KOMATSU

P&H

SR Drive Procedures

Section 06–03–06 Gen2



LDG2-S-DP-EN-0001

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Preface

This Manual is provided as a guide to personnel involved with the operation, maintenance and repair of Komatsu Mining Corp. equipment. We recommend that such personnel review and become familiar with the general procedures and information contained within this manual. In addition, we recommend that this manual be kept readily available for reference when repairs or maintenance are necessary.

Read and become familiar with this Manual and any other general safety practices before attempting any procedures.

Due to the complexities of mining equipment and the environment in which it operates, situations may arise which are not directly discussed in detail in this Manual. When such a situation arises, past experience, availability of equipment and common sense play a large part in what steps are to be taken. In addition, a Komatsu Mining Corp. service center representative is available to answer your questions and assist you upon request.

Komatsu Mining Corp. reserves the right to continually improve its products and associated documentation. Therefore, physical alterations to Komatsu equipment may not be identified in this Manual. Revisions may be frequently made to this Manual in an effort to ensure that information contained within is current as alterations occur to the equipment. If you find an error or have other feedback regarding this Manual, please contact Product Training and Publications at *Pro.Train.Pub@mining.komatsu*.

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Safety

This publication contains special instructions that pertain to safety, operation, maintenance, and repair of the machine. Listed below are the signal words and symbols that precede these instructions and their meanings:

DANGER

The danger label indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

The warning label indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

The caution label, used with the safety alert symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury (includes the safety alert symbol).

CAUTION

The caution label (without safety alert symbol) is used to address practices not related to personal injury – only equipment damage.

NOTICE

The notice label indicates areas of importance to the reader that are not related to personal injury or machine damage.

Safety, Warnings and Cautions

It is important that all personnel read and understand all SAFETY, CAUTIONS and WARNINGS before operating, or working on or near the machine. The following CAUTIONS and WARNINGS are a summary of those found throughout this document.

WARNING

CRUSH HAZARD

- Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process.
- Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

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- Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.
- Risk of crush hazard and collision may occur as the loader will be run at full speed in both forward and reverse. Make sure the loader is in an area where there is ample space in front and behind the machine. Make sure all personnel are a safe distance away from the loader. Failure to perform test in adequate area may result in incomplete test or risk of collision or crush hazard.
- Crush hazard exists if all personnel are not cleared from around the bucket and lift arm area before using the hydraulic hoist and bucket pilot pressure bleed down valves to relieve pressure from the hoist and bucket pilot circuit. Clear all personnel from the area around the bucket and lift arms before operating hydraulic hoist and bucket pilot pressure bleed down valves. Using the hydraulic bleed down valves could result in some movement of the lift arms and bucket which could cause injury or death.
- Struck by or crushing hazard exists if jack rod not bottomed into the threaded recess in cylinder rod. Jack rod must be bottomed into threaded recess in cylinder rod. Use flats on jack rod to tighten and keep it from screwing out of rod when turned counterclockwise. Failure to bottom Jack rod into threaded recess in cylinder rod may result in the release of stored energy (spring tension), resulting in serious injury or death.

ELECTRICAL SHOCK

- Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED’s in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.
- Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.
- Reduced electric (dynamic) braking may result if the grid connections (55 and 58) are not relocated from the isolated generator converter assembly to an operational generator converter assembly. Relocate the grid connections to an operational generator converter assembly before operating the machine. Operation of the machine without relocation of the grid connections will result in the electric (dynamic) braking being reduced causing reduced operating speeds while digging, longer stopping times, and the higher potential for over speed on grades.
- Risk of fatal shock by contact in the electrical cabinet or possibility of falling is possible. High voltage will be present in the electrical cabinet and the vehicle will be moving while performing this test procedure. High voltage will be present when the red LED’s are lit. Do not stand on walk-way or in electrical cabinet during this test. All personnel must be clear of vehicle or secure in the operators cab while conducting this test. Risk of fatal shock or falling may result if in non compliance to this warning.
- Risk of shock exists while performing the RPT settings. Make sure the DC current supply unit is OFF prior to attaching the leads to the terminal posts and before continuing with this test procedure. Shock and equipment arcing is possible if trying to connect the DC current supply while the unit is powered on.
- Risk of shock by contact of the braking grids is possible. Do not open the door over the braking grids or touch anything on the grids when the engine is running or the converter panel bus LED’s are glowing red in the electrical cabinet. Do not touch or enter these areas unless the engine has been shut down and the bus discharge procedure has been followed. Do not manually hold the wire to the grids as this may provide a potential path for electricity. Electrical shock or other serious injury may result in non compliance of this warning.

