the solenoid. If any other diagnostic codes are active for the solenoid, correct the problem before performing this procedure.

CALIBRATION

A. Perform the calibration procedure for the solenoid. Refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- YES – The calibration procedure was performed successfully. Resume normal machine operation.

  STOP.

- NO – The calibration was not successful.

  Repair: Repeat the calibration procedure for the solenoid.

  If the second calibration procedure is not successful, replace the solenoid. After solenoid replacement, refer to Testing and Adjusting, “Calibration” section of this manual for the correct calibration procedure. If the problem is still present after replacement and calibration of the new solenoid, the ECM may have failed.

  Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06204517

MID 082 - CID 3423 - FMI 13

SMCS Code: 7220-038

Conditions Which Generate This Code:

This diagnostic code is associated with the calibration of the valve for the grade control system.

Possible causes for this diagnostic code are listed:

- The calibration has not yet been performed.
- New software has been flashed to the ECM.
- The ECM has been replaced.
- The data has become corrupted.

RECALIBRATE THE VALVE

A. Perform a valve calibration. Refer to Testing and Adjusting, “Valve-Calibrate”.

Note: The left lift valve and right lift valve will also need to be calibrated.

Expected Result:

Calibration of the valve causes the diagnostic code to become inactive.

Results:

- YES – Calibration of the valve causes the diagnostic code to become inactive.

  Repair: Return the machine to operation.

  STOP.

- NO – The diagnostic code is still active. The calibration was not performed correctly.

  Repair: Perform the calibration procedure again. Refer to Testing and Adjusting, “Valve - Calibrate”.

  STOP.

i05819478

MID 082 - CID 3694 - FMI 09

SMCS Code: 1439-038-BG; 6151-038-NS

Conditions Which Generate This Code:

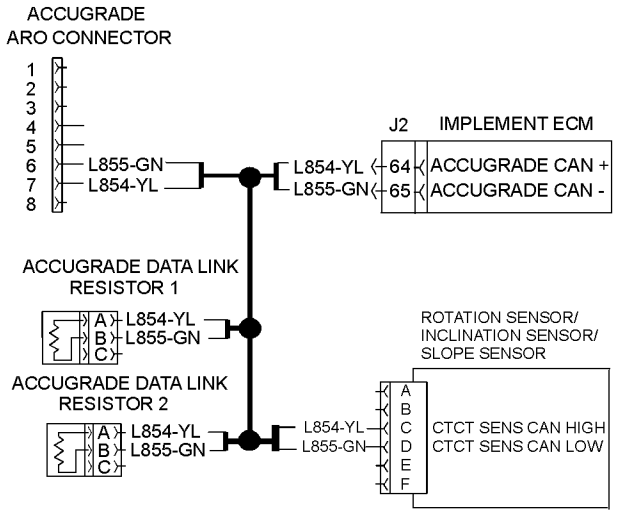


Illustration 527 g02727904

Accugrade Data Link

This diagnostic code is recorded when the Implement ECM cannot receive data off the Accugrade data link from the slope sensor. The Implement ECM should receive information from the Accugrade data link at a specific rate.

Possible causes of this diagnostic code are listed:

- The slope sensor is not functioning.
- The termination resistor on the Accugrade data link is disconnected.
- The ECM has failed. This condition is unlikely.

Test Step 1. CHECK THE INPUT VOLTAGE OF THE SENSOR.

A. Turn the key start switch to the ON position. Do NOT start the tractor.

B. Remove the floorplate.

Note: Ensure that the tractor has cooled. Avoid contact with the manifold.

C. Disconnect the machine harness connector for the slope sensor.

D. Measure the voltage across contact A (wire L872-BU(Blue)) and contact E (wire T744-WH(White)).

Expected Result:

The voltage that is measured is between 18 VDC and 32 VDC.

Results:

- YES – The voltage that is measured is between 18 VDC and 32 VDC. The sensor is receiving the correct voltage. Proceed to test step 2.
- NO – The sensor is NOT receiving input voltage. Verify that the connector for the sensor and the harness are correct.Proceed to test step 2.

Test Step 2. CHECK THE TERMINATION RESISTOR.

A. De-energize the system.

B. The machine harness connector for the sensor remains disconnected.

C. Measure the resistance across contact C (wire L854-YL(Yellow)) and contact D (wire L855-GN(Green)).

Expected Result:

The resistance that is measured is 60 ± 10 ohms.

Results:

- YES – The resistance that is measured is 60 ± 10 ohms. Repeat this test step. If the same results occur, an internal component to the sensor has failed.

  Repair: Replace the sensor.

  STOP.

- NO – The resistance that is measured is NOT 60 ± 10 ohms.

  Repair: Replace the termination resistor.

  STOP.

Test Step 3. CHECK THE BATTERY VOLTAGE.

A. The engine should not be running.

B. At the battery, measure the voltage of the battery.

Expected Result:

The voltage that is measured is less than 18 VDC.

Results:

- YES – The voltage that is measured is less than 18 VDC. The voltage is NOT correct.

  Repair: Check the charging system. See Special Instruction, REHS0354.

  STOP.

- NO – The voltage that is measured is between 18 and 32.5 VDC. There is an open in the circuit between the battery and the sensor.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

i05819481

MID 082 - CID 3694 - FMI 13

SMCS Code: 1439-038-BG; 6151-038-NS

Conditions Which Generate This Code:

This diagnostic code is associated with the Blade Slope Sensor . The sensor provides an Analog input signal to the Implement ECM. The FMI 13 diagnostic code is activated when the ECM detects a sensor that needs calibration.

CALIBRATION

A. Perform the calibration procedure for the sensor. Refer to the Testing and Adjusting, “Calibration” Story in this manual for the correct calibration procedure.

Expected Result:

The calibration procedure was performed successfully.

Results:

- OK – The calibration procedure was performed successfully. Resume normal machine operation

  STOP.

- NOT OK – The calibration was not successful.

  Repair: Repeat the calibration procedure for the sensor.

  If the second calibration procedure is not successful, replace the implement control lever assembly.

After sensor replacement, refer to the Testing and Adjusting, “Calibration” Story in this manual for the correct procedure. If the problem is still present after replacement and calibration of the new sensor, the ECM may have failed.

Prior to replacing an ECM, always contact the Technical Communicator at your dealership for possible consultation with Caterpillar. This consultation may effect repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to the Testing and Adjusting, “Electronic Control Module (ECM) - Replace” Story in this manual for additional information.

STOP.

i06193741

MID 082 - CID 3895 - FMI 03

SMCS Code: 7332-038-ART

Conditions Which Generate This Code:

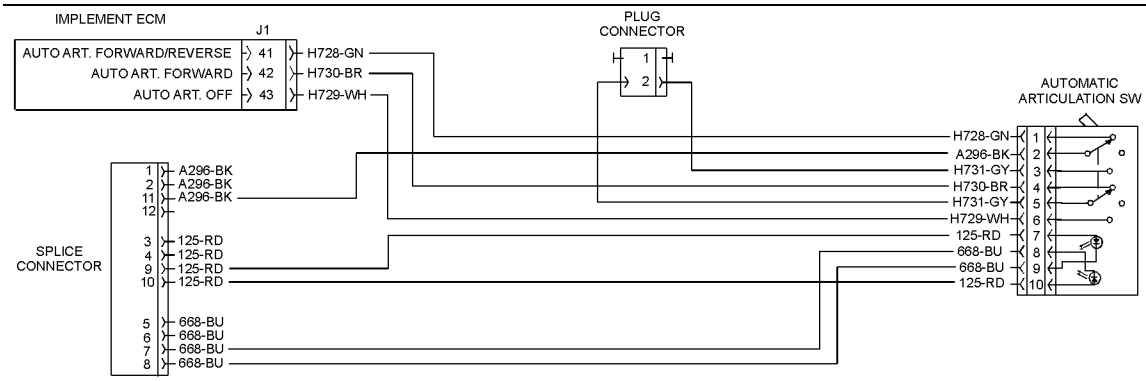


Illustration 528 g03845112

Schematic of the “Auto Articulate” Switch

This switch is double-pole switch connected to inputs of the ECM. The inputs to the ECM are normally closed. This diagnostic code is recorded when the status of both the inputs to the ECM are grounded at the same time.

The possible causes of this diagnostic code are listed below:

- The inputs are shorted to ground.
- The circuits are shorted to ground in the harness.
- The circuits are shorted together. The switch must be in one specific position.
- The switch has failed.

System Response:

The machine response is listed:

- The operator switch will not change the forward/ reverse steering position.

Note: Table 43 contains wire numbers and connector contacts. Use this information to troubleshoot the failed circuit.

Table 43

“Auto Articulation Switch Status”		
Switch Position	**J1-41 “Auto Art. Forward/Reverse Sw” H728-GN(Green)**	**J1-42 “Auto Art. Forward Sw” H730-BR(Brown)**
Auto Articulation Off	Closed	Closed
Auto Articulation Forward/Reverse	Open	Closed
Auto Articulation Forward	Closed	Open

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the original diagnostic code is corrected.

Note: Ensure that the diagnostic code indicator is active and that the diagnostic code is active.

Test Step 1. CHECK THE SWITCH.

A. Observe ON/OFF status of the diagnostic code indicator.

B. Disconnect the connector of the switch from the harness.

Expected Result:

The diagnostic code indicator remains active.

Results:

- YES – The diagnostic code indicator remains active. The switch is not the cause of the diagnostic code.Proceed to Test Step 2.
- NO – The diagnostic code indicator is inactive. The switch has failed.

  Repair: Repeat this test in order to verify the failure of the switch. Repair the switch or replace the switch.

  STOP.

Test Step 2. CHECK THE HARNESS CIRCUIT.

A. This test checks the continuity of the entire harness circuit. This test includes the switch that was previously checked.

B. Turn the disconnect switch to the OFF position.

C. Reconnect the switch that was disconnected in the previous step.

D. Disconnect the harness from the ECM.

E. Activate the switch. At the harness connector for the ECM, check the continuity to ground of the normally closed contact and the normally open contact.

Expected Result:

The continuity agrees with Table 43 .

Results:

- YES – The continuity agrees with the values in the preceding table. The harness circuit is correct.

  Repair: An ECM failure is unlikely. Exit this procedure and perform this troubleshooting procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The continuity check DOES NOT agree with values in the preceding table.

  Repair: The harness circuit has failed. There is a short to ground in the harness between the ECM and the switch. Repair the harness or replace the harness.

  STOP.

i06193747

MID 082 - CID 3895 - FMI 04

SMCS Code: 7332-038-ART

Conditions Which Generate This Code:

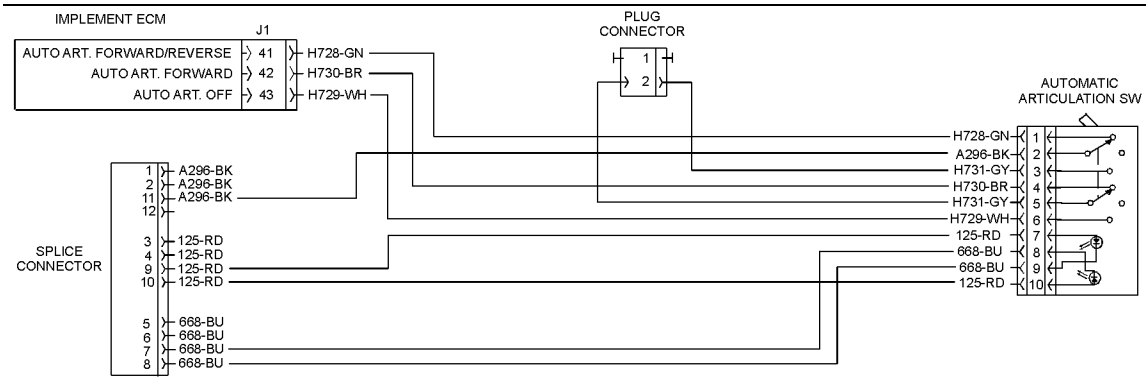


Illustration 529 g03845121

Schematic of the Automatic Articulation Mode Switch

This switch is a three-position switch. The inputs are AUTO ART. OFF, AUTO ART. FORWARD, and normally open. When a circuit is measured with a voltmeter, an open circuit will measure approximately 0 DCV. A closed circuit will measure approximately 5 DCV to 7 DCV.

An FMI 03 diagnostic code is recorded when the status of both the inputs are grounded.

The possible causes of this diagnostic code are listed below:

- The “AUTO ART. OFF” signal circuit (wire H729-WH(White)) is shorted to ground.
- The “AUTO ART. FORWARD/REVERSE” signal circuit (wire H728-GN(Green)) is shorted to ground.
- The ECM has failed. An ECM failure is unlikely.

Test Step 1. CHECK THE SWITCH

A. Turn the key start switch to the ON position.

B. The diagnostic code is active.

C. Remove the ground wire 296-BK(Black) at the switch.

D. Toggle the switch and note the status of the diagnostic code.

Expected Result:

The diagnostic code is no longer active in any position.

Results:

- OK – The diagnostic code is no longer active in any position.

  Repair: The economy mode switch has failed. Replace the switch. Verify that the new switch corrects the diagnostic code.

  STOP.

- NOT OK – The diagnostic code is active in at least one of the positions.Proceed to Test Step 2.

Test Step 2. CHECK THE SIGNAL CIRCUITS FOR A SHORT TO GROUND

A. Turn the key start switch to the OFF position.

B. Disconnect the machine harness connectors from the ECM.

C. Measure the resistance between contact J1-41 (wire H728-GN(Green)) and frame ground.

D. Measure the resistance between contact J1-43 (wire H729-WH(White)) and frame ground.

Expected Result:

The resistances should be greater than 5000 ohms.

Results:

- OK – The resistances are greater than 5000 ohms.

Repair: An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the diagnostic code is still present, replace the ECM. Refer to Troubleshooting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NOT OK – The resistance is less than 5000 ohms on one of the readings.

  Repair: The circuit with the low resistance is shorted in the machine harness. Repair the machine harness or replace the machine harness.

  STOP.

i06303952

MID 082 - CID 4386 - FMI 03

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

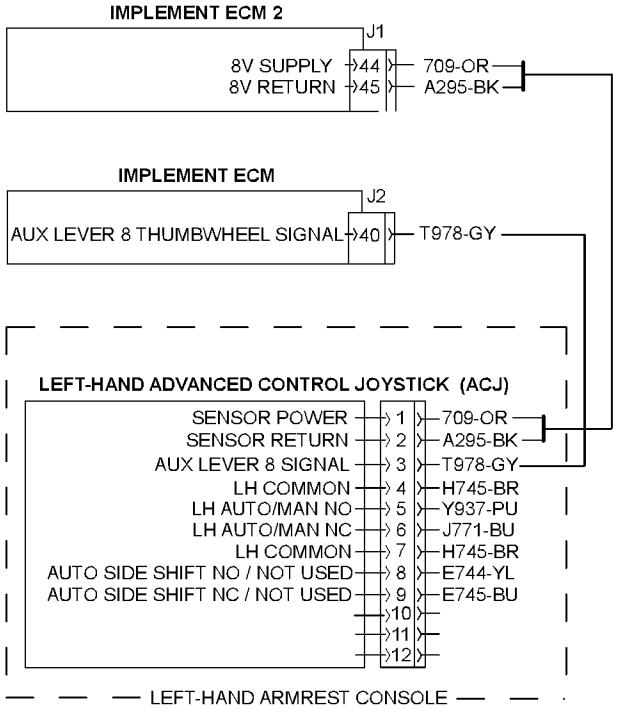


Illustration 530 g03896310

Connections for the Thumbwheel, “Auxiliary Lever #8 Position Sensor” , on the Left-Hand Advanced Control Joystick (ACJ).

This diagnostic code is recorded when the ECM determines that the input signal voltage of the “Auxiliary Lever #8 Position Sensor” is above normal. This proportional thumbwheel sensor is located in the left-hand Advanced Control Joysticks (ACJ).

Note: The left-hand and right-hand ACJs are attached to the left-hand and right-hand joysticks. The ACJ harness connectors are in the armrest consoles. The controls on the ACJs take the place of the Cat Grade Control or AccuGrade® push-button controls. ACJ controls can also be configured to control any of the auxiliary hydraulic valves in use, if grade control is not installed.

The auxiliary lever #8 thumbwheel sensor receives power from the 8 V power supply of Implement ECM 2. The sensor is internally connected to the ground from the 8 V sensor return for the Implement ECM 2. The illustration above indicates the power and ground connections for this thumbwheel position sensor.

Reference: Systems Operation , RENR9013, “Electrical Input Components (AccuGrade® Control Switches)” Testing and Adjusting , RENR9013, “Auxiliary Hydraulic System - Configure” Special Instruction, REHS8847, “Procedure For Installation of the Right Hand and Left Hand Advanced Control Joysticks on M Series, M Series 2, and M Series 3 Motor Graders”

Table 44

Duty Cycles For ACJ Thumbwheels When Used For Auxiliary Valve Control	
0 - 5%	Shorted Low
5- 45%	Valve Port A Modulation
45 - 55%	Center Position - No Command
55 - 100%	Shorted High/Open Circuit

The possible causes of this diagnostic code are listed:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. This condition is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE POWER SUPPLY OF THE SENSOR CIRCUIT

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the left joystick, insert 7X-1710 Multimeter Probes along the +V contacts of the power supply J1-44 (wire 709-OR(Orange)) and along ground contact J1-45 (wire A295-BK(Black)).

C. Do not disconnect the machine harness from the J1 connector.

D. Measure the DC voltage of the sensor power supply.

Expected Result:

The voltage measurement is approximately 8 DCV.

Results:

- OK – The voltage measurement is approximately 8 DCV. The power supplies for the sensor are correct. Proceed to Test Step 2.

- NOT OK – The voltage measurements are less than 8 VDC. The power supply for the sensor is not correct.

  Repair: If the voltage measurement is not correct, the problem is most likely in the wire of the power circuit. This condition will cause multiple diagnostic codes to activate.

  Refer to the complete Electrical System Schematic of the machine. Examine all of the connectors that are in the circuits. Ensure that the connections are clean, that all connections are secure and that all connections are in good condition.

  For troubleshooting the ECM power supply, refer to the CID 41 diagnostic code procedures in the troubleshooting section of this manual.

  Repair the faulty power supply circuit before proceeding with this procedure.

  STOP.

- NOT OK – The voltage measurement is not correct.

  Repair: If one of the voltage measurements is correct, and the other voltage measurement is not correct. There is a problem in the ground circuit that registered the bad measurement. This condition will not cause this diagnostic code to activate. There is another problem that is causing this active diagnostic code. However, the ground circuit must be repaired before proceeding with this procedure.

  Do not operate the machine with only one ground connection for the left joystick.

  Repair the faulty ground circuit or the power supply circuit before proceeding with this procedure.

  After repairing the faulty ground circuit, proceed to Test Step 2.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the left joystick. At the harness connectors for the joystick, place a jumper wire between the ground contact J1-2 (wire A295-BK(Black)) and the signal contact J1-3 (wire T978-GY(Grey)).

C. Disconnect machine harness connectors J1 of the Implement ECM and J2 from the Implement ECM.

D. At the harness connector for the ECMs, measure the resistance from return contact J1-45 (wire A295-BK(Black)) to signal contact J2-40 (wire T978-GY(Grey)).

E. Observe the resistance measurement and wiggle the ECM connector and the sensor connector. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms at all times during the manipulation of the wiring harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor signal circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement for the signal circuit is greater than 5 ohms. There is an open or a bad connection in one of the circuits.

  Repair: Check the signal circuit for opens or for a bad connection.

  A resistance measurement that is greater than 5 ohms but less than 5000 ohms, indicates a loose or corroded connection in the circuit. A resistance measurement that is greater than 5000 ohms would indicate an open in the circuit.

  Check all of the connectors that are in the sensor signal circuit or in the ground circuits. Ensure that all connections are clean, secure and in good condition. Repair or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the ECM, measure the resistance from the sensor signal contact J2-40 (wire T978-GY(Grey)) to all of the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurements do not indicate a short in the circuit.Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low resistance measurement.

  Check all of the connectors that are in the sensor circuit. Ensure that all connections are clean, secure and in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, RENR9013, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Inspect all of the harness connectors for the left-hand ACJ and the ECM. Clean the contacts of the harness connectors and check the wires for damage to the insulation. Reconnect all harness connectors. Ensure that the connectors are fully seated. Observe that the clips for each connector are fastened.

B. At the machine harness connector J1 for the left-hand ACJ, use a 151-6320 Removal Tool to remove the signal wire T978-GY(Grey) and the socket at contact J1-3 from the harness connector. The machine harness connector J1 remains connected to the connector of the left-hand ACJ.

C. At the back of the connectors J1 of the left-hand ACJ. Insert 7X-1710 Multimeter Probes along the ground contact at J1-2 and the signal contact at J1-3.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor at the connector pins of the steering control between the contacts J1-2 and J1-3. Move the left-hand ACJ through the full range of the blade of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the left-hand ACJ.Proceed to Test Step 5.

- NOT OK – The duty cycle of the sensor is not correct according to the description at the beginning of this procedure. The sensor has failed.

Repair: Perform this test step again to verify that the sensor signal is not correct.

If the thumbwheel position sensor is not correct, replace the left-hand ACJ. After replacement, verify that the operation of the new ACJ is correct before operating the machine.

STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

Reference: Testing and Adjusting, RENR9013, “Electrical Connector - Inspect”

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 4386 FMI 03 diagnostic code is active.

Expected Result:

The CID 4386 - FMI 03 diagnostic code is not active.

Results:

- OK – The CID 4386 - FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 4386 - FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Perform a Wiggle Test on the machine wiring harness with the Caterpillar Electronic Technician (Cat ET) service tool. The Wiggle Test can detect the following in the machine wiring harness:

  - Momentary shorts
  - Intermittent shorts
  - Opens

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Perform this procedure again. If the cause of the failure is not found, contact the Technical Communicator at your dealership for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, RENR9013, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06508568

MID 082 - CID 4386 - FMI 04

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

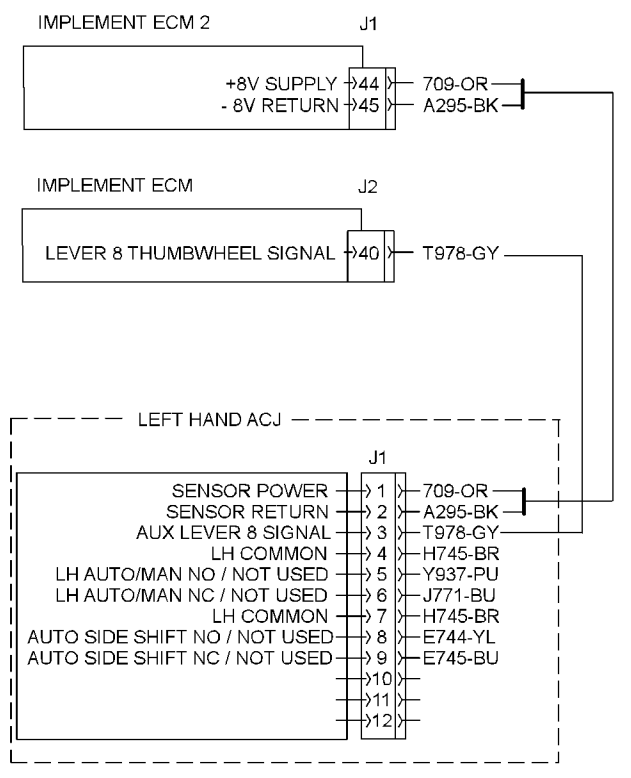


Illustration 531 g06002371

Connections of the Auxiliary Lever #8 Position on the left Advanced Control Joystick (ACJ) when configured for auxiliary hydraulic control.

This diagnostic code is recorded when the ECM reads the input signal from the auxiliary lever #8 position sensor. The signal is activated when the voltage is above normal. The sensor is located in the left ACJ.

The auxiliary lever #8 position sensor receives power from the 8V power supply of the Implement ECM. The sensor is internally connected to the ground from the 8V sensor return for the Implement ECM. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left ACJ, refer to the Systems Operation, “Features” section of this manual.

Table 45

Duty Cycles For ACJ Thumbwheels When Used For Auxiliary Valve Control	
0 - 5%	Shorted Low
5- 45%	Valve Port A Modulation
45 - 55%	Center Position - No Command
55 - 100%	Shorted High/Open Circuit

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Inspect the connections for the following:

- Connections are clean.
- Connections are secure.
- Connections are in good condition.

Note: If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the left ACJ. Observe the status of the active CID 4386 FMI 04 diagnostic code.

Expected Result:

The status of the CID 4386 FMI 04 diagnostic code did not change when the connector of the ACJ was disconnected. A CID 4386 FMI 03 diagnostic code has not been activated by the ECM. The CID 4386 FMI 04 diagnostic code remains active when the connector of the ACJ is disconnected.

Results:

- OK – The CID 4386 FMI 04 diagnostic code remains active when the connector of the ACJ is disconnected. The sensor is not causing the problem.Proceed to Test Step 2.
- NOT OK – The CID 4386 FMI 04 diagnostic code is no longer active when the connector of the ACJ is disconnected. A CID 4386 FMI 03 diagnostic code has been activated by the ECM when the connector of the ACJ is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The position sensor is causing the problem. Replace the assembly of the left ACJ. Verify that the operation of the new left ACJ assembly is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector for the ACJ J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J1 for the ECM, measure the resistance from contact J2-40 (wire T978-GY(Grey)) to frame ground and measure the resistance to all the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.
- NOT OK – One or more of the resistancemeasurementis NOT correct.

Repair: There is a short in the machine harness. The short is between the signal circuit and frame ground or the short is between the signal circuit and the circuit with the low-resistance measurement.

Refer to the Electrical Schematic of the machine. Check all the connectors that are in the sensor circuit. Inspect the connections for the following:

- Connections are clean.
- Connections are secure.
- Connections are in good condition.

For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform the following:

- Visually inspect the harness connectors.
- Clean the contacts of the harness connectors.
- Visually inspect the insulation of the wires for damage that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 4386 FMI 04 diagnostic code is active.

Expected Result:

The CID 4386 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 4386 FMI 04 diagnostic code is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 4386 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Perform a Wiggle Test on the machine wiring harness with the Caterpillar Electronic Technician (Cat ET) service tool. The Wiggle Test can detect the following in the machine wiring harness:

  - Momentary shorts
  - Intermittent shorts
  - Opens

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your Cat Dealership Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06510896

MID 082 - CID 4386 - FMI 08

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

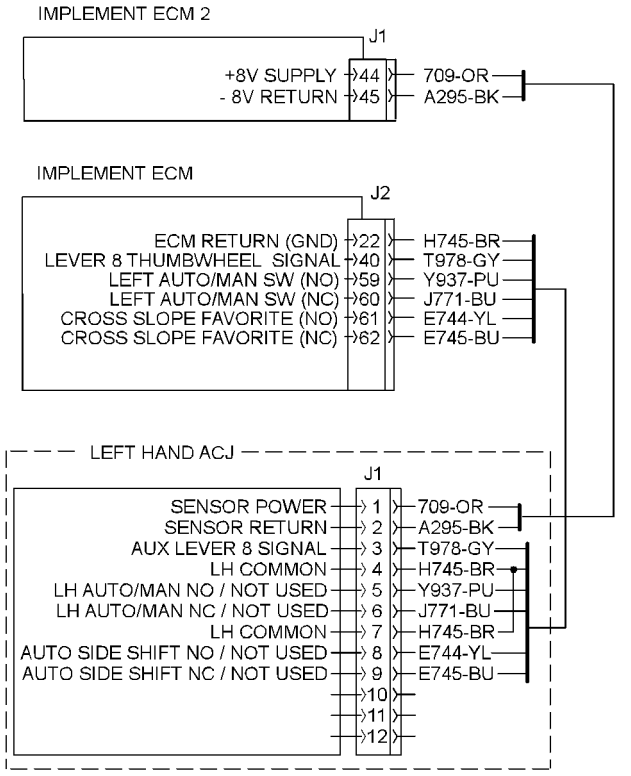


Illustration 532 g06002842

This diagnostic code is recorded when the ECM reads the input signal from the auxiliary lever #8 position sensor of the auxiliary control joystick (ACJ), and the voltage of the signal is above normal. The sensor is located in the left ACJ.

