



Systems Operation Troubleshooting Testing and Adjusting

120M, 12M, 140, 140M , 150 , 14M, 160M , 160 , 16M, 24M Motor Graders Monitoring System

B92 1-UP (Machine)	D9G 1-UP (Machine)
B93 1-UP (Machine)	B9T 1-UP (Machine)
B54 1-UP (Machine)	D9T 1-UP (Machine)
B55 1-UP (Machine)	B9W 1-UP (Machine)
B56 1-UP (Machine)	R9C 1-UP (Machine)
B57 1-UP (Machine)	D9W 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)	
B9K 1-UP (Machine)	
B9G 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.



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

Failure to follow this warning may lead to premature failures, product damage, personal injury or death.

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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Systems Operation Section

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General Information

SMCS Code: 7490

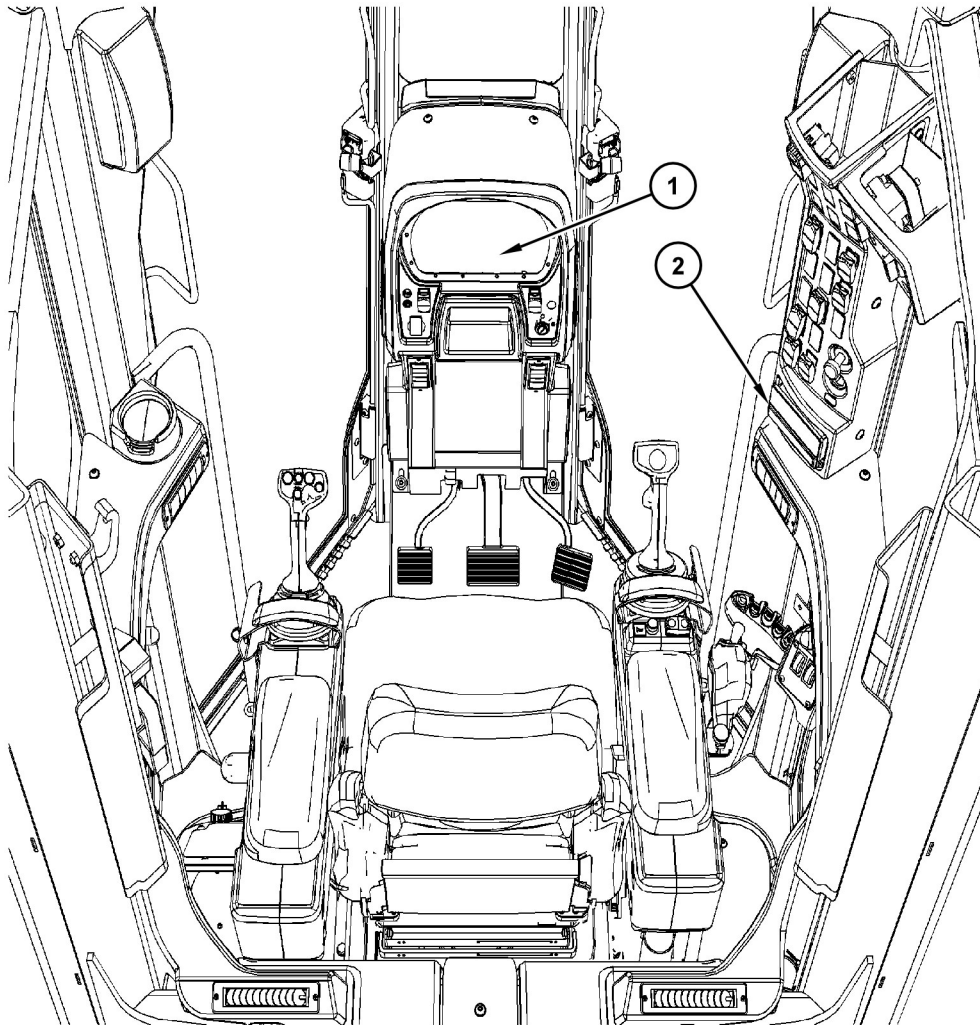


Illustration 1

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(1) Instrument Cluster

(2) Messenger Display Module

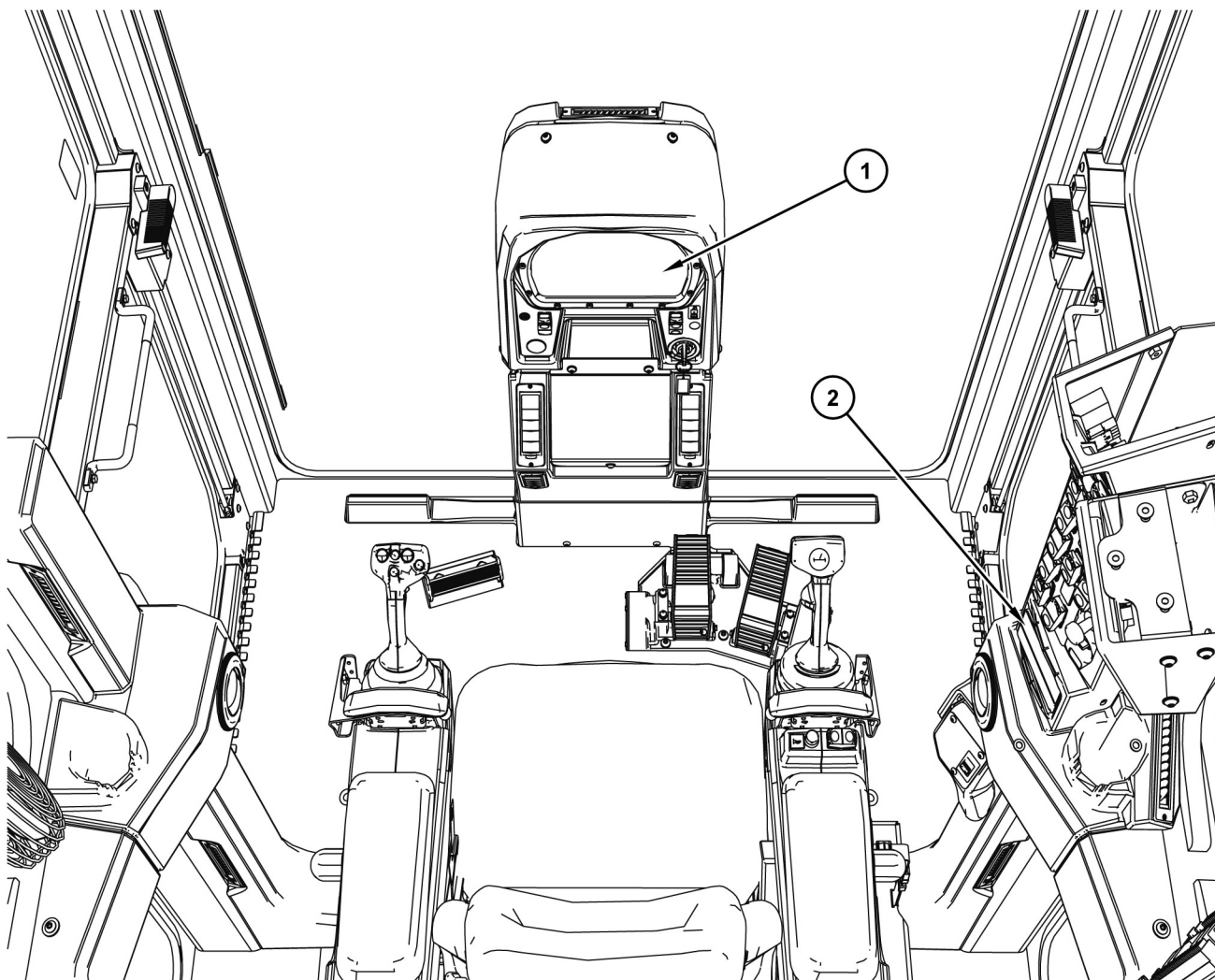


Illustration 2

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Inside of the Cab for 24M

(1) Instrument Cluster

(2) Messenger Display Module



Illustration 3
(1) Instrument Cluster

g01305751



Illustration 4
(2) Messenger Display Module

g01305752

Details on the hardware components and the software that make up the system will be identified. The Messenger monitoring system is the new standard system that is used in the previously listed machines. This manual will also discuss the means of navigating through the various screens of the Messenger.

The Messenger monitoring system continuously monitors all machine systems. Messenger consists of both software and hardware components. The hardware components are listed below.

- Messenger display module
- Action alarm
- Instrument cluster

Messenger communicates with the Electronic Control Module (ECM) of other systems via the Cat Data Link. Messenger can indicate warnings that have occurred in the ECM of other systems. These systems include the following:

- Engine ECM

- Implement ECM
- Implement 2 ECM
- Implement 3 ECM (If equipped)
- Transmission/Chassis ECM
- All Wheel Drive ECM (If equipped)
- Product Link ECM (If equipped)

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Monitoring System

SMCS Code: 7490



Illustration 5

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Messenger Display Module

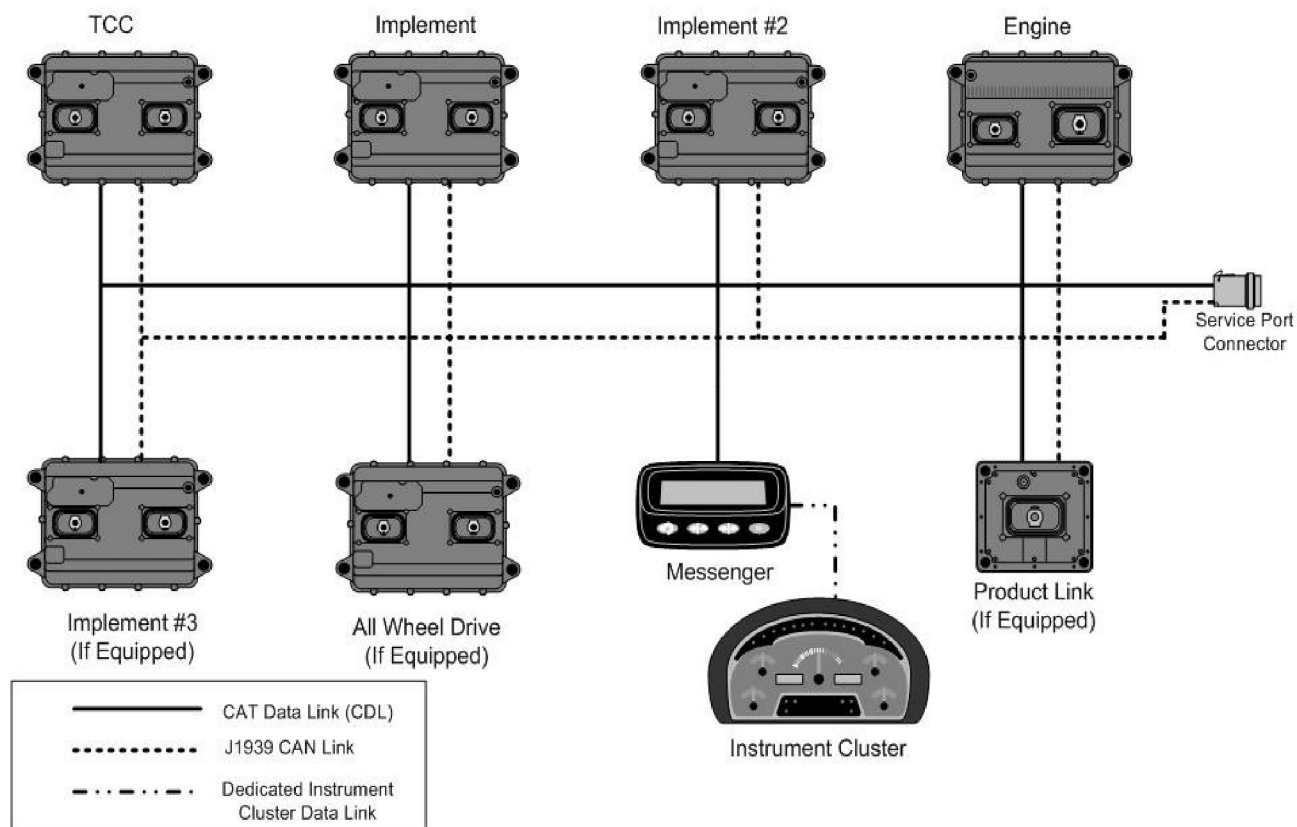


Illustration 6

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Block Diagram Of The Messenger Monitoring System and All Other Machine Control Systems

The Messenger monitoring system monitors the operation of the machine.

The Messenger provides the operator with the following information:

- Operating characteristics of the machine
- Diagnostics
- Events
- Modes of operation

Instantaneous information and lifetime totals about the machine's condition and performance is constantly gathered by Messenger.

The operator is able to adjust many of the settings in order to match the machine to the desired application. The operator can also use the Messenger in order to observe preferences and observe parameters.

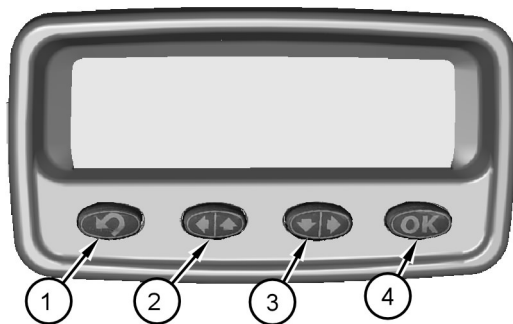


Illustration 7

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Messenger Screen Display

- (1) Back button
- (2) Left/Up button
- (3) Right/Down button
- (4) OK (Enter/Select) button

The operator can provide input to Messenger by using the following buttons that are located below the display:

- Back button (1)
- Left or Up button (2)
- Right or Down button (3)
- Enter button (4)

Messenger allows the technician to access the following:

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

Note: Messenger will refer to the instrument cluster as the gauge cluster.

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

When the engine key start switch is turned on, the Messenger continuously monitors all of the following machine systems:

- Sensors
- Electronic Control Modules (ECM)

- System components for the monitor

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Display Module

SMCS Code: 7490

Warning Indicators

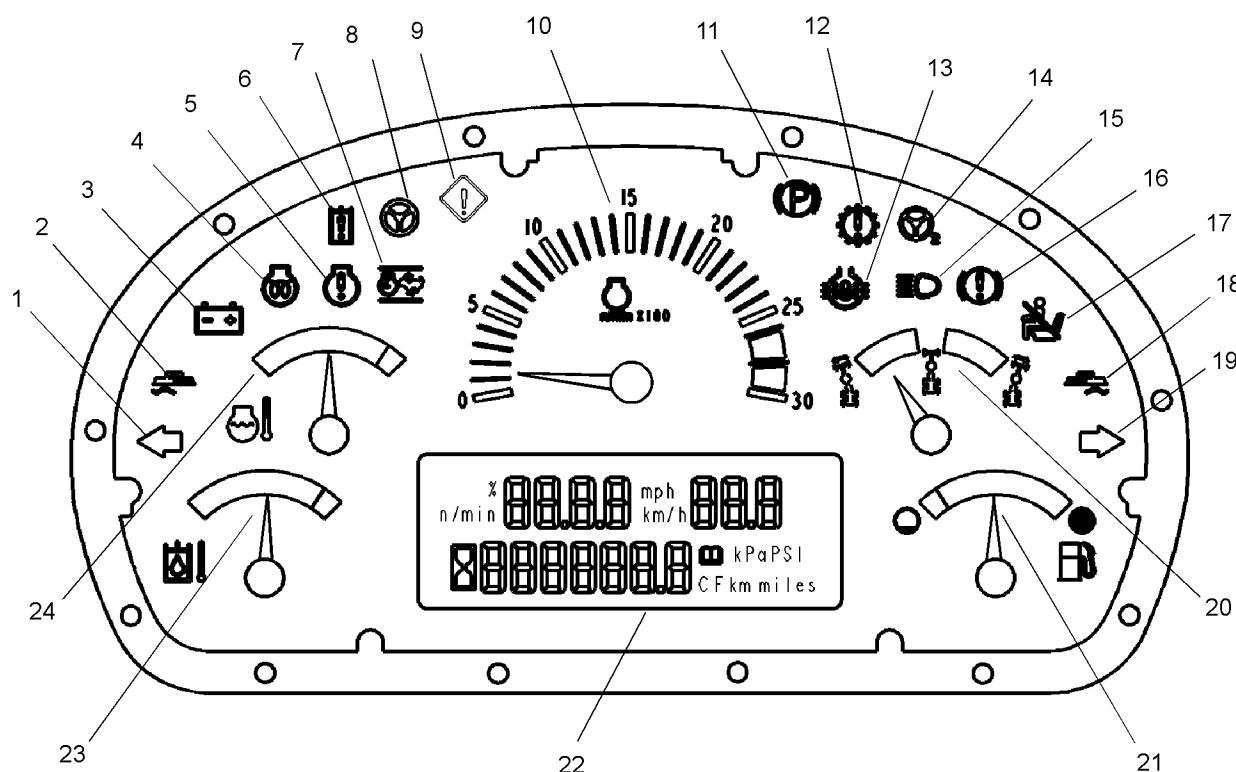


Illustration 8

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- (1) Left Turn Signal
- (2) Blade Left Float
- (3) Charging System
- (4) Air Inlet Heater
- (5) Engine System
- (6) Implement System
- (7) Throttle Lock
- (8) Primary Steering System

- (9) Action Lamp
- (10) Tachometer
- (11) Parking Brake
- (12) Transmission System
- (13) Differential Lock
- (14) Secondary Steering System
- (15) High beam
- (16) Braking System

- (17) Operator Not Present
- (18) Blade Right Float
- (19) Right Turn Signal
- (20) Articulation Angle
- (21) Fuel Level
- (22) LCD
- (23) Hydraulic Oil Temperature
- (24) Engine Coolant Temperature

The LED indicators will illuminate in one of the following colors in order to alert the operator that a certain condition exists: green, blue, amber and red.



Left Turn Signal Indicator (1) – This indicator flashes green when the left turn signal is operating.



Left Blade Float (2) – This indicator will illuminate green when the left side of the blade is in FLOAT mode.



Charging System Indicator (3) – The indicator will illuminate red when there is a problem with the charging system.

Table 1

Warning Table for the Charging System		
Warning	Description	EID
Low System Voltage	Messenger has determined that the system voltage is too low for the current operating conditions.	875
High System Voltage	Messenger has determined that the system voltage is too high for the current conditions.	876
Alternator Not Charging	This warning will be active when the signal from the alternator is not present and the engine is running.	179



Air Inlet Heater Indicator (4) – This indicator will illuminate amber when the air inlet heater is active.



Check Engine Indicator (5) – This indicator will illuminate red when there is an active warning that relates to the engine.



Implement System Indicator (6) – This indicator illuminates red when there is an active warning in the implement system or the AccuGrade system.



Throttle Lock Indicator (7) – This indicator will illuminate green when the throttle for the engine is locked.



Primary Steering Indicator (8) – This indicator will illuminate red when there is an active warning that relates to the primary steering system.



Action Indicator (9) – The action indicator will flash red when a warning Level 2 or 3 diagnostic code or an event is active. When the action indicator is flashing, some type of response is required by the operator or the technician. The appropriate response will depend on the severity of the warning. For more information on the action indicator, refer to Systems Operation, “Warning Operation” in this manual.

Note: Do not operate the machine if the monitoring system is not working or if the monitoring system fails the self-diagnostic test at start-up. Stop the machine immediately if the alert indicator flashes amber.

- Engage the parking brake and stop the engine. Investigate the cause of the problem.

- Do not operate the machine until the cause of the problem has been corrected.



Parking Brake Indicator (11) – This indicator monitors the parking brake. The indicator will illuminate red if the parking brake is applied.



Transmission System Indicator (12) – This indicator will illuminate red when there is an active warning that relates to the transmission system.



Differential Lock Indicator (13) – This indicator will illuminate green when the differential lock is locked.



Secondary Steering Indicator (14) – This indicator will illuminate either red or amber. The indicator will illuminate amber when the secondary steering system is active. The indicator will illuminate red when there is a Level 1, 2, or 3 warning that is related to the secondary steering system.



High Beam (15) – This indicator will illuminate blue when the high beam headlights are ON.



Brake System Indicator (16) – This indicator will illuminate red when there is a problem with the braking system.



Operator Not Present Indicator (17) – This indicator illuminates amber when the system has determined that the operator is NOT present in the cab.



Right Blade Float (18) – This indicator will illuminate green when the right side of the blade is in FLOAT mode.



Right Turn Signal Indicator (19) – This indicator flashes green when the right turn signal is operating.

Gauge Indicators



Hydraulic Oil Temperature (23) – The gauge indicates the temperature of the hydraulic oil in the hydraulic oil sump for the steering and implement circuits. If the gauge needle enters the red zone, reduce the load that is on the machine until the hydraulic oil temperature decreases.



Engine Coolant Temperature Gauge (24) – This gauge indicates the temperature of the engine coolant.



Tachometer Gauge (10) – This gauge indicates the engine speed in revolutions per minute (rpm). Table 2 indicates the engine speed that corresponds with the position of the needle on the gauge.

Table 2

Color of Zone	RPM Range
White	0-2599
Amber	2600-2799
Red	2800-3000



Articulation Angle Gauge (20) – This gauge indicates that the machine is articulated to the left or to the right. Use the gauge for the articulation in order to center the machine.



Fuel Level Gauge (21) – This gauge indicates the amount of fuel that is in the fuel tank. The red range of the gauge indicates that the fuel level is below 10%.

LCD Readouts

One Liquid Crystal Display (LCD) is located on the instrument cluster that will provide a digital display of various machine parameters. When the key switch is in the ON position, the displays will be illuminated in order to ensure good visibility.

During normal operation, the LCD (22) will show the following data:

- Machine speed
- Actual gear
- Hour meter or requested gear

The units can be displayed in either miles per hour or kilometers per hour. This change can be made through the Messenger monitor. When the data for a particular display is not known, all dashes will be displayed.



Machine Service Hours Icon

Messenger Display Module

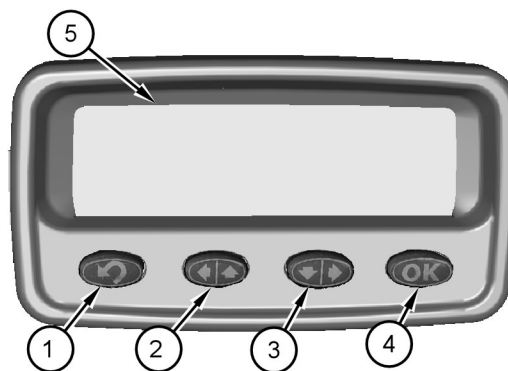


Illustration 9

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Messenger Screen Display

- (1) Back Button
- (2) Left or Up Button
- (3) Right or Down Button
- (4) OK (Enter or Select) Button
- (5) Display Menu

The four buttons on the bottom of the Messenger display module are the user interface. Use the buttons for the following purposes: navigating, accessing screens for the menu and retrieving data information

Back (1) – This button is used to return to the previous screen.

Left/Up (2) – This button is used for the following purposes: navigating, retrieving data information and increasing a setting value.

Right/Down (3) – This button is used for the following purposes: navigating, retrieving data information and decreasing a setting value.

OK (4) – This button is used in order to make selections on the screen. This button is used in order to confirm a password entry on the screen. This button is used in order to save an operator profile.

Display Menu (5) – This display area shows the menus and submenus in order to navigate from one screen to another screen. Also, this display area depends on the menu or the submenu that is selected in order to show the information in the system, system status, and operator warnings.

Use the arrow buttons to highlight the desired selection in order to navigate through the menus and submenus. Then press the “OK” button. Also, use the arrow buttons to highlight a mode or parameter setting. Then, press the “OK” button in order to select that option.

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Input Components

SMCS Code: 7490

The Messenger monitoring system does not receive any direct inputs. Messenger will receive inputs from the ECM of other systems via the Cat Data Link.