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- Risk of shock by contact in the electrical cabinet or on the braking grids is possible. High voltage may be present in the electrical cabinet and on the braking grids. Prior to performing a stand alone Low Impedance Test without replacing the Fault Isolation Monitor, complete the Bus discharge Verification Procedure, as detailed previously in this document, before attaching any wires in the electrical converter cabinet on the grids. Electrical shock or other serious injury may result if in non compliance of this warning.
- Risk of shock by contact of the braking grids is possible. Do not open the door over the braking grids or touch anything on the grids when the engine is running or the converter panel bus LED's are glowing red in the electrical cabinet. Do not touch or enter these areas unless the engine has been shut down and the bus discharge procedure has been followed. Do not manually hold the wire to the grids as this may provide a potential path for electricity. Electrical shock or other serious injury may result in non compliance of this warning.

STRUCK BY HAZARDS

- Operation of the machine on less than four wheel motors, or with any of the converter panels disabled, will result in a reduction in electric (dynamic) braking and could possibly lead to an over speed on grades and/or longer stopping distances when using dynamic braking. Failure to properly employ the service brake under these conditions could lead to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.
- The machine should only be operated with less than four service brakes in order to move the machine away from a dangerous situation. Do not tram the machine or operate the machine in production with less than four service brakes. The service brakes must be maintained and working properly (e.g.., disks in spec, pads in spec, gaps in spec, pressures in spec, no leaks, etc.). Failure to properly inspect and maintain all four service brakes may compromise braking capability leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.
- Failure to appropriately reduce the machine's speed while descending a grade with disabled converter panels and/or disabled motors can create the risk of a machine runaway leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

⚠ CAUTION

CRUSH HAZARD

- Crush hazard exists. Using improper lifting techniques or inadequate equipment could cause the load to fall and crush. Removal or installation of the converter assembly is a two man lift, or ideally a lifting device such as a come-along or a crane suitably rated for the weight of the component may be used. If using a lifting device, be certain that the lifting devices are firmly attached to the component being lifted. Keep all persons clear of the area when lifting, lowering or moving the component being removed or installed.
- Crush hazard exists. The middle pinion weighs approximately 200 lbs (91 kgs). Use caution when removing and replacing the middle pinion. The removal arm will provide a balancing point when hoisting the pinion to and from the planetary drive, if the lifting sling is positioned against the mounting face of the removal arm, as shown in illustration "Middle Pinion Removal and Replacement". Maintain a firm grasp on the removal arm at all times while hoisting the pinion. An unsecured pinion may cause crushing or other injuries.

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Load Bank Test

The braking grids can be used to obtain a horsepower reference for the engine. This method is not intended to accurately measure engine horsepower.

Safety Preparations

⚠ WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

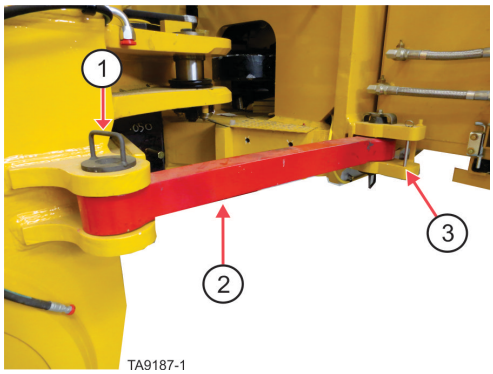
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

⚠ WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 1: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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Horsepower Test

1. Make sure engine and hydraulics are at operating temperature.
2. Select High Throttle. Drives should enable automatically.