The auxiliary lever #8 position sensor receives power from the 8V power supply of the Implement ECM. The sensor is internally connected to the ground from the 8V sensor return for the Implement ECM. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the left ACJ, refer to the Systems Operation, “Features” section of this manual.

Table 46

Duty Cycles For ACJ Thumbwheels When Used For Auxiliary Valve Control	
0 - 5%	Shorted Low

(continued)

(Table 46, contd)

5- 45%	Valve Port A Modulation
45 - 55%	Center Position - No Command
55 - 100%	Shorted High/Open Circuit

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Inspect the connections for the following:

- Connections are clean.
- Connections are secure.
- Connections are in good condition.

Note: If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SIGNAL AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the connector of the left ACJ J1, use a 151-6320 Removal Tool to remove the signal wire and the socket at contact J1-3 (wire T978-GY(Grey)) from the harness connector. The machine harness connector J1 remains connected to the connector of the right ACJ.

C. At the back of the connector of the ACJ J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-3 and the ground contact at J1-2.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor at the connector contacts of the ACJ J1-2 and J1-3. Move the ACJ through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the problem.Proceed to Test Step 2.
- NOT OK – The duty cycle of the sensor is not correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The position sensor is not operating correctly. Replace the assembly of the left ACJ. Verify that the operation of the new left-hand ACJ assembly is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the left ACJ. At the machine harness connector of the sensor J1, place a jumper wire between the ground contact J1-2 (wire A295-BK(Black)) and the signal contact J1-3 (wire T978-GY(Grey)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-45 (wire A295-BK(Black)) to signal contact J2-40 (wire T978-GY(Grey)).

Expected Result:

The resistance measurement should be less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the Electrical Schematic of the machine. Check all the connectors that are in the sensor signal circuit and the return circuit. Inspect the connections for the following:

  - Connections are clean.
  - Connections are secure.
  - Connections are in good condition.

  Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform the following:

- Visually inspect the harness connectors.
- Clean the contacts of the harness connectors.
- Visually inspect the insulation of the wires for damage that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 4386 FMI 08.

Expected Result:

The CID 4386 FMI 08 is not active.

Results:

- OK – The CID 4386 FMI 08 is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation

  STOP.

- NOT OK – The CID 4386 FMI 08 is active. The diagnostic code has not been corrected.

Repair: Check the circuit again. Perform a Wiggle Test on the machine wiring harness with the Caterpillar Electronic Technician (Cat ET) service tool. The Wiggle Test can detect the following in the machine wiring harness:

- Momentary shorts
- Intermittent shorts
- Opens

If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your Caterpillar Dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i06510993

MID 082 - CID 4387 - FMI 03

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

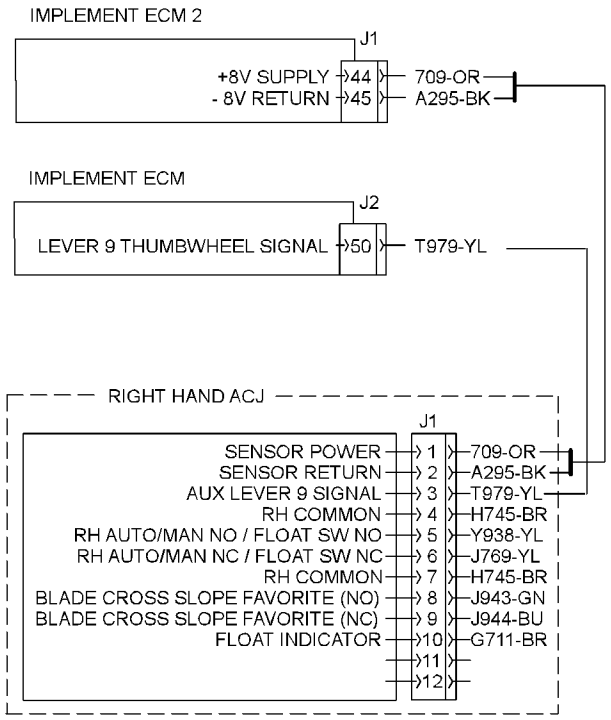


Illustration 533 g06002869

Connections of the Auxiliary Lever #9 Position on the right Advanced Control Joystick (ACJ) when configured for auxiliary hydraulic control.

This diagnostic code is recorded when the ECM reads the input signal from the auxiliary lever #9 position sensor and the voltage of the signal is above normal. The sensor is located in the right ACJ.

The auxiliary lever #9 position sensor receives power from the 8V power supply of the Implement ECM. The sensor is internally connected to the ground from the 8V sensor return for the Implement ECM. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right ACJ, refer to the Systems Operation, “Features” section of this manual.

Table 47

Duty Cycles For ACJ Thumbwheels When Used For Auxiliary Valve Control	
0 - 5%	Shorted Low
5- 45%	Valve Port A Modulation
45 - 55%	Center Position - No Command
55 - 100%	Shorted High/Open Circuit

The possible causes of this diagnostic code are listed:

- The power supply circuit of the sensor is open.
- The return circuit of the sensor is open.
- The signal circuit is open.
- The signal circuit is shorted to the sensor power supply.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, that all connections are secure, and that all connections are in good condition. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE POWER SUPPLY OF THE SENSOR CIRCUIT

A. Turn the disconnect switch and the key start switch to the ON position.

B. At the J1 harness connector for the right ACJ, insert 7X-1710 Multimeter Probes along the +8V contacts of the power supply J1-44 (wire 709-OR(Orange)) and along ground 2 contact J1-45 (wire A295-BK(Black)).

C. Do not disconnect the machine harness from the J1 connector.

D. Measure the DC voltage of the sensor power supply.

Expected Result:

The voltage measurement is approximately 8.0 ± 0.4 DCV.

Results:

- OK – The voltage measurement is approximately 8.0 ± 0.4 DCV. The power supplies for the sensor are correct.Proceed to Test Step 2.
- NOT OK – The voltage measurements are less than 8.0 ± 0.4 VDC. The power supply for the sensor is not correct.

  Repair: If the voltage measurement is not correct, the problem is most likely in the wire of the power circuit. This condition will cause multiple diagnostic codes to activate.

  Refer to the complete Electrical System Schematic of the machine. Examine all the connectors that are in the circuits. Ensure that the connections are clean, that all connections are secure, and that all connections are in good condition.

  For troubleshooting the ECM power supply that is providing power to the sensor, refer to the CID 0041 diagnostic code procedures in the troubleshooting section of the manual for the Implement ECM.

  Repair the faulty power supply circuit before proceeding with this procedure.

  STOP.

- NOT OK – The voltage measurement is not correct.

  Repair: If one of the voltage measurements is correct and the other voltage measurement is not correct, there is a problem in the ground circuit that registered the bad measurement. This condition will not cause this diagnostic code to activate. There is another problem that is causing this active diagnostic code. However, the ground circuit must be repaired before proceeding with this procedure.

  Do not operate the machine with only one ground connection for the right ACJ.

  Repair the faulty ground circuit or the power supply circuit before proceeding with this procedure.

  After repairing the faulty ground circuit, proceed to Test Step 2.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right ACJ. At the harness connectors for the ACJ, place a jumper wire between the ground contact J1-2 (wire A295-BK(Black)) and the signal contact J1-3 (wire T979-YL(Yellow)).

C. Disconnect machine harness connectors J1 of the Implement ECM and J2 from the Implement ECM.

D. At the harness connector for the ECMs, measure the resistance from return contact J1-45 (wire A295-BK(Black)) to signal contact J2-50 (wire T979-YL(Yellow)).

E. Observe the resistance measurement and wiggle the ECM connector and the sensor connector. Gently pull on the wires and wiggle the wires for both connectors.

Expected Result:

The resistance measurement is less than 5 ohms always during the manipulation of the wiring harness and connectors.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor signal circuit is not open in the machine harness.Proceed to Test Step 3.

- NOT OK – The resistance measurement for the signal circuit is greater than 5 ohms. There is an open or a bad connection in one of the circuits.

  Repair: Check the signal circuit for opens or for a bad connection.

  A resistance measurement that is greater than 5 ohms but less than 5000 ohms would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5000 ohms would indicate an open in the circuit.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor signal circuit or in the ground circuits. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SIGNAL CIRCUIT FOR A SHORT

The key start switch and the disconnect switch remain in the OFF position.

A. Remove the jumper wire that was installed in the last step.

B. At the J2 machine harness connector for the ECM, measure the resistance from the sensor signal contact J2-50 (wire T979-YL(Yellow)) to all the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The resistance measurements do not indicate a short in the circuit.Proceed to Test Step 4.

- NOT OK – A resistance measurement is less than 5000 ohms.

  Repair: There is a short in the machine harness. The short is between the signal circuit and the circuit with the low-resistance measurement.

  Refer to the complete Electrical System Schematic of the machine. Check all the connectors that are in the sensor circuit. Ensure that all connections are clean, that all connections are secure, and that all connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE SIGNAL AT THE SENSOR

The key start switch and the disconnect switch remain in the OFF position.

A. Inspect all the harness connectors for the ACJ and the ECM. Clean the contacts of the harness connectors and check the wires for damage to the insulation. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

B. At the machine harness connector J1 for the right ACJ, use a 151-6320 Removal Tool to remove the signal wire T979-YL(Yellow)and the socket at contact J1-3 from the harness connector. The machine harness connector J1 remains connected to the connector of the right ACJ.

C. At the back of the connectors J1 of the ACJ, insert 7X-1710 Multimeter Probes along the ground contact at J1-2 and the signal contact at J1-3.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor at the connector pins of the steering control between the contacts J1-2 and J1-3. Move the ACJ through the full range of the blade of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the cause of the problem. Reconnect the signal wire and the socket in the machine harness connector for the ACJ.Proceed to Test Step 5.
- NOT OK – The duty cycle of the sensor is not correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: Perform this test step again to verify that the sensor signal is not correct.

  If the position sensor for the blade right lift lever is not correct according to the description at the beginning of this procedure, replace the assembly of the right ACJ. After replacement of the assembly of the right ACJ, verify that the operation of the new assembly of the ACJ is correct before operating the machine.

  STOP.

Test Step 5. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Inspect the harness connectors. Clean the contacts of the harness connectors. Check the wires for damage to the insulation that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated. Observe that the clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 4387 FMI 03 diagnostic code is active.

Expected Result:

The CID 4387 FMI 03 diagnostic code is not active.

Results:

- OK – The CID 4387 FMI 03 diagnostic code is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation.

  STOP.

- NOT OK – The CID 4387 FMI 03 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Perform a Wiggle Test on the machine wiring harness with the Caterpillar Electronic Technician (Cat ET) service tool. The Wiggle Test can detect the following in the machine wiring harness:

  - Momentary shorts
  - Intermittent shorts
  - Opens

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact your Cat Dealership Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06511795

MID 082 - CID 4387 - FMI 04

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

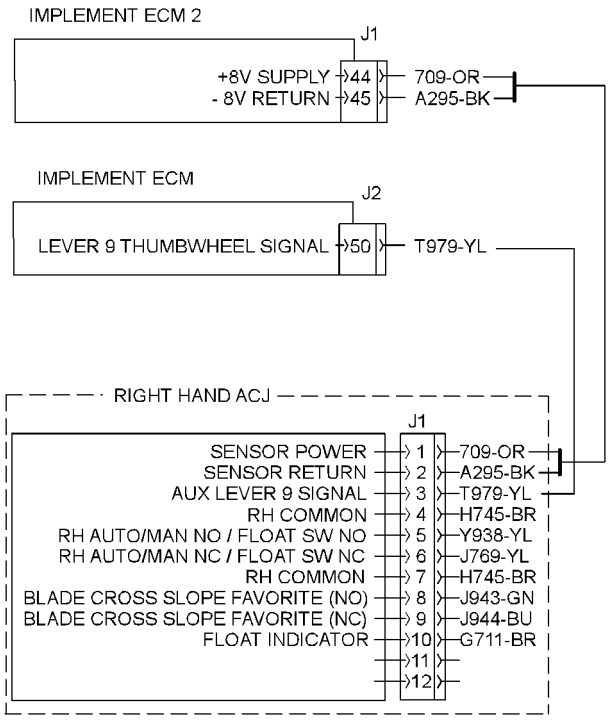


Illustration 534 g06003367

Connections of the Auxiliary Lever #9 Position on the right Advanced Control Joystick (ACJ) when configured for auxiliary hydraulic control.

This diagnostic code is recorded when the ECM reads the input signal from the auxiliary lever #9 position sensor and the voltage of the signal is above normal. The sensor is located in the right ACJ.

The auxiliary lever #9 position sensor receives power from the 8V power supply of the Implement ECM. The sensor is internally connected to the ground from the 8V sensor return for the Implement ECM. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right ACJ, refer to the Systems Operation, “Features” section of this manual.

Table 48

Duty Cycles For ACJ Thumbwheels When Used For Auxiliary Valve Control	
0 - 5%	Shorted Low
5- 45%	Valve Port A Modulation
45 - 55%	Center Position - No Command
55 - 100%	Shorted High/Open Circuit

The possible causes of this diagnostic code are listed:

- The signal circuit is shorted to ground.
- The sensor has failed.
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Inspect the connections for the following:

- Connections are clean.
- Connections are secure.
- Connections are in good condition.

Note: If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SENSOR

A. Turn the disconnect switch and the key start switch to the ON position.

B. Disconnect the machine harness connector J1 from the right ACJ. Observe the status of the active CID 4387 FMI 04 diagnostic code.

Expected Result:

The status of the CID 4387 FMI 04 diagnostic code did not change when the connector of the ACJ was disconnected. A CID 4387 FMI 03 diagnostic code has not been activated by the ECM. The CID 4387 FMI 04 diagnostic code remains active when the connector of the ACJ is disconnected.

Results:

- OK – The CID 4387 FMI 04 diagnostic code remains active when the connector of the ACJ is disconnected. The sensor is not causing the problem.Proceed to Test Step 2.

- NOT OK – The CID 4387 FMI 04 diagnostic code is no longer active when the connector of the ACJ is disconnected. A CID 4387 FMI 03 diagnostic code has been activated by the ECM when the connector of the ACJ is disconnected. The machine harness and the ECM are operating correctly.

  Repair: The position sensor is causing the problem. Replace the assembly of the right ACJ. After replacement of the assembly of the right ACJ, verify that the operation of the new assembly of the ACJ is correct before operating the machine.

  STOP.

Test Step 2. CHECK THE SIGNAL CIRCUIT FOR A SHORT TO GROUND

A. The connector for the ACJ J1 remains disconnected from the machine harness.

B. Turn the key start switch and the disconnect switch to the OFF position.

C. Disconnect the J1 and J2 machine harness connectors from the Implement ECM.

D. At machine harness connector J1 for the ECM, measure the resistance from contact J2-50 (wire T979-YL(Yellow)) to frame ground and measure the resistance to all the other J1 and J2 contacts that are used for the Implement ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The machine harness is correct. Proceed to Test Step 3.

- NOT OK – One or more of the resistance measurements are NOT correct.

  Repair: There is a short in the machine harness. The short is between the signal circuit and frame ground or the short is between the signal circuit and the circuit with the low-resistance measurement.

  Refer to the Electrical Schematic of the machine. Check all the connectors that are in the sensor circuit. Inspect the connections for the following:

  - Connections are clean.
  - Connections are secure.
  - Connections are in good condition.

  For information on testing for short circuits and finding short circuits, refer to Testing and Adjusting, “Wiring Harness (Short Circuit) - Test”. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform the following:

- Visually inspect the harness connectors.
- Clean the contacts of the harness connectors.
- Visually inspect the insulation of the wires for damage that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the sensor circuit.

C. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Determine if the CID 4387 FMI 04 diagnostic code is active.

Expected Result:

The CID 4387 FMI 04 diagnostic code is not active.

Results:

- OK – The CID 4387 FMI 04 diagnostic code is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation

  STOP.

- NOT OK – The CID 4387 FMI 04 diagnostic code is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Perform a Wiggle Test on the machine wiring harness with the Caterpillar Electronic Technician (Cat ET) service tool. The Wiggle Test can detect the following in the machine wiring harness:

  - Momentary shorts
  - Intermittent shorts
  - Opens

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your Cat Dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time.

  If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06512120

MID 082 - CID 4387 - FMI 08

SMCS Code: 5737-038-AX

Conditions Which Generate This Code:

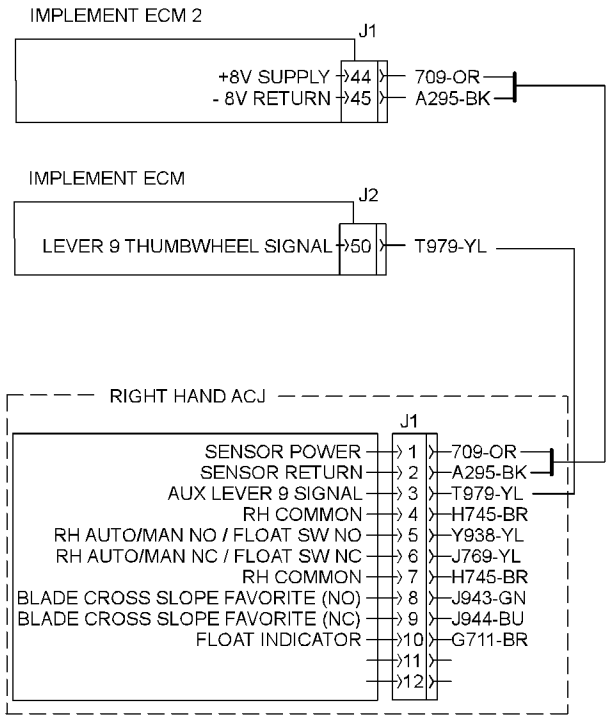


Illustration 535 g06003460

Connections of the Auxiliary Lever #9 Position on the right Advanced Control Joystick (ACJ) when configured for auxiliary hydraulic control.

This diagnostic code is recorded when the ECM reads the input signal from the auxiliary lever #9 position sensor and the voltage of the signal is above normal. The sensor is located in the right ACJ.

The auxiliary lever #9 position sensor receives power from the 8V power supply of the Implement ECM. The sensor is internally connected to the ground from the 8V sensor return for the Implement ECM. The illustration above indicates the power and ground connections for the position sensor.

Note: For a schematic of the internal power and ground assignments for each individual component in the right ACJ, refer to the Systems Operation, “Features” section of this manual.

Table 49

Duty Cycles For ACJ Thumbwheels When Used For Auxiliary Valve Control	
0 - 5%	Shorted Low
5- 45%	Valve Port A Modulation
45 - 55%	Center Position - No Command
55 - 100%	Shorted High/Open Circuit

The possible causes of this diagnostic code are listed below:

- The sensor has failed.
- Intermittent connections or poor connections
- The ECM has failed. An ECM failure is unlikely.

Note: Before performing this procedure, inspect the harness connectors that are involved in the circuit. Poor connections can often be the cause of a problem in an electrical circuit. Inspect the connections for the following:

- Connections are clean.
- Connections are secure.
- Connections are in good condition.

Note: If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Note: The following test procedure may create other diagnostic codes. Ignore these created diagnostic codes and clear the diagnostic codes when the problem has been corrected.

Test Step 1. CHECK THE SIGNAL AT THE SENSOR

A. Turn the key start switch and the disconnect switch to the OFF position.

B. At the connector of the right ACJ J1, use a 151-6320 Removal Tool to remove the signal wire and the socket at contact J1-3 (wire T979-YL(Yellow)) from the harness connector. The machine harness connector J1 remains connected to the connector of the right ACJ.

C. On the back of the ACJ connector J1, insert 7X-1710 Multimeter Probes along the sensor signal contact J1-3 and the ground contact at J1-2.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Measure the duty cycle of the sensor at the connector contacts of the ACJ J1-2 and J1-3. Move the ACJ through the full range of the sensor that is described at the beginning of this procedure.

Expected Result:

The duty cycle of the position sensor is correct according to the description at the beginning of this procedure.

Results:

- OK – The duty cycle of the sensor is correct. The sensor is not the problem.Proceed to Test Step 2.
- NOT OK – The duty cycle of the sensor is not correct according to the description at the beginning of this procedure. The sensor has failed.

  Repair: The position sensor is not operating correctly. Replace the assembly of the right ACJ. After right ACJ replacement, verify the operation of the new assembly. Verify that the ACJ is correct before operating the machine.

  STOP.

Test Step 2. CHECK FOR AN OPEN IN THE SENSOR CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connector J1 from the right ACJ. At the machine harness connector of the sensor J1, place a jumper wire between the ground contact J1-2 (wire A295-BK(Black)) and the signal contact J1-3 (wire T979-YL(Yellow)).

C. Disconnect machine harness connectors J1 and J2 from the Implement ECM.

D. At the harness connectors for the ECM, measure the resistance from return contact J1-45 (wire A295-BK(Black)) to signal contact J2-50 (wire T979-YL(Yellow)).

Expected Result:

The resistance measurement should be less than 5 ohms.

Results:

- OK – The resistance measurement is less than 5 ohms. The sensor circuit is not open.Proceed to Test Step 3.

- NOT OK – The resistance measurement is greater than 5 ohms. There is an open or a bad connection in the signal circuit.

  Repair: Refer to the Electrical Schematic of the machine. Check all the connectors that are in the sensor signal circuit and the return circuit. Inspect the connections for the following:

  - Connections are clean.
  - Connections are secure.
  - Connections are in good condition.

  Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Perform the following:

- Visually inspect the harness connectors.
- Clean the contacts of the harness connectors.
- Visually inspect the insulation of the wires for damage that is caused by excessive heat, battery acid, or chafing.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the circuit.

C. Reconnect all harness connectors. Verify the following:

- The connectors are fully seated.
- The clips for each connector are fastened.

D. Turn the disconnect switch and the key start switch to the ON position.

E. Operate the machine.

F. Check the status of the CID 4387 FMI 08.

Expected Result:

The CID 4387 FMI 08 is not active.

Results:

- OK – The CID 4387 FMI 08 is not active. The diagnostic code does not exist currently. The initial diagnostic code was probably caused by a poor connection or a short at one of the connectors that was disconnected and reconnected. Resume normal operation

  STOP.

- NOT OK – The CID 4387 FMI 08 is active. The diagnostic code has not been corrected.

  Repair: Check the circuit again. Perform a Wiggle Test on the machine wiring harness with the Caterpillar Electronic Technician (Cat ET) service tool. The Wiggle Test can detect the following in the machine wiring harness:

  - Momentary shorts
  - Intermittent shorts
  - Opens

  If the cause of the active diagnostic code is not found, the ECM that has activated this diagnostic code may have failed.

  An ECM failure is unlikely. Exit this procedure and perform this procedure again. If the cause of the failure is not found, replace the ECM. Prior to replacing an ECM, always contact your Cat Dealer Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM that activated the diagnostic code. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

i06194744

MID 082 - CID 4784 - FMI 03

SMCS Code: 7332-038-BG

Conditions Which Generate This Code:

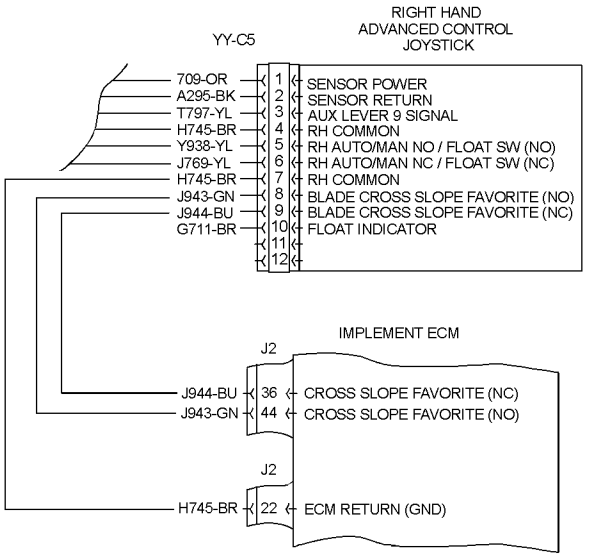


Illustration 536 g03845939

Schematic of the Push Button Switch (Blade Cross Slope Switch)

This diagnostic code is associated with the Push Button Switch (Blade Cross Slope Switch) located on the RH joystick. The switch is connected to two inputs of the ECM. One contact is open and the other contact is grounded during proper operation.

This FMI 03 diagnostic code means that the ECM has determined that the normally open contact and the normally closed contact are open.

Note: The following test procedure may create other diagnostic codes. Ignore these diagnostic codes and clear the diagnostic codes when the original diagnostic code has been corrected. **Ensure that the diagnostic code of CID 4784 FMI 03 is active before performing this procedure.**

Test Step 1. CHECK THE GROUND CIRCUIT OF THE SWITCH IN THE HARNESS.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness connectors from the ECM.

C. Measure the resistance between contact J2-22 (wire H745-BR(Brown)) of the machine harness for the ECM and contact 7 (wire H745-BR(Brown)) at the joystick connector.

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The circuit is correct.Proceed to Test Step 2.
- NOT OK – The resistance is greater than 5000 ohms. The circuit is open. The machine harness has failed.

  Repair: Repair the machine harness or replace the machine harness.

  STOP. STOP

Test Step 2. CHECK THE SWITCH CIRCUITS FOR A SHORT TO THE +BATTERY CIRCUIT.

A. The machine harness connectors remain disconnected from the ECM.

B. The disconnect switch and the key start switch remain in the OFF position.

C. Disconnect connector for the joystick from the connector of the machine harness.

D. At the machine harness connector for the ECM, measure the resistance from contact J2-36 (wire J944-BU(Blue)) and contact J2-44 (wire J943-GN(Green)) of the machine harness to all the contacts that are used in the machine harness connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- OK – Each resistance measurement is greater than 5000 ohms. The harness is correct.Proceed to Test Step 3.
- NO – One or more of the measurements were less than 5 ohms. There is a short in the machine harness.

  Repair: The short is between wire J943-GN(Green) and the circuit with the lowest resistance measurement or the short is between wire J944-BU(Blue) and the circuit with the lowest resistance measurement. Repair the machine harness or replace the machine harness.

  STOP. STOP

Test Step 3. CHECK THE SWITCH CIRCUITS IN THE HARNESS.

A. The machine harness remains disconnected from the ECM and the joystick.

B. At the harness connector for the joystick, connect a jumper wire between contact 8 (wire J943-GN(Green)) and contact 9 (wire J944-BU(Blue)).

C. At the harness connector for the ECM, measure the resistance from contact J2-36 (wire J944-BU(Blue)) to contact J2-44 (wire J943-GN(Green)).

Expected Result:

The resistance is less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms.Proceed to Test Step 4.
- NOT OK – The resistance is greater than 5000 ohms. The circuit is open.

Repair: The machine harness has failed. Repair the machine harness or replace the machine harness.

STOP. STOP

Test Step 4. CHECK THE OPERATION OF THE SWITCH.