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Output Components

SMCS Code: 7490

Instrument Cluster

The instrument cluster uses different types of devices in order to indicate the status of the machine systems to the machine operator or the service technician. The following devices are used:

- Action alarm
- 18 Light Emitting Diodes (LED) warning indicators
- 5 Gauges
- 1 Liquid Crystal Display (LCD)

Action Alarm

The action alarm is driven by the instrument cluster. If a Level 3 warning is active, the action alarm will sound a pulsing tone. A Level 3 warning requires an immediate safe machine shutdown. The action alarm will sound this tone in order to alert the machine operator that immediate action is required. For more information on the action alarm, refer to Systems Operation, “Warning Operation” in this manual.

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Warning Operation

SMCS Code: 7490

The action indicator (9) 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 pulsing tone. The action alarm will sound this tone in order 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 warning level will be displayed. Table 3 indicates the response for each warning level.

Table 3

WARNING OPERATION		
Warning Level	Action Alarm	Action Indicator
Level 1	OFF	OFF
Level 2	OFF	Flash ON and OFF.
Level 2S	ON	ON
Level 3	Pulse ON and OFF.	Flash ON and OFF.

The following actions should be taken by the machine operator if a warning occurs.

When a warning message is displayed on the Messenger display module, the warning message may be snoozed by pressing the “OK” button in order to acknowledge the warning. Each warning level will be snoozed for a different amount of time.

- Level 1 (indefinite)
- Level 2 (indefinite)
- Level 2S (indefinite)
- Level 3 (5 minutes)

Warning Categories

Note: Do not operate the machine if the monitoring system is not working or if the monitoring system fails the self-diagnostic test at start-up. Stop the machine immediately if the alert indicator flashes amber.

- **Engage the parking brake and stop the engine. Investigate the cause of the problem.**
- **Do not operate the machine until the cause of the problem has been corrected.**

The monitoring system provides three warning categories. The first warning category requires only operator awareness. The second warning category requires a change to machine operation or the performance of maintenance to the system. The third warning category requires immediate shutdown of the machine.

Warning Category 1

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In this category, only the alert indicator comes on. This category alerts the operator that the machine system needs attention.

Warning Category 2

In this category, the alert indicator and the action light come on. This category requires a change in machine operation.

Warning Category 2S

In this category, the alert indicator and the action light come on and the action alarm sounds. This category requires an immediate change in machine operation.

Warning Category 3

In this category, the alert indicator and the action light come on and the action alarm sounds. This category requires immediate shutdown of the machine in order to prevent injury or death. This category requires immediate shutdown of the machine in order to prevent severe damage to the machine.

Menu Navigation

SMCS Code: 7490

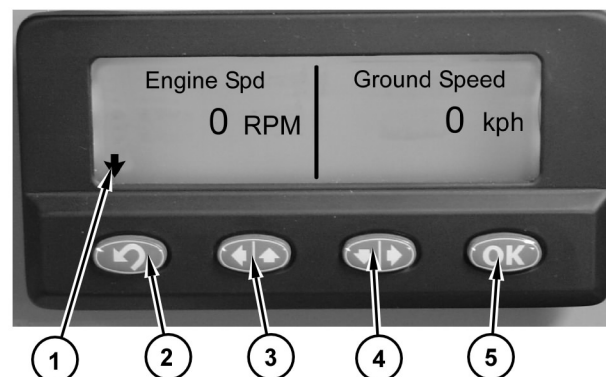


Illustration 10

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- (1) "More Options" Arrow
- (2) "Back" Button
- (3) "Left/Up" Button
- (4) "Right/Down" Button
- (5) "OK" Button

The Messenger menu is arranged in a list. Press the "OK" button (5) to select a menu. A submenu will appear. More selections may be available from the submenu screen. Press the "Back" button (2) to go back to the previous screen. There may be more than one page of information or options. This is indicated by the "More Options" arrow (1). The arrow may point in the up direction or in the down direction. Press the "Left/Up" button (3) or the "Right/Down" button (4) to view the information on the additional screens.

Illustration 10 shows the default screen of the Messenger. This screen will be displayed at the start-up of the machine (until the operator or the technician navigates to another screen). The default screen is identical to the "Performance" menu.

There are a total of four main menus that are available for navigation. Only one menu can be displayed at a time. Access the menus from the default menu by pressing the "Back" button (2). The names of the four menus are: Performance (same as the default screen), Totals, Settings, and Service. Use the "Left/Up" button (3) or "Right/Down" button (4) to navigate between menus.

Messenger Display

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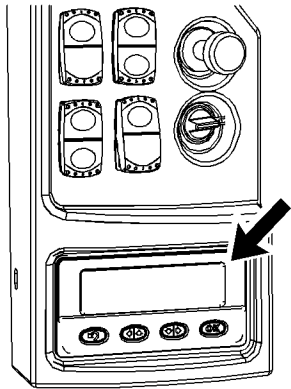


Illustration 11

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Functional Test

To ensure the proper operation of the monitoring system, check the system daily.

The battery disconnect switch must be in the ON position.

When the engine start switch key is turned from the OFF position to the ON position, the monitoring system will perform an automatic self-diagnostic test. The self-diagnostic test verifies that the outputs (gauges, alert indicators, and alarms) are operating correctly.

When the engine start switch key is turned to the ON position, the following systems are tested for approximately one second: alert indicators, gauges, and LCD. The gauges must go to the far Right positions. All alert indicators must come on momentarily. The action alarm must sound.

Performance Menu

SMCS Code: 7490

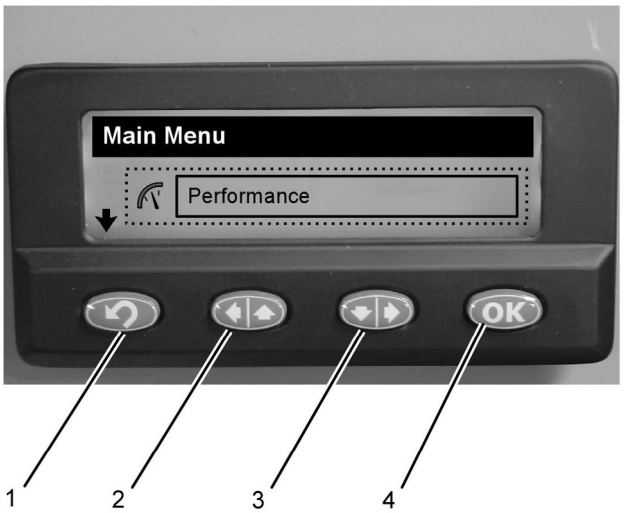


Illustration 12

g03714325

- (1) Back Button
- (2) Left/Up Button
- (3) Right/Down Button
- (4) OK Button

The “Performance” menu is the same menu as the default menu. The “Performance” menu allows the operator or the technician to view three pages of information. These pages of information monitor the vital data of the machine during operation. This information can only be viewed. The “Performance” menu uses three screens to show the real-time status of machine information.

Table 4

Performance Screen 1	
Description	Units
Ground Speed	mph or km/h
Engine Speed	rpm

Table 5

Performance Screen 2	
Description	Units
Hydraulic Temperature	°C or °F
Fuel Level	0 - 100%

Table 6

Performance Screen 3	
Description	Units
Actual Gear	–
Desired Gear	–

The “Performance” menu option is selected by navigating through the main menu. Press the “Left/Up” button (2) or the “Right/Down” button (3) until “Performance” is shown on the screen. Then press the “OK” button (4).



Illustration 13
“Performance Screen 1”

Performance screen 1 is the default operational screen that is displayed during the start-up of the machine. To access Performance Screen 2 or Performance Screen 3, press the “Right/Down” button (3).

Use the buttons to page up or down one screen.

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Totals Menu

SMCS Code: 7490

The “Totals” menu allows the operator or the technician to access lists of data. The lists of data provide information about the machine systems. This information can be used to determine when service work needs to be performed.

To select the “Totals” menu option, press the “Left/Up” button or the “Right/Down” button until the “Totals” menu is displayed. Then press the “OK” button.

The following screen will be displayed.



Illustration 14
g01121983

The “Totals” menu organizes the information into two categories “Lifetime Totals” and “Trip Totals” . This information is view-only. Use the “Left/Up” button or the “Right/Down” button to display either the “Lifetime Totals” or the “Trip Totals” . Then press the “OK” button.



Illustration 15
g01121985

The first page of either the “Lifetime Totals” or the “Trip Totals” is now displayed. This information is view-only. You cannot change the information that is displayed using Messenger. Use the appropriate button to scroll through the information.



Illustration 16 g01121991

The following information may be viewed by using the “Totals” menu.

Table 7

Lifetime Totals	
Description	Units
Forward	mph or km/h
Reverse	mph or km/h
Fuel	L or GAL

Table 8

Trip Totals	
Description	Units
Forward	mph or km/h
Reverse	mph or km/h
Fuel	L or GAL

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Settings Menu

SMCS Code: 7490

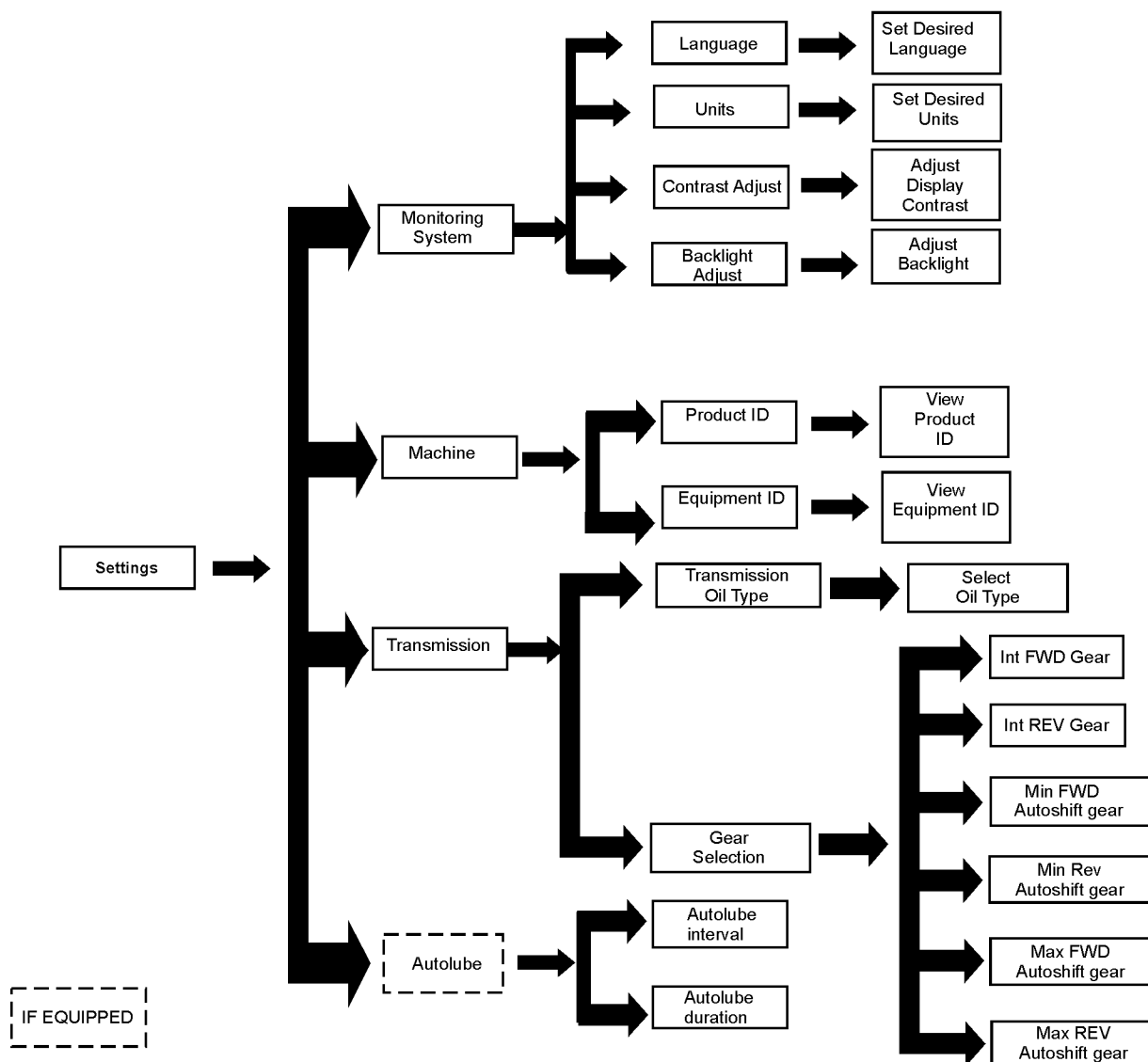


Illustration 17

"Settings Menu"

g01400987

The "Settings" menu allows the user to adjust parameters for the Messenger display. The "Settings" menu also allows the user to view machine serial numbers.

The "Settings" menu option is entered by selecting "Settings" from the main menu. Press the "Left/Up" button or the "Right/Down" button until the "Settings" menu is displayed. Then press the "OK" button.



Illustration 18

g01122189

The “Settings” menu organizes the parameters into three categories. The only menu that does not have adjustable parameters is the “Machine” menu.



Illustration 19

g01122197

The categories for the “Settings” menu are listed below.

- Monitoring System
- Transmission
- Machine
- Autolube (If Equipped)

To view the associated parameters, press the “Left/Up” button or the “Right/Down” button until the desired category is displayed. Then press the “OK” button in order to access the parameters in that category. Finally, use the “Left/Up” button or the “Right/Down” button, and the “OK” button to make necessary changes to the monitoring system. Use the “Left/Up” button or the “Right/Down” button to view the parameters of the machine.

Machine Parameters

From the Machine menu, use the appropriate “Left/Up” button or the “Right/Down” button in order to display the desired parameter. Then press the “OK” button. This will allow access to that parameter's screen. Then use the “Left/Up” button or the “Right/Down” button in order to view the desired parameters. All the parameters in this category relate to identification numbers. The following parameters may be viewed:

- Equipment ID
- Product Identification

i05895861

Service Menu

SMCS Code: 7490

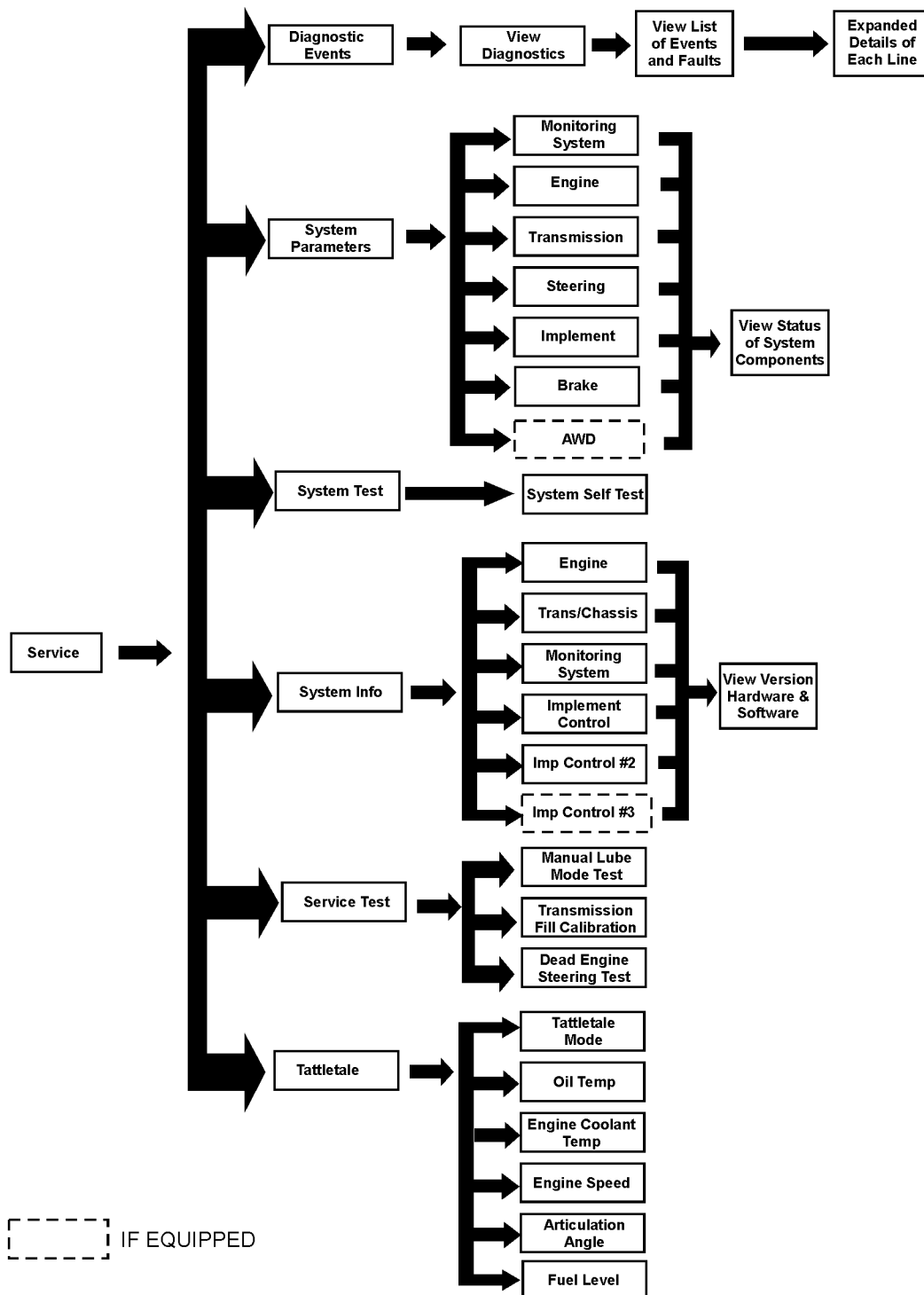


Illustration 20
Service menu

The Service menu allows the operator or the technician to access the parameters of the machine. The operator or the technician can also make selections to view logged events and active events or codes.

The status of electronic components in the machine's major systems can also be viewed.

The Service menu option is displayed by selecting "Service" from the main menu. Press the "Left/Up" button or the "Right/Down" button until "Service" is displayed. Then press the "OK" button.



Illustration 21

g01122302

Service menu

The Service menu contains the following menus:

- Diagnostics and Events
- System Parameters
- System Information
- System Test
- Tattletale
- Service Test

The "Diagnostics and Events" menu contains the "View Diagnostics" submenu.



Illustration 22

g01122303

Diagnostics submenu

The System Parameters menu contains the following submenus:

- Engine
- Monitoring System
- Transmission
- AWD (If Equipped)
- Steering
- Implement
- Brake

The "System Info" menu contains the following submenus:

- Engine
- Transmission/Chassis
- Monitoring System
- Implement Control
- Implement Control 2
- Implement Control 3 (if equipped)

To access the Service menu options, press the "Left/Up" button or the "Right/Down" button until the desired category is displayed. Then press the "OK" button.

Diagnostics and Events

The Diagnostics Events menu option will show a complete list of all active event codes, inactive event codes, and diagnostic codes.

From the Service menu, use the appropriate button to display the "Diagnostics and Events" option. Then press the "OK" button to access the "Diagnostics and Events" option. Select the "View Diagnostics" display by pressing the "OK" button. The "View Diagnostics" option will display a complete list of codes. Each line on the list will show the following information:

- SRC (Source ID)
- Code
- OCC (Number of occurrences of the event or code)
- Status of Code (active or inactive)

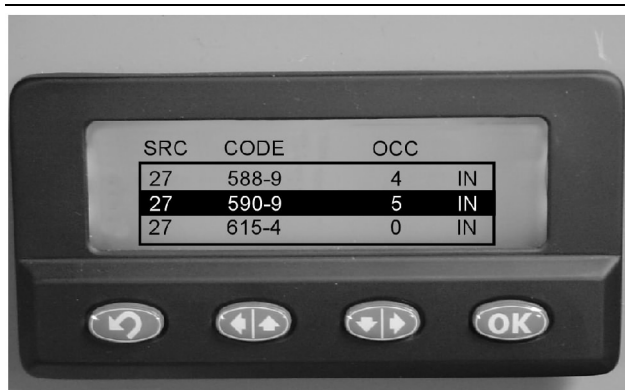


Illustration 23

g01122504

Diagnostic event screen

From the “View Diagnostics” menu, use the appropriate button to highlight a diagnostic code or an event code on the list. Press the “OK” button to display a detailed view of the selected code. The detailed view will display a message that shows the following information:

- The reporting ECM
- The failed component code (CID)
- An explanation of the event



Illustration 24

g01374369

Diagnostic detailed view

System Parameters

From the “Service” menu, use the appropriate button to display the “System Parameters” option. Press the “OK” button to access the “System Parameters” option. The “System Parameters” option will divide all parameters into the following seven categories:

- Steering
- Monitoring System
- Engine

- Transmission
- Implement
- AWD (if equipped)
- Brake

From the “System Parameters” menu, use the appropriate button to display a desired category. Press the “OK” button to access the list of parameters in the category.

Note: Using Messenger to view system parameters is similar to using Cat® Electronic Technician (Cat ET) Service Tool.

System Information

The “System Info” menu option allows the user to display all of the Electronic Control Modules (ECMs) on the machine. From the “Service” menu, use the appropriate button to display the “System Info” option. Press the “OK” button to access the “System Info” menu. Use the appropriate button to display an ECM from this menu. Messenger will display the following information for the selected ECM.

- Serial Number
- Part Number
- Software Group Part Number or Flash File
- Software Group Release Date
- Software Group Description

Troubleshooting Section

Introduction

Failure of an electrical component can cause the failure of other components. Also, failure of an electrical component can be caused by the failure of other components. Always attempt to correct the cause of an electrical system failure before you replace a component.

When you are removing the machine harness from any ECM, first unscrew the single screw in the center of the harness connector.

i05895895

General Information

SMCS Code: 7000

The diagnostics for a system's Electronic Control Module (ECM) can be accessed through the Caterpillar monitoring system or the Cat[®] Electronic Technician (Cat ET) Service Tool. Troubleshooting a system requires additional information from the machine Service Manual:

- Testing and Adjusting Manual
- Electrical System Schematic
- Parts Manual
- Operation and Maintenance Manual

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

When the troubleshooting procedure instructs you to "Repair or Replace the Harness", use the Electrical System Schematic for the machine that is being serviced to trace the circuit. Perform continuity checks at the harness connectors to locate harness failures. At the component connectors, always check the ground circuit. There must be less than five ohms of resistance between any system ground and the frame ground. Excessive ground resistance that is greater than five ohms can cause incorrect diagnosing of problems.

During troubleshooting, inspect all 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.

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 Tape.

i05895908

Service Tools

SMCS Code: 0785

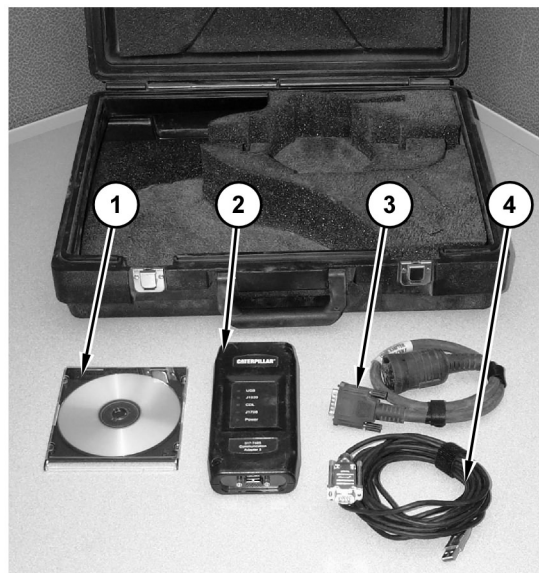


Illustration 25

g02615483

Components of the Communication Adapter 3 Gp (317-7484) are listed:

- (1) Current version of Cat® Electronic Technician (Cat ET) Service Tool software for use with a Windows-based personal computer
- (2) 317-7485 Control Gp-Electronic (Comm Adapter 3)
- (3) 327-8981 Cable As. (Data Link Cable CA3)
- (4) 370-4617 Cable As. (CA3 PC USB Cable)

Note: Plus+1 Service Tool for Caterpillar software will be required in addition to Cat ET software.