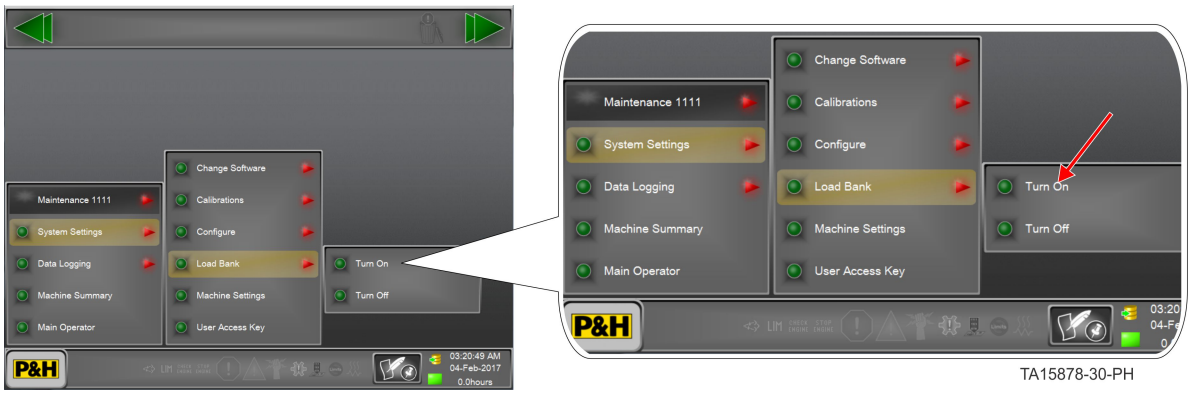
Figure 2: High throttle selected, drives enabled



TA15644g

3. Log in to LINCS with Maintenance level access or higher, press the Main Menu button in the lower left corner, select System Settings, Load Bank and turn on Load Bank Mode.

Figure 3: Load bank on



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- When Load Bank is selected, the Load Bank Icon will appear at the bottom of the display.

Figure 4: Load bank icon



TA15436D8

- Once Load Bank is selected the radiator fan and blower will increase in speed.

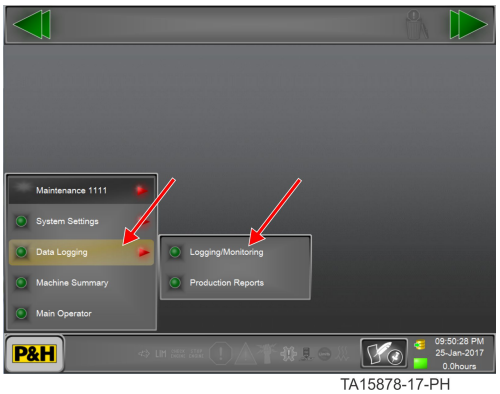
NOTICE

It can take up to 10 seconds for the radiator fan and blower to reach full speed. Make sure both are at full speed before applying speed control pedal.