A. Remove the jumper that was installed in the previous Test Step.

B. The machine harness remains disconnected from the joystick.

C. Connect one lead from a multimeter to contact 7 (wire H745-BR(Brown)) of the harness connector for the joystick.

D. Connect the other lead from a multimeter to contact 8 (wire J943-GN(Green)) of the harness connector for the joystick.

E. Measure the resistance between contact 7 (wire H745-BR(Brown)) and contact 8 (wire J943-GN(Green)). Note the resistance.

F. Disconnect the lead from contact 7 (wire H745-BR(Brown)) and connect the lead to contact 9 (wire J944-BU(Blue)).

G. Measure the resistance between contact 7 (wire H745-BR(Brown)) and contact 9 (wire J944-BU(Blue)).

Expected Result:

The resistance from contact 7 to contact 9 is less than 5 ohms. The resistance from contact 7 to contact 8 is greater than 5000 ohms.

Results:

- YES – The resistance from contact 7 to contact 9 is less than 5 ohms. The resistance from contact 7 to contact 8 is greater than 5000 ohms. The switch is operating correctly.Proceed to Test Step 5.
- NO – The resistance measurements do not differ for both contacts, or the measurements have not changed from the previous Test Step. The switch has failed.

  Repair: The switch is integrated into the joystick and cannot be serviced, therefore the joystick must be replaced in order to replace the switch.

  STOP. STOP

Test Step 5. CHECK THE OPERATION OF THE SWITCH.

A. The machine harness remains disconnected from the switch.

B. Press and hold the switch.

C. Connect one lead from a multimeter to contact 7 (wire H745-BR(Brown)) of the harness connector for the switch.

D. Connect the other lead from a multimeter to contact 8 (wire J943-GN(Green)) of the harness connector for the switch.

E. Measure the resistance between contact 7 (wire H745-BR(Brown)) and contact 8 (wire J943-GN(Green)). Note the resistance.

F. Disconnect the lead from contact 7 (wire H745-BR(Brown)) and connect the lead to contact 9 (wire J944-BU(Blue)).

G. Measure the resistance between contact 7 (wire H745-BR(Brown)) and contact 9 (wire J944-BU(Blue)).

Expected Result:

The resistance from contact 7 (wire H745-BR(Brown)) to contact 8 (wire J943-GN(Green)) is less than 5 ohms, and the resistance from contact 7 (wire H745-BR(Brown)) and contact 9 (wire J944-BU(Blue)) is greater than 5000 ohms. These measurements are opposite of the measurements from the previous Test Step.

Results:

- YES – The resistance from contact 7 to contact 8 is less than 5 ohms. The resistance from contact 7 and contact 9 is greater than 5000 ohms. These measurements are opposite of the measurements from the previous Test Step. The switch is operating correctly.Proceed to Test Step 6.
- NO – The resistance measurements do not differ for both contacts, or the measurements have not changed from the previous Test Step. The switch has failed.

  Repair: Replace the joystick in order to replace the switch.

  STOP. STOP

Test Step 6. CHECK IF THE DIAGNOSTIC CODE REMAINS.

A. Inspect the contacts of the harness connectors and clean the harness connectors.

B. Reconnect all the harness connectors.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Check the status of the CID 4794 FMI 03 diagnostic code.

Expected Result:

The CID 4784 FMI 03 diagnostic code is active.

Results:

- YES – The CID 4784 FMI 03 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: A failure of the ECM is unlikely. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 4784 FMI 03 diagnostic code is not active. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors. Resume normal machine operation.

  STOP. STOP

i06194779

MID 082 - CID 4784 - FMI 04

SMCS Code: 7332-038-BG

Conditions Which Generate This Code:

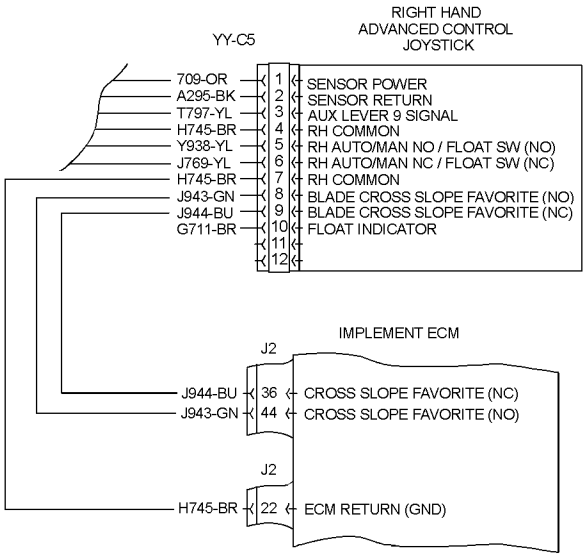


Illustration 537 g03846164

Schematic of the RH Advanced Control Joystick Push Button Switch (Blade Cross Slope Switch)

This diagnostic code is associated with the Push Button Switch (Blade Cross Slope Switch). The switch is connected to two inputs of the ECM. The inputs are “Normally Open” and “Normally Closed” . One of the inputs is open and the other input is grounded during proper operation.

The FMI 04 diagnostic code means that the ECM has determined that the “Normally Open” and “Normally Closed” circuits are grounded.

Note: The following test procedure may create other diagnostic codes. Ignore these diagnostic codes and clear these diagnostic codes when the original diagnostic code has been corrected.**Ensure that the diagnostic code of CID 4784 FMI 04 is active before performing this procedure.**

Test Step 1. CHECK THE SWITCH.

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness from the joystick.

C. Turn the key start switch and the disconnect switch to the ON position.

Expected Result:

The CID 4784 FMI 04 diagnostic code has been replaced by a CID 4784 FMI 03 diagnostic code.

Results:

- OK – The CID 4784 FMI 04 diagnostic code has been replaced by a CID 4784 FMI 03 diagnostic code. The machine harness and the ECM are correct.Proceed to Test Step 3.
- NOT OK – The CID 4784 FMI 04 diagnostic code is still active.Proceed to Test Step 2.

Test Step 2. CHECK THE HARNESS.

A. Turn the disconnect switch and the key start switch to the OFF position.

B. The machine harness remains disconnected from the joystick.

C. Disconnect the machine harness connectors from the ECM.

D. Measure the resistance between contacts J2-44 (wire J943-GN(Green)) and J2-36 (wire J944-BU(Blue)) of the machine harness to all the contacts that are used in machine harness connectors for the ECM.

Expected Result:

Each resistance measurement is greater than 5000 ohms.

Results:

- YES – Each resistance measurement is greater than 5000 ohms. The ECM has failed.

  Repair: A failure of the ECM is unlikely. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP. STOP

- NO – One or more of the resistance measurements are less than 5 ohms. The harness has failed. The short is between J2-44 (wire J943-GN(Green)) and the circuit with the lowest resistance or the short is between J2-36 (wire J944-BU(Blue)) and the circuit with the lowest resistance.

  Repair: Repair the wiring harness or replace the wiring harness.

  STOP. STOP

Test Step 3. CHECK THE OPERATION OF THE SWITCH.

A. The machine harness remains disconnected from the joystick.

B. Connect one lead from a multimeter to contact 7 (wire H745-BR(Brown)) of the harness connector for the joystick.

C. Connect the other lead from a multimeter to contact 8 (wire J943-GN(Green)) of the harness connector for the joystick.

D. Measure the resistance between contact 7 (wire H745-BR(Brown)) and contact 8 (wire J943-GN(Green)). Note the resistance.

E. Disconnect the lead from contact 8 (wire J943-GN(Green)) and connect the lead to contact 9 (wire J944-BU(Blue)).

F. Measure the resistance between contact 7 (wire H745-BR(Brown)) and contact 9 (wire J944-BU(Blue)).

Expected Result:

The resistance from contact 7 (wire H745-BR(Brown)) to contact 9 (wire J944-BU(Blue)) is less than 5 ohms, and the resistance from contact 7 (wire H745-BR(Brown)) to contact 8 (wire J943-GN(Green)) is greater than 5000 ohms.

Results:

- YES – The resistance from contact 7 (wire H745-BR(Brown)) to contact 9 (wire J944-BU(Blue)) is less than 5 ohms, and the resistance from contact 7 (wire H745-BR(Brown)) to contact 8 (wire J943-GN(Green)) is greater than 5000 ohms.Proceed to Test Step 4.
- NO – The resistance measurements do not differ. The switch has failed.

  Repair: The switch is integrated into the joystick and cannot be independently repaired, therefore the joystick must be replaced.

  STOP. STOP

Test Step 4. CHECK THE OPERATION OF THE SWITCH ON THE JOYSTICK.

A. The machine harness remains disconnected from the joystick.

B. Press and hold the switch.

C. Connect one lead from a multimeter to contact 7 (wire H745-BR(Brown)) of the harness connector for the joystick.

D. Connect the other lead from a multimeter to contact 8 (wire J943-GN(Green)) of the harness connector for the joystick.

E. Measure the resistance between contact 7 (wire H745-BR(Brown)) and contact 8 (wire J943-GN(Green)). Note the resistance.

F. Disconnect the lead from contact 8 (wire J943-GN(Green)) and connect the lead to contact 9 (wire J944-BU(Blue)).

G. Measure the resistance between contact 7 (wire H745-BR(Brown)) and contact 9 (wire J944-BU(Blue)).

Expected Result:

The resistance from contact 7 (wire H745-BR(Brown)) to contact 8 (wire J943-GN(Green)) is less than 5 ohms, and the resistance from contact 7 (wire H745-BR(Brown)) and contact 9 (wire J944-BU(Blue)) is greater than 5000 ohms. These measurements are opposite of the measurements from the previous Test Step.

Results:

- YES – The resistance from contact 7 (wire H745-BR(Brown)) to contact 8 (wire J943-GN(Green)) is less than 5 ohms, and the resistance from contact 7 (wire H745-BR(Brown)) and contact 9 (wire J944-BU(Blue)) is greater than 5000 ohms. These measurements are opposite of the measurements from the previous Test Step. The switch is operating correctly.Proceed to Test Step 5.
- NO – The resistance measurements do not differ for both contacts, or the measurements have not changed from the previous Test Step. The switch has failed.

  Repair: Replace the joystick.

  STOP. STOP

Test Step 5. CHECK IF THE DIAGNOSTIC CODE REMAINS.

A. Inspect the contacts of the harness connectors and clean the connectors.

B. Reconnect all harness connectors.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if CID 4784 FMI 04 diagnostic code is present.

Expected Result:

The CID 4784 FMI 04 diagnostic code is active.

Results:

- YES – The CID 4784 FMI 04 diagnostic code is active. The diagnostic code has not been corrected. The ECM may have failed.

  Repair: A failure of the ECM is unlikely. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP. STOP
- NO – The CID 4784 FMI 04 diagnostic code is not active. The diagnostic code is NOT present. The diagnostic code does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors. Resume normal machine operation.

  STOP. STOP

i04814847

MID 145 - CID 0168 - FMI 01

SMCS Code: 1406-038

Conditions Which Generate This Code:

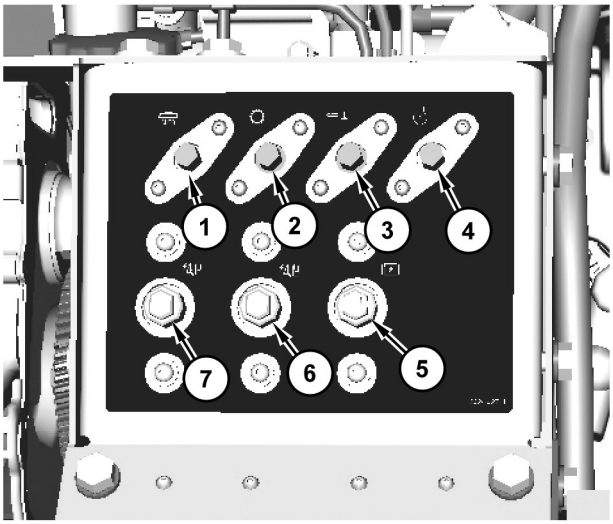


Illustration 538 g01323933

The Circuit Breaker Box is located on left side of machine behind the Cab.

(1) Accugrade Breaker (20 Amp)
(2) Transmission Control Breaker (15 Amp)
(3) Key Switch Breaker (15 Amp)
(4) Engine Control Breaker (20 Amp)
(5) Alternator Breaker (150 Amp)
(6) Load Breaker (80 Amp)
(7) Main Breaker (80 Amp)

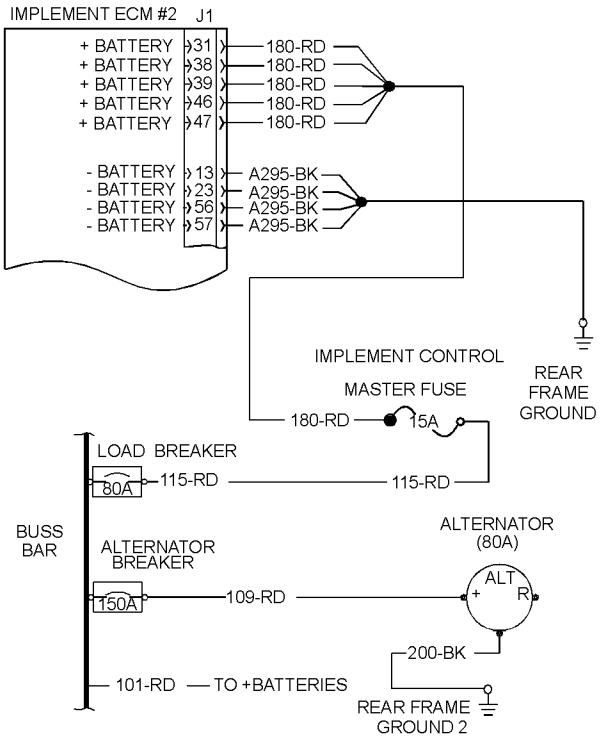


Illustration 539 g01448709

System Voltage connections

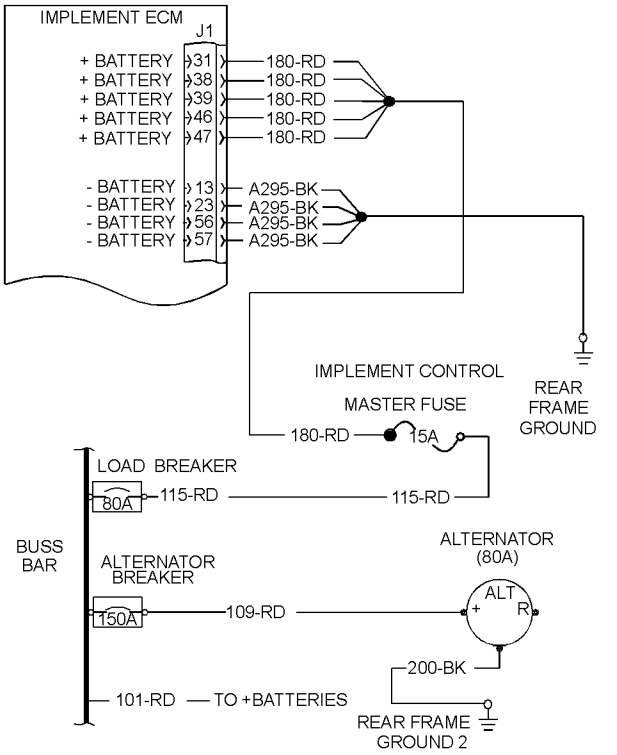


Illustration 540 g01284928

This diagnostic code is associated with the system voltage of the machine that is supplied to the Implement ECM 2. The FMI 01 diagnostic code indicates that the ECM detects that the system voltage is below normal. The ECM activates this diagnostic code when the system voltage is below 18.0 VDC.

The possible causes of this diagnostic code are listed below:

- An open circuit connection or a poor system ground circuit connection.
- An open circuit or a poor connection in the system voltage supply circuit.
- A charging system component has failed.
- The ECM has failed, however ECM failure is unlikely.

Note: Before performing this procedure, verify that all circuit breakers and fuses in the charging circuit and the machine supply circuit of the ECM are closed. If a problem with a circuit breaker or a fuse is found, correct the problem and verify that this diagnostic code is active before performing this procedure.

Test Step 1. CHECK THE SYSTEM VOLTAGE OF THE ECM

A. Turn the disconnect switch and the key start switch to the OFF position.

B. At the J1 harness connector for the Implement ECM, insert a7X-1710 Multimeter Probe along the contact of the system power J1-31 (wire 180-RD(Red)). Use the other multimeter probe to make contact to frame ground.

C. Turn the disconnect switch to the ON position.

D. Start the engine and run the engine at half throttle.

E. Measure the voltage between contact J1-31 (wire 180-RD(Red)) and frame ground.

F. At the J1 harness connector for the Implement ECM, insert the 7X-1710 Multimeter Probe that was used for the ground (frame) contact along the negative battery contact of the system power J1-15 (wire A295-BK(Black)).

G. Measure the voltage between contact J1-31 (wire 180-RD(Red)) and contact J1-15 (wire A295-BK(Black)).

Expected Result:

Both voltage measurements are approximately the same and both voltage measurements are in the range of 18.0 VDC to 32.0 VDC.

Results:

- OK – Each voltage measurement is approximately the same and each voltage measurement is in the range of 18.0 VDC to 32.0 VDC. The system voltage is correct.Proceed to Test Step 6.
- NOT OK – Each voltage measurement is approximately the same, however, the measurements are less than 18.0 VDC. The system voltage is below normal.Proceed to Test Step 4.
- NOT OK – The measurement from the positive battery contact to frame ground is in the range of 18.0 VDC to 32.0 VDC, however, the measurement between the ECM positive battery contact and the ECM negative battery contact is not in the correct range. The ground circuit may have failed.Proceed to Test Step 2.

Test Step 2. CHECK THE GROUND CIRCUIT

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Disconnect the machine harness J1 connector from the ECM.

C. At the J1 harness connector for the ECM, measure the resistance between each of the four negative battery contacts and frame ground. The contacts for the four negative battery connections are illustrated in the connection diagram at the beginning of this procedure.

Expected Result:

Each resistance measurement is less than 5.0 ohms.

Results:

- OK – Each resistance measurement is less than 5.0 ohms. The ground circuit is correct.Proceed to Test Step 3.
- NOT OK – One or more of the resistance measurements is greater than 5.0 ohms. There is an open circuit or a poor connection in the ground circuit.

  Repair: The open or the possible poor connection is in the ground circuit of the ECM (wire A295-BK(Black)) in the machine wiring harness. Refer to the complete Electrical System Schematic of the machine. Check the rear frame ground connection point where wire A295-BK(Black) is connected. Ensure that the ground connection is clean, that the ground connection is tight and that the ground connection is in good condition. Check all of the connectors and splice points that are in the ground circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 3. CHECK THE SUPPLY CIRCUITS

The key start switch and the disconnect switch remain in the OFF position. The machine harness J1 connector remains disconnected from the ECM.

A. At the J1 harness connector for the ECM, using a length of spare wire, measure the resistance between the alternator “B” terminal (wire 109-RD(Red)) to each of the five positive battery contacts that are connected to the J1 harness connector. The contacts for the five positive battery connections are illustrated in the connection diagram at the beginning of this procedure.

Expected Result:

Each resistance measurement is less than 5.0 ohms.

Results:

- OK – Each resistance measurement is less than 5.0 ohms. The supply circuit is correct. Reconnect the J1 machine harness connector to the ECM before proceeding to the next test step.Proceed to Test Step 4.
- NOT OK – One or more of the resistance measurements is greater than 5.0 ohms. There is an open circuit or a poor connection in the supply circuit.

  Repair: The open or the possible poor connection is in the supply circuit for the ECM system voltage (wire 180-RD(Red) within the machine wiring harness. Verify that there are no open circuit breakers or fuses in the circuit.

  Refer to the complete Electrical System Schematic of the machine. Check all of the connectors and splice points that are in the supply circuit. Ensure that all connections are clean, that all connections are secure and that all connections are in good condition. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE CURRENT OUTPUT OF THE ALTERNATOR

A. Before performing this test step, partially discharge the batteries. Partially discharging the batteries can be done by cranking the engine for approximately 30 seconds without starting the engine. Partially discharging the batteries can also be done by turning on the lights for about 10 minutes without running the engine.

B. Turn the disconnect switch and the key start switch to the OFF position.

C. At the alternator, connect multimeter probes between the alternator “B” terminal (wire 109-RD(Red)) and the alternator case (frame ground).

D. Connect a clamp on 225-8266 Ammeter Tool Gp or an equivalent ammeter around the output wire 109-RD(Red).

E. Turn the disconnect switch to the ON position.

F. Start the engine.

G. Run the engine at approximately half throttle.

H. Immediately check the output current of the alternator.

Expected Result:

The output current of the alternator at half throttle is approximately 40 amps, half the alternator full current output rating (80 Amps).

Results:

- YES – The output current of the alternator at half throttle is approximately 40 amps. Proceed to Test Step 5.
- NO – The output current of the alternator at half throttle is not approximately 40 amps. The current output of the alternator is not correct.

  Repair: Refer to Service Manual, SENR4130 for brushless alternators for further testing and repair procedures for the alternator.

  STOP.

Test Step 5. CHECK THE OUTPUT VOLTAGE OF THE ALTERNATOR

The multimeter and the ammeter are still connected from the prior test step. The engine is running.

A. Run the engine for approximately 10 minutes at half throttle.

B. Check the voltage at the alternator output, terminal “B” .

Expected Result:

The voltage measurement is 28.0 ± 1.0 VDC.

Results:

- YES – The voltage measurement is 28.0 ± 1.0 VDC. The voltage output of the alternator is correct. Proceed to Test Step 6.
- NO – The voltage is less than 18.0 VDC.

  Repair: Refer to the complete Electrical System Schematic for your machine. Check all connections that are in the charging circuit. Ensure that all ground connections are clean, that all connections are tight and that all connections are in good condition.

  If a problem is not found in the machine harness or connection points, refer to Service Manual, SENR4130 for brushless alternators for further testing and repair procedures for the alternator.

  STOP.

Test Step 6. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn the disconnect switch and the key start switch to the OFF position.

B. Reconnect any harness connectors that were disconnected.

C. Turn the disconnect switch and the key start switch to the ON position.

D. Operate the machine.

E. Determine if the CID 0168 FMI 01 diagnostic code is active.

Expected Result:

The CID CID 0168 FMI 01 diagnostic code is active.

Results:

- YES – The CID 0168 FMI 01 diagnostic code is active.

  Repair: Perform this procedure again. Confirm that the measurements of the alternator output are correct. Verify that the circuit connections for the system voltage are in good condition and that the connections are tight.

  If the problem remains and no cause can be found, the ECM may have failed.

  However, ECM failure is unlikely. Verify that all possible causes of the diagnostic code have been investigated. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The CID 0168 FMI 01 diagnostic code is not active. The problem does not exist at this time.

  Repair: The initial diagnostic code was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

  STOP.

i02911064

MID 145 - CID 0248 - FMI 09

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

CAT DATA LINK

The CID 0248 FMI 09 diagnostic code is used by the Implement ECM 2 as a “companion code” that is activated simultaneously with another diagnostic code from a control module in order to indicate that the Cat Data Link has an abnormal condition.

The FMI 09 will match the FMI 09 that is activated for the diagnostic code from the control module. The FMI 09 means that the Implement ECM 2 has lost all communication with the other control module.

The CID 0248 FMI 09 diagnostic code will never be activated by the Implement ECM 2 as a stand-alone diagnostic code. The Implement ECM 2 will only activate the CID 0248 FMI 09 diagnostic code along with one of the following module communication codes:

CID 0296 FMI 09 – Transmission/Chassis ECM

CID 0588 FMI 09 – Monitoring System

CID 0590 FMI 09 – Engine ECM

CID 1558 FMI 09 – Implement ECM 2

CID 2143 FMI 09 – Implement ECM 3

For example, if the Implement ECM 2 detects that no communication is being received from the Transmission/Chassis ECM over the Cat data link, the Implement ECM 2 will simultaneously activate a CID 0296 FMI 09 (Transmission/Chassis ECM) diagnostic code and a CID 0248 FMI 09 (Cat Data Link) diagnostic code.

If the Implement ECM 2 did not activate the companion diagnostic code CID 0248 FMI 09 along with the control module code, the technician would not know which data link circuit (Cat Data Link or J1939 Data Link) is involved.

When the CID 0248 FMI 09 diagnostic code is activated by the Implement ECM 2, always look for one of the diagnostic codes from the control module that are listed above in order to troubleshoot the problem.

Perform the following procedure when the CID 0248 FMI 09 diagnostic code is activated. Verify that the CID 0248 FMI 09 diagnostic code is active before performing this procedure.

A. The CID 0248 FMI 09 diagnostic code for the Cat Data Link is active. Look for one of the active diagnostic codes from the control module that is listed at the beginning of this procedure.

Expected Result:

One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

Results:

- YES – One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

  Repair: Go to the troubleshooting procedure for the active control module CID FMI diagnostic code. Perform the troubleshooting procedure for the Cat data link circuit that is detailed for the control module in order to isolate the problem.

  STOP.

i02911071

MID 145 - CID 0248 - FMI 14

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

CAT DATA LINK

The CID 0248 FMI 14 diagnostic code is used by the Implement ECM 2 as a “companion code” that is activated simultaneously with another diagnostic code from a control module in order to indicate that the CAT data link has an abnormal condition.

The FMI 14 will match the FMI 14 that is activated for the diagnostic code of the control module. The FMI 14 diagnostic code means that the Implement ECM 2 is communicating with the other control module, however, the Implement ECM 2 is not receiving all of the expected information.

The CID 0248 FMI 14 diagnostic code will never be activated by the Implement ECM 2 as a stand-alone diagnostic code. The Implement ECM 2 will only activate the CID 0248 FMI 14 diagnostic code along with one of the following module communication codes:

CID 0296 FMI 14 – Transmission/Chassis ECM

CID 0588 FMI 14 – Monitoring System

CID 0590 FMI 14 – Engine ECM

For example, if the Implement ECM 2 detects that some expected operating parameter information is not being received from the Transmission/Chassis ECM over theCAT Data Link, the Implement ECM 2 will simultaneously activate a CID 0296 FMI 14 (Transmission/Chassis ECM) diagnostic code and a CID 0248 FMI 14 (CAT Data Link) diagnostic code.

If the Implement ECM 2 did not activate the companion diagnostic code CID 0248 FMI 14 along with the control module code, the technician would not know which data link circuit (Cat Data Link or J1939 Data Link) is involved.

When the CID 0248 FMI 14 diagnostic code is activated by the Implement ECM 2, always look for one of the diagnostic codes from the control module that are listed above in order to troubleshoot the problem.

Perform the following procedure when the CID 0248 FMI 14 diagnostic code is activated. Verify that the CID 0248 FMI 14 diagnostic code is active before performing this procedure.

A. The CID 0248 FMI 14 diagnostic code for the CAT Data Link is active. Look for one of the diagnostic codes from the active control module that is listed at the beginning of this procedure.

Expected Result:

One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

Results:

- YES – One of the diagnostic codes from the control module that is listed at the beginning of this procedure is active.

  Repair: Go to the troubleshooting procedure for the active control module CID FMI diagnostic code. Perform the troubleshooting procedure for theCAT Data Link circuit that is detailed for the control module in order to isolate the problem.

  STOP.

i02911120

MID 145 - CID 0650 - FMI 02

SMCS Code: 1408-038

Conditions Which Generate This Code:

This diagnostic code is recorded when the Power train ECM does not recognize the harness code that is received from the Caterpillar Monitoring System on the data link (wires 944-OR(Orange) and 945-BR(Brown)).