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

Table 9

Service Tools	
Part Number	Part
JERD2129	Most Recent Version of Cat® Electronic Technician (Cat ET) Service Tool
	Windows-based PC
8T-3224	Needle Tip Group
7X-1710	Multimeter Probe Group
8T-8726	Cable Assembly (Three Pin) (3-Pin Breakout)
6V-3000	Connector Repair Kit (Sure Seal)
190-8900	Connector Repair Kit (Deutsch)

(continued)

(Table 9, contd)

Service Tools	
Part Number	Part
175-3700	Connector Repair Kit (Deutsch DT)
317-7484	Communication Adapter 3 Gp
One of the Following Digital Multimeters	
237-5130	Digital Multimeter
257-9140	Digital Multimeter
146-4080 ⁽¹⁾	Digital Multimeter Gp

⁽¹⁾ This multimeter can use an RS232C cable to connect to a Laptop computer or DataView tool group for troubleshooting.

For instructions on servicing Sure Seal connectors, see Special Instruction, SMHS7531. For service instructions about the Deutsch "DT" Type connectors, see Special Instruction, SEHS9615.

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

Use the digital multimeter for making continuity checks or for measuring voltage. For instructions about the use of the Digital Multimeter, see the owners manual that is provided with the multimeter. The 7X-1710 Multimeter Probe is used to measure the voltage at the connectors without disconnecting the connectors. The probe cables are pushed into the back of the connector along the wire. The 8T-8726 Adapter Cable has a three-pin breakout. 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 Cat electrical circuits.

i05895925

Connector Locations

SMCS Code: 7553-546-WW

To locate electrical components and connectors, use the Electrical System Schematic, Parts Manual, and Operation and Maintenance Manual for the vehicle that is being serviced.

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

- The “Component Location” table uses white circles to mark the locations in the profile of the vehicle and in the area views. Letters in the “Machine Location” column indicate a general area of the vehicle. 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 to mark the locations in the general view and in the area views. Letters in the “Machine Location” column indicate a general area of the vehicle. Refer to the corresponding footnote at the end of the table for a description of the location.

Connector Contact Numbers

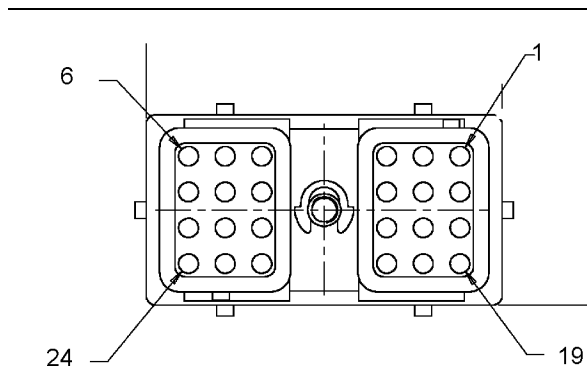


Illustration 27

g01324753

Dash Cluster 24 pin Connector

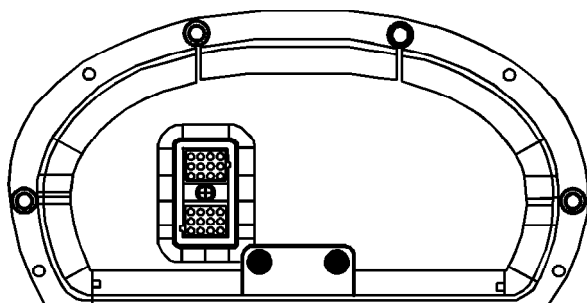


Illustration 26

g01030469

Rear of Dash Cluster

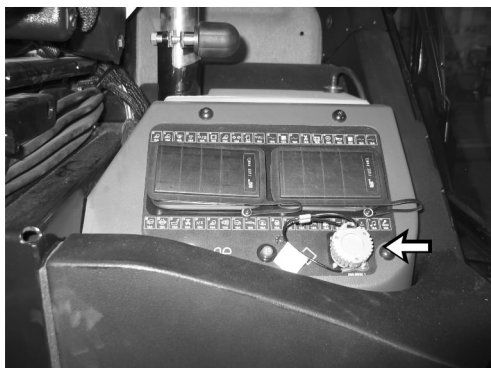


Illustration 28
Service Connector

g01329144

i02702546

Diagnostic Capabilities

SMCS Code: 1400

The Caterpillar Electronic Technician (ET)



Illustration 29
Connections for the Caterpillar Electronic Technician (ET)

g01277712

The Caterpillar Electronic Technician (ET) is a software program that is used to access data. The service technician can use the ET in order to perform maintenance on the machine. Some of the options that are available with the Caterpillar Electronic Technician are listed below:

- View the active diagnostic codes and active event codes. View the logged diagnostic codes and the logged event codes. See Troubleshooting, “Using the Caterpillar Electronic Technician to Determine Diagnostic Codes”.
- View the status of parameters.
- 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 description for each logged event and each active event is displayed. The description for each logged diagnostic and each active diagnostic is displayed.
- Load new FLASH software.

Code	Description	Occ.	First	Last
Monitor 14M - Diagnostic Clock = 1207 hours				
296- 9	Transmission Control : Abnormal Update Rate	4	1207	1207
590- 9	Engine Control Module : Abnormal Update Rate	5	1207	1207
596- 9	Implement Control : Abnormal Update Rate	6	1207	1207
811- 9	Gauge Cluster #1 : Abnormal Update Rate	4	1207	1207
1558- 9	Electronic Implement Control #2 : Abnormal Updat	5	1207	1207
271- 5	Action Alarm : Current Below Normal	127	1206	1207
297- 9	All Wheel Drive Control : Abnormal Update Rate	17	1205	1207

Illustration 30

g01308956

Typical ET screen for logged diagnostic codes

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.

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

Status Groups For The Electronic Technician

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

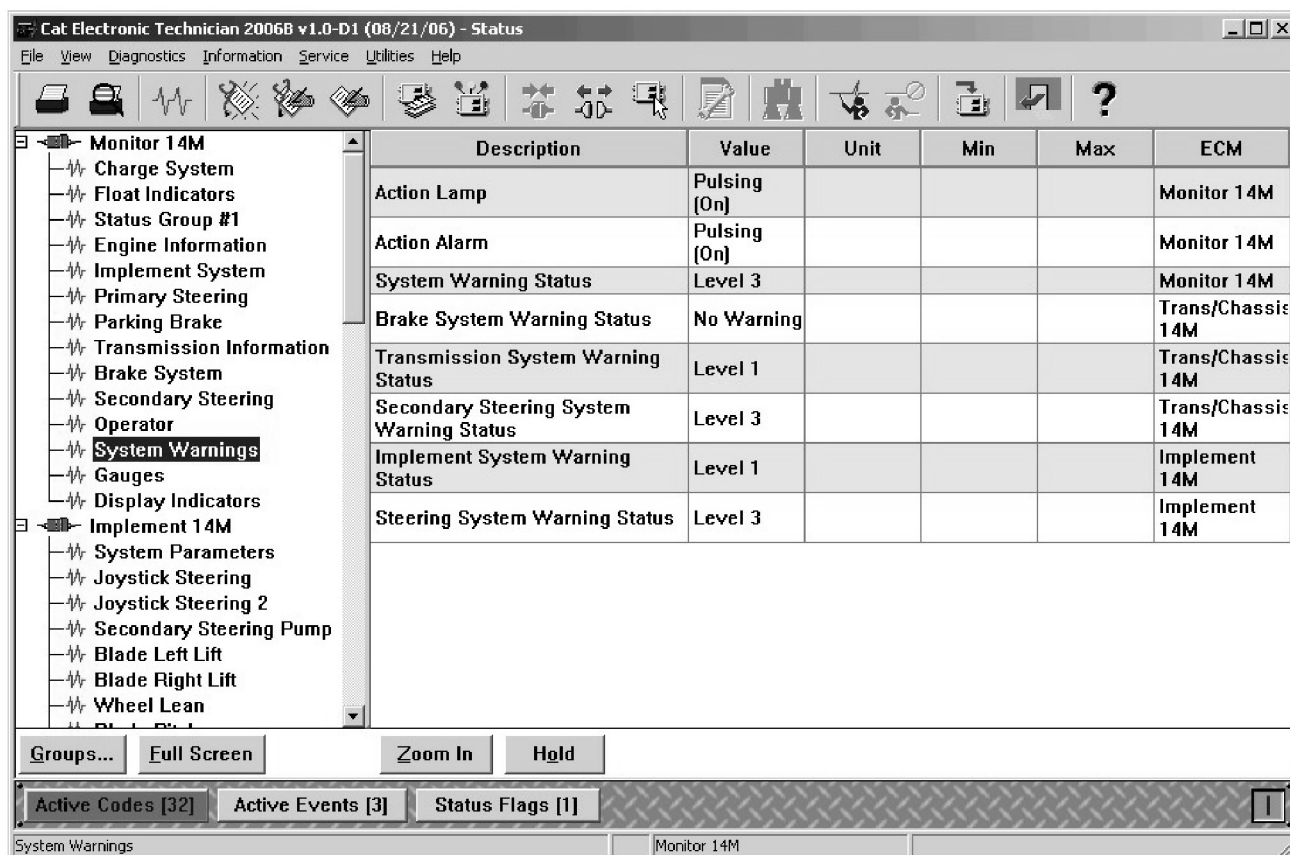


Illustration 31

g01308958

Typical ET Status Screen

Instrument Cluster

The instrument cluster display is located in the center of the dash panel.

The instrument cluster monitoring system monitors the operation of the machine. The instrument cluster displays information in the following three ways:

- Status Indicators
- Gauges
- LCD Display

See this System Operation, "Display Module" for details.

Messenger

The Messenger display is located on the right side of the dash panel.

The Messenger monitoring system monitors the operation of the machine.

The Messenger provides the operator with the following information:

- Operating Characteristics of the Machine
- Diagnostics
- Events

Instantaneous information and lifetime totals about the machine's condition and performance are constantly gathered by Messenger.

The operator is able to adjust many of the settings in order to match the machine to the desired application.

Messenger allows the technician to access the following:

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

- View the system parameters.

Note: Messenger will refer to the instrument cluster as the gauge cluster.

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

When the engine key start switch is turned on, the Messenger continuously monitors all of the following machine systems:

- Sensors
- Electronic Control Modules (ECM)
- System components for the monitor

See this System Operation, “Display Module” for details.

i05895977

Event Code List

SMCS Code: 1400

Table 10

Warning Operation			
Warning Level	Action Alarm	Action Indicator	Messenger Display Pop Up Message
Level 1	OFF	OFF	ON
Level 2	OFF	Flash ON and OFF	ON
Level 3	Pulse ON and OFF	Flash ON and OFF	ON

Recommended actions to be taken by the machine operator in response to the different warning levels.

Level 1 – This warning level will cause the involved alert indicator to illuminate. A level 1 warning will indicate that the operator should be aware of a condition of one or more of the machine systems.

Level 2 – This warning level will indicate that the operation of the machine should be changed or maintenance should be performed to the machine. Possible damage to components on the machine may occur.

Level 3 – This warning level will indicate that the machine needs to have an immediate, safe emergency engine shutdown. Possible injury to the operator or severe damage to components may occur.

If an action alarm, alert indicator, or a warning occurs, a pop-up message will override any screen that was displayed on the Messenger display module.

Table 11

Event Codes for the Messenger			
EID	Warning Level	Description	Messenger Action
861	1	Clock Adjust Required	Use CAT [®] Electronic Technician (CAT ET) Service Tool to align the clock manually with the other control modules.
875	2	Low System Voltage	Shut down Safely.
876	1	High System Voltage	Active when input voltage is 29.5 V or higher AND Actual Engine Speed is greater than 750 rpm.
876	3	High System Voltage	Shut down Safely.

Symptom Procedures

i07793150

Symptom Troubleshooting

SMCS Code: 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.

i05896002

Emerging Symptom Information

SMCS Code: 7000-035

This space is for new symptom information for this product.

Note: Use the Service Information System on the Web 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.

i05896037

Action Alarm Does Not Sound

SMCS Code: 7407-035

System Operation Description:

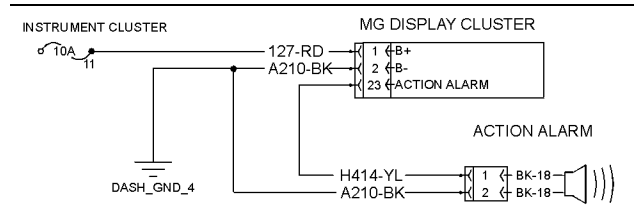


Illustration 32

g03714545

Connections for the action alarm

The action alarm is connected to power (wire H414-YL(Yellow)) through the instrument cluster. The action alarm is connected to ground through the dash ground (wire A210-BK(Black)). When the key start switch is in the ON or START position and the engine is not running, the action alarm will sound.

Test Step 1. CHECK THE INSTRUMENT CLUSTER FOR POWER

- A. Turn the key start switch and the disconnect switch to the ON position.
- B. At the harness connector for the instrument cluster, measure the voltage. Measure the voltage from contact 1 (wire 127-RD(Red)) to contact 2 (wire A210-BK(Black)).

Expected Result:

The voltage that is measured is approximately battery voltage.

Results:

- OK – The voltage that is measured is approximately battery voltage. Proceed to Test Step 2.
- NOT OK – The voltage that is measured is NOT approximately battery voltage. The fuse for the instrument cluster has blown or the fuse has popped.

Repair: Check the fuse for the instrument cluster. If the fuse has popped, replace the fuse. If the fuse has failed, replace the fuse.

STOP.

Test Step 2. CHECK FOR +BATTERY AT ALARM

- A. The key start switch and the disconnect switch remain in the ON position.
- B. At the action alarm, measure the voltage at connector contact 1 (wire H414-YL(Yellow)) to frame ground.

Expected Result:

The voltage is approximately battery voltage.

Results:

- OK – The voltage is correct. Proceed to test step 3.
- NOT OK – The voltage is not correct. Proceed to test step 4.

Test Step 3. CHECK THE ALARM AND THE CIRCUIT TO GROUND

- A. Turn the disconnect switch and the key start switch to the OFF position.
- B. Place a jumper wire from connector contact 2 (wire A210-BK(Black)) at the action alarm harness to connector contact 2 (wire A210-BK(Black)) at the instrument cluster harness.
- C. Turn the disconnect switch and the key start switch to the ON position.

Expected Result:

The action alarm sounds.

Results:

- OK – The action alarm sounds. There is an open in the circuit for ground.

Repair: Repair the wiring harness. See the full system schematic for more information.

STOP.

- NOT OK – The action alarm does not sound. The alarm has failed.

Repair: Replace the alarm. Make sure that this corrects the problem.

STOP.

Test Step 4. CHECK THE RESISTANCE TO THE +BATTERY

- A. Turn the disconnect switch and the key start switch to the OFF position.
- B. Insert a multimeter probe to connector contact 23 of the machine harness for the instrument cluster. Insert the other probe to connector contact 1 of the harness for the action alarm.

Expected Result:

The resistance is less than 5.0 ohms.

Results:

- OK – The resistance is less than 5.0 ohms. The wiring harness is correct. The instrument cluster has failed.

Repair: Replace the instrument cluster. Make sure that this corrects the problem.

STOP.

- NOT OK – The resistance is greater than 5.0 ohms. An open exists in the wiring harness for power.

Repair: Repair the wiring harness. See the full system schematic for more information.

STOP.

- B. Disconnect the machine harness connector from the instrument cluster.

- C. Disconnect the machine harness from the action alarm.

- D. At the machine harness connector for the instrument cluster, measure the resistance from the connector Contact 23 (wire H414-YL(Yellow)) to all possible sources of ground.

Expected Result:

The resistance should be greater than 5000 ohms for each measurement.

Results:

- OK – The resistance is greater than 5000 ohms for each measurement. The machine harness is correct. The alarm has failed.

Repair: Replace the alarm.

STOP.

- NOT OK – The resistance is NOT correct. There is a short in the machine harness. The short is between signal contact 23 (wire H414-YL(Yellow)) and the circuit with the low resistance measurement.

Repair: Repair or replace the harness.

STOP.

i05896150

Action Alarm Is On Continuously

SMCS Code: 7407-035

System Operation Description:

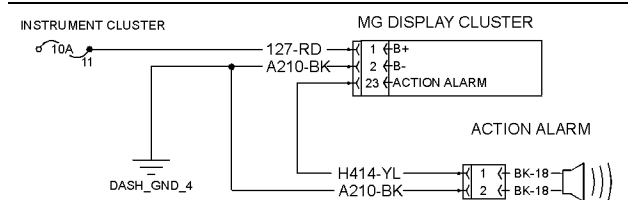


Illustration 33

g03714545

Connections of the action alarm

CHECK THE HARNESS FOR A SHORT TO GROUND

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

Diagnostic Code Procedures

Diagnostic Code List

SMCS Code: 7569

Use Cat® Electronic Technician (Cat ET) Service Tool or Cat Messenger to determine the diagnostic codes. After the diagnostic codes are determined, refer to the corresponding test procedure for more information. Perform the procedure that corresponds to the diagnostic code (CID and FMI).

The following table is a list of possible diagnostic codes for Cat Messenger.

Table 12

Diagnostic Codes for the Cat Messenger ECM (MID No. 053) ⁽¹⁾	
For troubleshooting, see the procedure with the same CID FMI.	
CID / FMI	Description
CID 0168 - Electrical System Voltage	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
CID 0248 - Cat Data Link	
FMI 09	Abnormal update rate
FMI 14	Special Instruction
CID 0271 - Action Alarm	
FMI 03	Voltage above normal
FMI 04	Voltage below normal
FMI 05	Current below normal
CID 0296 - Transmission Control	
FMI 09	Abnormal update rate
FMI 14	Special Instruction
CID 0297 - All Wheel Drive Control	
FMI 09	Abnormal update rate
FMI 14	Special Instruction
CID 0590 - Engine Control Module	
FMI 09	Abnormal update rate
FMI 14	Special Instruction

i05897573

(Table 12, contd)

Diagnostic Codes for the Cat Messenger ECM (MID No. 053) ⁽¹⁾	
For troubleshooting, see the procedure with the same CID FMI.	
CID / FMI	Description
CID 0596 - Implement Control	
FMI 09	Abnormal update rate
FMI 14	Special Instruction
CID 0811 - Gauge Cluster #1	
FMI 09	Abnormal update rate
CID 1558 - Electronic Implement Control #2	
FMI 09	Abnormal update rate
FMI 14	Special Instruction

⁽¹⁾ For the Cat Messenger ECM, the MID is 053. This table pertains only to diagnostic codes with an MID of 053.

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:

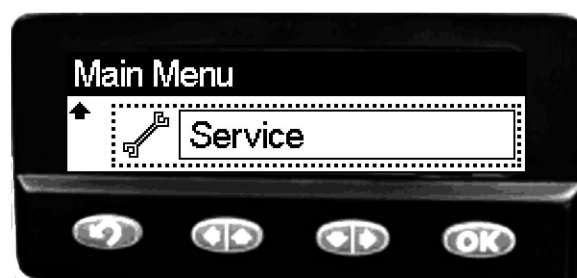


Illustration 34

g02352535

Messenger Main Menu

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

(continued)



Illustration 35

g02352538

Messenger Service Menu

- 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.

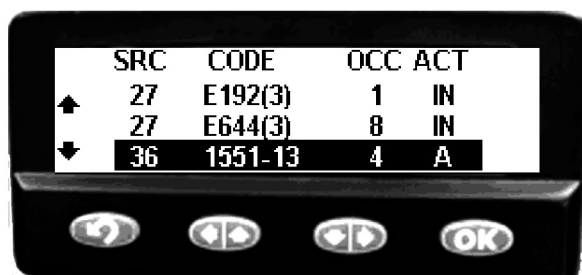


Illustration 36

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 37

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:

- Connect Cat ET to the machine.
- Turn the keyswitch on.
- 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.

- Select the desired ECM.
- 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

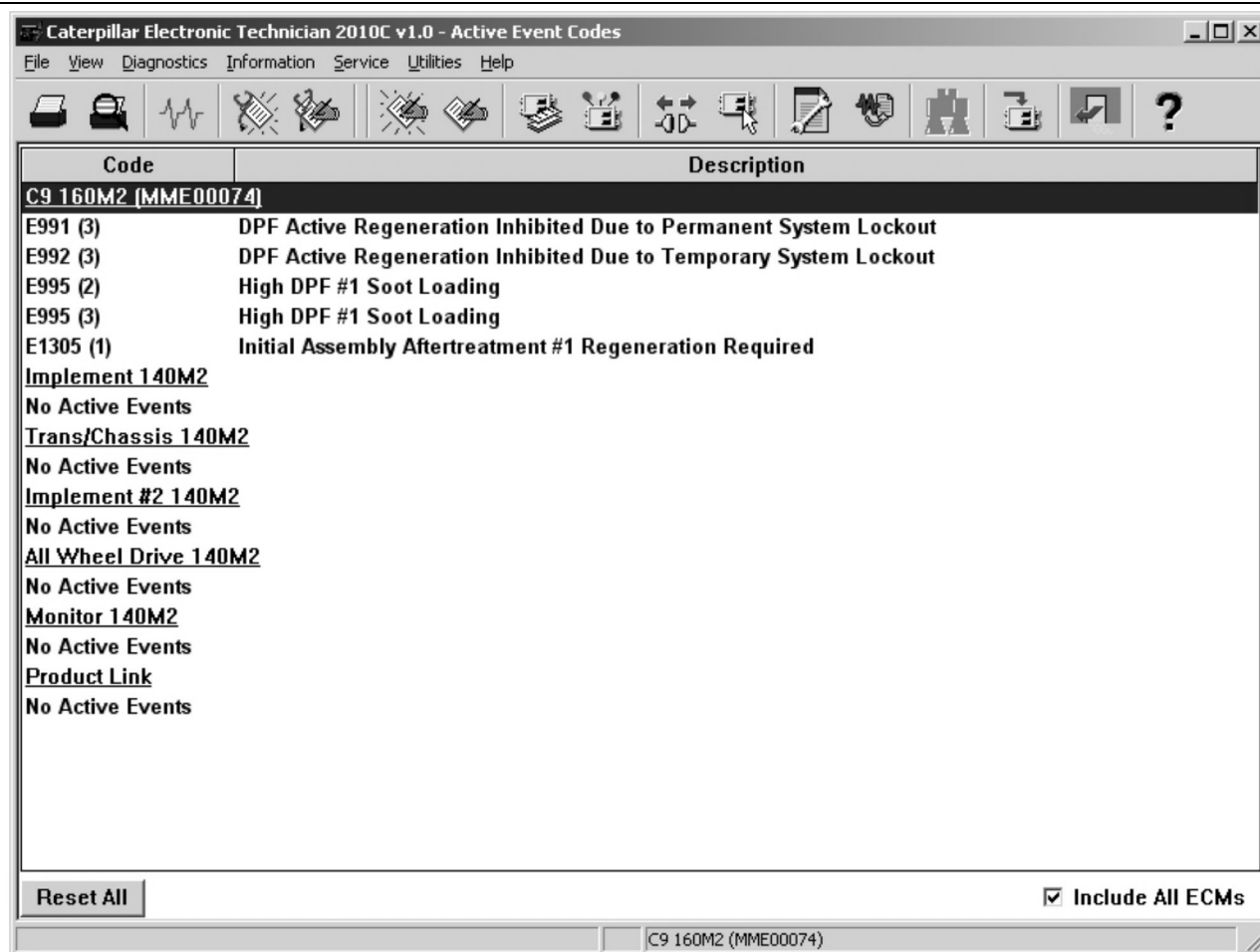


Illustration 38

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

Caterpillar Electronic Technician 2010C v1.0 - Logged Event Codes				
File View Diagnostics Information Service Utilities Help				
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 39

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.

i05897626

MID 053 - CID 0168 - FMI 03

SMCS Code: 1406-038

Conditions Which Generate This Code:

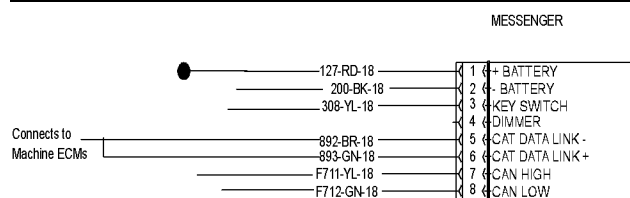


Illustration 40

g02276325

Schematic of the System Voltage.