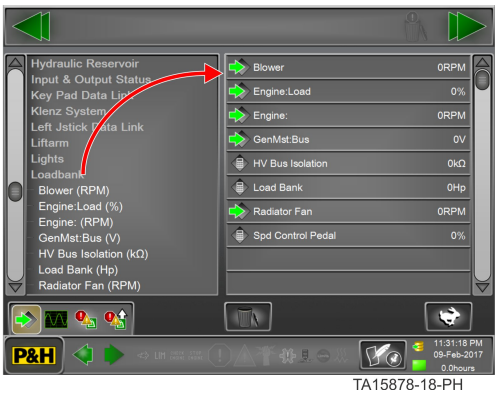
Load Bank Measurement to be Observed

4. Select the Load Bank Group for display in the Logging/Monitoring

Figure 5: Load bank group select



TA15878-17-PH

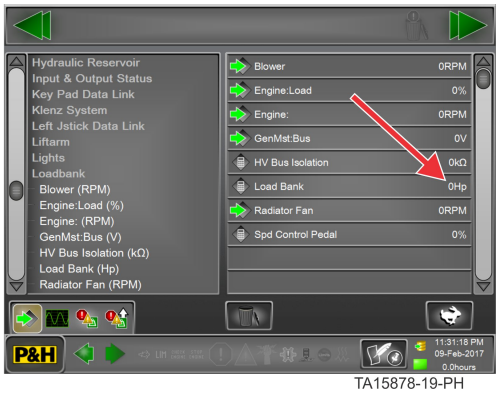


TA15878-18-PH

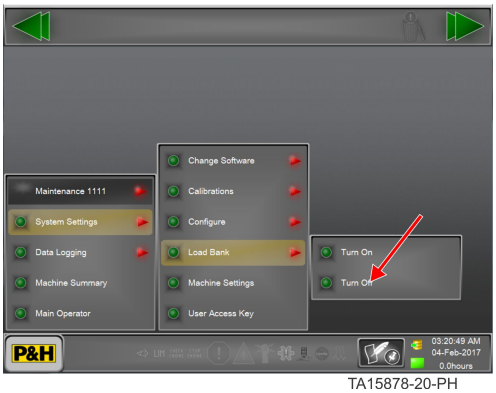
5. Observing the Load Bank HP channel, press the speed control pedal fully and wait for the Load Bank HP reading to stabilize. Once Load Bank hp is stable, release the speed control pedal. Repeat this step 3 more times, allowing time for the grids to cool between tests.

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Figure 6: Load bank HP and load bank off



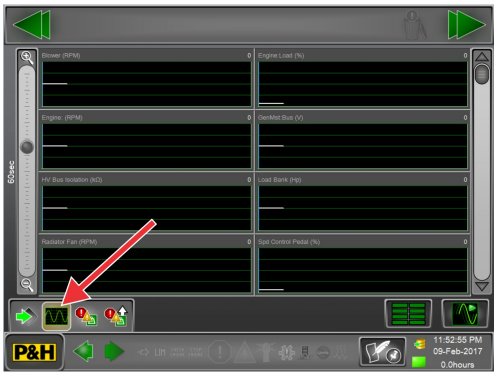
TA15878-19-PH



TA15878-20-PH

6. After the final test, allow the engine and grids sufficient time to cool.
7. Turn the key switch OFF.
8. When the engine RPM is zero, turn the key switch back to the ON position to keep LINCS booted.
9. Navigate to the charting view of the Load Bank Group Channels.

Figure 7: Load bank channels chart view



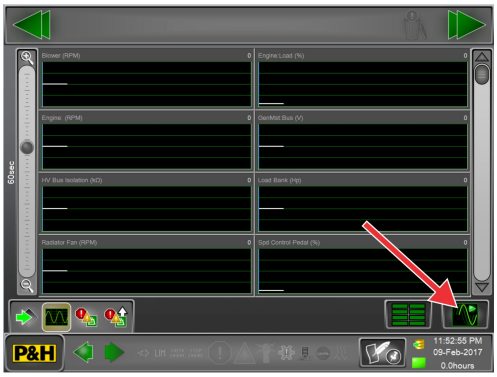
TA15878-21-PH

NOTICE

Initially the charting view is in Live Mode. Select view recorded information by touching the lower right hand icon. Display will now turn to a stack of disc with a green arrow.

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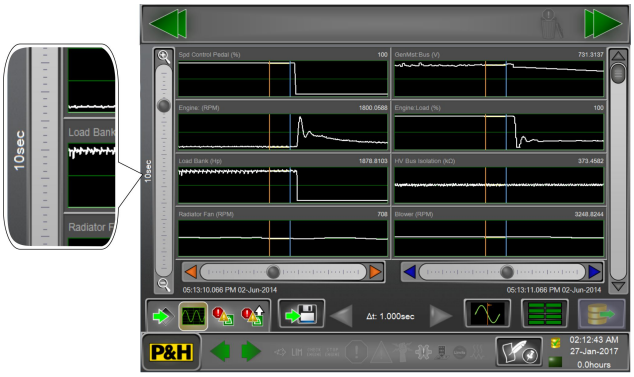
Figure 8: Load bank channels recorded information select