Note: Ensure that the diagnostic code is active and that the diagnostic code indicator is active.

Test Step 1. Check the Monitoring System.

A. Check the monitor for a related diagnostic code. Refer toTroubleshooting, “Using Caterpillar Monitoring System to Determine Diagnostic Codes”.

Expected Result:

The monitor should not have a related diagnostic code.

Results:

- YES – The monitor does not have a related diagnostic code.

  Repair: Perform the troubleshooting procedure for the diagnostic code (CID 248 FMI 02) for the data link.

  STOP.

- NO – The monitor has a related diagnostic code.

  Repair: Correct the related diagnostic code. Proceed to test step 2.

Test Step 2. Recheck for the Diagnostic Code.

A. Check if the diagnostic code indicator remains active for this diagnostic code.

Expected Result:

The diagnostic code indicator is inactive.

Results:

- YES – The diagnostic code indicator is inactive.

  Repair: Clear the diagnostic code. Watch for a recurrence of this diagnostic code.

  STOP.

- NO – The diagnostic code indicator is active.

  Repair: It is unlikely that the power train ECM has failed. Perform this test procedure again. If the cause of the problem is not found, replace the power train ECM. Refer to Testing and Adjusting, “Electronic Control Module (Power Train) - Replace”.

  STOP.

i02911133

MID 145 - CID 1326 - FMI 02

SMCS Code: 1408-038

Conditions Which Generate This Code:

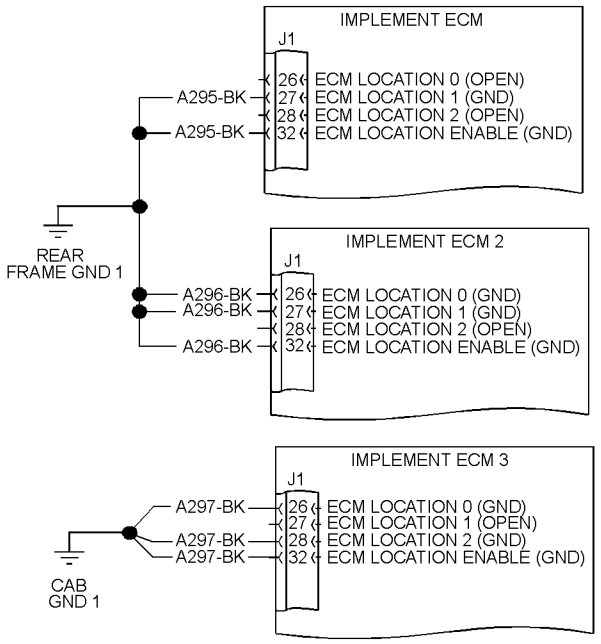


Illustration 541 g01301801

Location Code connections

This diagnostic code is recorded when the software location code for the Implement ECM 2 does not match the hard wired location codes.

The probable cause of this diagnostic code is software. The wrong software has been flashed into the ECM. A short to a ground source in one of the location code circuits in the machine harness could also cause this diagnostic code to activate.

Note: Do not change the hard wired location code if you have flashed the incorrect software into the control.

Note: For help with the verification of the correct location codes, in the Cat ET status screen, the “actual” location code and the “desired” location code for each ECM on the machine can be displayed.

Test Step 1. VERIFY HARDWARE AND SOFTWARE PART NUMBERS

A. Verify whether the part number of the software for the ECM is correct.

Expected Result:

Contact the Business Unit that is producing the product for the correct configuration for the machine.

Results:

- OK – All part numbers are correct for the ECM. Proceed to Test Step 2.
- NOT OK – All part numbers are NOT correct. The installed ECM has the wrong part number or incorrect configuration software is installed.

  Repair: Replace the ECM with a module that has the correct part number or flash the correct configuration software. See Troubleshooting, “Electronic Control Module - Flash Program”.

  STOP.

Test Step 2. VERIFY THAT THE LOCATION CODE MATCHES THE CAT ET STATUS SCREEN

A. Check the CAT ET status screen in order to verify the location code . The codes are listed below:

Implement ECM 2
Implement ECM 2 3
Implement ECM 3 5

Expected Result:

The location codes in the CAT ET diagnostic screen are correct.

Results:

- OK – The location codes in the CAT ET diagnostic screen are correct.Proceed to Test Step 3.
- NOT OK – The location codes are NOT correct.

  Repair: Repeat this test step in order to verify that the software and hardware part numbers are correct.
  Proceed to Test Step 3 if the part numbers are correct.

Test Step 3. INSPECT HARNESS CONNECTIONS

A. Turn the key start switch and the disconnect switch to the OFF position.

B. Inspect the harness connections that are related to the location codes. Make sure that the connectors are clean. Make sure that the connectors are tight.

C. Check for the proper mating of the connector.

D. Check all wires at the connector.

E. Check each wire for nicks. Check each wire for signs of abrasion in the insulation.

F. Check for moisture at the connector.

G. Check for dirty contacts or corroded contacts.

H. Check each pin and check each socket.

Expected Result:

The machine harness connectors are tight and the machine harness connectors are free of corrosion.

Results:

- OK – The machine harness connectors are tight and the machine harness connectors are free from corrosion.Proceed to Test Step 4.
- NOT OK – One or more of the machine harness connectors are in need of repair.

  Repair: Repair the connector and verify that all connections are correct before reconnecting to the mating connector. After the connector is repaired, verify that the problem has been corrected before operating the machine.

  STOP.

Test Step 4. CHECK FOR A SHORT TO GROUND

A. The disconnect switch and the key start switch remain in the OFF position.

B. Disconnect the machine harness connector from the ECM.

C. At the machine harness for the ECM, measure the resistance between the frame ground and the J1 contacts of the location code.

Expected Result:

The resistance that is measured is greater than 5 ohms at contacts J1-26 and J1-28. The resistance measures less than 5 ohms at contacts J1-27 and J1-32.

Results:

- OK – The resistance measurements are correct. The harness circuit is correct.Proceed to Test Step 5.
- NOT OK – One or more of the resistance measurements is NOT correct. The machine harness has failed.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

Test Step 5. CHECK FOR AN OPEN HARNESS

A. The disconnect switch and the key start switch remain in the OFF position. The ECM remains disconnected from the machine harness.

B. At the machine harness for the ECM, measure the resistance between the frame ground and J1-27.

C. At the machine harness for the ECM, measure the resistance between the frame ground and J1-32.

Expected Result:

The resistance measurements are less than 5 ohms.

Results:

- OK – The resistance measurements are less than 5 ohms. The location code circuit is correct. The ECM may have failed.

  Repair: Check the location code circuit again. Use the Caterpillar Electronic Technician (ET) service tool, if available, in order to perform a wiggle test on the machine wiring harness. The wiggle test can detect momentary or intermittent shorts or opens in the machine wiring harness.

  If the cause of the problem can not be found, The ECM may have failed. Prior to replacing an ECM, always contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the cause of the diagnostic code is not found, replace the ECM. Refer to Troubleshooting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NOT OK – The resistance is greater than 5 ohms. The machine harness has failed.

  Repair: Repair the machine harness or replace the machine harness.

  STOP.

i02911156

MID 145 - CID 1960 - FMI 09

SMCS Code: 7631-038

Conditions Which Generate This Code:

This diagnostic code is recorded when the Implement ECM 2 does not receive expected information from the key reader over the data link.

Note: The Machine Security System (MSS) must be installed in order for this diagnostic code to be logged.

Test Step 1. CHECK THE ET SCREENS.

A. Check the active diagnostic screen and the logged diagnostic screen for a communication error between the machine ECM and the key reader.

Expected Result:

The electronic technician reports code CID 1960 FMI 09 as being active, or the diagnostic code has been logged.

Results:

- YES – The electronic technician reports code CID 1960 FMI 09 as being active, or the diagnostic code has been logged.

  Repair: Troubleshoot the connections on the CAN data link between the key reader and the Implement ECM 2.

  Proceed to Test Step 2.

- NO – The diagnostic code has NOT been logged or the diagnostic is NOT active.Proceed to Test Step 3.

Test Step 2. CHECK THE TERMINATING RESISTORS

A. Disconnect the J2 harness connector for the ECM from the Implement ECM 2.

B. Measure the resistance between J2-67 (CAN A +) and J2-68 (CAN A -) on the machine harness connector for the power train ECM.

Expected Result:

The resistance is approximately 60 ± 3 Ohms.

Results:

- OK – The resistance is within the range.Proceed to Test Step 3.
- Not OK – The resistance is approximately 120 ± 6 Ohms. A terminating resistor is missing or damaged.

  Repair: If a termination resistor is missing, install the missing resistor. If both resistors are present, measure the resistance between pin A and pin B of each termination resistor. The resistance should measure 120 ± 3 Ohms. Replace the termination resistor if the resistance is not 120 ± 3 Ohms.

  Refer to the schematic in order to determine the missing resistor.

  Verify that the repair eliminates the problem.

  STOP.

Test Step 3. CHECK FOR POWER TO THE KEY READER.

A. With the keyswitch in the ON position, check for system voltage between contact 3 and contact 4 of the key reader.

Expected Result:

The voltage that is measured is approximately system voltage.

Results:

- YES – The voltage that is measured is approximately system voltage. The voltage is correct.Proceed to Test Step 5.
- NO – System voltage is NOT present. The wiring harness has failed.

  Repair: Check the wiring harness for signs of damage. Repair the machine harness or replace the machine harness.

  STOP.

Test Step 4. CHECK THE CAN DATA LINK WIRING OF THE MACHINE HARNESS FOR AN OPEN CIRCUIT.

A. Disconnect the J2 harness connector from the Implement ECM 2.

B. On the end of the harness that is near the key reader, install a jumper wire between contact 3 and contact 4.

C. At the J2 of the Implement ECM 2, measure the resistance between contact 67 and contact 68 of the connector for the Implement ECM 2.

Expected Result:

The resistance is greater than 5000 ohms.

Results:

- YES – The resistance is greater than 5000 ohms between contact 3 and contact 4. The wiring for the CAN data link between the ECM and the key reader is not correct.

  Repair: Check the wiring harness for signs of damage. Repair the machine harness or replace the machine harness.

  STOP.

- NO – The resistance is less than 5 ohms between contact 3 and contact 4. The wiring is correct. Proceed to Test Step 5.

Test Step 5. CHECK THE CAN DATA LINK WIRING OF THE MACHINE HARNESS FOR A SHORT TO GROUND.

A. The wiring harness connector for the key reader and the Implement ECM 2 remain disconnected.

B. The jumper wire remains installed.

C. Measure the resistance between contact 67 of connector J2 on the Implement ECM 2 and frame ground.

D. Measure the resistance between contact 68 of connector J2 of the Implement ECM 2 and frame ground.

Expected Result:

The resistance is greater than 5000 ohms.

Results:

- YES – The resistance is greater than 5000 ohms. The resistance is correct.Proceed to Test Step 6.

- NO – The resistance is less than 5 ohms. The wiring harness is shorted to the ground.

  Repair: Check the wiring harness for signs of damage. Repair the transmission harness or replace the transmission harness.

  STOP.

Test Step 6. CHECK THE CAN DATA LINK WIRING OF THE TRANSMISSION HARNESS FOR A SHORT TO + BATTERY.

A. The wiring harness connector for the key reader and the Implement ECM 2 remain disconnected.

B. The jumper wire remains installed.

C. Measure the resistance between contact 67 of connector J2 of the Implement ECM 2 and + battery.

D. Measure the resistance between contact 68 of connector J2 of the Implement ECM 2 and + battery.

Results:

- YES – The resistance is greater than 5000 ohms. The resistance is correct.

  Repair: The key reader or the Implement ECM 2 has failed. It is unlikely that the key reader or the Implement ECM 2 has failed. Perform the previous Test Steps again. If the cause of the problem is not found, replace the key reader and test again. If the problem still exists, replace the Implement ECM 2. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

  STOP.

- NO – The resistance is less than 5 ohms. The wiring harness is shorted to the + battery circuit.

  Repair: Check the wiring harness for signs of damage. Repair the transmission harness or replace the transmission harness.

  STOP.

Diagnostic System Procedures

i02627796

Power Supply Circuit of Electronic Control Module

SMCS Code: 1417-038-EK2; 1420-038-EK2

System Operation Description:

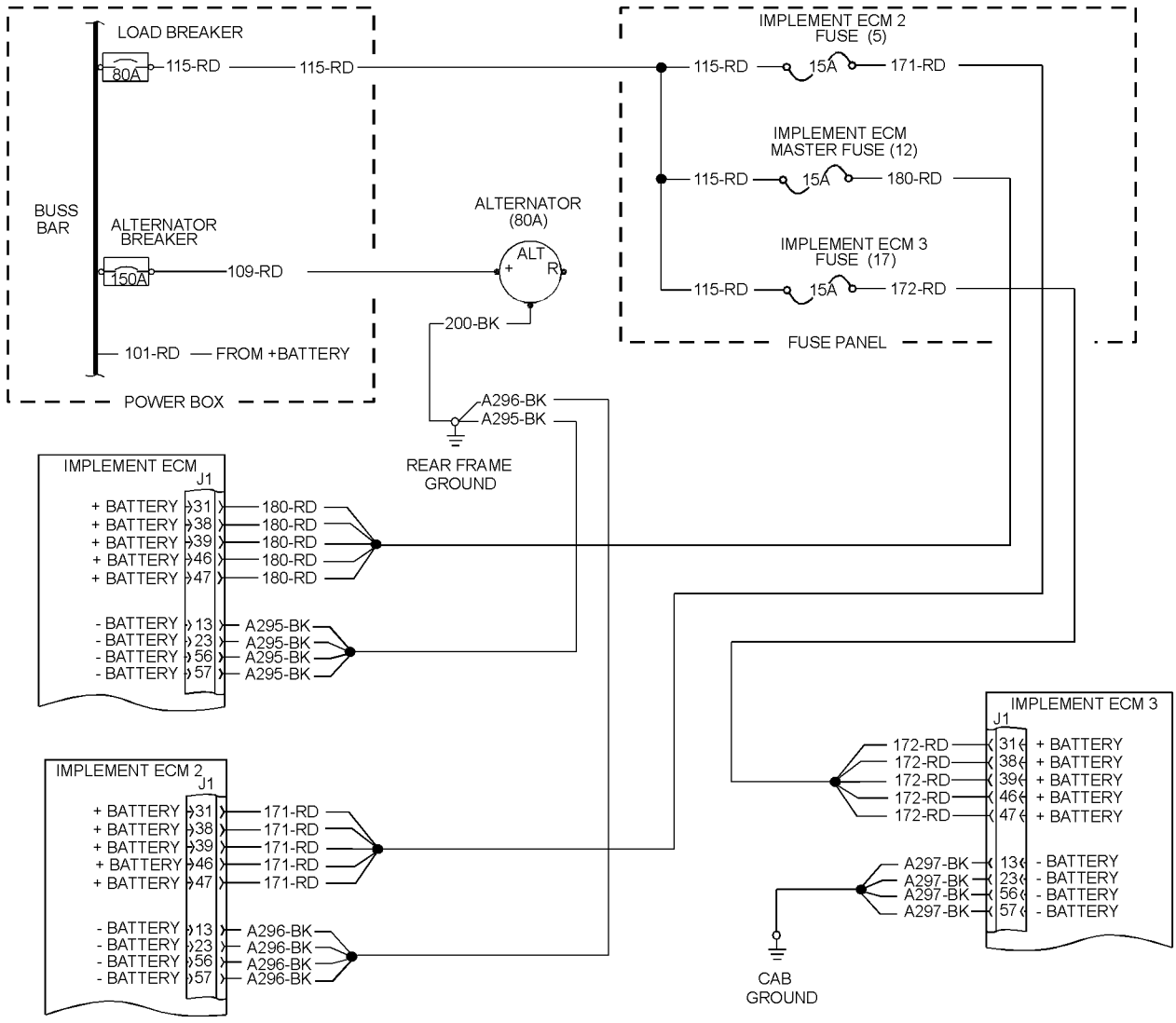


Illustration 542 g01317479

Implement ECM Power and Ground connections

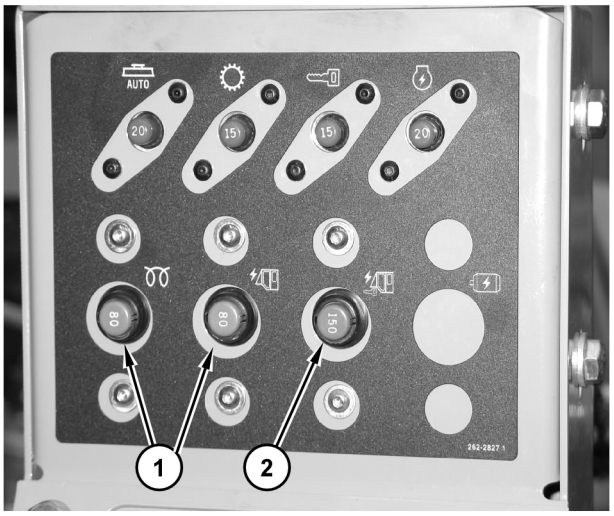


Illustration 543 g01331105

Circuit Breaker Panel located behind the door on left side of machine behind the cab

(1) Circuit breakers for the fuse panels buss
(2) Alternator breaker

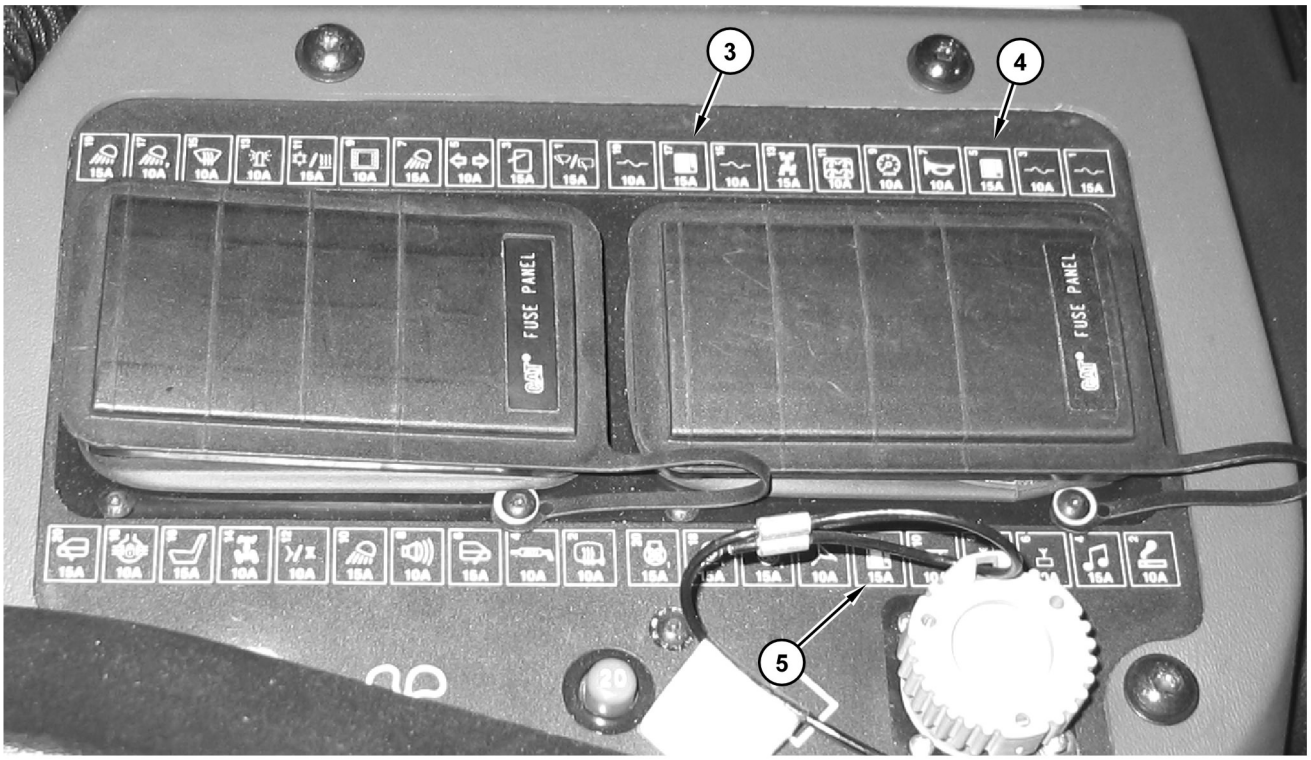


Illustration 544 g01317491

Fuse Panels located to the left of the seat in the cab

(3) Implement ECM 3 fuse (17)
(4) Implement ECM 2 fuse (5)
(5) Implement ECM fuse (12)

The Implement ECMs are connected to the machine system power at five contacts on the J1 connector. The Implement ECMs are connected to the machine grounds at four contacts on the J1 connector. Other ground connections are used for the location code contacts, however, these are not used for operating grounds.

An ECM would have to lose power at each of the five connections in order to completely lose all power for the ECM. There are conditions that can cause the ECM to completely lose power. An open fuse or circuit breaker will cause a loss of power. An open or a faulty connection in certain sections of the machine harness could cause a complete loss of power.

If power is completely lost to one of the Implement ECMs or to another ECM on the machine, the ECM that has lost power will not activate any diagnostic codes. When this occurs, a large amount of machine functions will not operate and the other ECMs on the machine will activate multiple diagnostic codes.

If multiple diagnostic codes have been activated within a short amount of time, always check the power circuits for the ECMs before investigating individual components. If the power circuits for the ECMs are OK, look for a common factor for the components that have the active diagnostic codes such as shared grounds or power circuits. An individual component is usually not causing the problem when more than one or two diagnostic codes are activated at the same time.

The following lists give examples of multiple diagnostic codes and events that will most likely be activated when a particular ECM has lost power:

Loss of power to the Implement ECM

CID 0569 FMI 09 - Implement ECM – Activated by: Transmission Chassis ECM, Engine ECM and the Messenger.

CID 0615 FMI 03 - Articulation Angle Sensor 1 – Activated by: Transmission Chassis ECM.

CID 1471 FMI 03 - Steer Position Sensor 1 – Activated by: Transmission Chassis ECM.

CID 1472 FMI 03 - Steer Position Sensor 2 – Activated by: Transmission Chassis ECM.

CID 2199 FMI 03 - Secondary Steer Request Signal – Activated by: Transmission Chassis ECM.

CID 2201 FMI 03 - Right Steering Cylinder Position Sensor – Activated by: Transmission Chassis ECM.

EID 0192 Level 3 - Steering System Malfunction – Activated by: Transmission Chassis ECM.

Loss of power to the Transmission Chassis ECM

CID 0569 FMI 09 - Transmission Chassis ECM – Activated by: Implement ECM, Engine ECM and the Messenger.

CID 1473 FMI 03 - Steer Position Sensor 3 – Activated by: Implement ECM

CID 2200 FMI 03 - Left Steering Cylinder Position Sensor – Activated by: Implement ECM.

CID 2252 FMI 03 - Articulation Angle Sensor 2 – Activated by: Implement ECM.

EID 0192 Level 3 - Steering System Malfunction – Activated by: Implement ECM.

EID 0263 Level 3 - Low Main Pump Pressure – Activated by: Implement ECM.

Loss of power to the Engine ECM

CID 0590 FMI 09 - Engine ECM – Activated by: Implement ECM, Transmission Chassis ECM and the Messenger.

EID 0192 Level 3 - Steering System Malfunction – Activated by: Implement ECM and Transmission Chassis ECM.

The Implement ECMs are receiving +battery power at all times. When the key start switch is in the OFF position, the ECM is in a “sleep mode” . When the key start switch is in the ON position, the ECM immediately becomes active and will activate a diagnostic code for another control module if expected information from that module is not received on the data link circuits.

If a the power circuit for one of the Implement ECMs is suspected to have failed, perform the following procedure. This procedure is for the Implement ECM. The same steps of the procedure should be followed for the other Implement ECMs on the machine. Refer to the schematic at the start of this procedure for details.

Note: The main disconnect switch is in the ON position.

Test Step 1. CHECK THE CIRCUIT BREAKER

The open “Load Breaker” circuit breaker will disrupt power to all of the Implement ECMs.

The key start switch is in the OFF position.

A. Check for an open at the 80 amp “Load Breaker” circuit breaker.

Expected Result:

The 80 amp “Load Breaker” circuit breaker is open.

Results:

- YES – The circuit breaker is open.

Repair: Reset the open circuit breaker. Resume machine operation.

STOP.

- NO – The 80 amp “Load Breaker” circuit breaker is not open.Proceed to Test Step 3.

Test Step 2. CHECK THE FUSE

A. Disconnect the 15 amp Implement ECM Master Fuse (fuse12) from the fuse panel.

B. Check the resistance across the two fuse contacts.

Expected Result:

The resistance measurement is less than 1.0 ohm.

Results:

- OK – The resistance measurement is less than 1.0 ohm. The fuse is not open. Proceed to Test Step 3.
- NOT OK – The resistance measurement is greater than 1.0 ohms. The fuse is open.

Repair: Replace the fuse with another 15 amp fuse.

STOP.

Test Step 3. CHECK THE POWER SUPPLY AT THE ECM

This step requires the use of a 7X-1710 Probe group or similar tool in order to enable voltage measurement at the ECM connector without disconnecting it.

The key start switch is in the OFF position.

A. At machine harness connector J1 for the Implement ECM, insert multimeter probes along supply contact J1-31 (wire 180-RD(Red)) and along ground contact J1-13 (wire A295-BK(Black)). Measure the DC voltage.

B. Repeat the last step for each of the ECM supply contacts and each of the ECM ground contacts that are shown in the illustration at the beginning of this procedure.

Expected Result:

Each voltage measurement measures between 18.0 and 32 VDC.

Results:

- OK – Each voltage measurement measures between 18.0 and 32 VDC. The voltage supply is correct.Proceed to Test Step 4.
- NOT OK – One or more of the voltage measurements is less than 18.0 VDC. There is an open or a bad connection in the machine harness.

Repair: The machine harness is faulty. There is an open or a bad connection in the machine harness for either the power supply circuit wire 180-RD(Red) or a ground wire A295-BK(Black).

Refer to the complete machine Electrical System Schematic. Check all of the connectors that are in the suspect power or ground circuit. Ensure that all connections are clean, secure and in good condition. Repair the machine harness or replace the machine harness.

STOP.

Test Step 4. CHECK THE STATUS OF THE ECM

A. Inspect the harness connectors and clean the contacts of the harness connectors in the power supply circuit. Check the wires for damage to the insulation. Verify that each connector contact is clean, secure and in good condition.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the power supply circuit.

C. Reconnect all harness connectors. Make sure that the connectors are fully seated and the clips for each connector are completely fastened.

D. Turn key start switch to the ON position.

E. Check the status of the ECM.

Expected Result:

The Implement ECM is performing normally.

Results:

- OK – The Implement ECM is performing normally. The diagnostic codes that were active are no longer active

Repair: The problem was probably caused by a poor electrical connection at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation.

STOP.

- NOT OK – The Implement ECM is not performing normally. The ECM is still not powered.

Repair: Check the power supply circuit again.

If the cause of the problem is not found, the ECM may have failed.