This diagnostic code is recorded when the Messenger module reads the electrical system voltage at Contact 1 at an above-normal range (more than 29.5 V for two seconds).

The possible causes of this diagnostic code are listed below:

- A charging system component has failed.
- The Messenger module may have failed. This cause is unlikely.

Note: Check the 15 amp fuse to make sure that the fuse is not disengaged.

Test Step 1. CHECK FOR AN ACTIVE DIAGNOSTIC CODE

- Turn the disconnect switch and the key start switch to the ON position.
- View the status of the diagnostic code.

Expected Result:

The diagnostic code is NOT active.

Results:

- YES – The diagnostic code is NOT active.

Repair: The diagnostic code is NOT active. The problem does not exist at this time. Watch for a recurrence.

STOP.

- NO – The diagnostic code is active. Proceed to Test Step 2.

Test Step 2. CHECK THE CHARGING SYSTEM

- Start the engine.
- Run the engine at high idle.
- View the status of the diagnostic code.

Expected Result:

The diagnostic code is NOT active.

Results:

- YES – The diagnostic code is NOT active. Watch for a recurrence.

STOP.

- NO – The diagnostic code is active.

Repair: The charging system is charging at an excessive voltage. Check the charging system. See Special Instruction, REHS0354, "Charging System Troubleshooting".

STOP.

i05897647

MID 053 - CID 0168 - FMI 04

SMCS Code: 1406-038

Conditions Which Generate This Code:

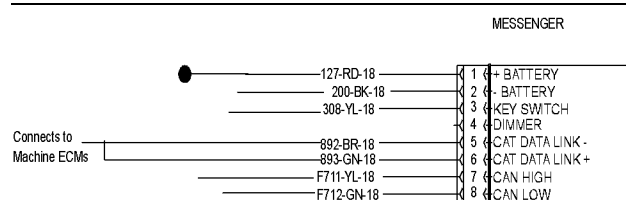


Illustration 41

g02276325

Schematic of the System Voltage

This diagnostic code is recorded when the Messenger module reads the electrical system voltage at Contact 1 as being below normal range (less than 24 V for two seconds).

The possible causes of this diagnostic code are listed below:

- A charging system component has failed.
- The wire harness has failed.

- The Messenger module has failed. This cause is unlikely.

System Response:

The outputs of the control may operate incorrectly.

Note: Check the 15 amp fuse to make sure that the fuse is not disengaged.

Test Step 1. CHECK FOR AN ACTIVE DIAGNOSTIC CODE

- A. Start the engine.
- B. Run the engine at high idle.
- C. View the status of the diagnostic code.

Expected Result:

The diagnostic code is NOT active.

Results:

- YES – The diagnostic code is NOT active. The problem does not exist at this time. Watch for a recurrence.

STOP.

- NO – The diagnostic code is active. Proceed to Test Step 2.

Test Step 2. CHECK THE BATTERY VOLTAGE

- A. Measure the voltage at the battery posts.

Expected Result:

The voltage is greater than 24 V.

Results:

- YES – The voltage is greater than 24 V. Proceed to Test Step 3.
- NO – The voltage is less than 24 V.

Repair: The charging system is not correct. Check the charging system. See Special Instruction, REHS0354, "Charging System Troubleshooting".

STOP.

Test Step 3. CHECK THE SYSTEM VOLTAGE AT THE MESSENGER MODULE

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

- B. Disconnect the machine harness connector from the Messenger module.

Note: As an alternative to disconnecting the machine harness connector from the Messenger module, use spoons to measure the voltage between Contact 1 and Contact 2 on the Messenger module.

- C. Turn the disconnect switch and the key start switch to the ON position.

- D. Run the engine at high idle.

- E. At the machine harness connector for the Messenger module, measure the voltage between Contact 1 and Contact 2.

Expected Result:

The voltage is greater than 24 V.

Results:

- YES – The voltage is greater 24 V. This condition should not cause the diagnostic code.

Repair: Inspect the connector. Connect the machine harness to the Messenger module. Check all connectors in the wire harness. If the CID 0168 FMI 04 remains active, replace the Messenger module. See Troubleshooting, "Electronic Control Module (ECM) - Replace".

STOP.

- NO – The voltage is less than 24 V. The machine harness has failed.

Repair: Check the +Battery circuit and the ground circuit in the machine harness. Repair or replace the machine harness.

STOP.

i05897690

MID 053 - CID 0248 - FMI 09

SMCS Code: 7490-038

Conditions Which Generate This Code:

Cat Data Link

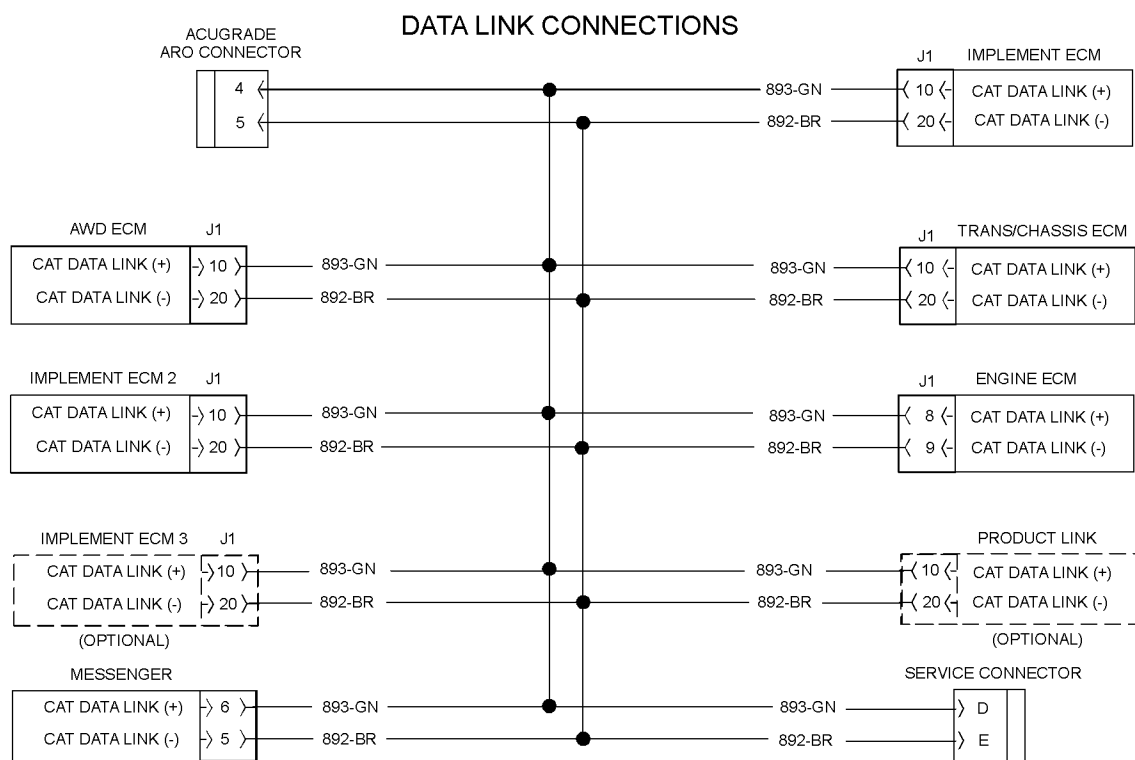


Illustration 42

g02370118

Connections of the Cat Data Link circuit.

The CID 0248 FMI 09 diagnostic code is used by the Messenger ECM as a companion code. The companion code is activated simultaneously with another diagnostic code of the ECM 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 of the ECM. The FMI 09 means that the Messenger ECM has lost all communication with the other control module.

The CID 0248 FMI 09 diagnostic code will never be activated by the Messenger ECM as a stand-alone diagnostic code. The Messenger ECM will only activate the CID 0248 FMI 09 diagnostic code with one of the following Component Identifier (CID) codes:

CID 0296 FMI 09 – Transmission/Chassis ECM

CID 0297 FMI 09 – AWD ECM (if equipped)

CID 0596 FMI 09 – Implement System

CID 0590 FMI 09 – Engine ECM

CID 1558 FMI 09 – Implement ECM 2

CID 2143 FMI 09 – Implement ECM 3

For example: The Implement ECM detects the communication from the Transmission/Chassis ECM over the Cat Data Link. If there is no communication from the Transmission/Chassis ECM, the Implement ECM activates a CID 0296 FMI 09 diagnostic code and a CID 0248 FMI 09 diagnostic code.

When the CID 0248 FMI 09 diagnostic code is activated by the Implement ECM, always look for one of the diagnostic codes listed above 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.

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 effected ECM. Disconnect the machine harness connector J1 from the other effected ECM.
- C. Inspect the harness connectors. 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. Inspect the contacts for the following:
 - Wires are secure.
 - Contacts are clean.
 - Contacts are in good condition.
- D. At the disconnected harness connector J1 for the effected ECM, connect a jumper wire between contact wire 893-GN(Green)and contact wire 892-BR(Brown).
- E. At the disconnected harness connector J1 for the effected ECM, connect a jumper wire between contact wire 893-GN(Green) and contact 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 the connection is poor.

Refer to the Electrical Schematic of the machine. Locate all the harness connections and examine all the harness connections of the machine that are involved in the data link circuit. Check each wire section from the connector to the connector for an open or a bad connection. Inspect the connections for the following:

- Connections are clean.
- Connections are secure.
- Connections are in good condition.

Repair 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. Verify the following:
 - The connectors are fully seated.
 - The clips for each connector are fastened completely.
- 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 0248 FMI 09 diagnostic code.

Expected Result:

The CID 0248 FMI 09 diagnostic code is not active.

Results:

- OK – The CID 0248 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 0248 FMI 09 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 Cat® 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 problem is not found, one of the ECM modules may have failed. The ECM that the diagnostic code is reported against may have failed.

Prior to replacing an ECM, always contact the Technical Communicator at 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 ECM that activated the diagnostic code. Refer to Testing and Adjusting, "Electronic Control Module (ECM) - Replace".

STOP.

i05897708

MID 053 - CID 0248 - FMI 14

SMCS Code: 7490-038

Conditions Which Generate This Code:

Cat Data Link

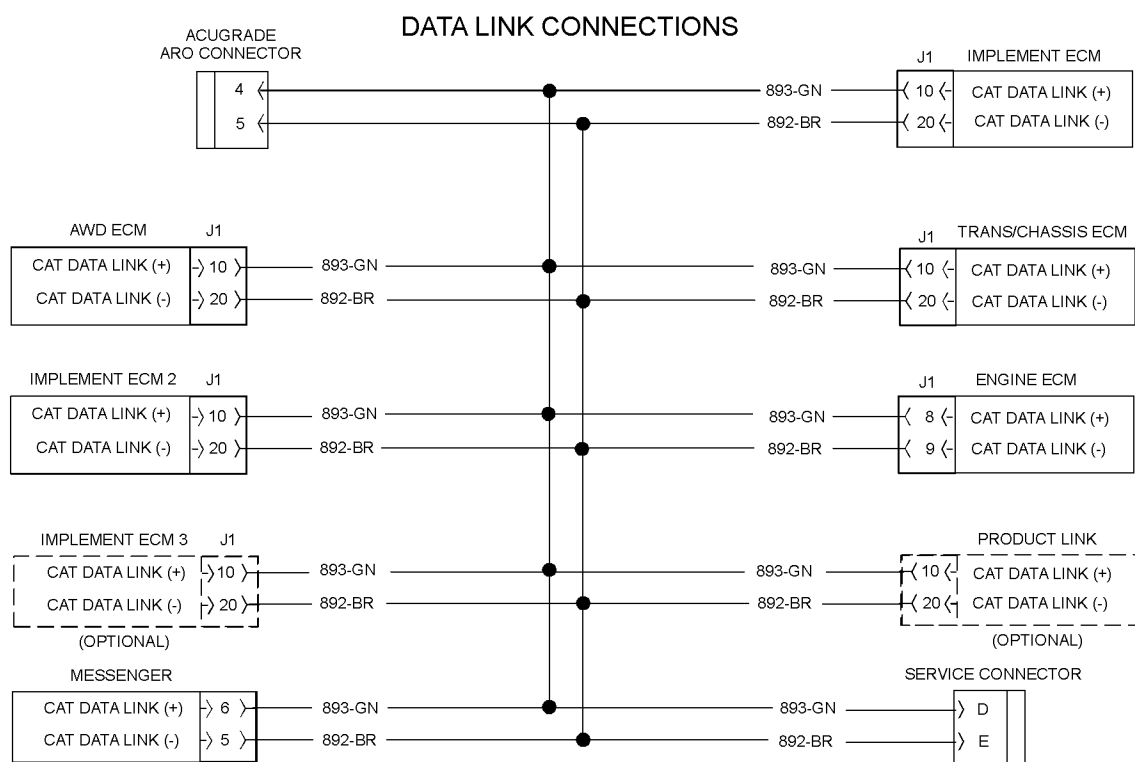


Illustration 43

g02364237

Cat Data Link connections

The CID 0248 FMI 14 diagnostic code is used by the Messenger ECM as a companion code that is activated simultaneously with a diagnostic code from another control module to indicate that the Cat Data Link has an abnormal condition.

Diagnostic Code Procedures

The FMI 14 will match the FMI 14 that is activated for the diagnostic code from the control module. An FMI 14 means that the Messenger ECM is communicating with the other control module. However, the Messenger 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 Messenger ECM as a stand-alone diagnostic code. The Messenger 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 0297 FMI 14 – All Wheel Drive ECM

CID 0590 FMI 14 – Engine ECM

CID 0596 FMI 14 – Implement ECM

CID 1558 FMI 14 – Implement 2 ECM

CID 2143 FMI 14 – Implement 3 ECM

For example, if the Messenger ECM detects that some expected operating parameter information is not being received from the Transmission/Chassis ECM over the Cat Data Link, the Messenger ECM will simultaneously activate the following diagnostic codes:

- CID 0296 FMI 14 (Transmission/Chassis ECM)
- CID 0248 FMI 14 (Cat Data Link)

When the CID 0248 FMI 14 diagnostic code is activated by the Messenger ECM, always look for one of the control module diagnostic codes listed above 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 listed at the beginning of this procedure.

Expected Result:

One of the diagnostic codes listed at the beginning of this procedure is active.

Results:

- YES – One of the diagnostic codes listed at the beginning of this procedure is active.

Repair: Go to the troubleshooting procedure for the active control module CID FMI diagnostic code. To isolate the problem, perform the

troubleshooting procedure for the Cat Data Link circuit that is associated with the control module.

STOP.

i05897755

MID 053 - CID 0271 - FMI 03

SMCS Code: 7407-038

Conditions Which Generate This Code:

(Action Alarm - Voltage Above Normal)

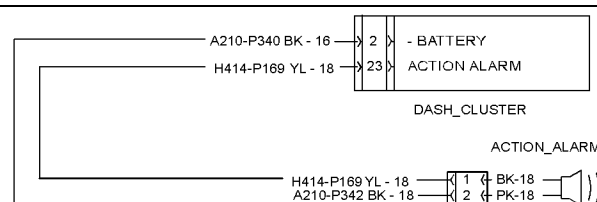


Illustration 44

g02276434

Schematic of the action alarm.

This diagnostic code is associated with the action alarm. The FMI 03 means that the Messenger module has determined that the voltage of the alarm circuit is above normal.

The possible causes of the diagnostic code are listed below:

- The action alarm has failed.
- The energize circuit of the alarm is shorted to the +Battery circuit.
- The dash cluster has failed. This cause 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 271 FMI 3 diagnostic code is active before performing this procedure.**

Note: Use the 146-4080 Digital Multimeter for the measurements in this procedure.

Test Step 1. CHECK THE ALARM

- Disconnect the harness connector from the action alarm.
- Use jumpers to connect the respective terminals of the alarm to +Battery and ground.

Expected Result:

The action alarm sounds when power is applied.

Results:

- OK – The alarm sounds when power is applied. The alarm functions properly. Proceed to Test Step 2.
- NOT OK – The alarm does NOT sound. The alarm has failed.

Repair: Repeat this Test Step “Check the Alarm” to verify the failure of the alarm.

Replace the alarm. Verify that the new alarm corrects the problem.

STOP.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE ALARM FOR A SHORT TO THE +BATTERY CIRCUIT

- Turn the key start switch and the disconnect switch to the OFF position.
- The machine harness connector remains disconnected from the alarm. Disconnect the machine harness from the dash cluster.
- At the machine harness connector for the display module, measure the resistance from contact IC-23 (wire H414-YL(Yellow)) to all contacts that are used in the machine harness connectors for the dash cluster.

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 for the dash cluster. The short is between IC-23 (H414-YL(Yellow)) and the circuit that has a low resistance measurement.

Repair: Repair or replace the machine harness.

STOP.

Test Step 3. CHECK THE HARNESS CONNECTORS

- Inspect and clean the harness connector contacts.
- 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 271 FMI 3 is active.

Expected Result:

The CID 0271 FMI 03 is active.

Results:

- YES – The CID 271 FMI 3 is active. The problem has not been corrected. The dash cluster may have failed.

Repair: Failure of the dash cluster is unlikely. Perform this procedure again. If the cause of the diagnostic code is not found, replace the dash cluster.

STOP.

- NO – The CID 271 FMI 3 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.

i05897797

MID 053 - CID 0271 - FMI 04

SMCS Code: 7407-038

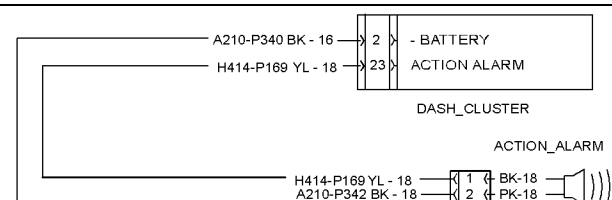
Conditions Which Generate This Code:

Illustration 45

g02276434

Schematic of the action alarm.

This diagnostic code is associated with the action alarm. The FMI 04 means that the Messenger module has determined that the alarm current is above normal.

The possible causes of this diagnostic code are listed:

- The energize circuit of the alarm is shorted to ground.

- The alarm has failed.
- The Dash Cluster has failed. This cause is unlikely.

Note: The following test procedure may create other diagnostic codes. Ignore and clear these diagnostic codes when the original diagnostic code has been corrected. **Ensure that the diagnostic code of CID 0271 FMI 04 is active before performing this procedure.**

Note: Use the 146 - 4080 Digital Multimeter for the measurements in this procedure.

System Response:

A warning will be displayed on the Messenger. The Messenger will have no control over the alarm circuit.

Test Step 1. CHECK THE ALARM

- Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.
- Observe the status of the diagnostic code.
- Disconnect the alarm with the active diagnostic code from the machine harness.

Expected Result:

CID 0271 FMI 04 changes to CID 0271 FMI 05 when the alarm is disconnected.

Results:

- YES – CID 0271 FMI 04 changes to CID 0271 FMI 05 when the alarm is disconnected. The circuit is correct.

Repair: The alarm has failed. Repeat this test "Check the Alarm" to verify the failure of the alarm. Replace the alarm.

STOP.

- NO – CID 0271 FMI 04 remains active. Proceed to Test Step 2.

Test Step 2. CHECK THE ENERGIZE CIRCUIT OF THE ALARM FOR A SHORT TO GROUND

- Turn the key start switch and the disconnect switch to the OFF position. The alarm remains disconnected from the machine harness.
- Disconnect the machine harness connector from the Dash Cluster.

- At the machine harness connector, measure the resistance from the signal contact IC-23 (wire H414-YL(Yellow)) to all contacts that are used in the machine harness connectors for the Dash Cluster.

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 IC-23 (wire H414-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 IF THE DIAGNOSTIC CODE REMAINS

- Inspect and clean the contacts of the harness connectors.
- Reconnect all harness connectors.
- Turn the disconnect switch and the key start switch to the ON position.
- Operate the machine.
- Check the status of the CID 0271 FMI 04.

Expected Result:

The CID 0271 FMI 04 is active.

Results:

- YES – The CID 0271 FMI 04 is active. The diagnostic code has not been corrected. The Dash Cluster may have failed.

Repair: It is unlikely that the Dash Cluster has failed. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the Dash Cluster. See Testing and Adjusting, "Electronic Control Module (ECM) - Replace".

STOP.

- NO – The CID 0271 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.

i05897816

MID 053 - CID 0271 - FMI 05

SMCS Code: 7407-038

Conditions Which Generate This Code:

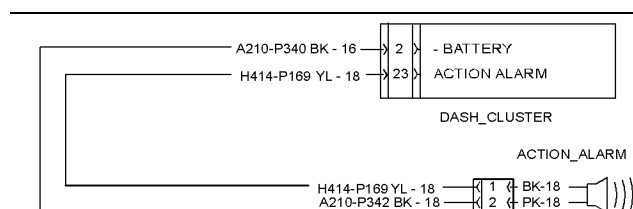


Illustration 46

g02276434

Schematic of the action alarm.

This diagnostic code is associated with the action alarm. The FMI 05 means that the Messenger module has determined that the alarm circuit current is below normal.

The possible causes of this diagnostic code are listed below:

- The energize circuit of the alarm is open.
- The return circuit of the alarm is open.
- The alarm has failed.
- The dash cluster has failed. This cause is unlikely.

Note: The following test procedure may create other diagnostic codes. Ignore and clear these diagnostic codes when the original diagnostic code has been corrected. **Ensure that the diagnostic code of CID 0271 FMI 05 is active before performing this procedure.**

Note: Use the 146 - 4080 Digital Multimeter for the measurements in this procedure.

Test Step 1. CHECK THE ALARM

- Turn the disconnect switch and the key start switch to the ON position. Do not start the engine.
- Disconnect the alarm with the active diagnostic code from the machine harness for the dash cluster.

- At the machine harness connector for the alarm, place a jumper wire from the positive contact (wire H414-YL(Yellow)) to the negative contact (wire 210-BK(Black)).

- Observe the status of the CID 0271 FMI 05.

Expected Result:

The CID 0271 FMI 05 diagnostic code remains active.

Results:

- YES – The diagnostic code remains active. The jumper wire does not affect the diagnostic code. Proceed to Test Step 2.
- NO – The diagnostic code is no longer active. The alarm has failed.

Repair: The alarm has failed. Repeat this Test Step “Check the Alarm” to verify the failure of the alarm. Replace the alarm. Verify that the new alarm corrects the problem.

STOP.

Test Step 2. CHECK THE HARNESS FOR AN OPEN

- Turn the key start switch and the disconnect switch to the OFF position.
- Disconnect the machine harness connector(s) from the dash cluster.
- The jumper wire that was installed in the previous test remains in place.
- At the machine harness connector for the dash cluster, measure the resistance from signal contact IC-23 (wire H414-YL(Yellow)) to contact IC-2 (wire 210-BK(Black)).

Expected Result:

The resistance is less than 5.0 ohms.

Results:

- OK – The resistance is less than 5.0 ohms. The machine harness for the dash cluster is correct. Proceed to Test Step 3.
- NOT OK – The resistance is greater than 5 ohms. The resistance measurement is not correct. There is an open circuit in the machine harness for the dash cluster.