TA15878-22-PH

10. Select a 10sec window duration.

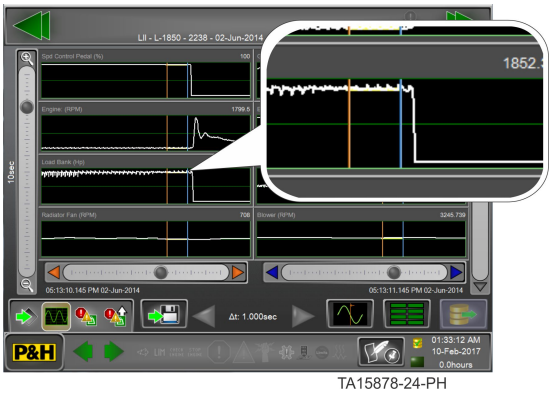
Figure 9: 10 second window duration



TA15878-23-PH

11. Scroll the chart back to the point where Load Bank (hp) was stable.

Figure 10: Load bank channels recorded information select

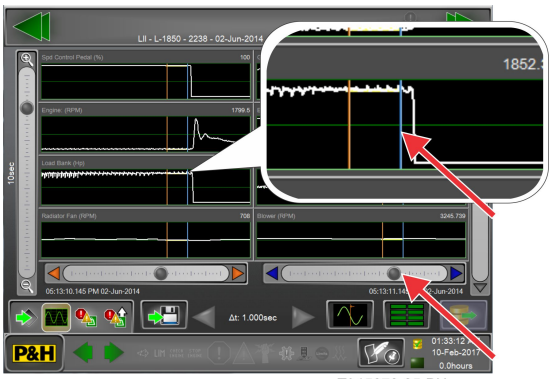


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12. Position the blue marker at the end of the stabilized Load Bank (hp) channel.

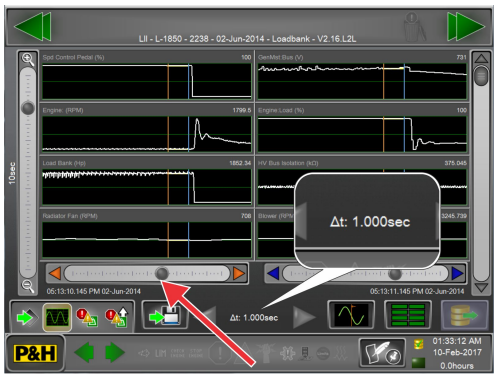
Figure 11: Blue marker position



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13. Move the red marker so that the Δt is set to 1.000sec.

Figure 12: Red marker Δt at 1sec



TA15878-26-PH

14. Select the display value to $\bar{x}$ (average).

Figure 13: Display value set to average

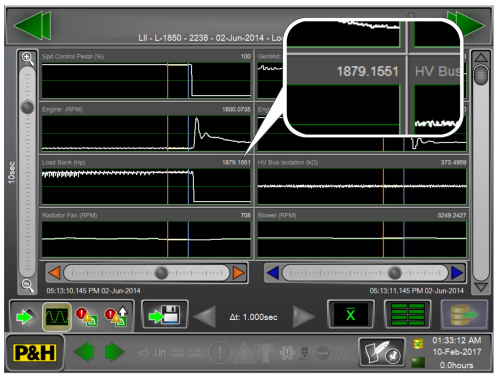


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15. Record the hp number in the top right corner of the box for Load Bank (hp).

Figure 14: Load bank (HP)



TA15878-28-PH

16. Using the following table or a replica, enter the hp information for each test in the columns provided.

17. Average the hp for all four tests, this is final hp value.

	Test 1	Test 2	Test 3	Test 4	Sum Total	Average (divide total by 4)
HP Reading						

18. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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Bus Discharge Verification Procedure

Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

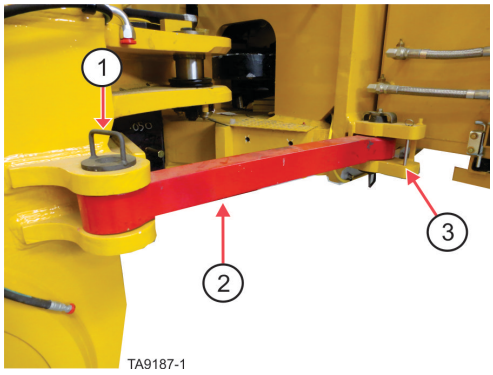
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 15: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