It is unlikely that the ECM has failed. Verify that all possible causes of the diagnostic code have been investigated. If the cause of the failure is not found, contact your dealership's Technical Communicator for possible consultation with Caterpillar. This consultation may greatly reduce repair time. If the ECM must be replaced, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

i02673243

Pulse Width Modulated Sensor

SMCS Code: 1439-038

System Operation Description:

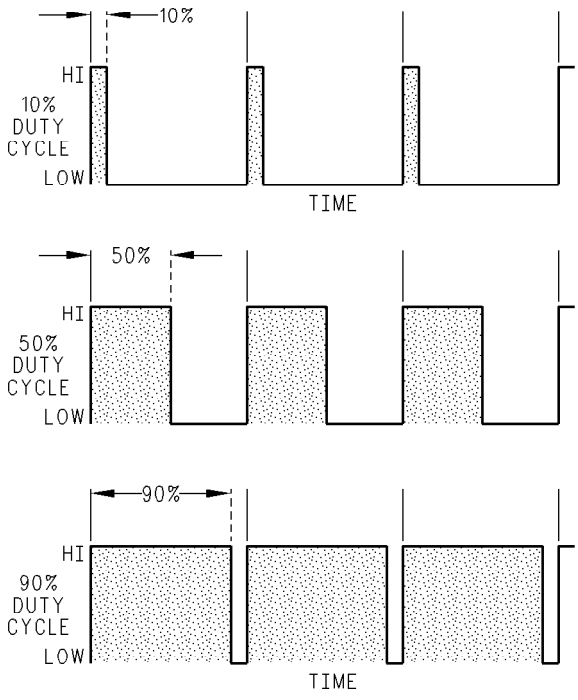


Illustration 545 g00288430

Typical Square Wave Pulse Width Modulated Duty Cycle Signal.

A Position sensor will continuously send a Pulse Width Modulated (PWM) Square Wave signal to the ECM. The frequency of the signal is usually 500 Hertz. Some sensors operate at 5000 hertz. The operating frequency remains at a steady rate during operation.

During operation, the duty cycle of the PWM Sensor signal changes. The change depends on the following:

- The direction of movement about the axis that is being monitored
- The amount of movement about the axis that is being monitored

The Duty Cycle is defined as the following:

- The percentage of time that the signal is high, compared to the total time of the cycle.

The Duty Cycle has the following characteristics:

- The percentage of duty cycle signal from a typical position sensor that the ECM will recognize as valid is 10 ± 5 percent to 90 ± 5 percent at the extreme ends of the axis movement. An axis that is in the center or neutral position would result in a duty cycle signal of approximately 50 ± 6 percent.

The Sensor Signal has the following characteristics:

- The sensor signal can also be measured as voltage. Most PWM sensor signals will measure an RMS (average) voltage of between 0.0 VDC to 5.0 VDC depending on the duty cycle value. A low duty cycle results in a low voltage measurement. A high duty cycle results in a higher voltage value. A valid duty cycle range that the ECM will accept of 10 ± 5 percent to 90 ± 5 percent equates to a voltage range of 0.5 VDC to 4.5 VDC.
- In order to aid in ECM circuit diagnostics, all of the PWM sensor signal input circuits have an internal “pull up voltage” . An above normal voltage is internally connected to the ECM sensor PWM signal input circuit through a resister.
- During normal operation, the sensor signal will hold the circuit at a certain signal amplitude, however, circuit conditions such as a loss of power to the component, a disconnection or an open circuit will allow the circuit to be pulled high by the ECM pull up voltage. This will result in an above normal voltage condition at the ECM contact. As a result, the ECM will activate a diagnostic code for the affected circuit.

When the ECM detects an abnormal condition in the circuit, the ECM will activate a diagnostic code for the PWM sensor signal circuit. The ECM will most often monitor the circuit for the following FMI conditions:

FMI 02 – Erratic Data, intermittent data, or incorrect data

FMI 03 – Voltage above normal

FMI 04 – Voltage below normal

FMI 08 – Abnormal frequency, pulse width, or period

FMI 13 – Out of calibration

Note: The ECM may activate diagnostic codes for FMI conditions that are not listed here. The FMI conditions that are listed here are the most common FMI conditions.

When the ECM activates an FMI 13 diagnostic code for a particular sensor, a calibration procedure must be performed in order to maximize performance in the involved system.

The PWM duty cycle of the sensor can be measured with most digital multimeters. The duty cycle should be in the acceptable range. The voltage of the signal circuit can also be measured. Most signals from the PWM sensors are usually measured as a Duty Cycle Percentage.

For information on a specific machine PWM position sensor, refer to the System Operation, “Electrical Input Components” section of this manual.

Component Identifier (CID) are assigned to all PWM sensors on a machine.

FINDING A TROUBLESHOOTING PROCEDURE FOR A SENSOR

A. When the ECM activates a diagnostic code for a PWM sensor, refer to the Troubleshooting, “Diagnostic Code Procedures” section of this manual. Go to the procedure for the CID FMI diagnostic code that has been activated and perform the procedure in order to isolate the probable cause of the problem.

Expected Result:

The troubleshooting procedure has been performed.

Results:

- OK – The troubleshooting procedure has been performed.

  STOP.

i02443774

Starting System

SMCS Code: 1450-038

System Operation Description:

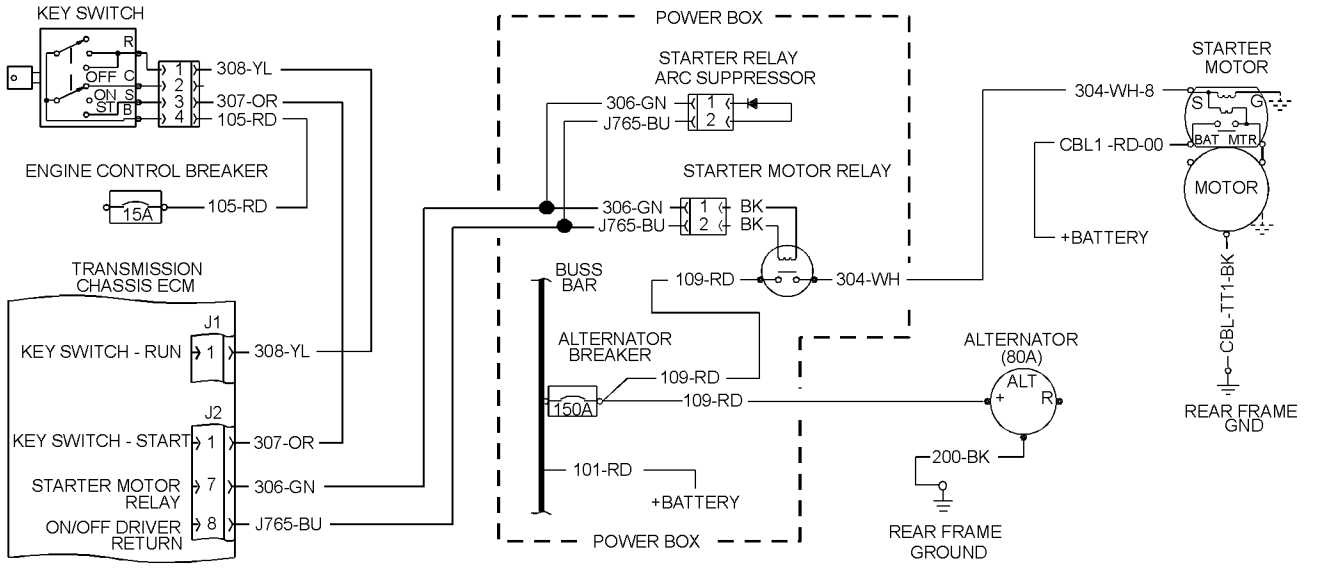


Illustration 546 g01331158

Engine Starting System connections

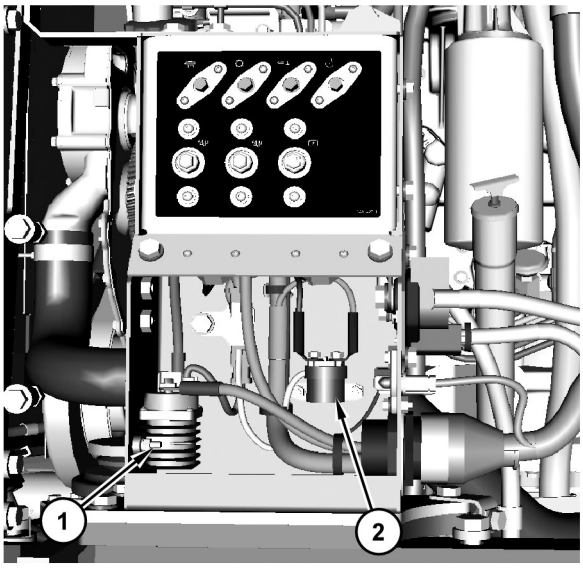


Illustration 547 g01331129

Power Breaker Box located on left side of machine behind the Cab

(1) Main Power Relay
(2) Starter Motor Relay

The Transmission Chassis ECM controls the engine starting system for the machine. The ECM monitors the status of the key start switch. When the key start switch is in the ON position or in the START position, a system voltage input is supplied to the ECM through the key switch contacts.

When the Transmission Chassis ECM detects the system voltage at the START input, the ECM will activate the starter motor relay in order to initiate the engine start process provided the following machine conditions are present:

- The parking brake is engaged.
- The transmission is in NEUTRAL.
- The operator present switch is indicating that an operator is in the seat.

System battery voltage that has passed through the buss bar and the 150 amp alternator breaker is present at one side of the starter motor relay contacts. When the starter motor relay is energized by the ECM, system battery voltage is directed through the closed relay contacts and on to the starter motor solenoid. The starter motor solenoid contacts will close and +battery voltage will be applied to the starter motor in order to crank the engine for starting.

In the event that the engine will not crank when the key start switch is in the START position, perform the following procedure.

Note: If the engine is cranking when the key start switch is in the START position and the engine is not starting, refer to the engine service manual for your model machine.

Verify that there are no active CID 0444 diagnostic codes for the starter motor relay. If a diagnostic code for the relay is active, troubleshoot and repair the relay circuit problem before attempting to start the engine.

Test Step 1. Verify That The Machine Conditions Are Correct

A. Verify that the following conditions are correct:

- The disconnect switch is in the ON position.
- The Alternator Breaker is not open.
- The parking brake is engaged.
- The transmission is in NEUTRAL.
- The operator present switch is indicating that an operator is in the seat.

Expected Result:

One or more of the listed machine conditions was not correct.

Results:

- YES – One or more of the listed machine conditions was not correct.

  Repair: Ensure that all the listed machine conditions are correct. Then attempt to start the engine again.

  STOP.

- NO – All of the listed machine conditions are correct. The engine still will not crank and no diagnostic codes for the starter motor relay are active.Proceed to Test Step 3

Test Step 2. Check The Relay

The key switch is in the OFF position.

A. Enlist the aid of another technician. Remove the lower cover from the power box in order to access the starter motor relay. Have the other technician turn the key start switch to the START position while observing the starter motor relay. The relay should create an audible “click” when the key is first moved to the START position in order to energize the relay.

Expected Result:

The relay is being energized by the ECM.

Results:

- OK – The relay is being energized by the ECM. Proceed to Test Step 3.
- NOT OK – The relay is not being energized by the ECM.

  Repair: There is a problem in the starter motor relay circuit. Refer to the Troubleshooting section of this manual. Perform the diagnostic code procedure for the CID 0444 FMI 05 (Starter Motor Relay - current below normal) in order to find the problem. Find the problem in the relay circuit and repair the circuit.

  STOP.

Test Step 3. Check The Condition Of The Batteries

The key switch is in the OFF position.

A. At starter motor relay inside of the power box, measure the battery voltage between the contact that is connected to the red cable (109-RD(Red)) and a good frame ground contact. Verify that the correct voltage is present at the relay contact. If no voltage is present, check the circuit back to the Alternator Breaker and then to the batteries in order to determine why no system voltage is present at one side of the relay contacts.

B. Verify that the battery connections are clean and tight. Load test the batteries. Use a 4C-4911 Battery Load Tester. Refer to , Special Instruction, SEHS9249, “Use of 4C-4911 Battery Load Tester for 6, 8 and 12 Volt Lead Acid Batteries” and Special Instruction, SEHS7633, “Battery Test Procedure”.

Expected Result:

The batteries pass the load test and the connections are in good condition.

Results:

- OK – The batteries and the connections are OK. Proceed to Test Step 4.
- NOT OK – The batteries do not pass the load test or the connections are not in good condition.

  Repair: Charge or replace the batteries if needed or clean and repair the battery connections.

  STOP.

Test Step 4. Check The Voltage At the Starter Motor

A. Turn the key start switch to the OFF position.

B. At the starter motor, measure the system voltage between the +battery contact (cable 1-RD-00(Red)) and a good frame ground contact.

C. At the starter motor, fasten ONE clamp-on multimeter probe to the starter solenoid power contact (304-WH-8(White)) and fasten the other clamp-on probe to a good frame ground.

D. While observing the multimeter for a voltage measurement, turn the key start switch to the START position for a few seconds.

Expected Result:

System voltage is present at the +battery contact (cable 1-RD-00(Red)) on the starter motor and system voltage is present at the starter solenoid power contact (304-WH-8(White)) when the key switch is in the START position.

Results:

- OK – The system voltage is present at the starter solenoid contact at the right time and system voltage is present at the starter motor contact.

  Repair: The starter motor should be cranking the engine when the key start switch is in the START position. The starter motor has failed. Replace the starter motor.

  STOP.

- NOT OK – There is a problem with the system voltage at the starter motor or at the starter solenoid connection.

  Repair: Investigate the circuit that is not providing the correct voltage at the starter motor or the starter motor solenoid. Repair the system voltage circuit.

  If the voltage is not present at the starter solenoid when the key start switch is turned to the START position, verify that the voltage is passing through the starter motor relay contacts. Check the relay operation and the wire from the relay to the starter motor solenoid contact.

  STOP.

Testing And Adjusting Section

Testing and Adjusting

i02613828

Calibration

SMCS Code: 5700

Calibration of a component in the Implement ECM control system allows the ECM to determine the correct output level for solenoids and allows the ECM to determine the correct input signal range for position sensors.

Many of the solenoids and position sensors that are under Implement ECM control can be calibrated using the Caterpillar Electronic Technician (ET) service tool.

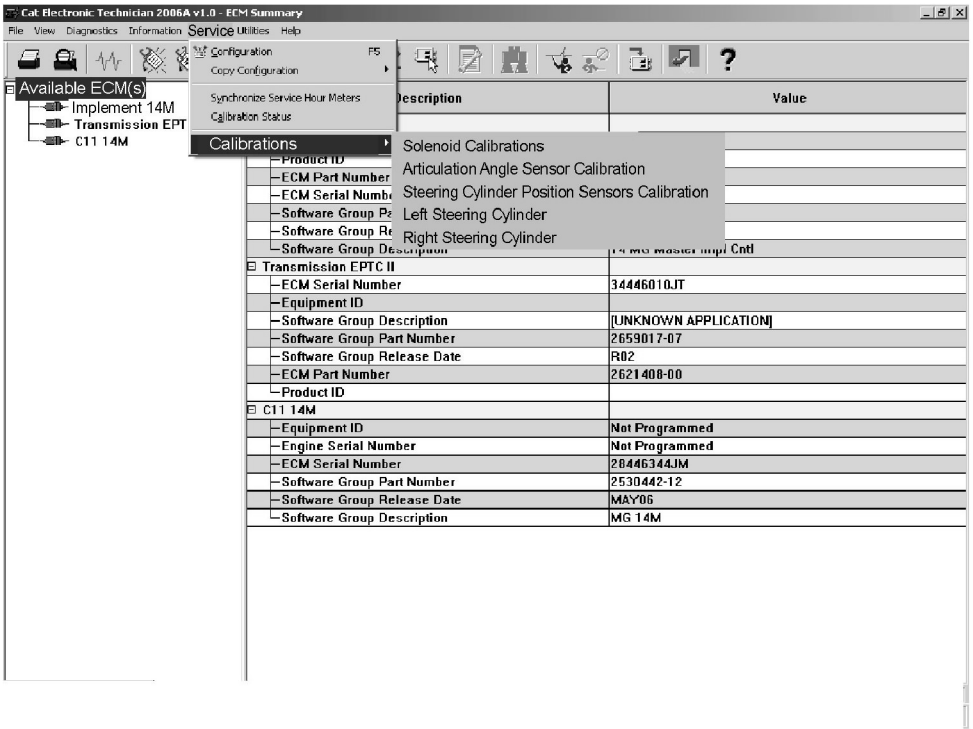


Illustration 548 g01308574

Service - Calibrations - Choose the calibration procedure

To access the calibration procedures for the Implement ECM, establish the Cat ET connection to the Implement ECM. Navigate to the calibration screens by clicking “Service” , then “Calibrations” . Click on the solenoid calibration or position sensor calibration that is needed.

Once the specific calibration is selected, the Cat ET display will guide you through the calibration procedure.

The Cat ET display will list initial machine conditions that must be satisfied before the ECM will allow the calibration procedure to continue. Follow the specific instructions on the display in order to successfully complete the calibration procedure.

The following list details the calibrations that can be performed for Implement ECM controlled components.

Solenoid Calibrations

Solenoid calibrations allow the ECM to determine the correct amount of output current that is required to initiate the opening of the affected pilot valve in order to provide optimum performance and control of the hydraulic system.

To perform a solenoid calibration, select the specific solenoid in the CAT ET screen and follow the displayed directions. Calibration procedures are available for the following solenoids:

Blade Lift Control – Blade left/right raise solenoids, Blade left/right lower solenoids, Blade left/right lower float solenoids

Circle Drive Control – Circle right/left solenoids

Blade Pitch Control – Blade pitch forward/backward solenoids

Blade Sideshift Control – Blade sideshift left/right solenoids

Circle Sideshift Control – Circle sideshift left/right solenoids

Articulation Control – Articulate left/right solenoids

Wheel Lean Control – Wheel Lean left/right solenoids

Auxiliary Valves 1 thru 6 Control – Solenoid 1 and solenoid 2 for each valve

Position Sensor Calibrations

For position sensor calibrations, select the specific position sensor from the CAT ET screen and follow the displayed directions. Calibration procedures are available for the following position sensors:

Articulation Angle Position Sensor – Position sensor 1 - The Articulation Angle Sensor Calibration allows the ECM to calibrate the two articulation angle sensors in order to display the correct articulation angle and provide optimum automatic neutral articulation performance.

Articulation Angle Position Sensor – Position sensor 2

Steer Cylinder Length Sensor – Steer right cylinder position sensor - Steer cylinder length sensor calibration allows the ECM to determine the correct left and right steer cylinder length position sensor positions for a zero degree steering angle. When the steer cylinder length sensors are correctly calibrated, the position sensor input to the ECM is optimized.

Steer Cylinder Length Sensor – Steer left cylinder position sensor

Note: When steer cylinder position sensors are replaced, a special procedure for downloading or manually entering position sensor parameter information to the Implement ECM must be performed, refer to the following procedures in this manual. After replacement of only the steer cylinder position sensor, refer to Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set”. After replacement of the complete steer cylinder group, refer to Testing and Adjusting, “New Steer Cylinder Group - Set”.

i05969923

Auxiliary Hydraulic System - Configure

SMCS Code: 5700-025-AX; 7610-025-II

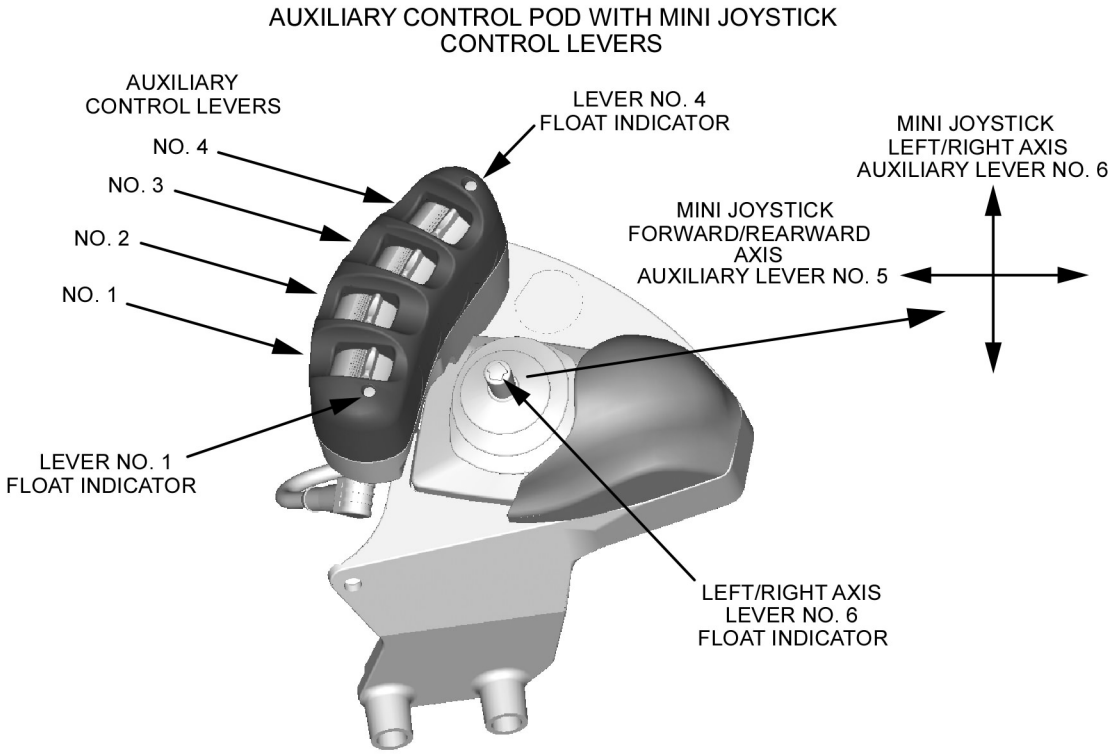


Illustration 549 g01372895

Auxiliary Control Pod with Mini Joystick

Illustration 550 g01372876

Auxiliary Control Levers No. 6 and No. 7.

The Implement ECM can be configured to allow any one auxiliary control lever to control any one hydraulic valve installed on the machine.

The different combinations of auxiliary hydraulic control levers that can be installed in the system are:

- Stand-alone thumb rocker lever no. 7
- Stand-alone thumb rocker levers no. 6 and no. 7
- Auxiliary control pod (with or without the mini joystick)
- Auxiliary control pod (with or without the mini joystick), and the Stand-alone thumb rocker lever no. 7
- Advanced Control Joystick (ACJ) thumb rockers when configured for auxiliary hydraulic control Lever 8 (LH) and Lever 9 (RH).

Illustration 551 g03742861

(1)Auxiliary Control Levers No. 8.

Illustration 552 g03742864

(2)Auxiliary Control Levers No. 9.

When the machine is shipped from the factory with an attachment implement installed, the implement is assigned to a factory default auxiliary control lever. The following table lists the default control lever assignments for factory installed attachments.

Table 50

M Series Motor Grader Auxiliary Hydraulic Factory Default Control Lever Assignments								
Attachments	Auxiliary Control Pod (ACP) Levers						Stand-Alone Handle	Stand-Alone Handle
	Lever 1 (Float)	Lever 2	Lever 3	Lever 4 (Float)	5(1)	6(2)(Float)	Lever 6(3) (Float)	Lever 7
Ripper								Ripper
Ripper, Plow							Plow Lift	Ripper
2 Function Wing, Plow, Ripper	Plow Lift				Wing Mast (Toe)	Wing Tilt 1		Ripper
2 Function Wing, 2-Function Plow, Ripper	Plow Lift	Dozer Angle			Wing Mast (Toe)	Wing Tilt 1		Ripper
2 Function Wing, 3-Function Plow, Ripper	Plow Lift	Dozer Angle	Dozer Angle		Wing Mast (Toe)	Wing Tilt 1		Ripper

(1) Mini joystick - froward/rearward axis.
(2) Mini joystick - left/right axis.
(3) Not available if the ACP with mini joystick is installed.

Assigning Auxiliary Control Levers

Configuring the auxiliary hydraulic system: Enables assignment of any one auxiliary control lever installed on the machine to control any one hydraulic valve installed on the machine.

Note: Auxiliary hydraulic valve 7 is controlled by ON/OFF solenoids. All of the other auxiliary hydraulic valves are controlled by proportional solenoids.

The following steps illustrate the procedure for assigning a specific auxiliary control lever to control a specific auxiliary hydraulic valve. In this example procedure, the auxiliary “control pod lever 2” will be configured to control the “auxiliary hydraulic valve 1” .

1. Connect the Caterpillar Electronic Technician (Cat ET) service tool to the machine service connector. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

2. Establish the Cat ET connection. Select the “Implement ” ECM for your model machine.

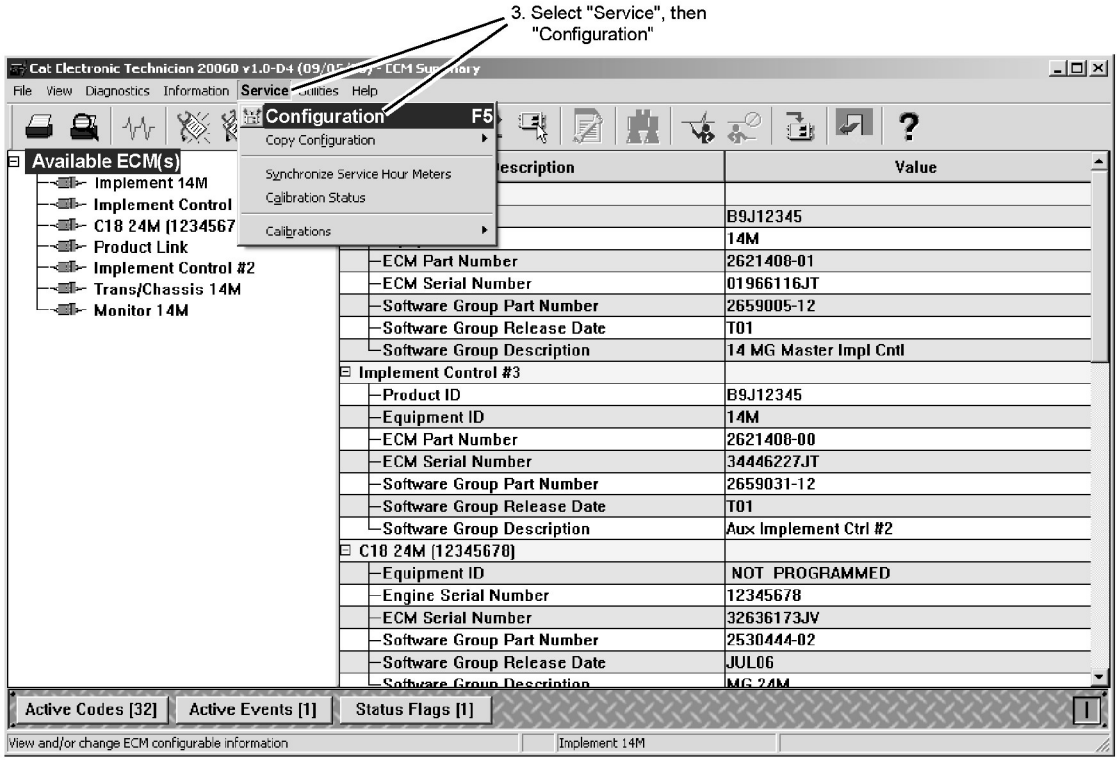


Illustration 553 g01312393

3. From the "Service" menu, select "Configuration".

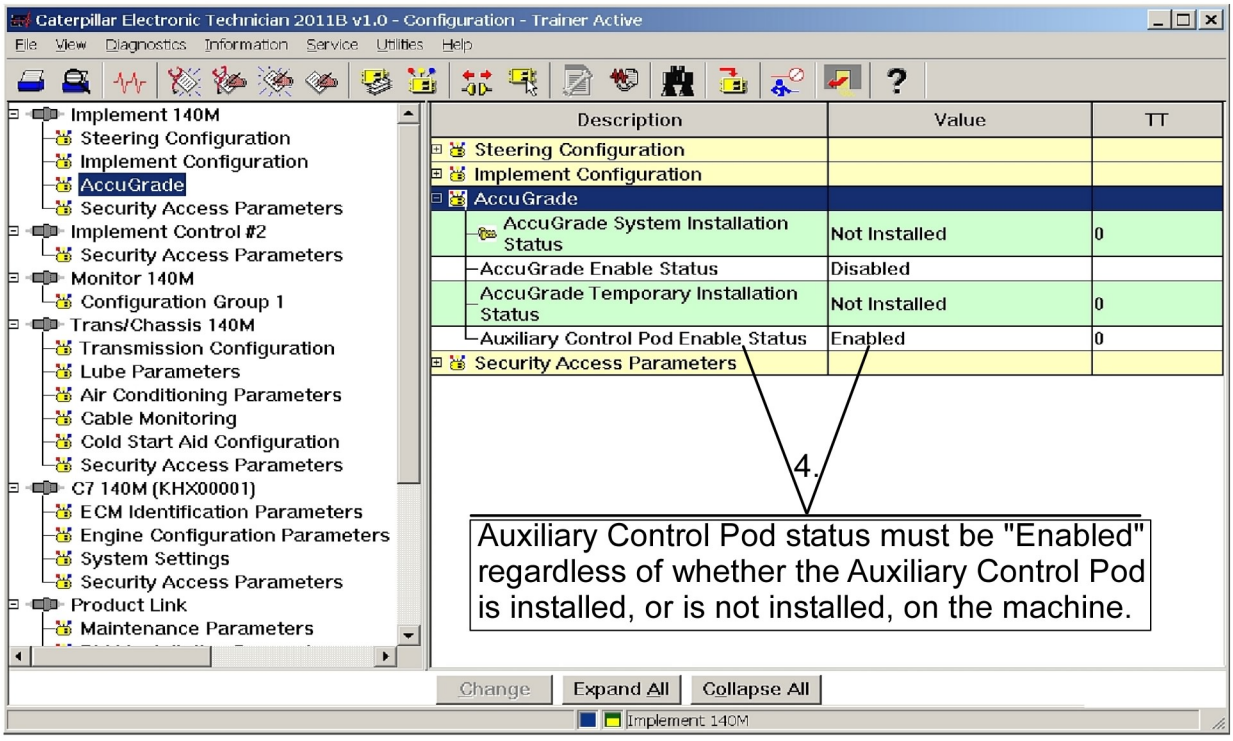


Illustration 554 g02814736

4. From the “Configuration” menu, select "Accugrade" and verify the "Auxiliary Control Pod Enable Status" is "Enabled".

If the "Auxiliary Control Pod Enable status" is not "Enabled", change the status to "Enabled".