Repair: The open is in wire H414-YL(Yellow) or in wire 210-BK(Black) of the machine harness for the dash cluster. Repair or replace the machine harness.

STOP.

Test Step 3. CHECK HARNESS CONNECTORS

- A.** Inspect the contacts of the harness connectors and clean 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.** Check the status of the CID 0271 FMI 05 diagnostic code.

Expected Result:

The CID 0271 FMI 05 diagnostic code is active.

Results:

- YES – The CID 0271 FMI 05 diagnostic code is active. The diagnostic code has not been corrected. The dash cluster may have failed.

Repair: It is unlikely that the dash cluster has failed. Exit this procedure and perform this procedure again. If the cause of the diagnostic code is not found, replace the dash cluster. See Troubleshooting, “Electronic Control Module (ECM) - Replace”.

STOP.

- NO – The CID 0271 FMI 05 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.

i05897867

MID 053 - CID 0296 - FMI 09

SMCS Code: 7610-038-DTN

Conditions Which Generate This Code:

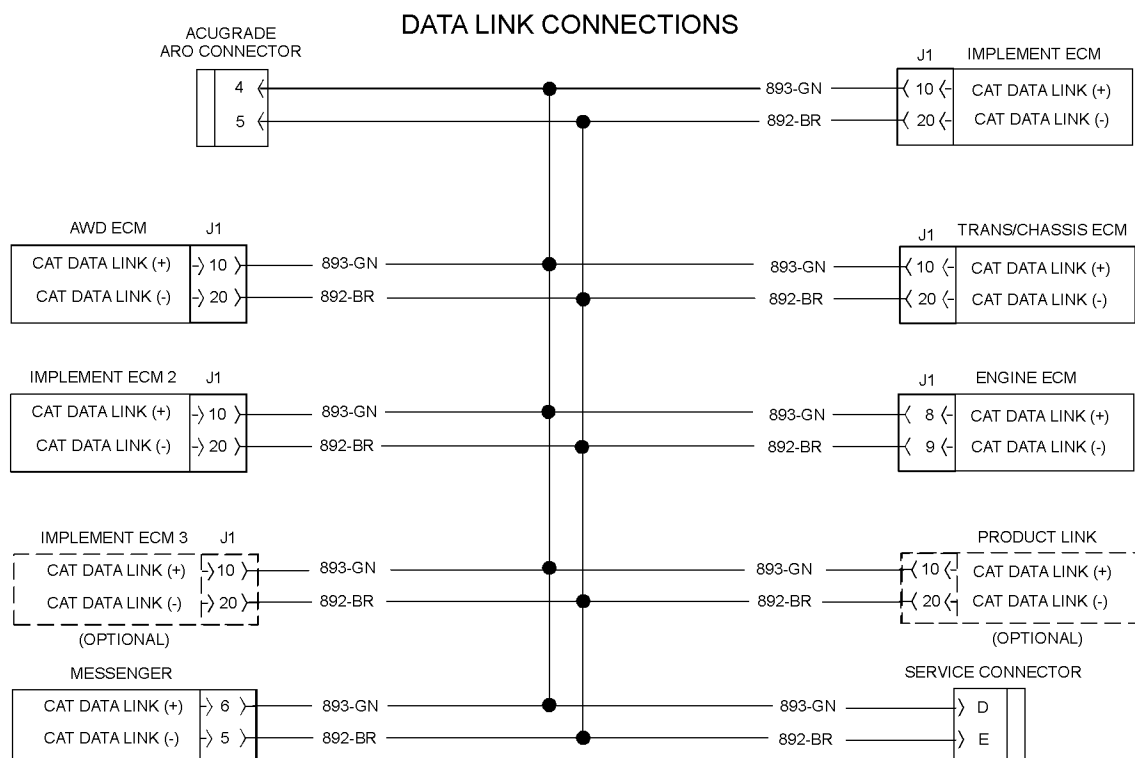


Illustration 47

g02364397

Schematic of the Cat Data Link.

This diagnostic code is associated with the communication between the Messenger ECM and the Transmission/Chassis ECM. The communication is conducted on the Cat Data Link circuit.

FMI 09 means that the Messenger ECM is not receiving communication from the Transmission/Chassis ECM on the Cat Data Link circuit.

A CID 0248 FMI 09 companion diagnostic code is activated when the CID 0296 FMI 09 diagnostic code is activated by the Messenger ECM. CID 0248 FMI 09 indicates the Cat Data Link is involved.

Note: CID 0248 FMI 09 is cleared when the CID 0296 FMI 09 diagnostic code is cleared.

The possible causes of the CID 0296 FMI 09 diagnostic code are listed below:

- An ECM or smart device not powering up
- Lack of keyswitch input to an ECM or smart device (where applicable)
- Excessive data link circuit noise
- Data link circuit open or poor connection
- Software configuration mismatch
- Transmission/Chassis ECM failure
- Messenger failure

Note: A loss of power in the Transmission/Chassis ECM system can cause the Messenger ECM to activate this diagnostic code. Ensure that the Transmission/Chassis ECM is powered up before proceeding with this procedure.

Note: Ensure that CID 0296 FMI 09 is active before performing this procedure.

DETERMINE THAT THE DATA LINK COMPANION CODE IS ACTIVE

- A.** Check the list of active diagnostic codes to determine if the CID 0248 FMI 09 companion diagnostic code is active.

Results:

- OK – CID 0248 FMI 09 is active, indicating that the problem is in the Cat Data Link. Proceed to the diagnostics for CID 0248 FMI 09.

i05897956

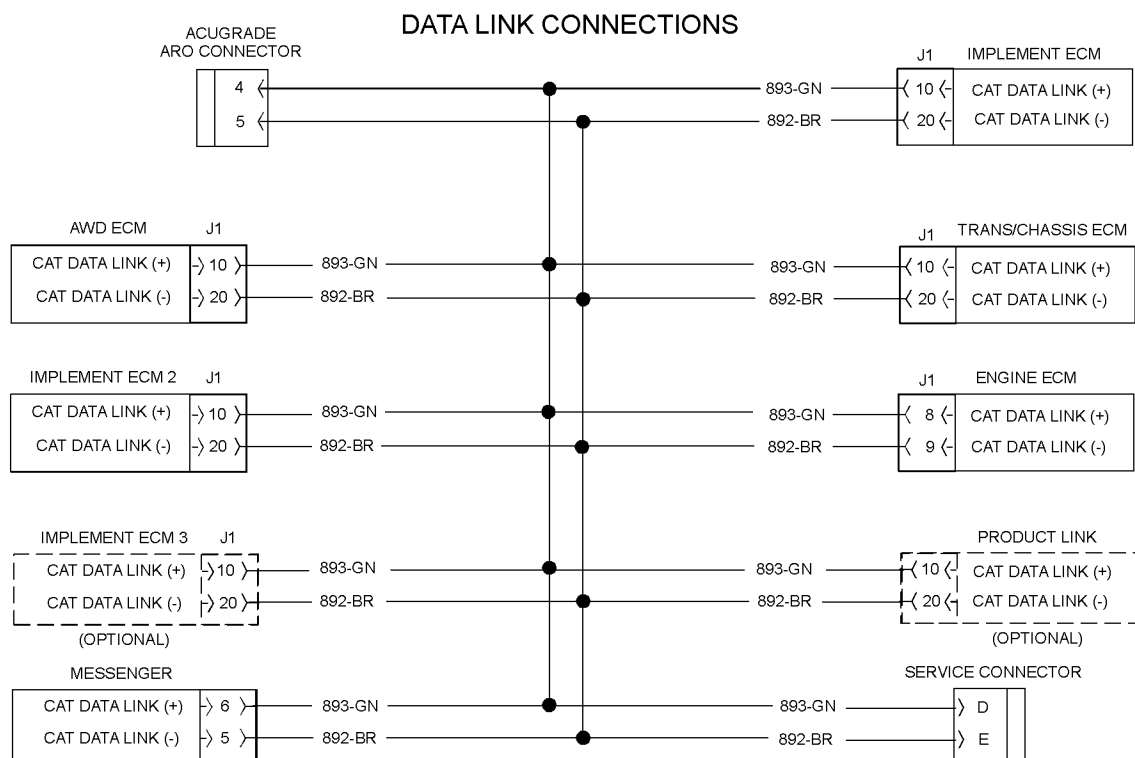
MID 053 - CID 0296 - FMI 14**SMCS Code:** 7610-038-DTN**Conditions Which Generate This Code:**

Illustration 48

g02364418

Schematic of the Cat Data Link.

This diagnostic code is recorded when the Transmission/Chassis ECM is not sending the necessary parameters to the Messenger module at the proper rate. The update rate for parameters that are generated by the Transmission/Chassis ECM is not correct.

The possible causes of this diagnostic code are listed:

- The Transmission/Chassis ECM has the incorrect software installed.
- The Messenger ECM has the incorrect software installed.
- Incompatible software may be installed.

Test Step 1. CHECK THE TRANSMISSION/CHASSIS ECM AND THE MESSENGER ECM FOR PROPER SOFTWARE VERSIONS

A. Use Cat[®] Electronic Technician (Cat ET) Service Tool to verify that the versions of software are compatible.

Expected Result:

The proper versions of software are installed on the Messenger ECM and the Transmission/Chassis ECM.

Results:

- YES – The versions of software are compatible. Proceed to Test Step 2.
- NO – The proper software is not installed.

Repair: Flash the proper software to the appropriate ECM. Cycle the key switch to initialize the new software. Ensure that the diagnostic code is no longer active.

STOP.

Test Step 2. RECHECK FOR DIAGNOSTIC CODES

A. Ensure that diagnostic code is active.

Expected Result:

The diagnostic code is inactive. The diagnostic code indicator is inactive.

Results:

- YES – The diagnostic code indicator and the diagnostic code are inactive.

Repair: Clear the diagnostic code.

STOP.

- NO – The diagnostic code is active.

Repair: Ensure that the proper software is installed before replacing the ECM. If the software is correct, replace the Messenger ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”. If the Messenger ECM was replaced, install a new Transmission/Chassis ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace” for the machine that is being serviced.

STOP.

i05897975

MID 053 - CID 0297 - FMI 09

SMCS Code: 7610-038-DTN

Conditions Which Generate This Code:

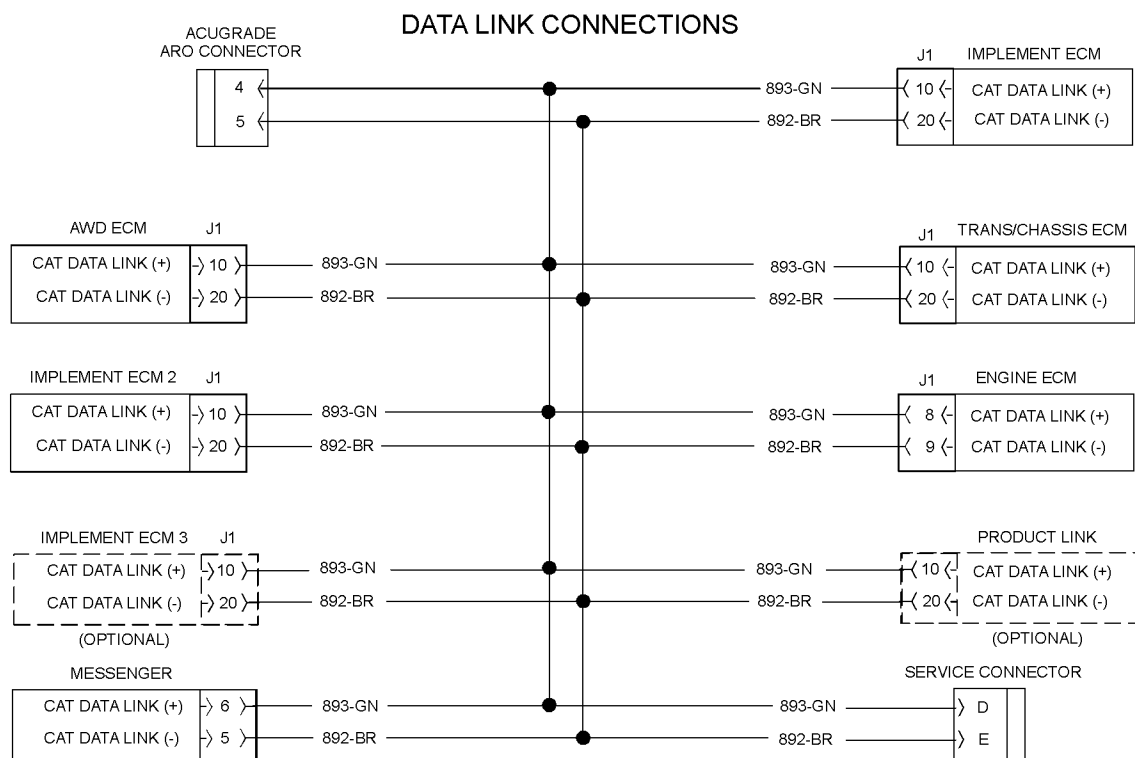


Illustration 49

g02364461

Cat Data Link

This diagnostic code is associated with the communication between the Messenger ECM and the All Wheel Drive (AWD) ECM. The communication is conducted on the Cat Data Link circuit.

FMI 09 means that the Messenger ECM is not receiving communication from the AWD ECM on the Cat Data Link circuit.

A CID 0248 FMI 09 companion diagnostic code is activated when the CID 0297 FMI 09 diagnostic code is activated by the Messenger ECM. CID 0248 FMI 09 indicates the Cat Data Link is involved.

Note: CID 0248 FMI 09 is cleared when the CID 0297 FMI 09 diagnostic code is cleared.

The possible causes of the CID 0297 FMI 09 diagnostic code are listed below:

- An ECM or smart device not powering up.
- Lack of keyswitch input to an ECM or smart device (where applicable).
- Excessive data link circuit noise.
- Data link circuit open or poor connection.
- Software configuration mismatch.
- AWD ECM failure.
- Messenger failure.

Note: A loss of power in the system to the AWD ECM can cause the Messenger ECM to activate this diagnostic code. Ensure that the AWD ECM is powered up before proceeding with this procedure.

Note: Ensure that CID 0297 FMI 09 is active before performing this procedure.

DETERMINE THAT THE DATA LINK COMPANION CODE IS ACTIVE

- A.** Check the list of active diagnostic codes to determine that the CID 0248 FMI 09 companion diagnostic code is active.

Results:

- OK – CID 0248 FMI 09 is active, indicating that the problem is in the Cat Data Link. Proceed to the diagnostics for CID 0248 FMI 09.

i05897997

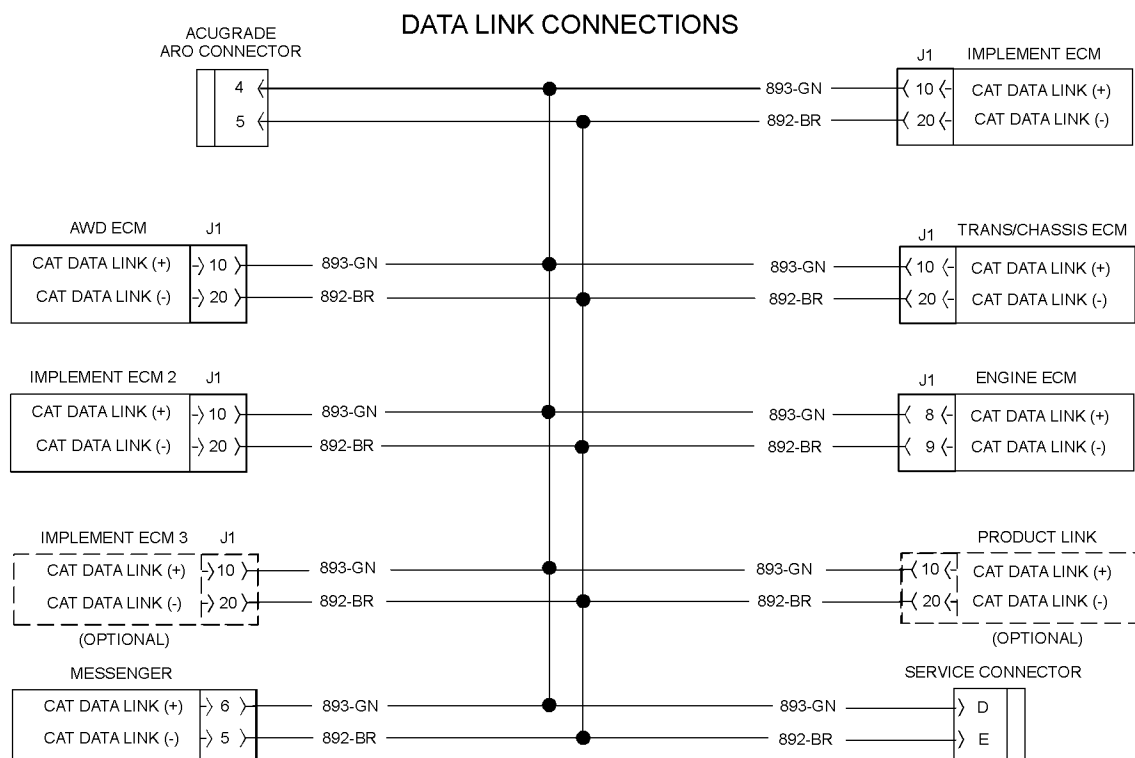
MID 053 - CID 0297 - FMI 14**SMCS Code:** 7610-038-DTN**Conditions Which Generate This Code:**

Illustration 50

g02364465

Schematic of the Cat Data Link.

This diagnostic code is recorded when the All Wheel Drive (AWD) ECM is not sending the necessary parameters to the Messenger module at the proper rate. The update rate for parameters that are generated by the AWD ECM is not correct.

The possible causes of this diagnostic code are listed:

- The AWD ECM has the incorrect software installed.
- The Messenger ECM has the incorrect software installed.
- Incompatible software may be installed.

Test Step 1. CHECK THE AWD ECM AND THE MESSENGER ECM FOR PROPER SOFTWARE VERSIONS

A. Use Cat[®] Electronic Technician (Cat ET) Service Tool to verify that the versions of software are compatible.

Expected Result:

The proper versions of software are installed on the Messenger ECM and the AWD ECM.

Results:

- YES – The versions of software are compatible. Proceed to Test Step 2.

- NO – The proper software is not installed.

Repair: Flash the proper software to the appropriate ECM. Cycle the key switch to initialize the new software. Ensure that the diagnostic code is no longer active.

STOP.

Test Step 2. RECHECK FOR DIAGNOSTIC CODES

A. Ensure that diagnostic code is active.

Expected Result:

The diagnostic code is inactive. The diagnostic code indicator is inactive.

Results:

- YES – The diagnostic code indicator and the diagnostic code are inactive.

Repair: Clear the diagnostic code.

STOP.

- NO – The diagnostic code is active.

Repair: Ensure that the proper software is installed before replacing the ECM. If the software is correct, replace the Messenger ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”. If the Messenger ECM was replaced, install a new AWD ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace” for the machine that is being serviced.

STOP.

i05898035

MID 053 - CID 0590 - FMI 09

SMCS Code: 1901-038

Conditions Which Generate This Code:

Cat Data Link

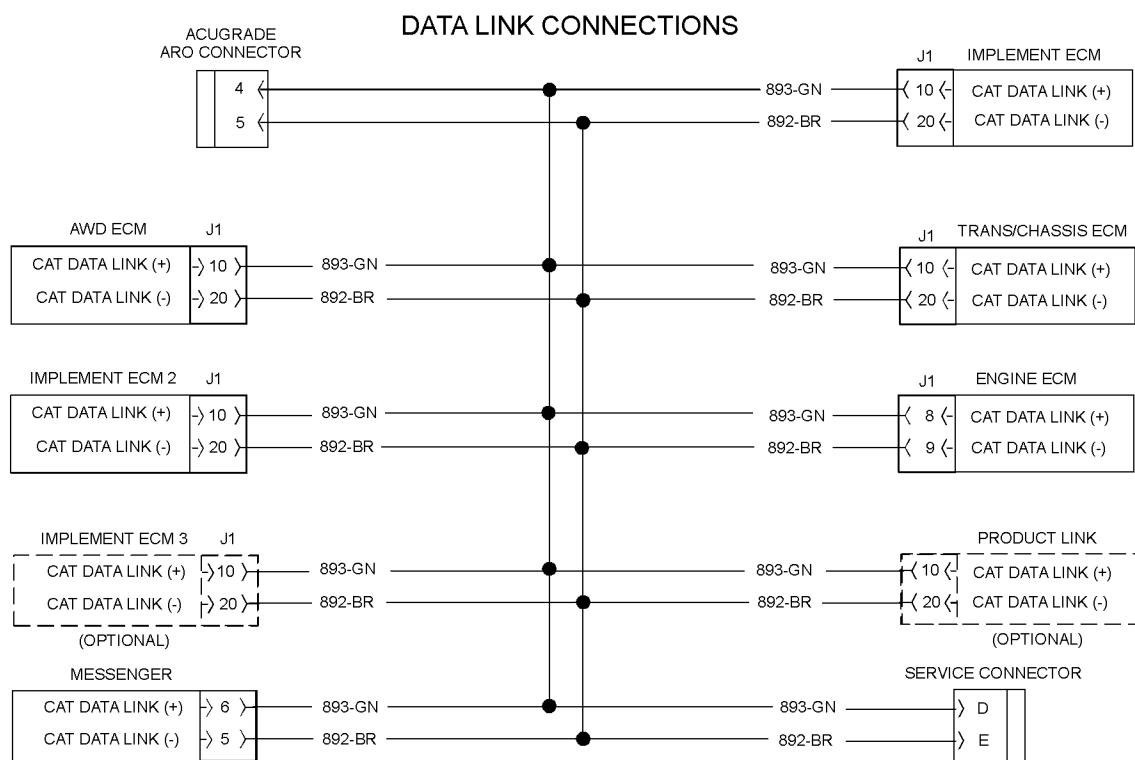


Illustration 51

g02364471

Cat Data Link circuit.

The CID 0590 FMI 09 diagnostic code is associated with the communication between the Messenger ECM and the Engine ECM. Communication is conducted on the Cat Data Link.

The FMI 09 means that the Messenger ECM is not receiving communication from the Engine ECM on the Cat Data Link circuit.

A CID 0248 FMI 09 companion diagnostic code is activated when the CID 0590 FMI 09 diagnostic code is activated by the Messenger ECM. CID 0248 FMI 09 indicates that the Cat Data Link is involved.

Note: CID 0248 FMI 09 is cleared when the CID 0590 FMI 09 diagnostic code is cleared.

Following are the possible causes of a CID 0590 FMI 09 diagnostic code:

- Data link circuit open or poor connection
- Engine ECM failure
- Messenger ECM failure

Note: A loss of power to the Engine ECM can cause the Messenger ECM to activate this diagnostic code. Make sure that the Engine ECM is powered up before proceeding with this procedure.

Note: Make sure that CID 0590 FMI 09 is active before performing this procedure.

DETERMINE THAT THE DATA LINK COMPANION CODE IS ACTIVE

- A.** Check the list of active diagnostic codes to determine that the CID 0248 FMI 09 companion diagnostic code is active.