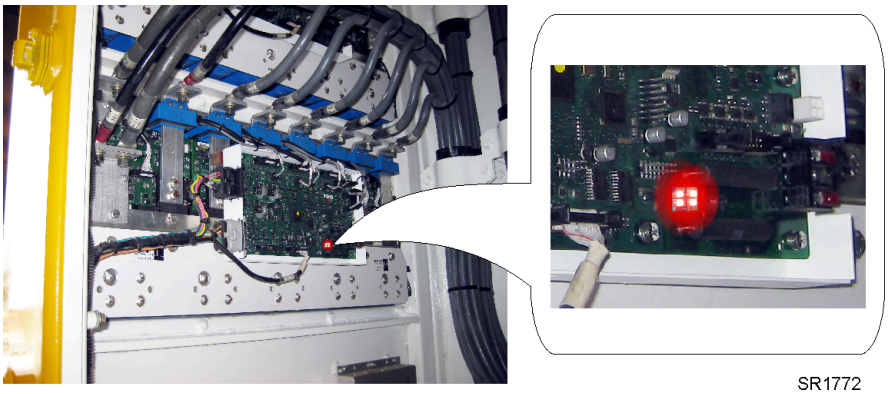
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Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 16: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

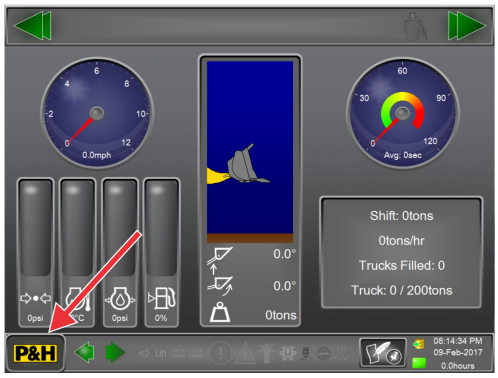
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 17: LINCS logging/monitoring menu access



TA15638-PH

Main Menu Button

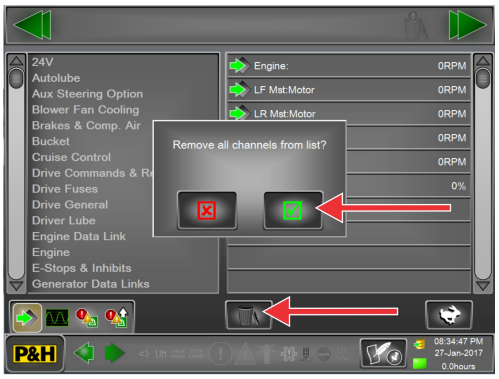


TA15639-PH

Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 18: Remove channels



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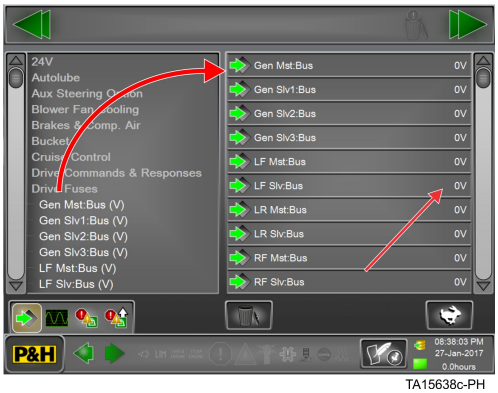
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 19: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 20: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

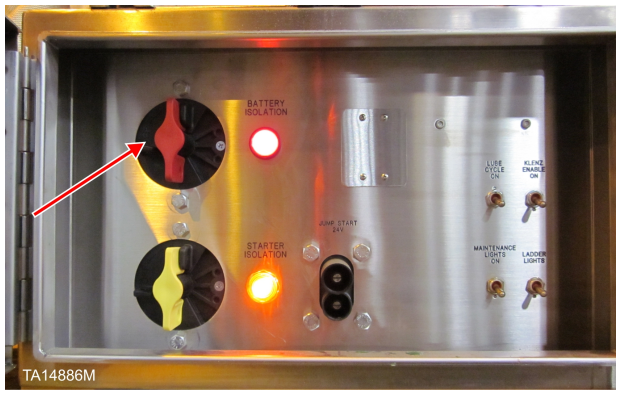
Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 21: Isolation and control switch assembly