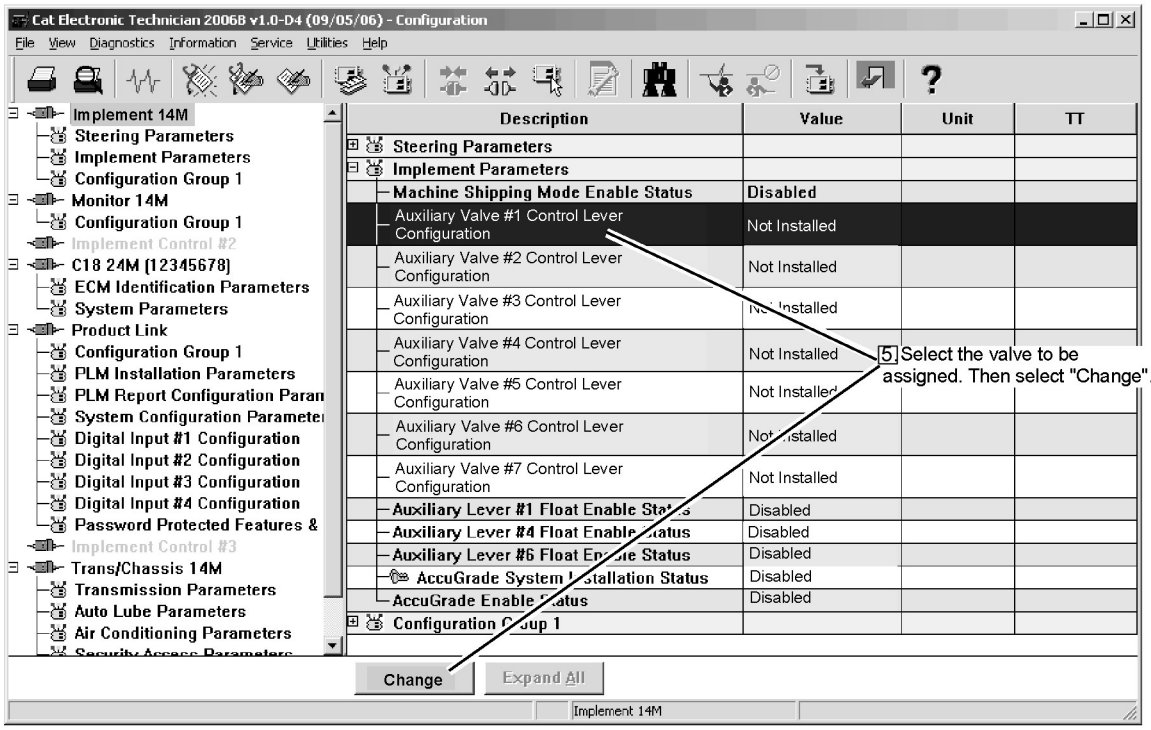


Illustration 555 g02816877

5. From the “Configuration” menu, select “Implement Parameters” . Select the auxiliary valve that will be assigned to the different control lever by either “double clicking” on the valve row, or by selecting the valve row and then selecting “Change” .

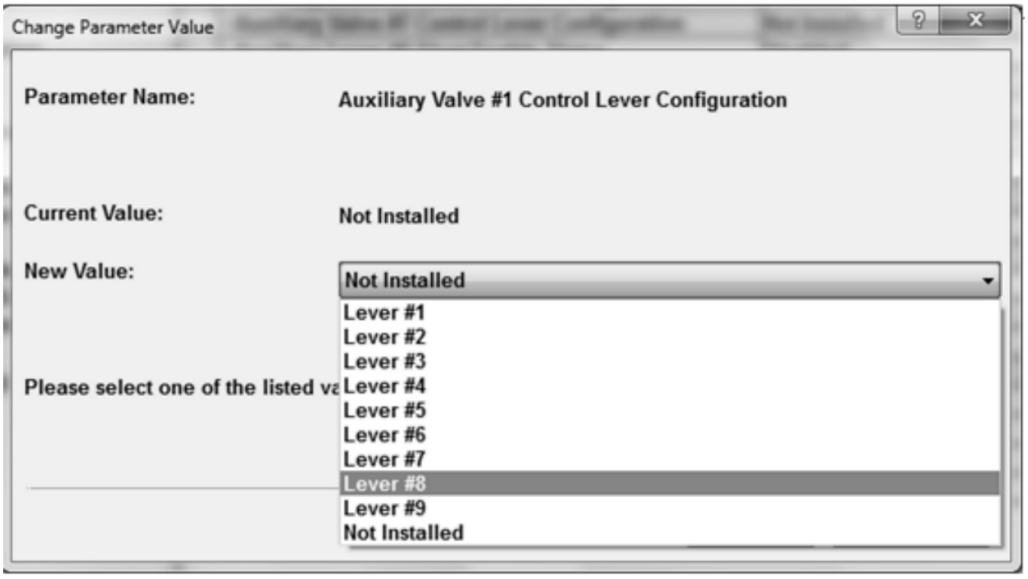


Illustration 556 g03744740

6. In the “Change Parameter Value” menu, the auxiliary valve that was selected in the last step is displayed. Select the lever that will control the displayed valve. Then, click the “OK” tab.

7. When prompted to confirm whether you want to “Program this parameter” , Click on the “Yes” tab.

8. Turn the key start switch to the OFF position. Wait at least 10 seconds, then turn the key start switch to the ON position. Start the engine to verify that the new lever assignment is correct.

The procedure is now complete. Auxiliary control lever 2 will now control the auxiliary hydraulic valve 1.

i02957612

Position Sensor (Steering Cylinder) - Set

SMCS Code: 1439-529-ZH; 430S-529-PSN

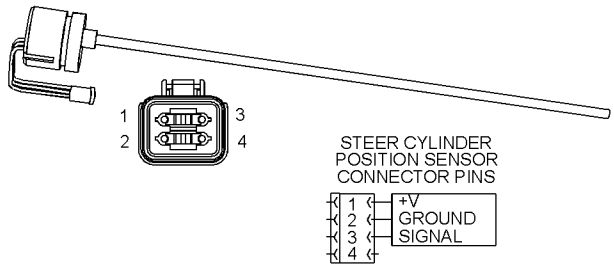


Illustration 557 g01283709

“Steering Cylinder” position sensor

When one of the “steering cylinder” position sensors on the machine has been replaced, two setup parameters must be changed in order for the Implement ECM to correctly control the cylinder operation.

This procedure is to be performed when a “steering cylinder” position sensor is replaced in a hydraulic steering cylinder that has previously been in operation on the machine.

When the complete hydraulic “steering cylinder” group is replaced, refer to the Testing and Adjusting, RENR9013, “New Steering Cylinder Group (Set)” for the setup procedure.

For removal and replacement of the position sensor from the hydraulic “steering cylinder” , refer to Disassembly and Assembly, RENR9704, “Clevis Style Cylinder Sensor - Remove and Install”.

Note: This procedure will require the use of the Caterpillar Electronic Technician (ET) service tool.

MANUAL INSTALLATION OF STEERING CYLINDER POSITION SENSOR SETUP PARAMETERS

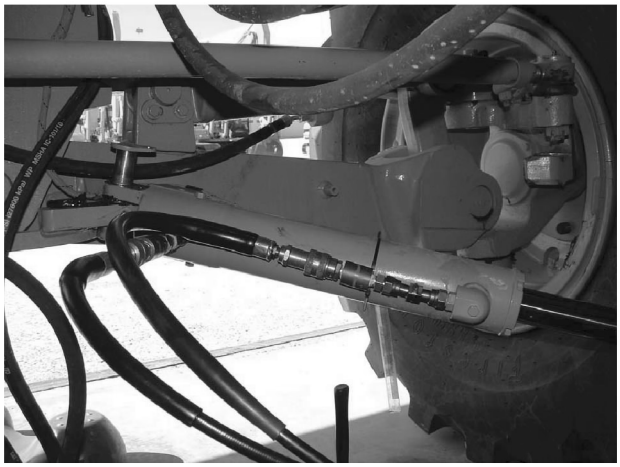


Illustration 558 g01283732

Steering cylinder with new position sensor connected at head end with portable hydraulic pump attached

The disconnect switch and the key start switch are in the OFF position. Cat ET is connected to the machine service connector.

1. After the new position sensor has been installed in the steering cylinder, fasten the cylinder to the machine at the cylinder head end only. Do not attach the rod end of the cylinder to the machine. Allow enough space for full extension of the cylinder rod.
2. Connect the correct connector of the machine wiring harness to the connector of the new position sensor for the steering cylinder.
3. Connect a portable hydraulic pump, a hand hydraulic pump, compressed air or a similar device to the hydraulic connectors of the cylinder that will enable manual retraction and extension of the cylinder.
4. Fully retract the cylinder rod to the mechanical stop of the cylinder.
5. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.

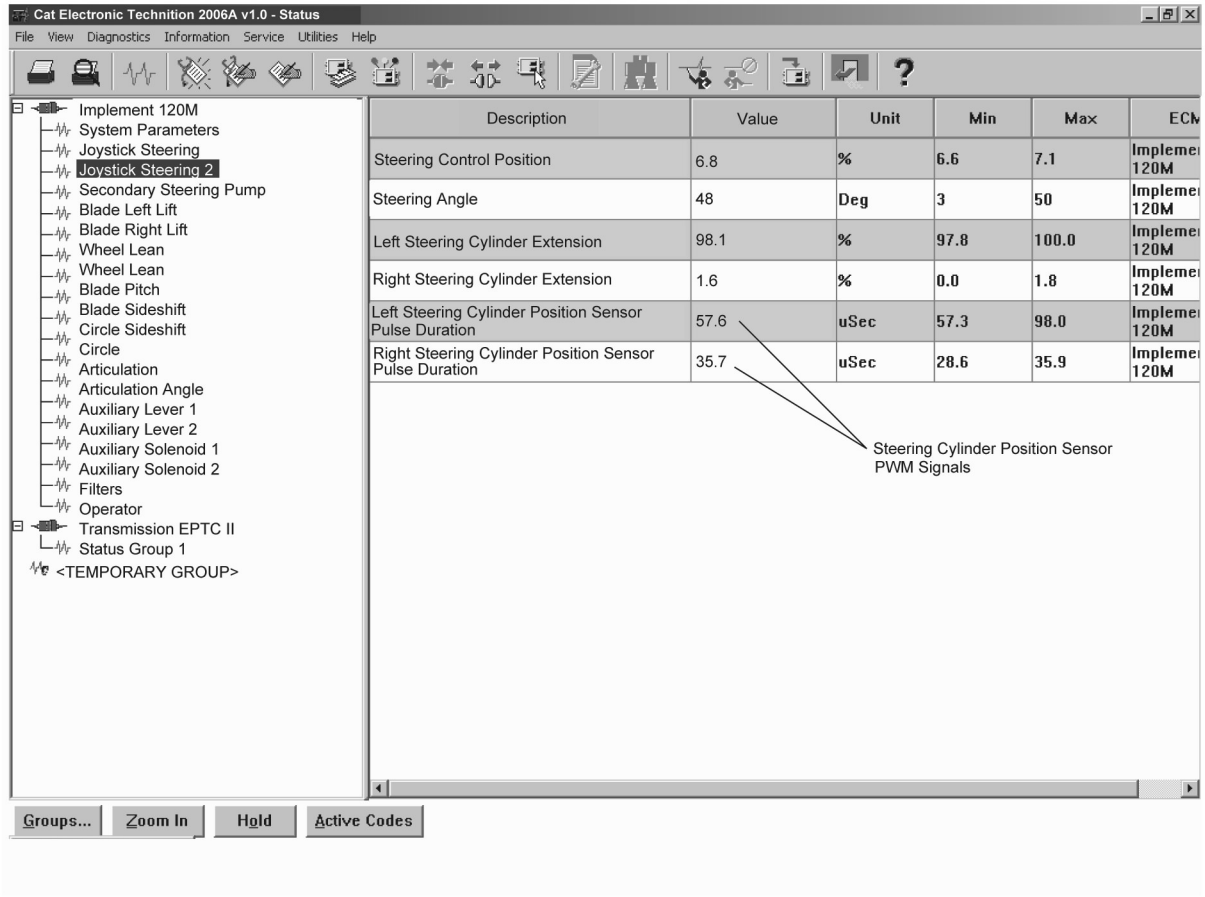


Illustration 559 g01283809

Implement ECM Status Screen

6. In the Cat ET Status screen for the Implement ECM, look under the “Joystick Steering 2” group. With the cylinder rod at full retraction, record the duration of the pulse of the “steering cylinder” position sensor that is listed for the position sensor that was replaced. Example: (Left/ Right) Steering Cylinder Position Sensor Pulse Duration.

7. Use the portable device that is connected to the cylinder to manually move the cylinder rod to full extension to the mechanical stop of the cylinder.

8. In the Cat ET Status screen for the Implement ECM, look under the “Joystick Steering 2” group. With the cylinder rod at full extension, record the duration of the pulse of the “steering cylinder” position sensor of the “(Left/ Right) Steering Sensor Cylinder Position Sensor Pulse Duration” .

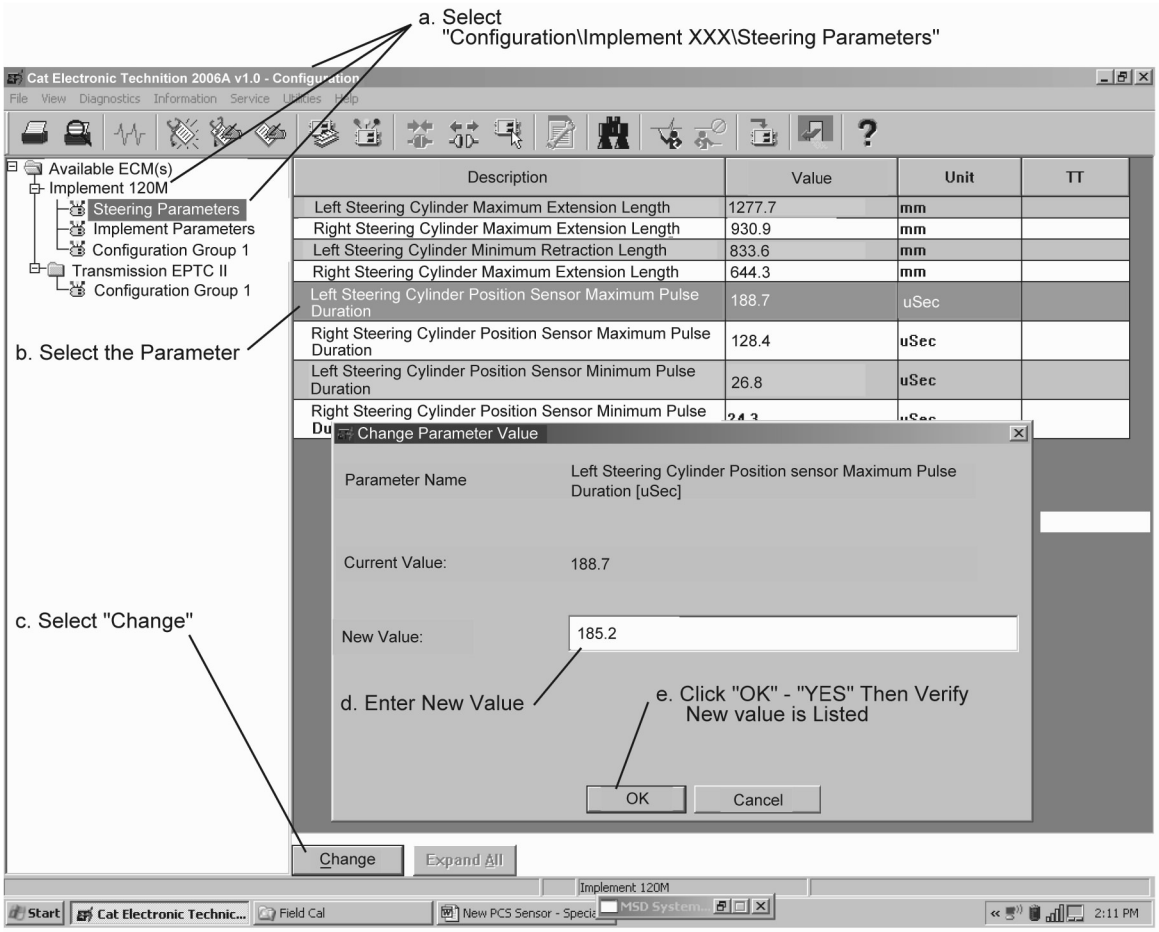


Illustration 560 g01284066

Cat ET - Implement Configuration\Steering Parameters screen

9. The two new values that were recorded for the cylinder rod retraction and extension must now be entered using Cat ET. Follow the steps:

a. In Cat ET, select the “Implement Configuration Tool” , then select “Steering Parameters” .

b. Select the parameter that needs to be changed. Example: If the left hand position sensor has been replaced, one at a time select and change “Left Steering Cylinder Position Sensor Maximum Pulse Duration” to the measurement while extended and “Left Steering Cylinder Position Sensor Minimum Pulse Duration” to the measurement while retracted. If the right hand position sensor has been replaced, one at a time select and change “Right Steering Cylinder Position Sensor Maximum Pulse Duration” to the measurement while extended and “Right Steering Cylinder Position Sensor Minimum Pulse Duration” to the measurement while retracted.

c. After the parameter is selected, click on the “Change” button. A “Change Parameter Value” box will appear with the name of the selected parameter, the current value for the parameter and a space for entering the new value.

d. Enter the appropriate value of the new pulse duration that was recorded, then click the “OK” button. Click “Yes” when prompted. Repeat this process for the other value that needs to be changed.

e. After both values have been changed, verify that the correct new values are listed for the correct parameter.

10. Turn the key start switch and the disconnect switch to the OFF position.

11. After the new parameters have been entered and the parameters have been verified, connect the rod end of the hydraulic steering cylinder to the machine. Verify that the head end is mounted securely.

12. Remove the portable device that was used to manually move the cylinder rod and connect the hydraulic hose connectors to the correct connectors of the cylinder. Verify that the connectors of the machine wiring harness are securely connected to the connector for the position sensor.

13. The procedure is now complete. Start the engine and enable the steering system. Verify that the steering system for the joystick is working properly before moving and operating the machine.

i04547947

New Steering Cylinder Group - Set

SMCS Code: 4303-529-PSN; 430S-529-PSN

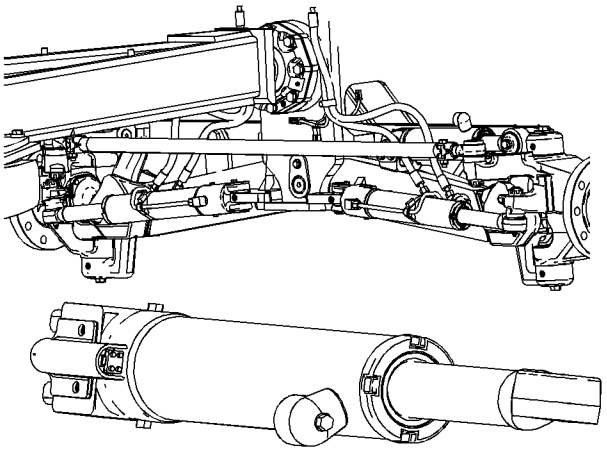


Illustration 561 g01308437
Front Steer Cylinder Group

This procedure is to be performed when a complete steer cylinder group is installed on the machine. The cylinder position sensor software files must be downloaded from the Service Information System (SIS) web site and installed in the Implement ECM using the Caterpillar Electronic Technician (ET) service tool.

DOWNLOADING SOFTWARE FILES AFTER NEW CYLINDER GROUP INSTALLATION

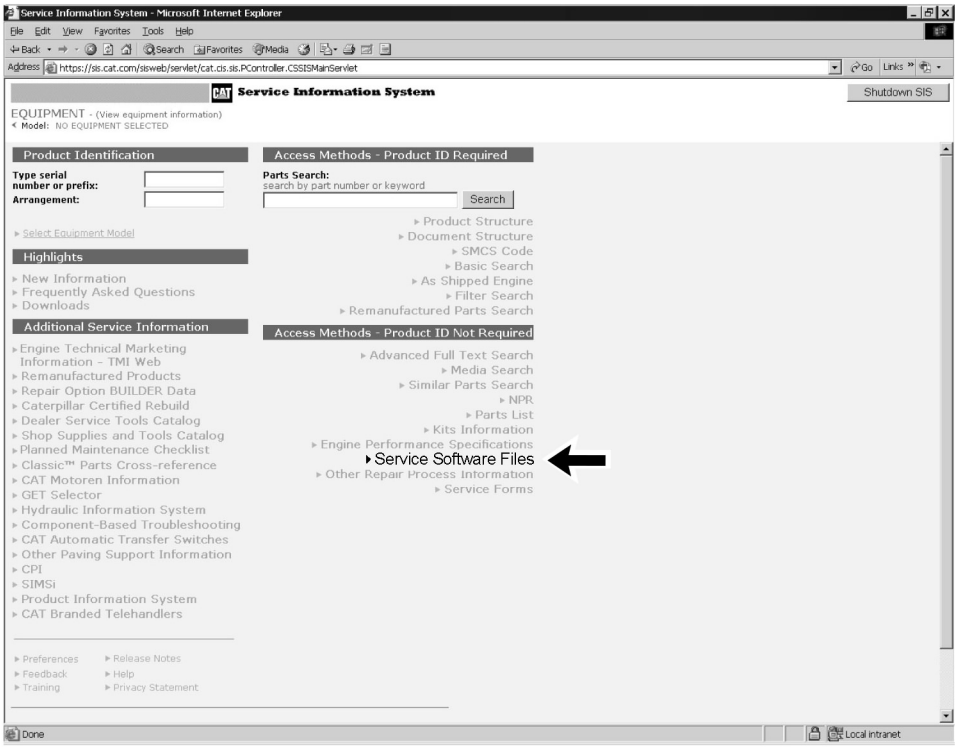


Illustration 562 g01308459

Accessing “Service Software Files” in SIS

1. After the new steer cylinder group has been installed on the machine, access the software parameter files for the “M” Series Motor Graders in the SIS opening screen by clicking on “Service Software Files” .

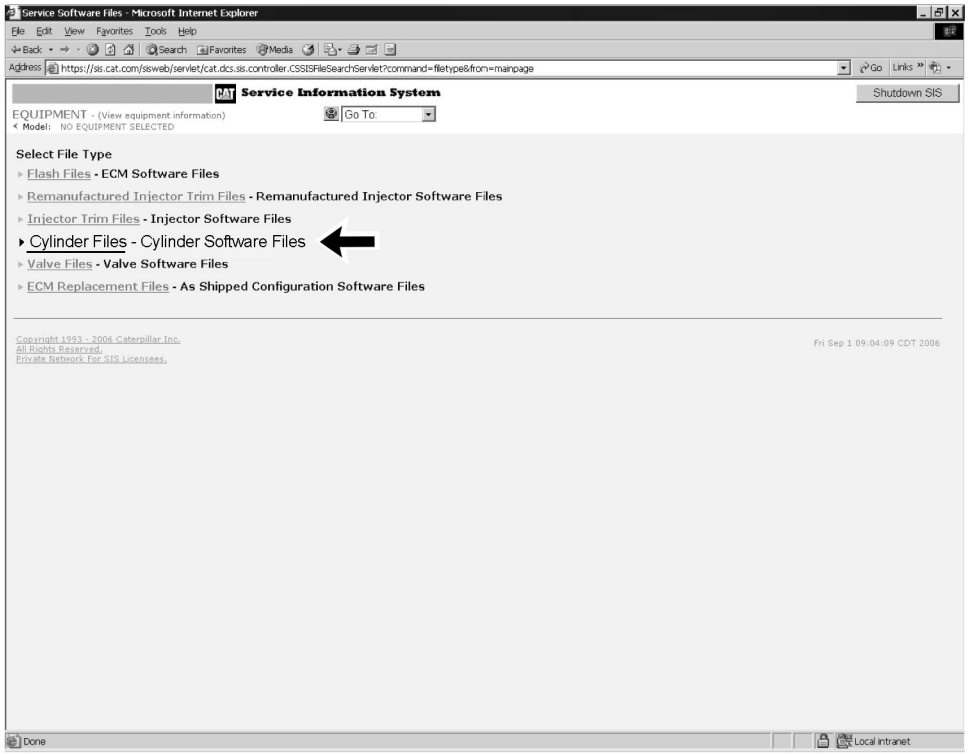


Illustration 563 g01308490

Select “Cylinder Files - Cylinder Software Files”

2. From the “Select File Type” menu, select “Cylinder Files - Cylinder Software Files” .

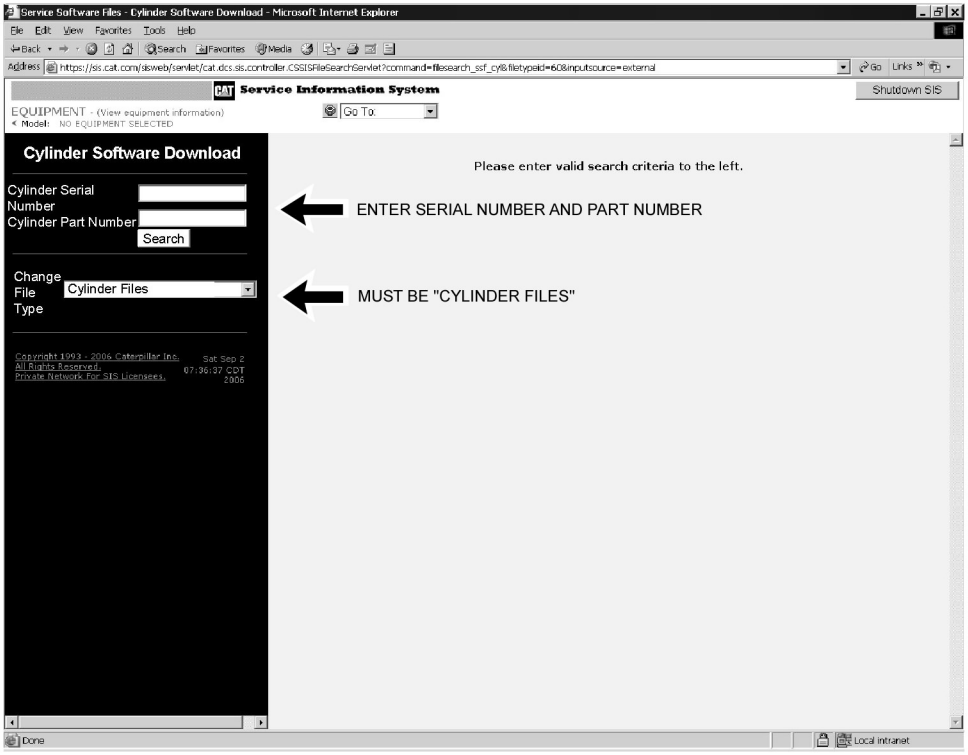


Illustration 564 g01308572

Enter: Serial Number, Part Number (000XXXXXXX)

3. Confirm that the selected file is “Cylinder Files” . The part number and the serial number that will be entered are on the data tag of the cylinder that is packaged with the new cylinder group. The location of the numbers on the tag is shown below.