Results:

- OK – The CID 0248 FMI 09 diagnostic code is active, indicating that the problem is in the Cat Data Link. Proceed to the diagnostics for CID 0248 FMI 09.

i05898051

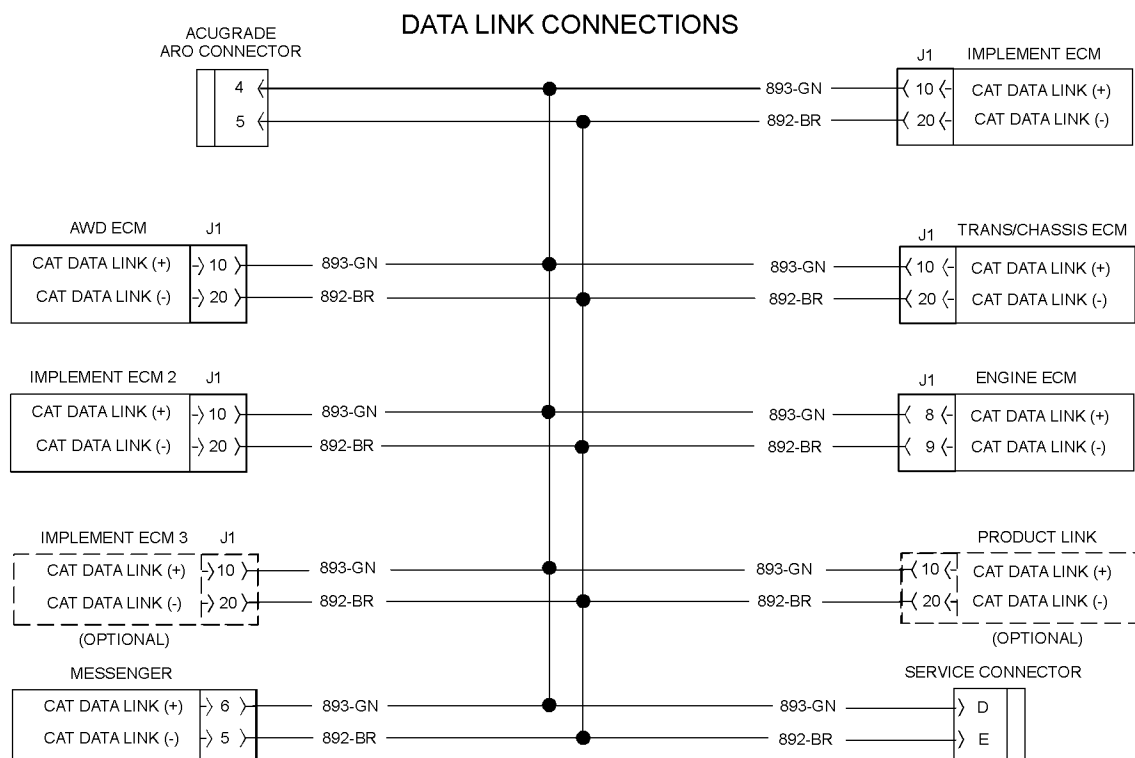
MID 053 - CID 0590 - FMI 14**SMCS Code:** 1901-038**Conditions Which Generate This Code:**

Illustration 52

g02364471

Schematic of the data link.

This diagnostic code is recorded when the Engine ECM is not sending the necessary parameters to the Messenger module at the proper rate. The update rate for parameters that are generated by the Engine ECM is not correct.

The possible causes of this diagnostic code are listed:

- The Engine ECM has the incorrect software installed.
- The Messenger ECM has the incorrect software installed.
- Incompatible software may be installed.

Test Step 1. CHECK THE ENGINE ECM AND THE MESSENGER ECM FOR PROPER SOFTWARE VERSIONS

A. Use Cat[®] Electronic Technician (Cat ET) Service Tool to verify that the versions of software are compatible.

Expected Result:

The proper versions of software are installed on the Messenger ECM and the Engine ECM.

Results:

- YES – The versions of software are compatible. Proceed to Test Step 2.

- NO – The proper software is not installed.

Repair: Flash the proper software to the appropriate ECM. Cycle the key switch to initialize the new software. Ensure that the diagnostic code is no longer active.

STOP.

Test Step 2. RECHECK FOR DIAGNOSTIC CODES

A. Ensure that diagnostic code is active.

Expected Result:

The diagnostic code is inactive. The diagnostic code indicator is inactive.

Results:

- YES – The diagnostic code indicator and the diagnostic code are inactive.

Repair: Clear the diagnostic code.

STOP.

- NO – The diagnostic code is active.

Repair: Ensure that the proper software is installed before replacing the ECM. If the software is correct, replace the Messenger ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”. If the Messenger ECM was replaced, install a new Engine ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace” for the engine that is being serviced.

STOP.

i05898064

MID 053 - CID 0596 - FMI 09

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

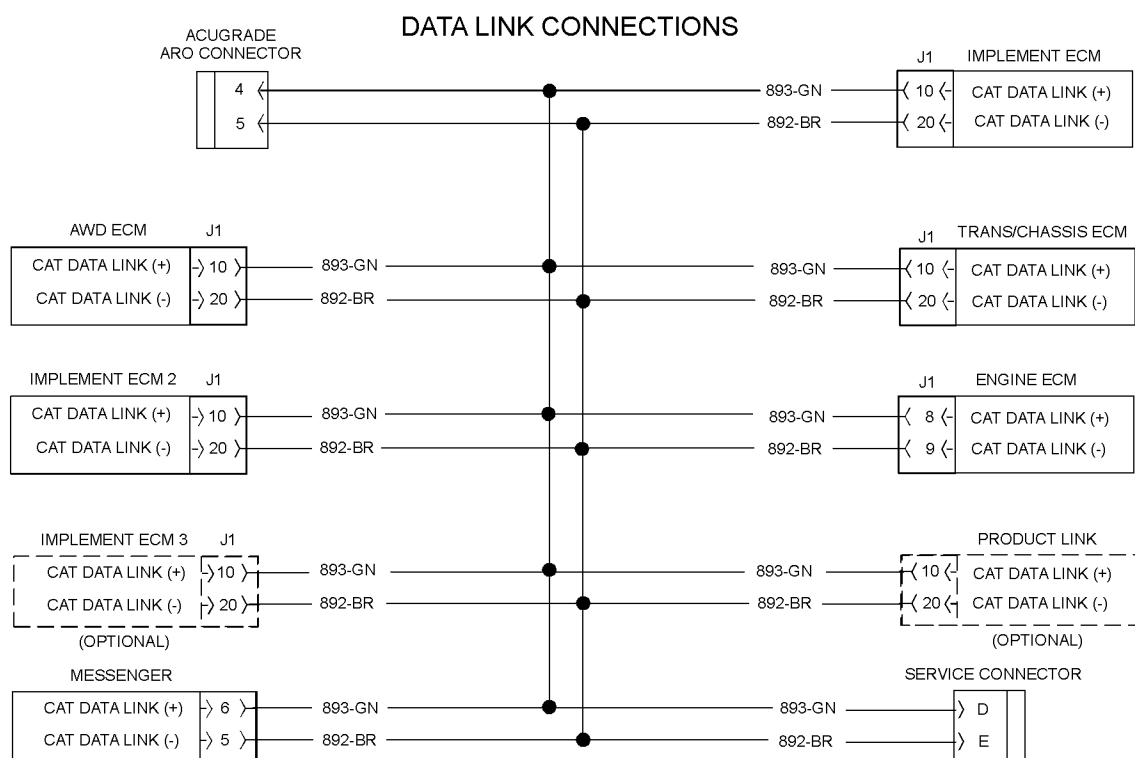


Illustration 53

g02364476

Schematic of the Cat Data Link.

This diagnostic code is associated with the communication between the Messenger ECM and the Implement ECM. The communication is conducted on the Cat Data Link circuit.

FMI 09 means that the Messenger ECM is not receiving communication from the Implement ECM on the Cat Data Link circuit.

A CID 0248 FMI 09 companion diagnostic code is activated when the CID 0596 FMI 09 diagnostic code is activated by the Messenger ECM. CID 0248 FMI 09 indicates the Cat Data Link is involved.

Note: CID 0248 FMI 09 is cleared when the CID 0596 FMI 09 diagnostic code is cleared.

The possible causes of the CID 0596 FMI 09 diagnostic code are listed below:

- An ECM or smart device not powering up
- Lack of keyswitch input to an ECM or smart device (where applicable)
- Excessive data link circuit noise
- Data link circuit open or poor connection
- Software configuration mismatch
- Implement ECM failure
- Messenger failure

Note: A loss of power in the system to the Implement ECM can cause the Messenger ECM to activate this diagnostic code. Ensure that the Implement ECM is powered up before proceeding with this procedure.

Note: Make sure that CID 0596 FMI 09 is active before performing this procedure.

DETERMINE THAT THE DATA LINK COMPANION CODE IS ACTIVE

- A.** Check the list of active diagnostic codes to determine that the CID 0248 FMI 09 companion diagnostic code is active.

Results:

- OK – CID 0248 FMI 09 is active, indicating that the problem is in the Cat Data Link. Proceed to the diagnostics for CID 0248 FMI 09.

i05898116

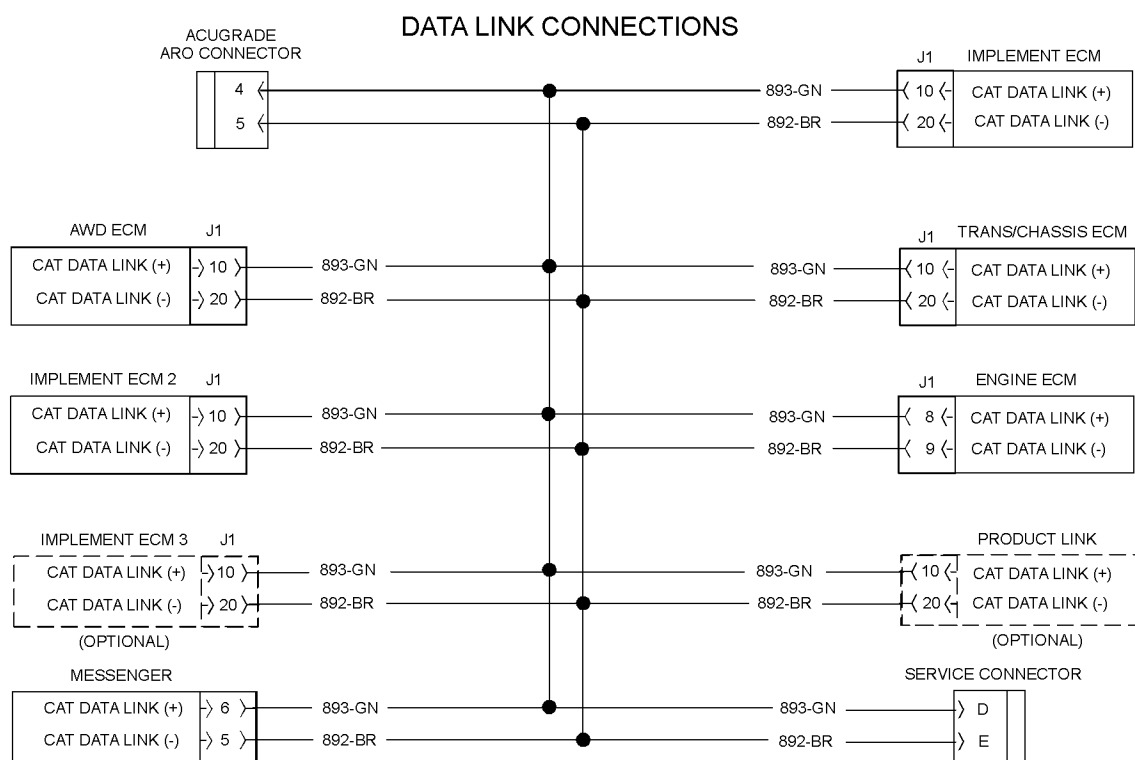
MID 053 - CID 0596 - FMI 14**SMCS Code:** 7610-038-II**Conditions Which Generate This Code:**

Illustration 54

g02364496

Schematic of the data link.

This diagnostic code is recorded when the Implement ECM is not sending the necessary parameters to the Messenger module at the proper rate. The update rate for parameters that are generated by the Implement ECM is not correct.

The possible causes of this diagnostic code are listed:

- The Implement ECM has the incorrect software installed.
- The Messenger ECM has the incorrect software installed.
- Incompatible software has been installed.

Test Step 1. CHECK THE IMPLEMENT ECM AND THE MESSENGER ECM FOR PROPER SOFTWARE VERSIONS

A. Use Cat[®] Electronic Technician (Cat ET) Service Tool to verify that the versions of software are compatible.

Expected Result:

The proper versions of software are installed on the Messenger ECM and the Implement ECM.

Results:

- YES – The versions of software are compatible. Proceed to Test Step 2.

- NO – The proper software is not installed.

i05898156

Repair: Flash the proper software to the appropriate ECM. Cycle the key switch to initialize the new software. Ensure that the diagnostic code is no longer active.

STOP.

Test Step 2. RECHECK FOR DIAGNOSTIC CODES

A. Ensure that diagnostic code is active.

Expected Result:

The diagnostic code is inactive. The diagnostic code indicator is inactive.

Results:

- YES – The diagnostic code indicator and the diagnostic code are inactive.

Repair: Clear the diagnostic code.

STOP.

- NO – The diagnostic code is active.

Repair: Ensure that the proper software is installed before replacing the ECM. If the software is correct, replace the Messenger ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace”. If the Messenger ECM was replaced, install a new Implement ECM. See Testing and Adjusting, “Electronic Control Module (ECM) - Replace” for the engine that is being serviced.

STOP.

MID 053 - CID 0811 - FMI 09

SMCS Code: 7490-038

Conditions Which Generate This Code:

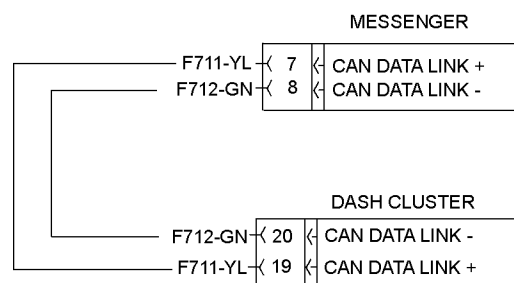


Illustration 55

g02278273

This diagnostic code is recorded when the Messenger module does not receive expected information from the Display module for more than five seconds.

Test Step 1. VERIFY THE HARDWARE AND THE SOFTWARE PART NUMBERS

A. Verify that the following information is correct:

- The part number of the flash software for the Messenger module
- The part number of the Messenger module
- The part number of the Display module

Note: Consult your Caterpillar Dealer for the correct part numbers of the flash software.

Expected Result:

All of the part numbers are correct.

Results:

- OK – All of the part numbers are correct. Proceed to Test Step 2.
- NOT OK – All of the part numbers are not correct.

Repair: The installed Messenger module or the Display module have the wrong part number or the incorrect flash software is installed. Replace the incorrect Messenger module or the Display module with a module that has the correct part number. Flash the correct software. See the

Troubleshooting, “Electronic Control Module (ECM) - Flash Program” section for additional information.

STOP.

Test Step 2. INSPECT THE HARNESS CONNECTIONS

- A. Turn the disconnect switch to the OFF position.
- B. Inspect all harness connections that are related to the CAN data link. Make sure that the connectors are clean and tight.
- C. Check the connectors for proper mating. Ensure that all the seals are present and in place.
- D. Check the harness for signs of damage or abrasion.
- E. Check the wires at the connector. Ensure that the wires are secured tightly into the connector. **Take care not to pull the wire out of the connector.**
- F. Check the exposed wires at the connectors for nicks or signs of abrasion.
- G. Check for moisture inside the connector.
- H. Check the connectors for dirty contacts or corroded contacts.
- I. Check each pin and each socket of the machine harness connectors. Ensure that the contacts are properly installed. The contacts should mate correctly when the two connectors are placed together.

Expected Result:

The machine harness connectors are tight and free of corrosion.

Results:

- OK – The machine harness connectors are tight and free of corrosion. Proceed to Test Step 3.
- NOT OK – The machine harness connectors are in need of repair.

Repair: Repair the machine harness or replace the machine harness.

STOP.

Test Step 3. CHECK THE DATA LINK FOR AN OPEN CIRCUIT

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

- B. Disconnect the machine harness connectors from the Messenger module and the Display module.
- C. Connect a jumper wire between the “CAN data +” contact 6 (wire 893-GN(Green)) and the “CAN data -” contact 5 (wire 892-GN(Green)) on the Messenger module connector.
- D. At the Display module harness connector, measure the resistance between the “CAN data +” contact J1-10 (wire 893-GN(Green)) and the “CAN data -” contact J1-20 (wire 892-BR(Brown)).

Expected Result:

The resistance measurement is 5 ohms or less with the jumper wire connected. The resistance measurement with the jumper wire disconnected is approximately 60 ohms.

Results:

- OK – When the jumper wire is connected, the resistance measurement is 5 ohms or less. This condition indicates that the CAN data link circuit between the Display module and the Messenger module is not open and does not appear to have a poor connection. When the jumper wire is disconnected, the resistance measurement is approximately 60 ohms. This condition indicates that the terminal resistors in the circuit are connected and in good condition. Proceed to Test Step 4.
- NOT OK – Either the resistance measurement with the jumper wire connected is greater than 5 ohms or the resistance measurement with the jumper disconnected is not 60 ohms.

Repair: If the resistance measurement with the jumper wire connected is greater than 5 ohms, there is an open or a poor connection in the CAN data link circuits between the Display module and the Messenger module.

Locate and examine all of the connections in the circuit. Check each wire at each connection for poor or loose connections in the connector. Ensure that all connections are clean, secure, and in good condition.

With the jumper wire disconnected, if the resistance measurement between the high and low circuits is greater than 60 ohms, one or both of the terminal resistors has either failed or is disconnected from the circuit. Disconnect each terminal resistor and individually check the resistance of each resistor. The resistance should be 120 ohms. Replace the resistors if necessary.

Once the problem is resolved, ensure that all of the connectors are securely connected.

STOP.

Test Step 4. CHECK FOR OPEN HARNESS

i05898221

- A.** The disconnect switch remains in the OFF position.
- B.** The Messenger module and the Display module remain disconnected from the machine harness.
- C.** Check the resistance of the data link circuit in the machine harness:
 - Measure the resistance between connector contact 5 (wire 892-BR(Brown)) of the Messenger module and connector contact J1-20 (wire 892-BR(Brown)) of the Display module.
 - Measure the resistance between connector contact 6 (wire 893-GN(Green)) of the Messenger module and connector contact J1-10 (wire 893-GN(Green)) of the Display module.

Expected Result:

The resistance measures less than 5 ohms.

Results:

- OK – The resistance is less than 5 ohms. The data link circuit in the machine harness is correct. The Display module may have failed.

Repair: Exit this procedure and perform the diagnostic code procedure again. If the problem persists, the Display module may have failed. Prior to replacing the Display module, 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 Messenger module. Refer to the Troubleshooting, "Electronic Control Module (ECM) - Replace".

STOP.

- NOT OK – The resistance is greater than 5 ohms. The machine harness has failed.

Repair: The data link circuit is open in the machine harness. Repair or replace the machine harness.

STOP.

MID 053 - CID 1558 - FMI 09**SMCS Code:** 7610-038-II**Conditions Which Generate This Code:**

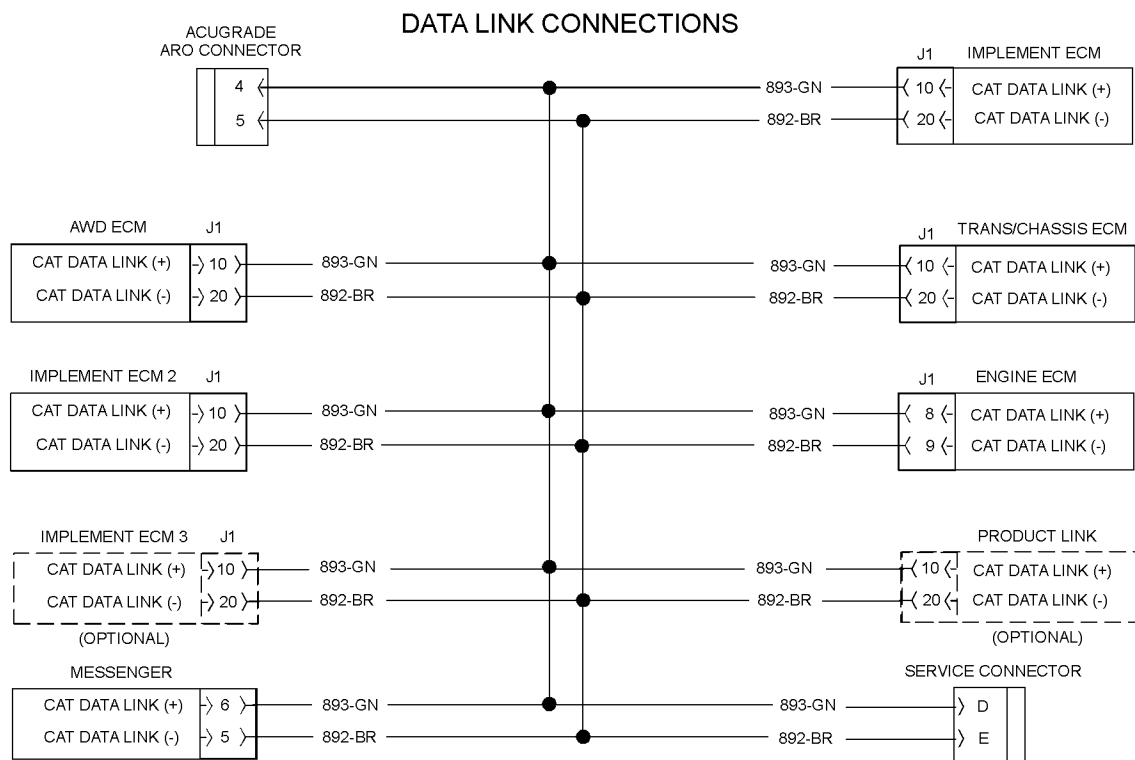


Illustration 56

g02364516

This diagnostic code is associated with the communication between the Messenger ECM and the Implement ECM 2. The FMI 09 diagnostic code means that the Messenger ECM has lost communication with the Implement ECM 2.

A companion diagnostic code is activated when the diagnostic code is activated by the Messenger ECM. The companion diagnostic code indicates the data link that is involved. The companion diagnostic code that has been activated will be the following:

CID 0248 FMI 09 – Cat Data Link

The companion code and the CID 1558 FMI 09 diagnostic code become active and inactive at the same time.

Note: A loss of power to the Implement ECM 2 can cause the Messenger ECM to activate this diagnostic code. Ensure that the Implement ECM 2 is powered up before proceeding with this procedure.

DETERMINE IF THE COMPANION CODE IS ACTIVE

A. Ensure that the CID 1558 FMI 09 diagnostic code is active.

Expected Result:

CID 0248 FMI 09 is active.

Results:

- OK – CID 0248 FMI 09 is active.

Repair: Proceed to the CID 0248 FMI 09 diagnostics.