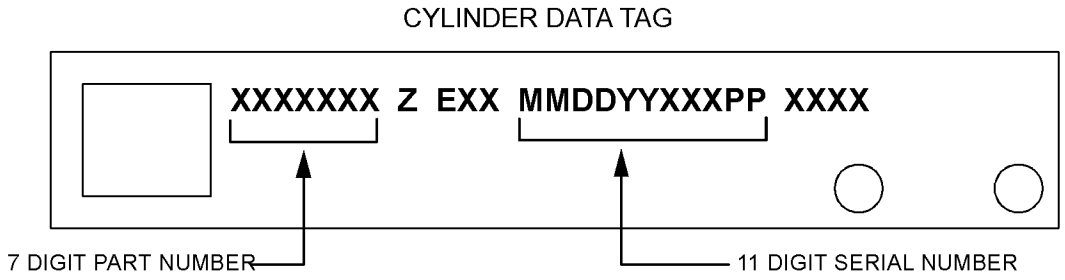


Illustration 565 g02720814

Location of part number and serial number

Note: In the next test step, the seven-digit part number will be entered in the ten-digit SIS field. The part number MUST be preceded by three zeroes in order to fill the ten-digit SIS field. See the example in the test step.

4. Enter the part number and the serial number from the cylinder data tag for the cylinder group that has been installed on the machine. The seven-digit part number must be preceded by three zeroes in order to fill the ten-digit SIS field. Example: part number “3456789” must be entered as “0003456789” . After the correct serial number and part number have been entered in the correct field, click “Search” . Place the cursor over the appropriate file and press the left button on the mouse in order to save the file.
5. Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.
6. In order to load the file into the ECM. Establish the Cat ET connection to the Implement ECM.
7. Navigate through the following Cat ET menus “Service” , “Calibrations” , Left or Right Steering Calibration.
8. Select the “Cylinder File” that you have downloaded from SIS and click “Open” . The Implement ECM will be updated with the updated software file.
9. If the file is successfully loaded, a message box will display a “Right/Left Steering Cylinder Data Programmed Successfully!” message.
10. Repeat this procedure for each new steer cylinder group that has been installed on the machine.
11. Turn the disconnect switch and the key start switch to the OFF position. Wait a short time. Start the engine. Verify that the steering system is operating correctly before operating the machine.

i02203138

Electrical Connector - Inspect

SMCS Code: 7553-040-WW

Reference: Special Instruction, SEHS9615, “Servicing DT Connectors”.

Reference: Special Instruction, REHS0148, “Listing Of Deutsch Connector Components”

Reference: Special Instruction, SEHS9065, “Use Of CE Connector Tools”.

Reference: Service Magazine, SEPD0342,27 January 97, “Field Repair Of Single Wire Breaks In Harnesses (Sealed Splice)”.

Reference: Service Magazine, SEPD0371,28 July 97, “Protection Of Unsealed Electrical Terminations For Machines In Corrosive Applications”.

Reference: Service Magazine, SEPD0473,24 May 99, “New DT Connector Plugs With Improved Seal Retention”.

Reference: Service Magazine, SEPD0545,09 October 00, “Dielectric Grease Should Not Be Used In Electrical Connectors”.

Reference: Pocket Guide, SEBD0402, “Guidelines For Routing And Installing Wire Harness Assemblies”.

Use this procedure under the following situation:

Use the following steps to help determine if the connector is the cause of the problem. If a problem is found in the electrical connector, repair the connector and verify that the problem has been corrected.

The following background information is related to this procedure:

Many of the operational procedures and the diagnostic code procedures in this troubleshooting guide will instruct you to check a specific electrical connector.

Intermittent electrical problems are often caused by poor connections. Always check for an active diagnostic code before breaking any connections. Also, always check for an active diagnostic code after the connector is reconnected in order to verify that the problem disappears.

Simply disconnecting the connectors and then reconnecting the connectors can temporarily solve a problem at times. If this occurs, likely causes are loose terminals, bent terminals, improperly crimped terminals, corrosion, or harness routing that is improper.

The original source of the problem must then be identified in order to ensure that the problem does not reoccur.

Follow this procedure to thoroughly inspect the connectors in order to determine if the connectors are the cause of the problem.

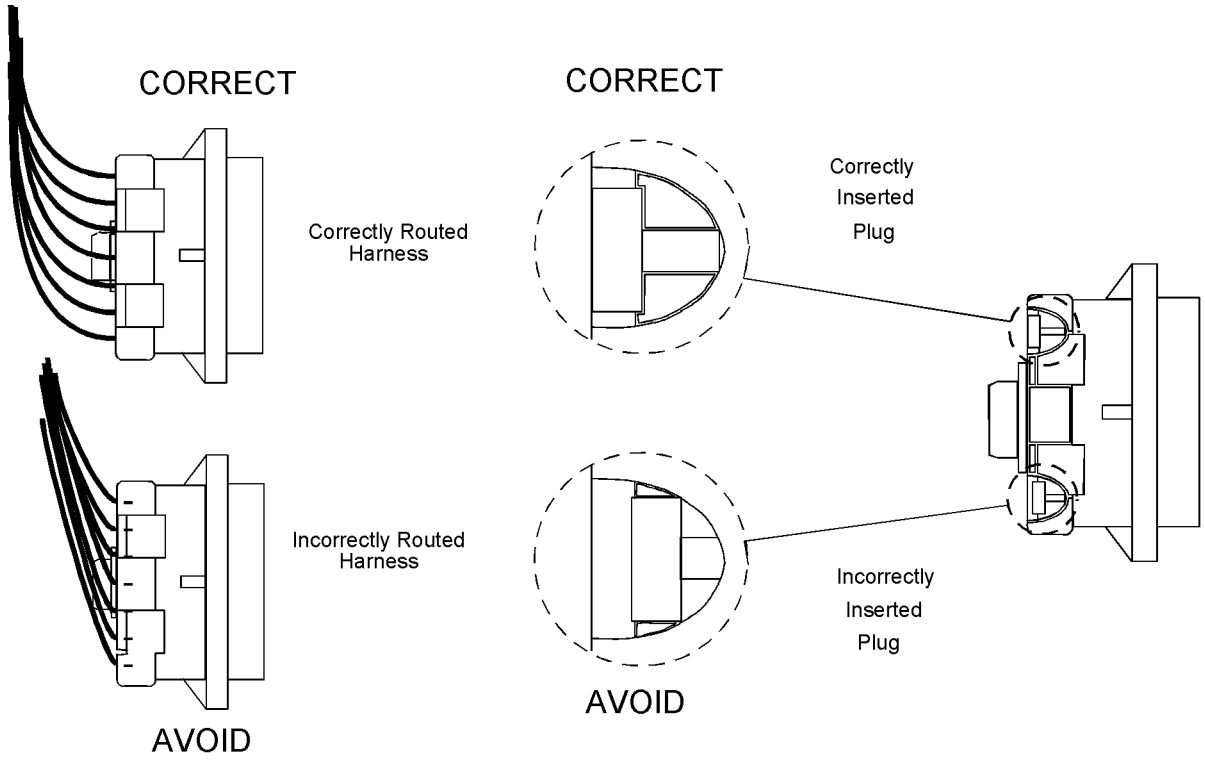


Illustration 566 g01135980

Correct way to route a harness and insert a plug

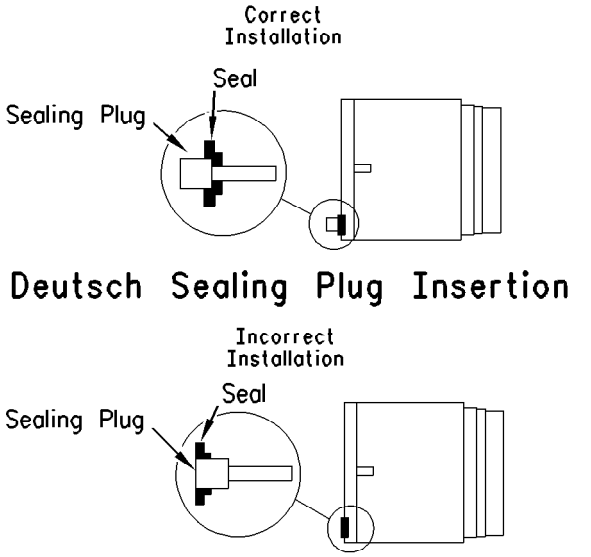


Illustration 567 g00690571

Proper Installation of Plug

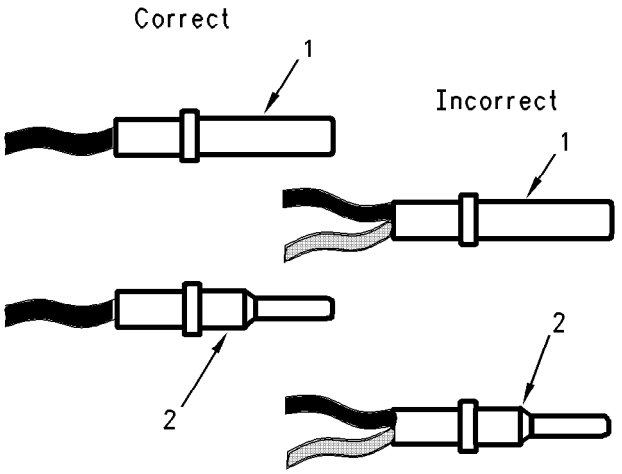


Illustration 568 g00828600

DT Type sealing plug

The 8T-8729 Connector Pin (2) and the 8T-8730 Connector Socket (1) is designed to accept only one 16/18 AWG wire. Do not insert multiple wires of a smaller wire size. An incorrect method would be using two 24 AWG wires. The 9W-0852 Connector Pin and the 9W-0844 Connector Socket is designed to accept only one 14 AWG wire. Do not insert multiple wires of a smaller wire size. An example of an incorrect method is the use of two 20 AWG wires.

1. CHECK THE CONNECTORS.

a. Ensure that the connector is properly locked. Also, ensure that the two halves of the connector can not be pulled apart.

b. Verify that the latch tab of the connector is properly latched. Verify that the latch tab of the connector is fully latched.

Expected Result: The connector will securely lock. The connector and the locking mechanism are without cracks or breaks.

Results:

OK – The connector will securely lock. The connector and the locking mechanism are without cracks or breaks. Proceed to test step 2.

NOT OK – A problem exists with the connector.

Repair: Repair the connector or replace the connector, as required.

STOP.

2. CHECK THE ALLEN HEAD SCREW ON THE HARNESS CONNECTOR OF THE ECM.

a. Ensure that the connector bolt is properly tightened. Be careful not to tighten the bolt too much. The bolt may break.

b. Do not exceed 6.0 N·m (53.0 lb in) of torque on the connector bolt of the harness when the connector is being installed on the ECM.

Expected Result: The harness connector is secure and the connector bolt of the ECM is properly torqued.

Results:

OK – The harness connector is secure and the connector is properly torqued. Proceed to test step 3.

NOT OK – A problem exists with the connector.

Repair: Secure the harness connector of the ECM. Ensure that the connector bolt is properly torqued.

STOP.

3. PERFORM A PULL TEST ON EACH CONNECTOR CONTACT.

a. Each connector contact should withstand 45 N (10 lb) of pull. Each wire should remain in the connector body. This test checks whether the wire was properly crimped in the contact and whether the contact was properly inserted into the connector.

b. The DT connectors use an orange wedge to lock the terminals in place.

c. Check in order to ensure that the orange wedge is not missing and that the orange wedge is installed properly on the DT connectors.

Note: A Crimp Tool should ALWAYS be used in order to crimp wires on connector contacts. Do not solder the terminals. Use the proper Crimp Tool.

Expected Result: Each connector contact should withstand 45 N (10 lb) of pull. Each wire remains in the connector body.

Results:

OK – Each connector contact withstands 45 N (10 lb) of pull. Each wire remains in the connector body. Proceed to test step 4.

NOT OK – A problem exists with the connector.

Repair: Repair the wiring or replace the connector contact.

STOP.

4. CHECK THE WIRES FOR NICKS OR ABRASIONS IN THE INSULATION.

a. Carefully inspect each wire for signs of abrasion, nicks, or cuts.

The following areas are locations that should be checked:

- Exposed insulation
- Points of rubbing wire

b. Check all of the hold down clamps for the harness in order to verify that the harness is properly clamped. Also check all of the hold down clamps for the harness in order to verify that the harness is not compressed by the clamp. Pull back the harness sleeves in order to check for a flattened portion of wire. The flattened portion of wire is caused by the clamp that holds the harness.

Expected Result: The wires are free of abrasion, nicks, or cuts and the harness is properly clamped.

Results:

OK – The wires are free of abrasion, nicks, or cuts and the harness is properly clamped. Proceed to test step 5.

NOT OK – A problem exists with the wiring.

Repair: Repair the wires or replace the wires, as required.

STOP.

5. CHECK THE CONNECTORS FOR MOISTURE OR CORROSION.

a. Ensure that the connector seals and the white sealing plugs are in place. If any of the seals or plugs are missing, replace the seal or plug. If necessary, replace the connector.

b. Check all of the wiring harnesses in order to verify that the harness does not make a sharp bend out of a connector. This will deform the connector seal and this will create a path for the entrance of moisture. See Illustration 566 .

Note: It is normal to see some minor seal abrasion on the ECM connector seals. Minor seal abrasion will not allow the entry of moisture.

c. Thoroughly inspect ECM connectors for evidence of moisture entry. If moisture or corrosion is evident in the connector, the source of the moisture entry must be found and the source of the moisture entry must be repaired. If the source of the moisture entry is not repaired, the problem will reoccur. Simply drying the connector will not fix the problem. Likely paths for the entrance of moisture are from missing seals, improperly installed seals, nicks in exposed insulation, and improperly mated connectors.

Note: Moisture can also travel from one connector through the inside of a wire to the ECM Connector. If moisture is found in the ECM connector, thoroughly check all connectors and wires on the harness that connect to the ECM. The ECM is not the source of the moisture. Do not replace an ECM if moisture is found in either ECM connector.

Note: If corrosion is evident on the contacts or the connector, use only denatured alcohol to remove the corrosion. Use a cotton swab or a soft brush to remove the corrosion. Do not use cleaners that contain trichloro-ethylene because trichloro-ethylene may damage the connector.

Expected Result: All of the connectors should be completely coupled and all of the seals should be completely inserted. The harness and the wiring should be free of corrosion, moisture, abrasion or pinch points.

Results:

OK – All of the connectors are completely coupled and all of the seals are completely inserted. The harness and the wiring are free of corrosion, moisture, abrasions or pinch points. Proceed to test step 6.

NOT OK – A problem exists with the connector, the wiring or the wiring harness. Moisture is present.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring. Ensure that all of the seals are properly in place and ensure that the connectors are completely coupled. Verify that the repair eliminates the problem by operating the machine for several minutes and by checking again for moisture.

STOP.

6. INSPECT THE CONNECTOR CONTACTS.

a. Verify that the contacts are not damaged. Verify that the contacts are properly aligned in the connector and verify that the contacts are properly located in the connector.

Expected Result: The contacts are properly aligned and the contacts appear undamaged.

Results:

OK – The contacts are properly aligned and the contacts appear undamaged. Proceed to test step 7.

NOT OK – A problem exists with the connector contacts.

Repair: Repair the contacts and wiring and/or replace the contacts and wiring.

STOP.

7. CHECK THE FIT OF THE CONTACTS.

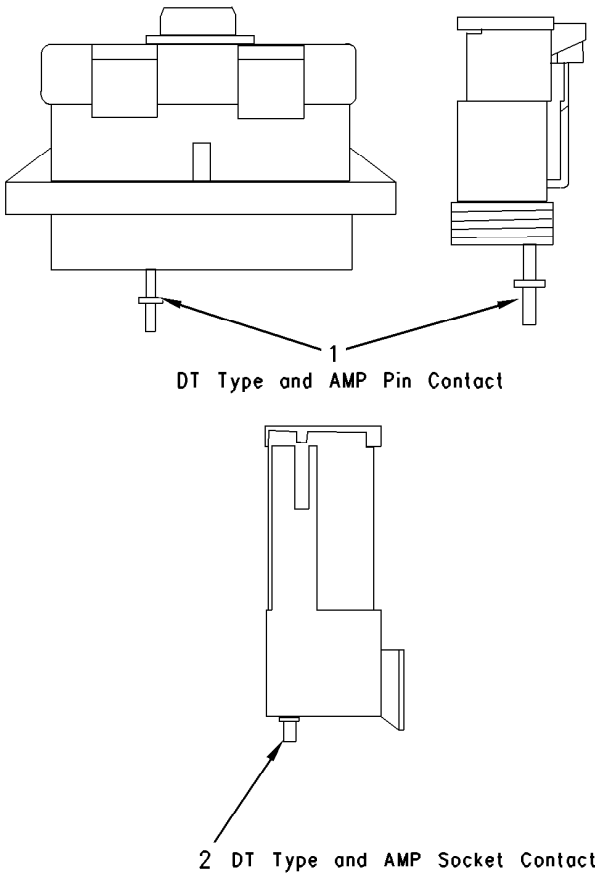


Illustration 569 g00838765

Retention of the Connector

(1) Pin Contact
(2) Socket Contact

Note: This is especially important for intermittent problems.

a. Use a new pin contact. Insert the pin contact into each socket contact one at a time in order to check for a good grip on the pin contact by the socket contact.

b. Use a new socket contact. Insert the pin contact into each socket contact one at a time in order to check for a good grip on the pin contact by the socket contact. The pin contact are located on the mating side of the connector.

c. The connector contact should stay connected when the connector is held in the position shown in Illustration 569 . The connector contact is the pin contact or the socket contact.

Expected Result: The pin contacts and the socket contacts appear to be OK.

Results:

OK – The pin contacts and the socket contacts appear to be OK. **STOP.**

NOT OK – A problem exists with the connector terminal.

Repair: Replace the connector contact.

STOP.

i02634314

Wiring Harness (Open Circuit) - Test

SMCS Code: 1408-081

An open circuit is a failure of an electrical circuit that results in no flow of electrical current. An open circuit is can be caused by a break in a circuit wire. Most often, an open circuit is caused by a poor connection or a failed connection in one of the electrical connectors that is used in a circuit.

The following procedure is a way to check for an open or a poor connection in a circuit.

TEST FOR AN OPEN CIRCUIT.

1. Identify the connectors and the wire numbers of the suspect circuits. Use the Electrical System Schematic of the machine to identify the circuits.

2. Turn the key start switch and the disconnect switch to the OFF position.

3. Disconnect the component and the ECM from the wiring harness.

4. At one of the disconnected harness connections, place a jumper wire from the contact of the suspect wire to frame ground.

5. At the other connector of the machine harness, use the multimeter probes to measure the resistance from the contact of the suspect wire to frame ground.

Expected Result: The resistance is less than 5 ohms.

OK – The resistance is less than 5 ohms. The harness circuit is correct.

Stop.

NOT OK – The resistance is greater than 5000 ohms. There is an open in the machine harness.

Repair: Repair the machine harness or replace the machine harness.

Stop.

When the resistance of a good circuit is measured, less than 5.0 ohms of resistance is expected. In a circuit that has an electrical wire or a connection that is completely open (broken or no connection), the flow of electrical current through the circuit is interrupted. A circuit that is completely open due to a broken wire or no connection in a connector will measure greater than 5000 ohms of resistance.

Many times a circuit is not completely open and will allow some current to pass through, however, not enough current will pass to allow the circuit to function properly. This can be caused by a wire that is partially broken but still is intact enough to allow a small amount of current to pass. Partial breaks in a wire are difficult to diagnose because the resistance measurement may check OK through the section of wire that is still intact. Partial breaks in a wire are not common. When a partial break is suspected in a wire, the current through the circuit should be checked under load in order to verify that the correct amount of current is present.

Most often, a resistance measurement of greater than 5.0 ohms and less than 5000 ohms is due to a poor connection in a circuit connector. The connector contacts may be corroded due to moisture that has entered the connector body. A connector pin or socket may not have been seated securely in the connector body and is not making good contact or a wire may be broken at the point where the pin or socket is connected. When checking for problems in a circuit, the connectors in the circuit should be examined closely.

When an open is suspected in a circuit, try to isolate the section of the machine harness where the open is occurring. The complete Electrical System Schematic for your machine must be used in order to identify and find the harness connectors that are in the suspect circuit.

Once the harness connectors for the circuit are identified, isolate the section of the circuit that is open. Start at either the component or the ECM end of the circuit. With the disconnect switch and the key start switch in the OFF position, disconnect the component or the ECM connector and use a jumper wire to connect two of the circuit wires. Go to the next harness connector in the circuit and disconnect the connector. Check the connector contacts for corrosion. Make sure the contacts are not damaged, are clean and are securely installed in the connector body. Use the electrical schematic to determine the contacts for the jumpered circuit wires. Check the resistance between the two wires. A good circuit will measure less than 5.0 ohms. Repeat the steps as you go to the next connector in the circuit until the faulty section of the circuit is identified.

Once the wire or connector that is causing the problem is found, replace the broken wire or repair the harness connector. Do not use a splice to repair a broken wire. A splice will not keep moisture out of the connection and will create another potential problem area in the circuit.

i02563153

Wiring Harness (Short Circuit) - Test

SMCS Code: 1408-081

A short circuit is a failure of an electrical circuit that results in the flow of electrical current through an unintended path. A circuit can be shorted to a ground source, either frame ground or a ground circuit, or a circuit can be shorted to another circuit in the machine wiring harness such as a system voltage (+battery) circuit, a sensor power supply circuit or a sensor signal circuit.

A short circuit to a ground source will cause excessive current to flow through the circuit and will cause the voltage in the circuit to decrease. In a machine circuit that is not controlled by an ECM such as a lighting circuit, this will cause the fuse or the circuit breaker for the circuit to open. In a ECM controlled circuit, the ECM will detect these conditions and can activate a diagnostic code for the circuit with an FMI 04 (voltage below normal) or an FMI 06 (current above normal) condition code.

A short circuit to another voltage source circuit can result in voltage being present in the circuit when no voltage should be present. When this occurs in ECM controlled output circuits (solenoids), uncontrolled machine movement can occur. When this occurs in ECM input circuits (sensors), machine functions may not operate when requested due to signal interference. The ECM will detect these conditions and can activate a diagnostic code for the circuit with an FMI 03 (voltage above normal) or possibly an FMI 08 (abnormal frequency, pulse width or period) condition code.

Short circuits can be caused by damage to the insulation of a wire as a result of repeated contact with the machine frame or with another wire. A short circuit can also be caused by a damaged or contaminated machine harness connector. A short circuit can also be caused by a failed circuit component.

When troubleshooting a circuit for a short, the connection schematics that are provided in the back of this manual are a good quick reference source, however, the complete Machine Electrical System Schematic should be used in order to identify all of the machine wiring harness connectors that are in a specific circuit.

Reference: For a complete electrical schematic, refer to Electrical System Schematic for the machine that is being serviced.

TEST FOR A SHORT CIRCUIT.

1. Identify the connectors and the wire numbers of the suspect circuits. Use the Electrical System Schematic of the machine to identify the circuits.

2. Turn the key start switch and the disconnect switch to the OFF position.

3. Disconnect the component and the ECM from the wiring harness.

4. At the machine harness connector for the ECM, place one of the multimeter probes on the contact of the suspect circuit wire.

5. Use the other multimeter probe to check the resistance between the suspect circuit wire and frame ground and all of the other contacts that are used in the ECM connectors.

6. As each measurement is made, observe the multimeter resistance measurement and wiggle the machine harness connectors for the ECM. Gently pull on the wires and move the wires around.

7. While observing the multimeter resistance measurement, wiggle the machine harness and the harness connectors that are involved in the circuit. Gently pull on the wires and move the wires around.

Expected Result: The resistance measurement is greater than 5000 ohms for each of the measurements.

OK – The resistance is greater than 5000 ohms for all the measurements. An obvious short is not evident. An intermittent short circuit could still be causing a problem.

NOT OK – One or more of the resistance measurements is less than 5 ohms. There is a short in the machine harness. The short is between the suspected circuit wire and the circuit wire with the lowest resistance measurement or the short is between the suspected circuit wire and the machine frame ground.

ISOLATING THE LOCATION OF THE SHORT CIRCUIT

Once it has been determined that a short circuit is present, the location of the short in the circuit must found and repaired.

Use the troubleshooting procedure for the specific diagnostic code that is activated in order to isolate whether the problem is caused by a system component or is present in the machine wiring harness.

When the machine wiring harness is suspected, examine the circuit on the full Machine Electrical System Schematic. Starting at the ECM, identify and locate each machine harness connector that is involved in the circuit. Starting at the ECM, one at a time, disconnect each connector. Inspect the pins and the sockets on the male connector and on the female connector. Verify that all of the contacts are securely installed in the connector body. Ensure that the contacts are clean and the contacts are in good condition.

While each of the connectors is disconnected, use a digital multimeter to again measure the resistance between either frame ground or measure the resistance between the suspect circuit wire and the circuit wire with the low resistance measurement. While observing the measurement, wiggle the connector and the machine harness in order to check for intermittent short circuits. Do this as you move outward from the ECM in order to isolate the section of the harness where the short circuit is occurring.

Reconnect the connector. Ensure that the locking clips on the connectors are engaged. Check all of the connectors that are in the suspect circuit in this manner. After the connectors have been examined, check to see if a short is still present in the circuit.

A "Short Finder" device is available from most tool distributors that will aid in locating the short. Inorder to locate the short, these devices detect the changes that a short creates in the magnetic field that is created by a current in the wire. Detailed instructions on the operation of the device is included with these devices.

When damaged insulation is present on a wire, use a good quality electrical tape or electrical heat shrink tubing to repair the section of insulation. Ensure that the section of wire or harness is not making contact with any part of the machine frame. Do not use an "RTV" or silicone sealer to repair the insulation as these types of sealants are not compatible with the copper wire.

i05610454

Electronic Control Module (ECM) - Flash Program

SMCS Code: 7610-591-II

An electronic control module (ECM) is flashed to upgrade the software and when an ECM has been replaced. The Cat ® Electronic Technician (Cat ET) contains the program WinFlash. WinFlash is used to load software into the ECM. The following procedure is used to flash software into the ECM.

Note: Use a 171 - 4400 Communication Adapter II to flash all machine components.

1. Procedure

a. Connect the Data Link cable between the 171 - 4400 Communication Adapter II and the Cat ET.

b. Connect the Data Link cable between the 171 - 4400 Communication Adapter II and the machine diagnostic connector.

c. Load the software with WinFlash.

i02738312

Electronic Control Module (ECM) - Configure

SMCS Code: 7610-025-II

When an Implement ECM is replaced, the ECM is configured when the software is flashed either at the factory or at the time of installation on the machine. The saved configuration data from the ECM that was replaced will restore the parameters that were configured.

If an ECM was replaced and the configuration data from the old ECM could not be saved, most factory default parameters will be loaded when the software is flashed to the new ECM, however, the cylinder length parameters and trim files for both of the steering cylinder position sensors must be manually determined and loaded in the Implement ECM before the machine can be operated.

If the manual loading of the steer cylinder parameters has not been performed for a replacement ECM where the original configuration data was not saved, refer to Testing and Adjusting, “Electronic Control Module (ECM) - Replace” and perform the procedure “**Replacement Procedure For An Implement ECM That Is Not Communicating**” .

The configured parameters for the Implement ECM that will load factory defaults when the software is flashed are listed below:

Auxiliary Valve Control Levers – Configured to allow any installed control lever to control any installed auxiliary hydraulic valve. Factory default is “Not Installed” . Refer to Testing and Adjusting, “Auxiliary Hydraulic System - Configure”

Machine Shipping Mode Enable Status – Locks out the articulation and the wheel lean functions. Factory default is “Disabled” . A change to “Enabled” will lockout the functions. Function control signals will be forced to zero when locked out.

Accugrade System Installation Status – Accugrade attachment for all M Series Motor Graders requires a factory password to install. Factory default is “Not Installed” .

Accugrade Enable Status – Indicates if the Accugrade System is enabled or disabled. Used to temporarily remove Accugrade from the machine. Factory default is “Disabled” .

Advanced Machine Security System Installation Status – This function is a software enabled attachment. A factory password is required to install this function. When installed, the Machine Security System will prevent machine start up. The factory default is “Not Installed” .

i02565049

Electronic Control Module (ECM) - Replace

SMCS Code: 7610-510-II

Prior to replacement of the ECM, ensure that replacement of the ECM is absolutely necessary. The ECM is seldom the cause of an active diagnostic code. Verify that all possible causes of the problem have been investigated. Always check that the proper ground and power is available to the ECM. Before replacing the ECM, contact your Caterpillar dealership's Technical Communicator for possible consultation with Caterpillar.

Note: New electronic control modules are available either pre-programmed for a particular machine or the ECM is not programmed. An ECM that has not been programmed must be programmed by using the Caterpillar Electronic Technician (Cat ET). See Testing and Adjusting, “Electronic Control Module (ECM) - Flash Program”. See step 8 in order to determine whether the ECM has been programmed.

The following “**Replacement Procedure For An ECM That Is Communicating**” procedure is for replacement of an ECM that is capable of communicating with Cat ET. This procedure can be performed for replacement of most ECM controls on most Caterpillar machine models.

For replacement of an Implement ECM on the M Series Motor Graders that will not communicate with Cat ET or will not save the configuration data to file, proceed to the “**Replacement Procedure For An Implement ECM That Is Not Communicating**” procedure below.

Replacement Procedure For An ECM That Is Communicating

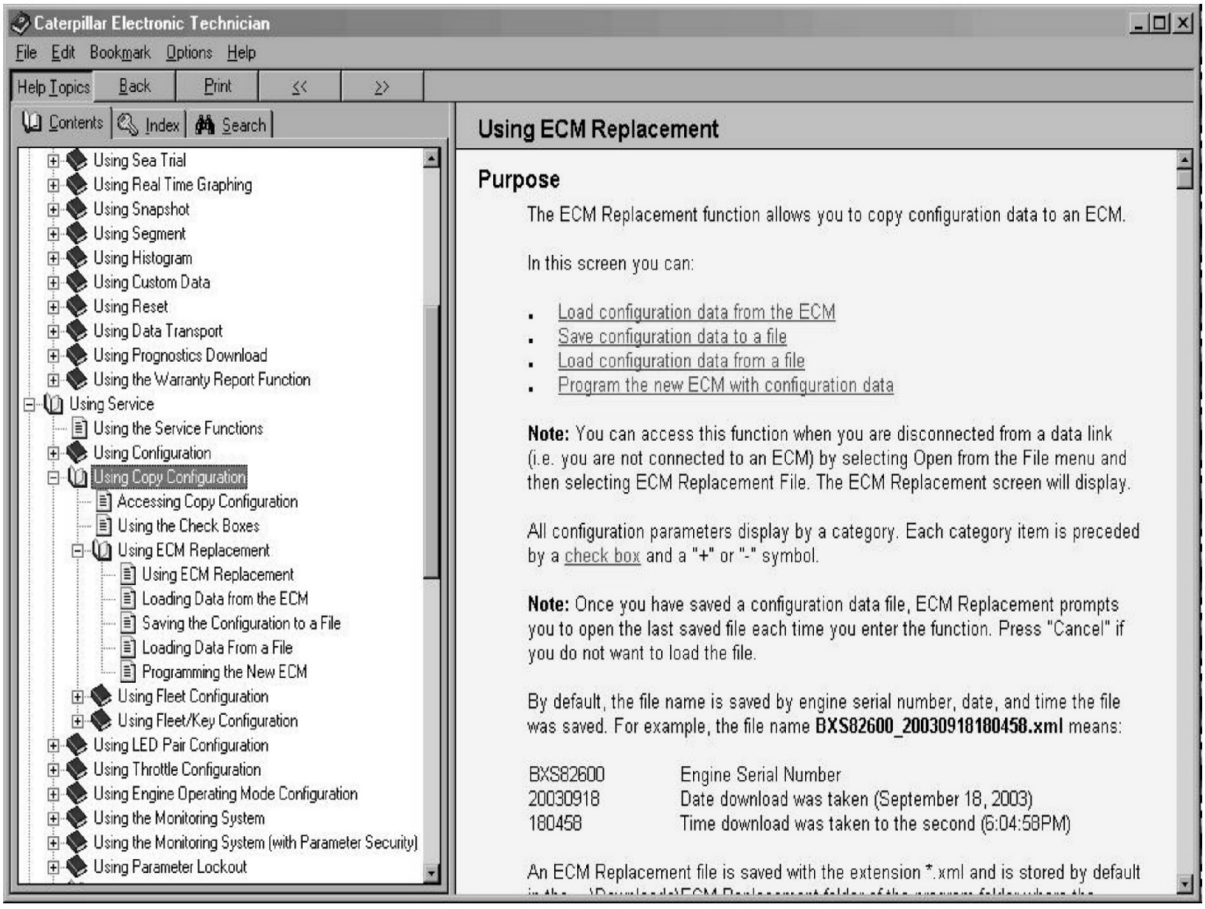


Illustration 570 g01121920

1. Save the ECM configuration data. Go to the help screen that is shown in illustration 570 , and follow the instruction in order to save the configuration data to a file. This file will be used in order to load the configuration data to the new ECM.

2. Turn the key start switch and the disconnect switch to the OFF position.

3. Disconnect the machine harness from the ECM.

4. Remove the ECM.

5. Ensure that the replacement ECM has the correct part number.

6. Connect the machine harness to the ECM.

Note: Two key start ON/OFF cycles are required for correct initialization of the new ECM.

7. Turn the disconnect switch and the key start switch to the ON position. Wait for a minute to let the ECM initialize. Turn the key start switch to the OFF position. Wait 10 seconds. Turn the key start switch to the ON position a second time for correct initialization of the ECM.

8. Determine whether the ECM has been programmed. Connect the (Cat ET) to the service tool connector. Cat ET communicates with the ECM.

Cat ET will indicate whether the ECM has been programmed. An ECM that has not been programmed must be programmed by using the WinFlash software which is contained in Cat ET. See Troubleshooting, “Electronic Control Module (ECM) - Flash Program”.

Cat ET will provide access to the ECM if the ECM has already been programmed.

9. Using the Cat ET service tool, select the “Service” function from the drop-down menu. Then, select the “Configuration” function. A list of items will appear. Each item in this list should be checked in order to verify that the setting matches the machine configuration. The following information is an example of what might be viewed in order to verify the proper machine configuration. Select “Ripper Installation Status” from the choices. Select the “change” button. Select “Installed” or “Not Installed” .

10. Select the “Service” function from the Cat ET. Select “Configuration” from the choices. A list of items will appear. From the list, select “Ripper Auto Stow Configurations” . Select the “change” button. Select “Ripper Raise” or “Ripper Raise And Shank In” .

11. Perform all applicable system calibrations. See the Testing and Adjusting, “Calibration” procedure in the service manual for your machine.

Note: Some variations in Cat ET menu may be experienced. View the proper subject for information about a specific Cat ET menu.

Note: Performance will be affected by ANY calibration procedures that are omitted. Make sure that all calibration procedures are performed. Perform all calibration procedures, even if the replacement ECM was acquired from a similar machine.

Replacement Procedure For An Implement ECM That Is Not Communicating

This procedure should be performed for an M Series Motor Grader Implement ECM that will not communicate with Cat ET or will not save the configuration data to a file.

Prior to replacement of the ECM, ensure that replacement of the ECM is absolutely necessary. The ECM is seldom the cause of an active diagnostic code. Verify that all possible causes of the problem have been investigated. Always check that the proper ground and power is available to the ECM. Before replacing the ECM, contact your Caterpillar dealership's Technical Communicator for possible consultation with Caterpillar.

Note: The first steps will verify that the Cat Data Link circuit between the service connector and the ECM that being replaced is not causing the communication problem.

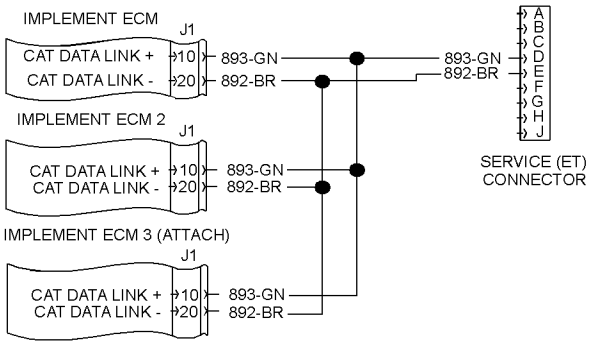


Illustration 571 g01330400

Cat Data Link connections

1. Turn the key start switch and the disconnect switch to the OFF position.

2. Disconnect the machine harness J1 connector from the Implement ECM that is being replaced.

3. Using the diagram for the Cat Data Link connections, connect a jumper wire between the J1 data link (+) contact (wire 893-GN(Green)) and the data link (-) contact (wire 892-BR(Brown)).

4. At the service connector, measure the resistance between data link (+) contact D (wire 893-GN(Green)) and data link (-) contact E (wire 892-BR(Brown)).

Result: The resistance measurement should be less than 5.0 ohms.

If the resistance measurement is greater than 5.0 ohms, there is an open or a poor connection in the Cat Data Link circuit. Refer to the complete machine Electrical System Schematic for your machine. Check the data link circuit for opens or bad connections. Repair the data link circuit and then try to establish communication with the ECM. If the ECM still will not communicate, proceed to the next step.

If the resistance measurement is less than 5.0 ohms, proceed to the next step.

5. Disconnect the machine harness connector J2 from the ECM.

6. Remove the Implement ECM.

7. Ensure that the replacement ECM has the correct part number.

8. Connect the machine harness connectors to the ECM.

Note: Two key start ON/OFF cycles are required for correct initialization of the new Implement ECM.

9. Turn the disconnect switch and the key start switch to the ON position. Wait for a minute to let the ECM initialize. Turn the key start switch to the OFF position. Wait 10 seconds. Turn the key start switch to the ON position a second time for correct initialization of the ECM.

10. Determine whether the ECM has been programmed. Connect the (Cat ET) to the service tool connector. Cat ET communicates with the ECM.

Cat ET will indicate whether the ECM has been programmed. An ECM that has not been programmed must be programmed by using the WinFlash software which is contained in Cat ET. See Troubleshooting, “Electronic Control Module (ECM) - Flash Program”.

Cat ET will provide access to the ECM if the ECM has already been programmed.

The Implement ECM should now be initialized. Most of the machine operating parameters that can be configured will be set to the factory default settings when the software is flashed to the ECM, however, **THE CYLINDER LENGTH PARAMETERS AND THE POSITION SENSOR TRIM FILES FOR BOTH OF THE STEERING CYLINDERS MUST BE CONFIGURED IN THE ECM BEFORE OPERATING THE MACHINE.**

Illustration 572 g01330461

Steer Cylinder Data Tag fastened to the head end of the cylinder (arrow)

In order to download the cylinder length parameters and manually load the position sensor trim files, the following procedures must be performed.

1. Locate the metal tag that is fastened to the head end of each steer cylinder. This tag is stamped with the cylinder part number and the serial number.

2. Record the part number and the serial number that is stamped on the tag for the left steer cylinder and for the right steer cylinder. Ensure that the correct part number and serial number is recorded for the left cylinder and is recorded for the right cylinder.

3. In order to download your steer cylinders length parameters to the Implement ECM, locate and perform the Testing and Adjusting, “New Cylinder Group - Set” procedure in this manual. Enter the recorded part numbers and serial numbers from your left and right steering cylinders when prompted in the procedure.

Note: Once the procedure for downloading the steering cylinder length parameters is complete, the position sensor trim files must be determined and manually loaded into the Implement ECM.

Note: The next procedure for “Position Sensor (Steering Cylinder) - Set” is set up to be performed when a steering cylinder position sensor is replaced. In this case, disregard any reference to replacement of the position sensor. The position sensor does not need to be replaced in order to perform the procedure.

4. In order to determine and manually load the cylinder trim files into the Implement ECM, locate and perform the Testing and Adjusting, “Position Sensor (Steering Cylinder) - Set” procedure in this manual.

When all of the listed procedures have been performed successfully, the ECM replacement is complete.

Verify that all machine functions are working properly before operating the machine.

Note: For a listing and explanation of the Implement System configurable parameters that will be defaulted to the factory settings when the ECM is replaced, refer to the Testing and Adjusting, “Electronic Control Module (ECM) - Configure” section of this manual.

Note:

i06675540

System Schematic

SMCS Code: 7566-DTN

S/N: B921–368

S/N: R9A1–Up

RENR9013-18

PAGES 993-1000 4FOLDOUT(S)

M SERIES IMPLEMENT ECM 3 - J1 AND J2 CONNECTIONS

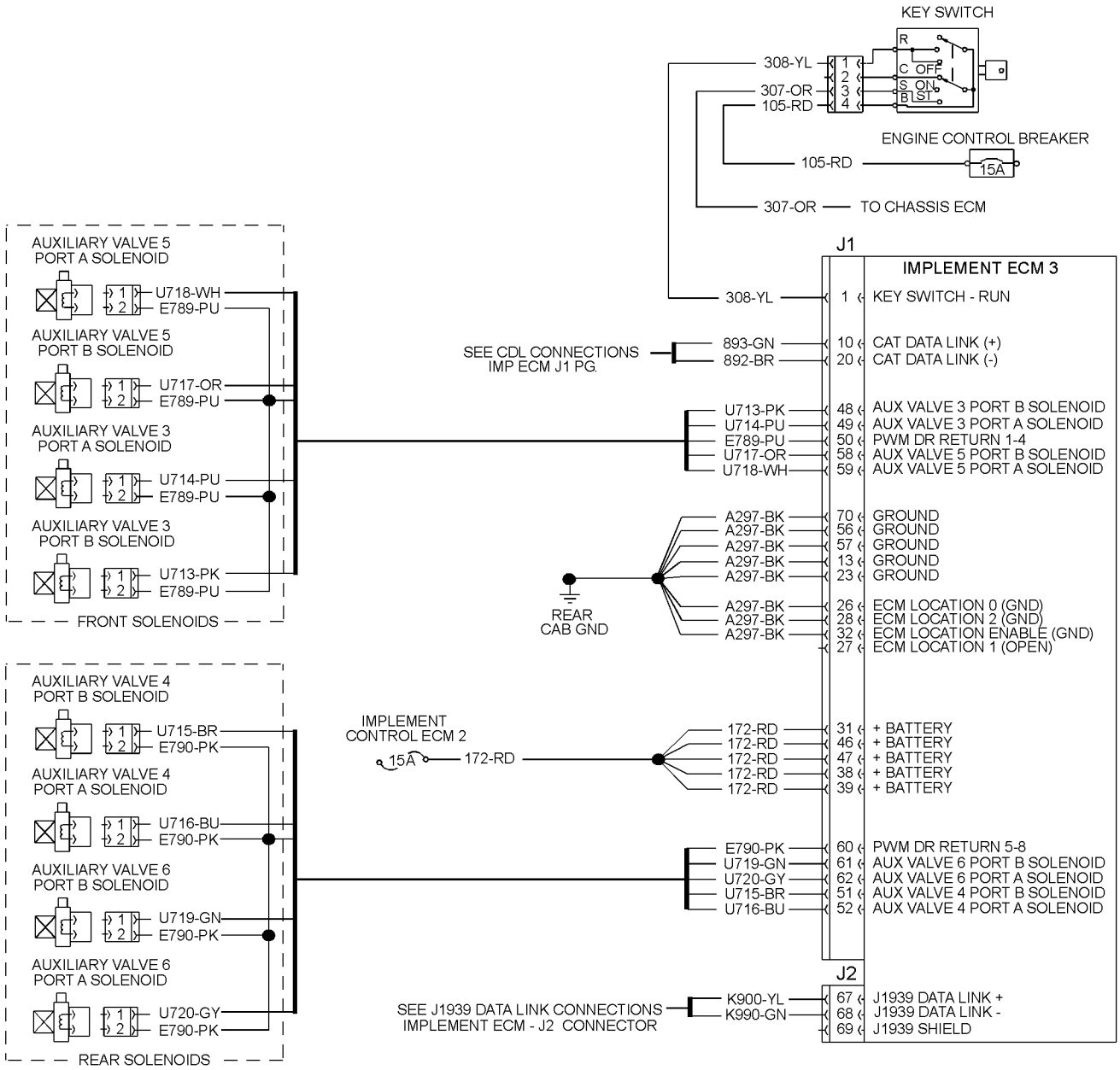


Illustration 576 g01320112

M SERIES - ADVANCED CONTROL JOYSTICK SCHEMATIC

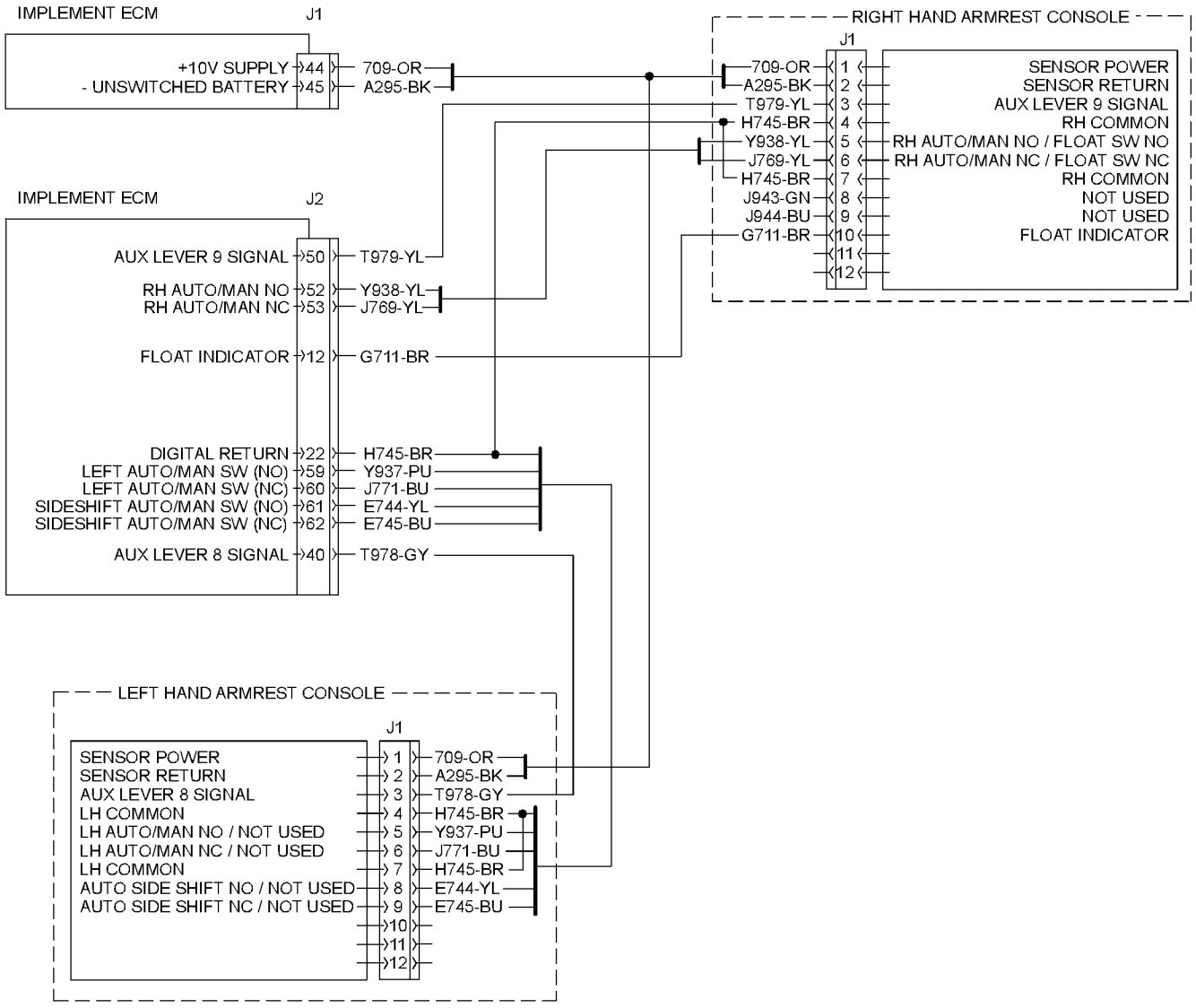


Illustration 577 g03741420

i06692565

System Schematic

SMCS Code: 7566-DTN

S/N: B92369–Up

S/N: B541–Up

S/N: B551–Up

S/N: B561–Up

S/N: B571–Up

S/N: B591–Up

S/N: B9D4763–Up

S/N: B9E1144–Up

S/N: D9G1586–Up

S/N: D9T1439–Up

2

RENR9013-18

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M SERIES - ADVANCED CONTROL JOYSTICK SCHEMATIC

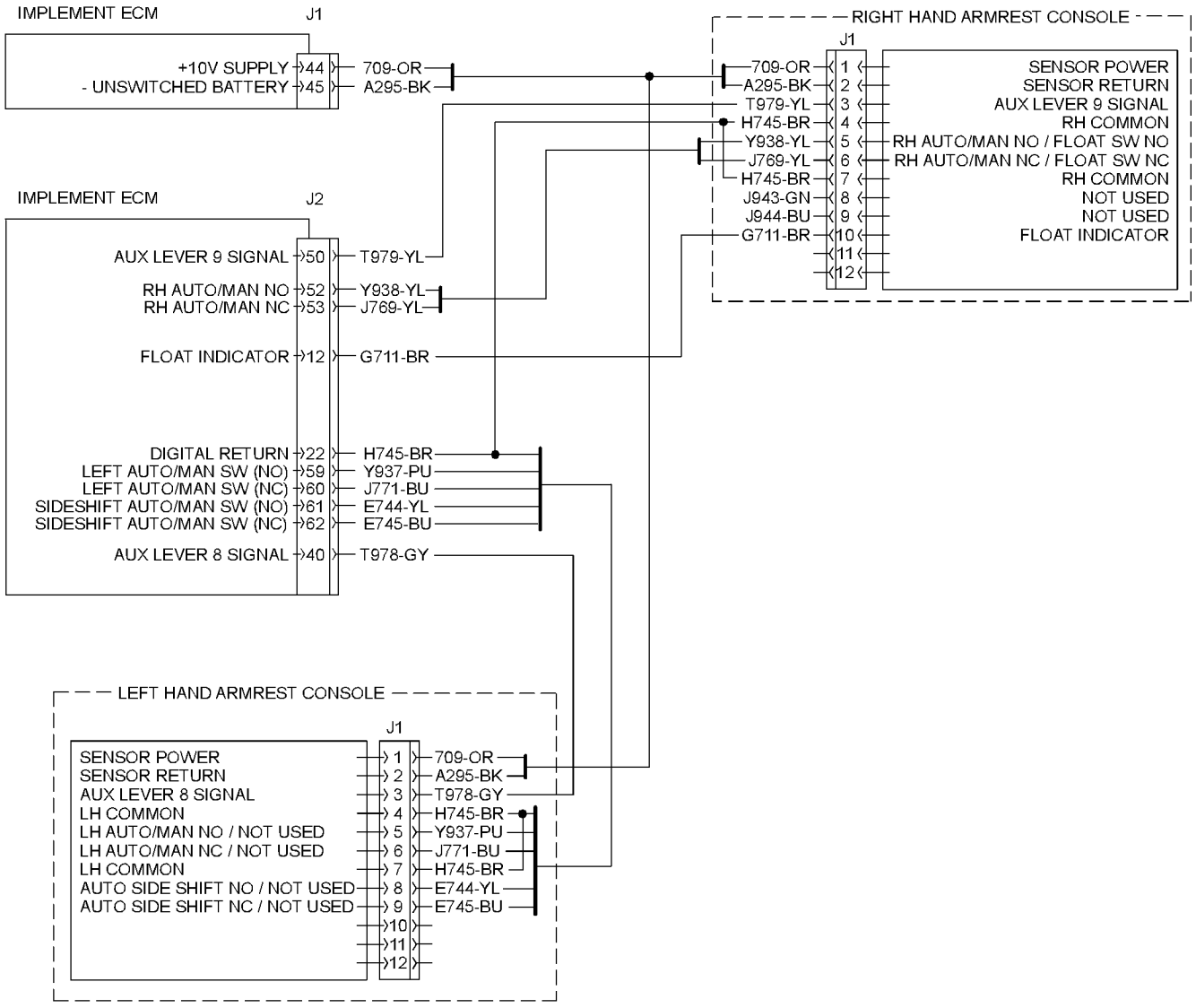

Illustration 582 g03741420

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