STOP.

i05898688

MID 053 - CID 1558 - FMI 14

SMCS Code: 7610-038-II

Conditions Which Generate This Code:

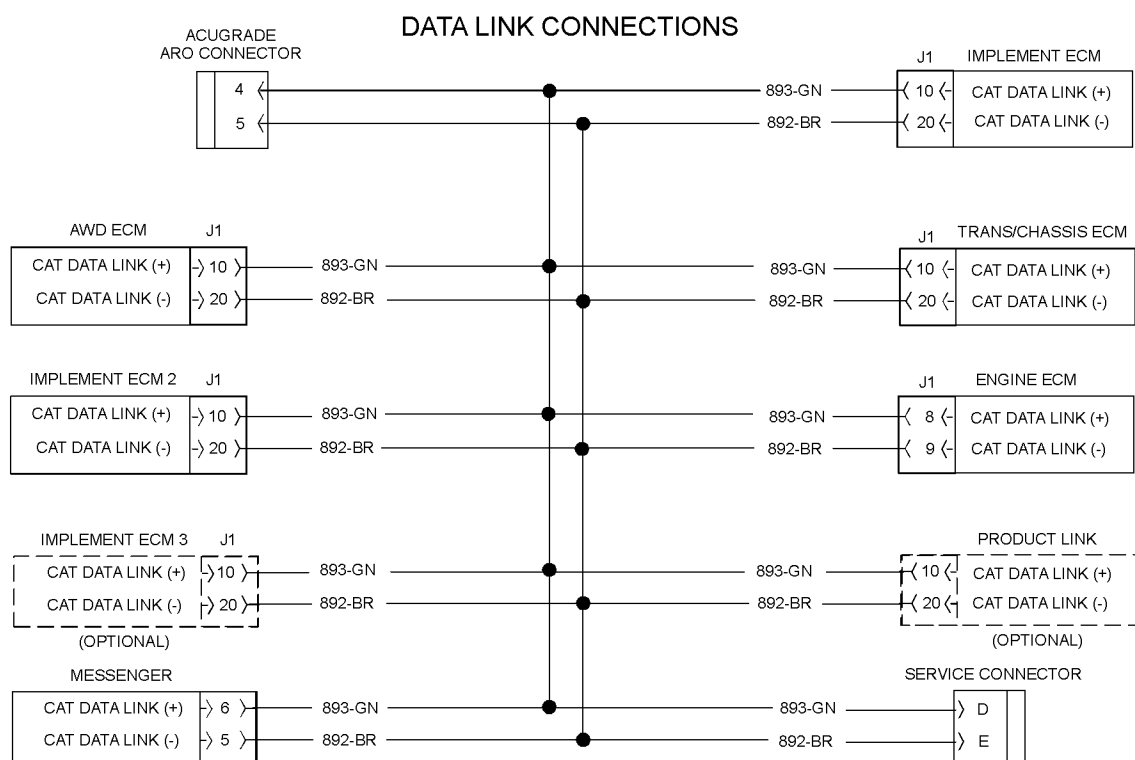


Illustration 57

g02364536

The CID 1558 FMI 14 diagnostic code is recorded when the Messenger ECM is communicating with the Implement ECM 2, but not receiving certain expected information.

FMI 14 means that the Messenger ECM and the Implement ECM 2 are communicating, but the Messenger ECM is not receiving expected operating parameter information.

Some conditions that can cause this diagnostic code are listed below:

- Incorrect Implement "ECM 2 ECM" software.
- Incorrect Messenger ECM software.
- New ECM with an incorrect part number has been installed.

- Incompatible software has been installed.

Test Step 1. VERIFY THE HARDWARE AND THE SOFTWARE PART NUMBERS

A. Verify that the following is correct:

- Messenger ECM software part number
- Implement ECM 2 software part number
- Messenger ECM part number
- Implement ECM 2 part number

Note: Contact the Technical Communicator at your Cat dealer for the correct part numbers.

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 incorrect hardware or software with the correct version.

For replacing ECMs, see Testing and Adjusting, “Electronic Control Module (ECM) - Replace”

For flashing software, see Testing and Adjusting, “Electronic Control Module (ECM) - Flash Program”.

Proceed to Test Step 2.

Test Step 2. CHECK THE STATUS OF THE DIAGNOSTIC CODE

A. Turn ON the disconnect switch and the keyswitch.

B. Operate the machine.

C. Check the status of the CID 1558 FMI 14 diagnostic code.

Expected Result:

CID 1558 FMI 14 is not active.

Results:

- OK – CID 1558 FMI 14 is not active.

Repair: The diagnostic code may have been caused by a problem during start-up with one of the controls of the ECM. Resume normal operation.

STOP.

- NOT OK – CID 1558 FMI 14 is active. The Messenger ECM may have failed. ECM failure is unlikely.

Repair: Exit this procedure. Perform this procedure again. If the failure is not found, contact your Cat dealer. If ECM replacement is required, see Testing and Adjusting, “Electronic Control Module (ECM) - Replace”.

STOP.

Diagnostic System Procedures

i05898699

Charging System

SMCS Code: 1406-038

System Operation Description:

Often when problems with the charging system are being investigated, the alternator is not the problem. If a low battery condition is present test the batteries first. See Special Instruction, SEHS7633, "Battery Test Procedure" for more information. If the engine cranks slowly, then test the starting system. See Service Magazine, SEPD0020, "Testing The Starter On The Engine" for more information. If a warning indicator for the charging system is ON, see Service Magazine, SEBD1751, "Difference Between Alternator Indicator In Electronic Monitoring System (EMS) And Low Voltage Indicator In Operating Monitoring System (OMS)".

Note: Severely discharged batteries can cause low system voltage. Severely discharged batteries can occur even while the engine is running above idle, and the alternator is working properly. Proper low engine idle is also important.

Table 13

Specifications for the Alternator		
	Peak Current Rating amp	Minimum Peak Current amp
12 V Alternators		
8C-5535	32	28
7N-4784, OR-5201	40	36
6T-1396, 7T-2096, 8C-5908, OR-3654	51	46
9W-2648, 9W-2949, 8T-9700, 105-2811(IG), OR-4327(IG), 105-2812(IG), OR-9273(IG), 34-3268, 68-4139, 3E-7295(D+), 7T-2876 (D+), 100-8223	55	49
7G-7889	60	54
8C-5510(I), OR5200	61	55
8N-2268	75	68
3E-7892, OR-3616	85	77

(Table 13, contd)

Specifications for the Alternator		
	Peak Current Rating amp	Minimum Peak Current amp
105-2813(IG), OR-9274(IG), 105-2814(IG), OR-4328(IG), 149-2064(REG), OR-9410(REG), 9X-0341(D+)	90	81
8C-6163, OR-1699, 107-2519	105	95
167-7816	110	99
9X-6796, 9X-9096, 121-4134, 121-4136, OR-3527	115	104
3E-8827, 121-4135, 117-1379(I)	130	117
152-8746	135	122
125-9597, OR-8332	145	131
24 V Alternators		
2P-1204, 3Y-8200	19	17
2Y-8310	21	19
6T-1395, 7T-2095, OR-3653	33	30
6N-9294, OR-5217, OR-3482	35	32
5N-5692, OR-2698	45	41
5S-9088, 100-5047, 112-5041, 3E-7578, OR-5206, OR-3667, OR-3668	50	45
169-3345	50	30
109-2362, 9W-3043, OR-3652(D+), 112-8032	55	50
3E-7772(IG), OR-9437(IG), 105-3132(IG), 4N-3986, OR-5203	60	54
200-2232	67.5	26
200-8281	67.5	26
155-7434, 132-2156(I), 107-7977 (I), OR-8279(I)	70	63
169-4319, 167-7812	75	67.5
107-7976, 114-2401, OR-8997, 3E-7577, OR-3615	75	68
197-8820	95	85.5
165-5140	100	90
9X-7803, OR-3749	100	90
Parts-Service Only Discontinued 12 V Alternators		
6T-1193	18	16
7N-6118, 6N-5460, 4N-4540	40	36

(continued)

(continued)

(Table 13, contd)

Specifications for the Alternator		
	Peak Current Rating amp	Minimum Peak Current amp
6T-1195	42	38
7X-1340	45	41
9G-6079, 6T-1194	63	57
Parts-Service Only Discontinued 24 V Alternators		
9G-6081, 6T-1196	40	36
D+ - Diode trio output. Alternator requires external excitation.		
REG - Regulator Terminal. Alternator requires external excitation.		
I - Ignition Terminal. Alternator can be externally excited through this terminal.		
IG - Ignition Terminal. System voltage must be supplied to this terminal to turn on the alternator. Some of these alternators use the IG terminal as a sense terminal.		

Test Step 1. DETERMINE THE ALTERNATOR EXCITATION METHOD

A. Check the rear of the alternator to determine the method of excitation. See table 13 to verify the proper alternator excitation.

Expected Result:

Test Method 1. These alternators have a "1", "REG", or "D+" terminal.

Test Method 2. These alternators are self-excited.

Test Method 3. These alternators have an "IG" terminal.

Results:

- Test Method 1 – The alternator has a "1", "REG", or "D+" terminal. Proceed to Test Step 2.
- Test Method 2 – The alternator is self-excited. Proceed to Test Step 4.
- Test Method 3 – The alternator has an "IG" terminal. Proceed to Test Step 3.

Test Step 2. CHECK THE RESISTANCE IN THE EXCITATION CIRCUIT

A. Turn the key start switch to the ON position.

B. Verify voltage at the excitation terminal. Connect the red lead from a multimeter to the excitation terminal. Connect the black lead to a ground source (alternator case ground).

C. Read the voltage that is shown on the multimeter.

Expected Result:

The voltage reads at least .2 volts.

Results:

- YES – The voltage reads .2 volts or more. The excitation circuit is correct. Proceed to Test Step 4.
- NO – The voltage is less than .2 volts. There is a problem in the wiring harness to the alternator or there is a poor electrical connection. Correct the problem and operate the machine. Watch for a recurrence of the problem.

STOP.

Test Step 3. CHECK THE RESISTANCE IN THE EXCITATION CIRCUIT (CONTINUED)

Note: This step is only for alternators with external excitation when the terminal for excitation is labeled: "IG".

A. Turn the key start switch to the ON position.

B. Verify voltage at the excitation terminal. Connect the red lead from a multimeter to the excitation terminal. Connect the black test lead to a ground source (alternator case ground).

Note: For G3B, K3A, and L3A alternators, Insert a 7X-1710 Multimeter Probe Group into the rear of the middle wire in the connector. Insert the probe spoon as shown in Illustration 58. Do not insert the probe between the wire insulation and the black seal. This terminal (IG) is the terminal for excitation.

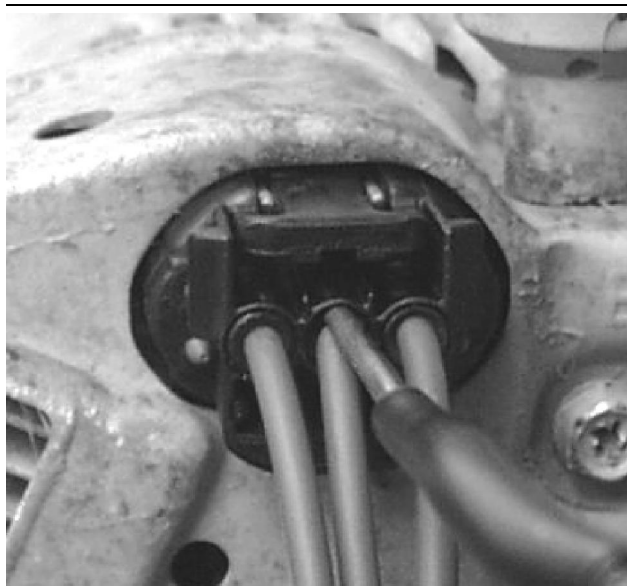


Illustration 58

g00496660

Special wire probe technique for G3B, Y3A, and L3A alternators.

C. Read the voltage that is shown on the multimeter.

Expected Result:

The voltage measurement is within .5 volts of the battery voltage.

Results:

- YES – The voltage reads battery voltage. The excitation circuit is correct. Proceed to Test Step 4.
- NO – The voltage that is measured is more than a .5 volt less than the battery voltage. There is a problem in the wiring harness to the alternator or there is a poor electrical connection. Correct the problem and operate the machine. Watch for a recurrence of the problem.

STOP.

Test Step 4. CHECK THE SYSTEM VOLTAGE

- A.** Before you start the machine, connect a voltmeter between the “B+” terminal and the case of the alternator. Turn OFF all electrical loads.
- B.** Turn the key to the ON position but do not start the engine. Read the voltage on the voltmeter. Make a note of the voltage that was measured.

Expected Result:

This voltage should be approximately system voltage.

Results:

- YES – The voltage is approximately system voltage. Proceed to Test Step 5.
- NO – The voltage is less than system voltage. Proceed to Test Step 7.

Test Step 5. CHECK THE OPERATION OF THE ALTERNATOR

- A.** The voltmeter remains connected between the “B+” terminal and the case of the alternator.
- B.** Start the machine. Set the throttle to at least 75 percent. Read the voltage on the voltmeter. Make a note of the voltage that was measured.

Expected Result:

The voltage measurement is greater than the voltage that was recorded in the previous Test Step “Check The System Voltage” .

Results:

- VOLTAGE HIGHER – The voltage measurement is greater than the voltage that was observed in the previous Test Step “Check The System Voltage” . The voltage is also less than the maximum voltage that is listed in the specifications for the alternator. The alternator is partially charging the battery. Proceed to Test Step 6.
- VOLTAGE TOO HIGH – The voltage measurement is greater than the voltage that was observed in the previous Test Step “Check The System Voltage” . The voltage is also greater than the maximum voltage that is listed in the specifications for the alternator. The alternator is over charging. Proceed to Test Step 19.
- VOLTAGE LOWER – The voltage is not higher than the voltage that was observed in the previous test step. Proceed to Test Step 7.

Test Step 6. TEST THE ALTERNATOR OUTPUT

Note: For the proper output current, refer to Table 13 .

A. Ensure that the batteries are NOT fully charged.

Note: A fully charged battery may have open circuit voltage above 12.5 V on 12 V systems. 24 V systems may be as high as 25 V.

- B.** If the batteries are fully charged, crank the engine for 30 seconds. This action reduces the battery voltage. As an alternative, operate the lights for 10 minutes while the engine is off.
- C.** Connect the 9U-5795 Current Probe to a DMM (digital multimeter) or use a 225-8266 Ammeter Tool Gp. The multimeter must have a peak hold feature. Clamp the probe around the alternator output wire "B+" . Before you clamp the probe around the wire, ensure that the probe is "zeroed".
- D.** Set the digital multimeter to "peak hold" or "max mode" on the "mV" scale.
- E.** Turn on all electrical accessories: lights, air conditioning, and radio.
- F.** Start the machine, and immediately set the throttle to at least 75 percent. The peak current will appear on the voltmeter in "peak hold" or "max" mode.

Expected Result:

The current reading should be at least 90 percent of the specified peak output.

Results:

- YES – The current is at least 90 percent of the specified peak output. Proceed to Test Step 13.
- NO – The current is less than 90 percent of the specified peak output. Proceed to Test Step 7.

Test Step 7. CHECK THE DRIVE SYSTEM OF THE ALTERNATOR

- A.** Check the condition of the alternator drive belt.
Clean the pulley and replace the drive belt if the drive belt is oily. Dry the drive belt if the belt is wet. Replace the drive belt if the belt is worn.
- B.** Check the tension of the alternator drive belt.
Adjust the drive belt to the correct tension.
- C.** Check the nut on the alternator pulley. Tighten the nut if the nut is loose.

Expected Result:

The drive system of the alternator is functioning correctly. No corrections to the drive system were necessary.

Results:

- YES – The drive system of the alternator is functioning correctly. No corrections were necessary. Proceed to Test Step 8.
- NO – The drive system of the alternator was not functioning correctly. Corrections were necessary.

Repair: Ensure that the problems have been corrected. Exit this procedure and retest the alternator charging system.

STOP.

Test Step 8. TEST THE CHARGING CIRCUIT

- A.** Verify that the nut on the "B+" alternator terminal is tight. Also, verify that the wire has a good connection to the "B+" terminal.
- B.** Many Caterpillar machines are equipped with a connector for the 6V-2150 Starting/Charging Analyzer. Use of this tester replaces the remainder of this test step. To operate the analyzer, refer to Tool Operating Manual, SEHS7768, "Using the 6V-2150".
- C.** Start the engine and set the throttle to at least 75 percent. Turn ON all electrical accessories for the remainder of this test step. Allow the engine to run for at least three minutes before continuing.
- D.** Measure the voltage between the "B+" alternator terminal and the alternator case ground. Make a note of the measured voltage. Perform the next measurement immediately.
- E.** Measure the voltage across the battery. Put the red lead on the battery positive terminal and put the black lead on the battery negative terminal. Make a note of the voltage that was measured.

Expected Result:

The voltage at the battery should be less than the voltage at the alternator. The difference in voltages should not be more than 1 V on 12 V systems. The difference should not be more than 2 V on 24 V systems.

Results:

- YES – The voltage at the battery is less than the voltage at the alternator. Also, the difference in voltages is less than 1 V for 12 V systems and the difference is less than 2 V for 24 V systems. The wiring that is related to the alternator is correct at this time.

Repair: There is an internal problem with the alternator. Repair or replace the alternator.

STOP.

- NO – The voltage at the battery is less than the voltage at the alternator. However, the difference in voltages is greater than 1 V for 12 V systems and the difference is greater than 2 V for 24 V systems. Proceed to Test Step 9.

Test Step 9. TEST THE POSITIVE SIDE OF THE CHARGING CIRCUIT

- A.** Measure the voltage between the frame ground and the “B+” alternator terminal. Make a note of the voltage that was measured. Perform the next measurement immediately.
- B.** Measure the voltage between the frame ground and the +Battery post. Make a note of the voltage that was measured.

Expected Result:

The voltage difference does not exceed 1 V on 24 V systems or 0.5 V on 12 V systems.

Results:

- YES – The voltage difference does not exceed the tolerance. The positive circuit is good. Proceed to Test Step 10.
- NO – The voltage difference exceeds the tolerance.

Repair: There is high resistance in the positive side of the charging circuit that is caused by one of the following conditions:

- An electrical connection has loosened.
- An electrical connection has corroded.
- The main relay has failed.
- A circuit breaker has failed.

Repair the problem or replace any component that has failed. Exit this procedure and retest the alternator charging system.

STOP.

Test Step 10. TEST THE NEGATIVE SIDE OF THE CHARGING CIRCUIT

- A.** Check the voltage between the negative battery post and the alternator case ground.

Expected Result:

The voltage does not exceed 1 V on 24 V systems or 0.5 V on 12 V systems.

Results:

- YES – The voltage difference does not exceed the tolerance. The negative circuit is good. Proceed to Test Step 11.
- NO – The voltage difference exceeds the tolerance.

Repair: There is high resistance in the negative side of the charging circuit that is caused by one of the following conditions:

- An electrical connection has loosened.
- The alternator ground has loosened.
- The engine ground has opened.

Repair the problem or replace any component that has failed. Exit this procedure and retest the alternator charging system.

STOP.

Test Step 11. TEST THE CIRCUIT OF THE “R” TERMINAL

- A.** Start the engine and set the throttle to at least 75 percent.
- B.** Connect a voltmeter between the “B+” terminal and the alternator case ground.
- C.** Disconnect the wire from the “R” terminal. Select “YES” if the “R” terminal is not used on the machine.

Expected Result:

The voltage does not change.

Results:

- YES – The voltage does not change. Proceed to Test Step 12.
- NO – The voltage rises and the alternator begins charging.

Repair: The wire to the “R” terminal is shorted. Repair the wiring or replace the wiring. Exit this procedure and retest the alternator charging system.

STOP.

Test Step 12. RESTORE THE RESIDUAL MAGNETISM OF THE ROTOR

- A.** Connect one end of a jumper wire to the “B+” terminal (D+ terminal for K1, N1, and N3) of the alternator.
- B.** Connect the other end of the jumper wire to the “R” terminal of the alternator for two seconds.

Expected Result:

The voltage output rises on the “B+” terminal. The residual magnetism of the rotor has been restored.

Results:

- YES – The voltage output rises. The residual magnetism of the rotor has been restored. The alternator is now charging.

Repair: Exit this procedure and retest the alternator charging system.

STOP.

- NO – The voltage output does not rise.

Repair: There is an internal problem with the alternator. Repair or replace the alternator.

STOP.

Test Step 13. TEST FOR UNDESIRABLE CURRENT FLOW IN THE ALTERNATOR CHARGING SYSTEM

- Turn off all of the accessories. Turn the keyswitch to the OFF position.
- Clamp a 9U-5795 Current Probe or 225-8266 Ammeter Tool Gp around the main ground cable. Clamp the tool with the positive side away from the battery. Reset the probe (zero) before you clamp the probe around the wire. Read the current on the meter. Make a note of the current that was measured.

Expected Result:

The current is below 2 A. The "YES" selection is dependent on the presence of a main disconnect switch on the machine that is being tested.

Results:

- YES - WITH DISCONNECT SWITCH – The current is below 2 A. For machines with a main disconnect switch, proceed to Test Step 14.
- YES - WITHOUT DISCONNECT SWITCH – The current is below 2 A. For machines without a main disconnect switch, proceed to Test Step 15.
- NO – The current is above 2 A. There is a current draw in the system. Proceed to Test Step 16.

Test Step 14. MEASURE THE CURRENT OF THE SYSTEM BY USING THE MAIN DISCONNECT SWITCH

- Turn the disconnect switch to the ON position.

- Connect a multimeter across the disconnect switch terminals. Connect the red lead to the terminal on the frame side. Connect the black lead to the terminal on the battery side. Use the 10 A connections in order to avoid damage.

- Turn the disconnect switch to the OFF position and read the current. Make a note of the measured current.

Note: The standard acceptable current draw is 50 mA. A current draw above 50 mA usually indicates a problem. However, some large machines with multiple Electronic Control Modules (ECM) have a higher acceptable limit. For more information, contact a Caterpillar dealer or contact the business unit that produces the machine.

Expected Result:

The current is below 0.050 A (50 mA).

Results:

- YES – The current is below 0.050 A. The charging system is functioning properly at this time. The failure is possibly an intermittent draw in the system. The batteries may have failed. Ensure that NO accessories were ON during the test. Exit this procedure and retest the alternator charging system.

STOP.

- NO – The current is above 0.050 A. There is a draw in the system. Proceed to Test Step 16.

Test Step 15. MEASURE THE CURRENT OF THE SYSTEM BY REMOVING THE NEGATIVE BATTERY CABLE

- Disconnect the ground cable from the negative battery post. There may be more than one battery that is connected to ground. Disconnect all of the batteries that are connected to ground. Do not disconnect cables that are between batteries that are connected in series.
- Connect a multimeter between the disconnected battery ground cable and one of the negative battery terminals. Connect the red positive lead of the multimeter to the cable. The negative lead should be connected to the battery terminal. Use the 10A connections to avoid damage.

Note: The standard acceptable current draw is 50 mA. A current draw above 50 mA usually indicates a problem. However, some large machines with multiple Electronic Control Modules (ECM) have a higher acceptable limit. For more information, contact a Caterpillar dealer or contact the business unit that produces the machine.

Expected Result:

The current is below .050 A (50 mA).

Results:

- YES – The current is below 0.050 A. The charging system is currently good. The problem is a possible intermittent current draw in the system. The batteries may have failed. Check that NO accessories were ON during the test.

STOP.

- NO – The current is above 0.050 A. There is excessive current flow in the system. Proceed to Test Step 16.

Test Step 16. TEST THE CURRENT OF THE ALTERNATOR OUTPUT BELOW 2 A

- Turn the keyswitch to the OFF position.
- Connect the 9U-5795 Current Probe to a DMM (digital multimeter) or use a 225-8266 Ammeter Tool Gp. Clamp the probe around the “B+” wire of the alternator. Before you clamp the probe around the wire, ensure that the probe is “zeroed”.
- Read the current on the meter. Make a note of the current that was measured.

Expected Result:

The current is under 2 A.

Results:

- YES – The current is under 2 A. Proceed to Test Step 17.
- NO – The current is over 2 A.

Repair: There is an internal problem with the alternator. Repair or Replace the alternator.

STOP.

Test Step 17. TEST THE OUTPUT CURRENT OF THE ALTERNATOR BELOW 0.015 A

- Disconnect the wire from the “B+” terminal of the alternator. Set the multimeter on the 10 A scale. Connect the red lead of the multimeter to the wire that was disconnected. Connect the black lead of the multimeter to the “B+” terminal of the alternator. Make a note of the current that was measured.

Expected Result:

The current is less than 0.015 A.

Results:

- YES – The current is under 0.015 A. The alternator is operating correctly. There may be a current draw on the machine. Proceed to Test Step 18.
- NO – The current is over 0.015 A.

Repair: There is an internal problem with the alternator. Repair or replace the alternator.

STOP.

Test Step 18. IDENTIFY THE SOURCE OF EXCESSIVE CURRENT DRAW

- Make sure that every electrical component is turned OFF. Make sure that the keyswitch is turned OFF. Make sure that the dome lights are OFF.
- Clamp a 9U-5795 Current Probe or 225-8266 Ammeter Tool Gp around the main ground cable. Clamp the tool with the positive side away from the battery. Reset the probe (zero) before clamping the probe around the wire. Use the current probe if the draw is above approximately 2 A. Use the Ammeter if the draw is below approximately 2 A.
- Remove the fuses or open the circuit breakers one at a time. Check the current after each fuse has been removed or each circuit breaker has been opened. After observing the current, reinstall the fuse or close the circuit breaker. Start with the main circuits first, and proceed to smaller circuits.
- Check if any components on the circuit are ON.
- If everything is OFF, then disconnect electrical components on the circuit one at a time. Monitor the current after each component is disconnected.
- All of the components in the circuit should be disconnected. If the problem still exists, then check the wiring in the circuit. There may be circuit leakage through corrosion or circuit leakage through a short.

Note: The standard acceptable current draw is 50 mA. A current draw above 50 mA usually indicates a problem. However, some large machines with multiple ECMs have a higher acceptable limit. For more information, contact a Caterpillar dealer or contact the business unit that produces the machine.

Expected Result:

The source of the excessive current draw was determined.

Results:

- YES – The source of the excessive current draw was determined.

Repair: Repair the problem or replace any component that has failed. Exit this procedure and retest the alternator charging system.

STOP.

- NO – The source of the excessive current draw was not determined.

Repair: Exit this procedure and retest the alternator charging system.

STOP.

Test Step 19. TEST FOR AN OVERCHARGING CONDITION FROM THE ALTERNATOR

- Verify that the nut on the “B+” alternator terminal is tight. Also, verify that the wire has a good connection to the “B+” terminal.
- Many Caterpillar machines are equipped with a connector for the 6V-2150 Starting/Charging Analyzer. Use of this tester replaces the remainder of this test step. To operate the analyzer, refer to Tool Operating Manual, SEHS7768, “Using the 6V-2150”.
- Start the engine and set the throttle to at least 75 percent. Turn ON all electrical accessories for the remainder of this test step. Allow the engine to run for at least three minutes before continuing.
- Measure the voltage between the “B+” terminal of the alternator and the case of the alternator. Make a note of the voltage that was measured. Perform the next measurement immediately.
- Measure the voltage across the battery. Put the red lead on the positive terminal of the battery and put the black lead on the negative terminal of the battery. Make a note of the voltage that was measured.

Expected Result:

The voltage at the battery should be less than the voltage at the alternator. On systems that are 12 V, the difference in voltages should not be more than 1 V. On systems that are 24 V, the difference should not be more than 2 V.

Results:

- YES – The voltage at the battery is less than the voltage at the alternator. Also, the difference in voltages is less than 1 V for 12 V systems and the difference is less than 2 V for 24 V systems. The wiring that is related to the alternator is correct at this time.

Repair: There is an internal problem with the alternator. Repair or Replace the alternator.

STOP.

- NO – The voltage at the battery is less than the voltage at the alternator. However, the difference in voltages is greater than 1 V for 12 V systems and the difference is greater than 2 V for 24 V systems. Proceed to Test Step 20.

Test Step 20. TEST THE POSITIVE SIDE OF THE CHARGING CIRCUIT

- Measure the voltage between the frame of the machine and the “B+” terminal of the alternator. Make a note of the voltage that was measured. Perform the next measurement immediately.
- Measure the voltage between the frame of the machine and the positive terminal of the battery. Make a note of the voltage that was measured.

Expected Result:

The voltage difference does not exceed 1 V on 24 V systems or 0.5 V on 12 V systems.

Results:

- VOLTAGE OK - ALT. WITHOUT IG/S TERM. – The voltage difference does not exceed the tolerance. The positive circuit is good.

Repair: There is an internal problem with the alternator. Repair or Replace the alternator.

STOP.

- VOLTAGE EXCESSIVE - ALL ALT. – The voltage difference exceeds the tolerance.

Repair: There is high resistance in the positive side of the charging circuit that is caused by one of the following conditions:

- An electrical connection has loosened.
- An electrical connection has corroded.
- The main relay has failed.
- A circuit breaker has failed.

Correct the problem. Exit this procedure and retest the alternator charging system.

STOP.

- VOLTAGE OK - ALT. WITH IG/S TERM. – The voltage difference does not exceed the tolerance. The positive circuit is good. Proceed to Test Step 21.

Test Step 21. ALTERNATOR OVERCHARGING TEST

- A.** Start the engine and set the throttle to at least 75 percent.
- B.** Measure the voltage between the sense terminal (S) and/or the “IG” terminal to the case of the alternator.

Expected Result:

The voltage at the “S” terminal and/or “IG” terminal is above the specification.

Results:

- YES – The measured voltage exceeds the specification. There is an internal malfunction in the alternator. See the appropriate service manual for the alternator in order to test the internal components and connections.

STOP.

- NO – The measured voltage is below the measurement that was taken in the initial tests (B+ to alternator case). The sense circuit in the generator set has high resistance. Correct the problem. Exit this procedure and retest the alternator charging system.

STOP.

Testing And Adjusting Section

Testing and Adjusting

i05898859

Self Test

SMCS Code: 7490-038

Self Test

The ECM controlled test of the instrument cluster will begin after the hardware is tested. The test will proceed while the engine key-start switch remains in the RUN position.

The duration of the ECM controlled test is three seconds. During this time, the following functions will be performed:

- The gauge needles are set to the minimum position. The needles move smoothly from the minimum value to the maximum value during the test.
- The icons and the segments are illuminated. The illumination continues for the duration of the self test.
- All LED indicators are illuminated for testing.
- The alarm mode activates at the beginning of the self test mode. The alarm state remains on for one second.

After completion of the self test, the instrument cluster goes to normal mode operation. This could include subsequent machine tests.

i05898897

Electrical Connector - Inspect

SMCS Code: 7553-040-WW

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 trouble code before breaking any connections. Also, always check for an active diagnostic trouble code after the connector is reconnected to verify that the problem disappears.

Simply disconnecting and reconnecting the connectors can temporarily solve a problem. If this occurs, likely causes are loose terminals, bent terminals, improperly crimped terminals, corrosion, or improper harness routing.

The original source of the problem must then be identified to ensure that the problem does not reoccur.

Follow this procedure to inspect the connectors to determine if the connectors are the cause of the problem.

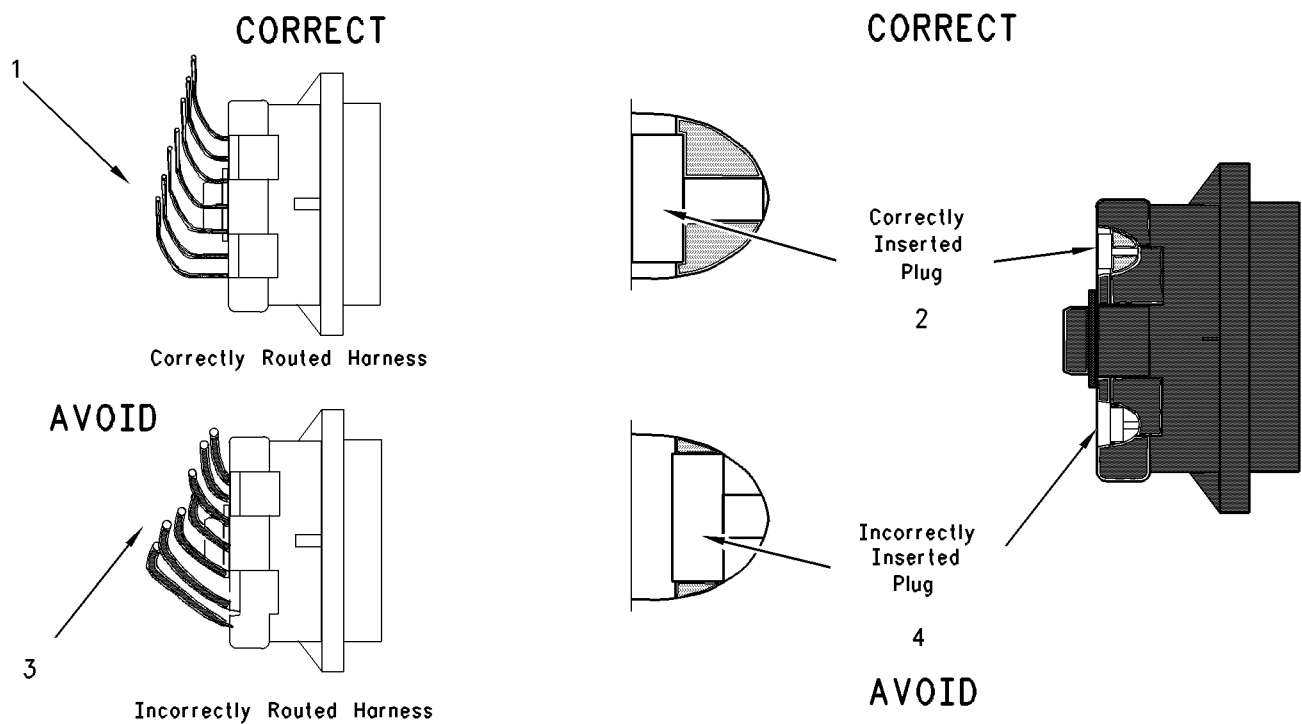
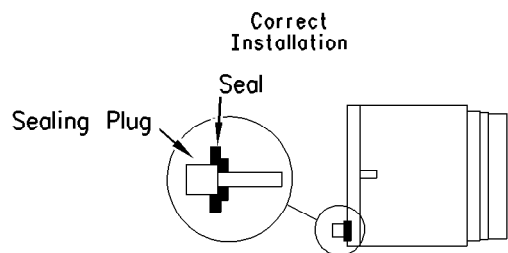


Illustration 59

g00820688

(1) Correctly Routed Harness
(2) Correctly Inserted Plug

(3) Incorrectly Routed Harness
(4) Incorrectly Inserted Plug



Deutsch Sealing Plug Insertion

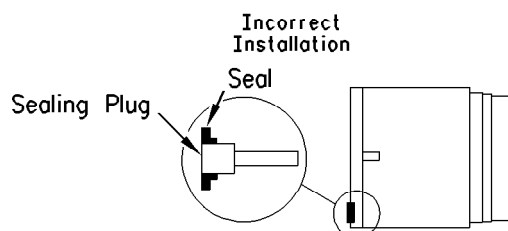


Illustration 60

g00690571

Proper Installation of Plug

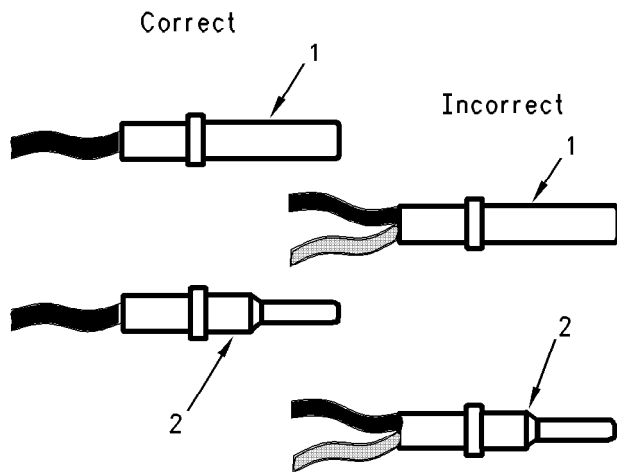


Illustration 61

g00828600

DT Type Sealing Plug

The 8T-8729 Connector Pin (2) and the 8T-8730 Connector Socket (1) are designed to accept only one 16/18 AWG wire. Do not insert multiple wires of a smaller wire size. The 9W-0852 Connector Pin and the 9W-0844 Connector Socket are designed to accept only one 14 AWG wire. Do not insert multiple wires of a smaller wire size.

1. CHECK THE CONNECTORS

- Ensure that the connector is properly locked. Also, ensure that the two halves of the connector cannot be pulled apart.
- Verify that the latch tab of the connector is properly 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 or replace the connector, as required.

STOP.

2. CHECK THE ALLEN HEAD SCREW ON THE HARNESS CONNECTOR OF THE ECM

- Ensure that the connector bolt is properly tightened. Be careful not to tighten the bolt too

much. The bolt may break.

- 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

- 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.
- The DT connectors use an orange wedge to lock the terminals in place.
- Verify that the orange wedge is not missing and that the orange wedge is installed properly on the DT connectors.

Note: Connector contacts should always be crimped onto the wires by using a Crimp Tool. 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 to verify that the harness is properly clamped. Also check harness hold-down clamps to verify that the harness is not compressed by the clamp. Pull back the harness sleeves 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. 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 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. Replace any missing seals or plugs. If necessary, replace the connector.
- b. Check all of the wiring harnesses to verify that the harness does not make a sharp bend out of a connector. This will deform the connector seal and create a path for the entrance of moisture. See Illustration 59.

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 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 a cotton swab, a soft brush, and only denatured alcohol to remove the corrosion. Do not use cleaners that contain trichloroethylene because trichloroethylene may damage the connector.

Expected Result: All of the connectors should be completely coupled and inserted. The harness and the wiring should be free of corrosion, moisture, abrasions, and pinch points.

Results:

OK – All of the connectors are completely coupled and inserted. The harness and the wiring are free of corrosion, moisture, abrasions, and 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 or replace the connectors or wiring. Ensure that all of the seals are properly in place and are completely coupled. To verify that the repair eliminates the problem, operate the machine for several minutes and check again for moisture.

STOP.

6. INSPECT THE CONNECTOR CONTACTS

- a. Verify that the contacts are not damaged. Verify that the contacts are properly aligned and 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 or replace the contacts and wiring.

STOP.

7. CHECK THE FIT OF THE CONTACTS

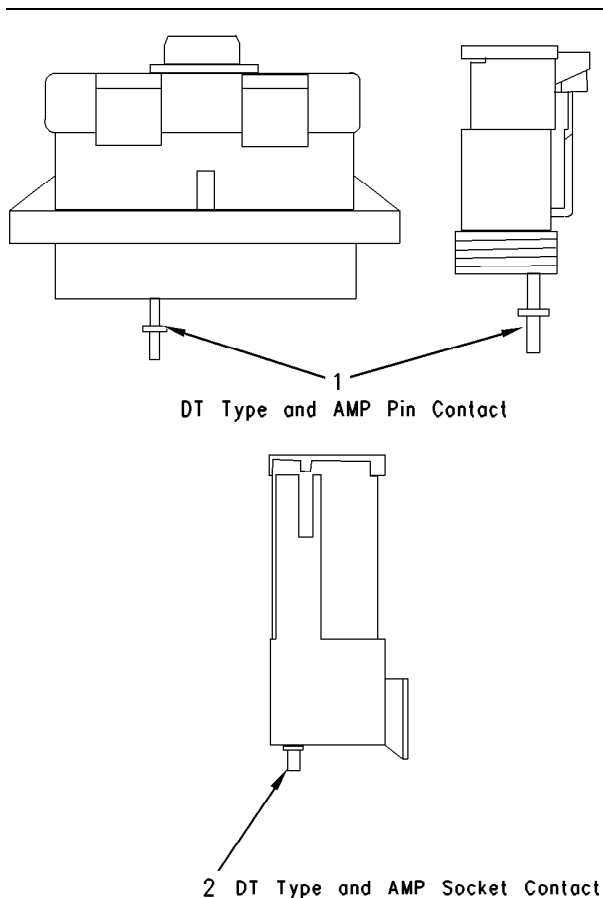


Illustration 62

g00838765

Retention of the Connector

- (1) Pin Contact
- (2) Socket Contact

Note: This Test Step is especially important for intermittent problems.

- a. Use a new pin contact. Insert the pin contact into each socket contact one at a time. Check for a good grip on the pin contact by the socket contact.
- b. Use a new socket contact. Insert the socket contact over each pin contact to check for a good grip on the pin contact. The pin contact is 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 62. The connector contact can be a pin contact or a 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.

i07475322

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 caused by failed electrical wires or a poor connection of electrical connectors. If an electrical wire or a connection is broken, the flow of electrical current through the circuit is interrupted. A normally closed circuit will have less than 5 ohms of resistance. The following procedure explains the test for an open circuit:

Reference: For a complete electrical schematic, refer to Electrical System Schematic for the machine that is being serviced.

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 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 or replace the machine harness.

Stop.

i07475333

Wiring Harness (Short Circuit) - Test

SMCS Code: 1408-081

A short circuit is a failure of an electrical circuit that results in undesired electrical current. Usually, a short circuit is a bypass of the circuit across a load. For example, a short across the wires in a circuit for a lamp produce too much current in the wires but no current is felt at the lamp. The lamp is shorted out. The resistance in a normal circuit can vary, but the resistance between a particular circuit and other unrelated circuits is always greater than 5 ohms. The following procedure explains the test for a short 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 from the wiring harness.

Note: Sometimes it may necessary on certain machines to disconnect the ECU from the wiring harness and test the connections.

4. At the machine harness connector, place one of the multimeter probes on the contact of the suspect wire. Place the remaining probe on frame ground. Repeat for all other contacts in the connectors.

Expected Result: The resistance is greater than 5 ohms for all the measurements.

OK – The resistance is greater than 5 ohms for all the measurements. The harness circuits are correct.

Stop.

NOT OK – The resistance is less than 5 ohms. There is a short in the machine harness. The short is

between the suspected wire and the wire with the lowest resistance measurement.

Repair: Repair or replace the machine harness.

Stop.

i05899098

Module - Replace

SMCS Code: 7490-510

Prior to replacement of a module, ensure that replacement is necessary. A diagnostic code is seldom caused by the module. Always ensure that the machine code is correct for the machine. Also verify that power is available to the main display module. The system voltage is required between the Contacts 1 and 2 of the connector for the main display module. To check the machine code, see System Operation, "Diagnostic Capabilities".

Procedure

1. Replace the module.

- a. Turn the key start switch to the OFF position.
- b. Disconnect the machine harness from the module.
- c. Make sure that the new module has the correct part number.
- d. Install the new module.
- e. Connect the machine harness to the module. If applicable, make sure that the harness code plug is installed.
- f. Turn the disconnect switch and the key start switches to the ON position. Make sure that the module successfully completes the self test.

Expected Result

The module has been successfully replaced and the module has completed the self test.

Results

- YES - The module has been successfully replaced and has completed the self test. Proceed to Step 2.
- NO - The module has been successfully replaced but has not performed the self test properly. Ensure that the module is correct. Verify that the installation is correct and that no related diagnostic codes are present.

Stop.

2. Setup

- a. To set up the optional display modules, see Systems Operation, “Settings Menu”.
- b. To set the desired units (English or Metric), see System Operation, “Settings Menu”.

i05899103

Connector Contact Description

SMCS Code: 7490-546-CY

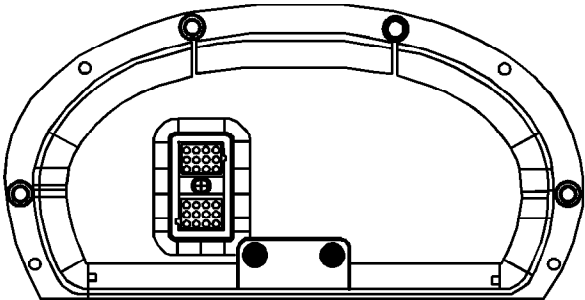


Illustration 63

g01030469

Rear view of the Instrument Cluster

Table 14

IC 24 Pin Connector			
Signal	Pin No	Signal	Pin No
+Battery	1	Not Used	13
-Battery	2	Not Used	14
Chassis Ground	3	High Beam	15
Not Used	4	Not Used	16
Not Used	5	Not Used	17
Not Used	6	Not Used	18
Not Used	7	CAN High	19
Not Used	8	CAN Low	20
Not Used	9	Not Used	21
Left Turn Signal	10	Not Used	22
Right Turn Signal	11	Horn Driver	23
Not Used	12	Key Switch Input	24

For wire numbers and connection information, refer to Service Manual module Testing and Adjusting, “System Schematic” or refer to the Electrical System Schematic for your machine model.

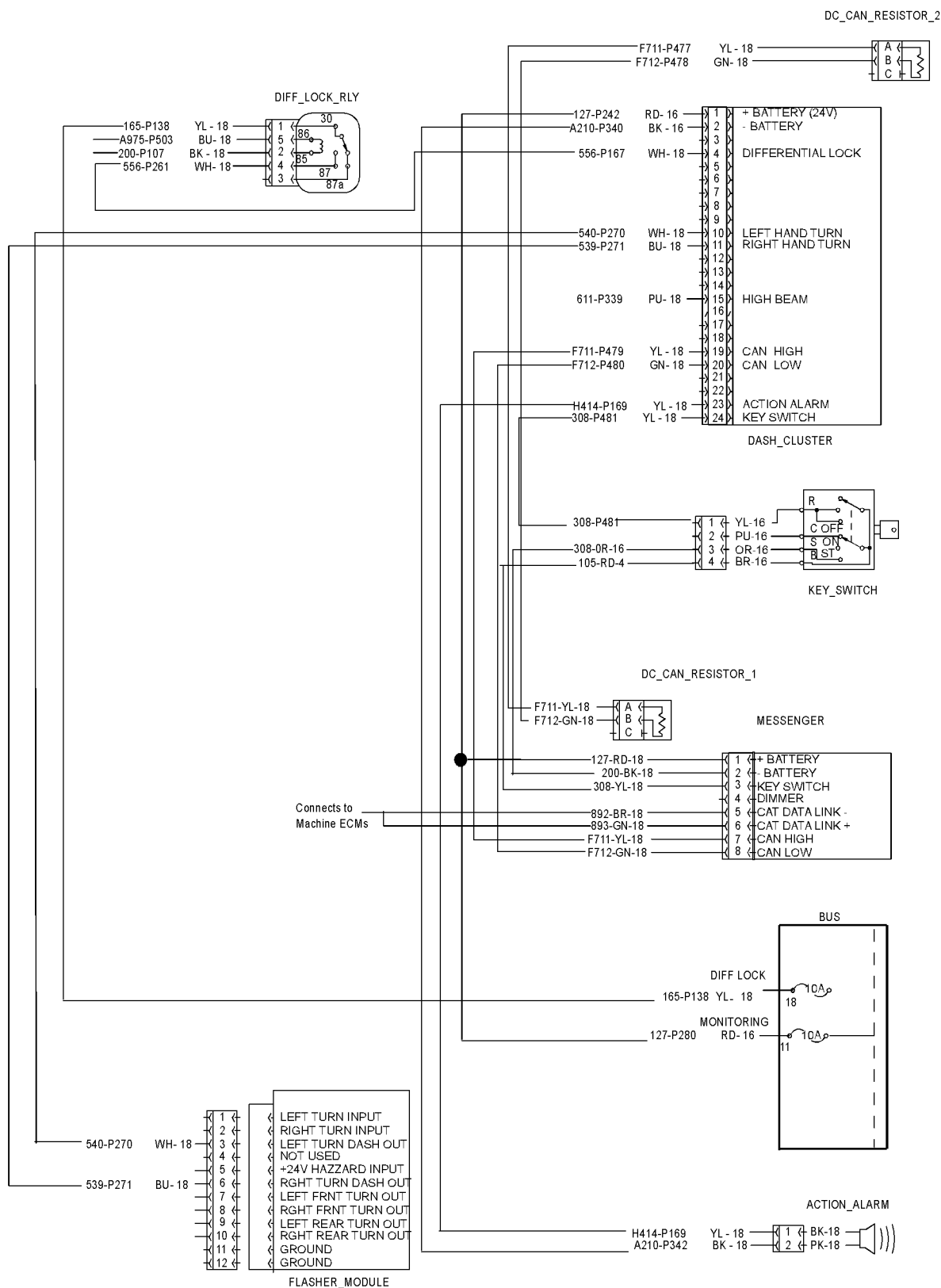
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System Schematic

SMCS Code: 7566

This is a simplified schematic of the Monitoring System that is electrically correct. This schematic does not show all possible harness connectors. Always refer to the Electrical System schematic in the service manual for an accurate schematic of a particular machine.

Testing and Adjusting



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