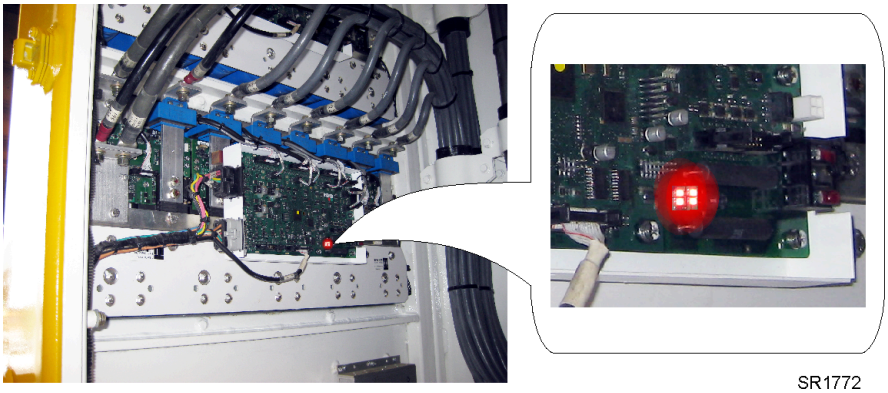


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 22: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

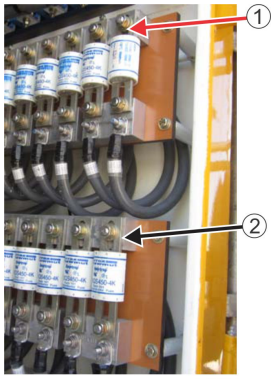
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 23: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

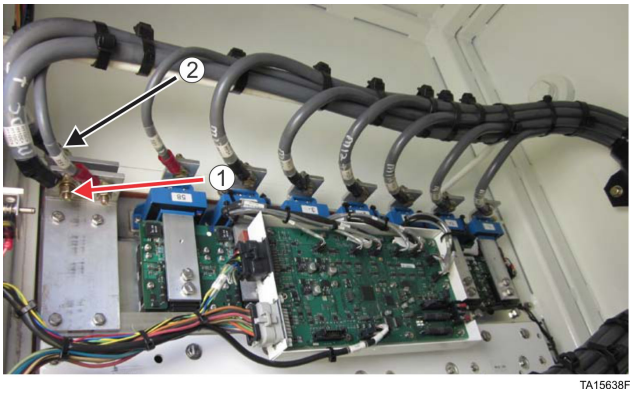
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Figure 24: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 25: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

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Lincs II Input Simulator Box (VCU via the Digital Board)

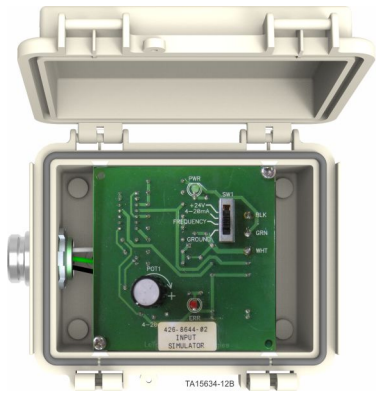
The LINCS II Input Simulator Box, P/N 4270252, is used for troubleshooting cabling and components upstream in a circuit from a remote sensor back to the VCU.

The LINCS II Input Simulator Box is connected in place of a remote sensor and is used to induce a signal back to the VCU to verify proper circuit operation. Use of this tester can expedite troubleshooting component failures and reduce downtime by isolating whether a sensor or cabling failure is the root cause.

The tester can be used to simulates all pressure transducers regardless of pressure rating, temperature sensors, and speed sensors as well as 24VDC and GND (i.e. high and low side switches).

Figure 26: LINCS II Input Simulator Box





3-Pin Connector

The Input Simulator Box has a 3-pin connector on one end of the enclosure which is used to attach the tester to the appropriate Turck® connector. The connector has a green GND wire (pin 1), a black signal wire (pin 2), and a white 24V wire (pin 3).



3–Pin Connector

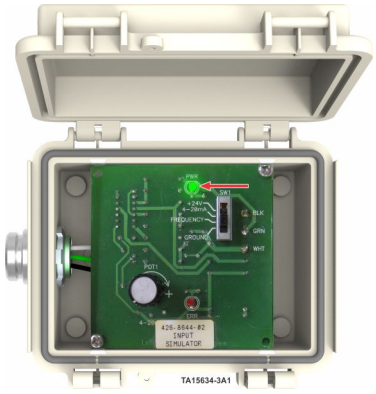
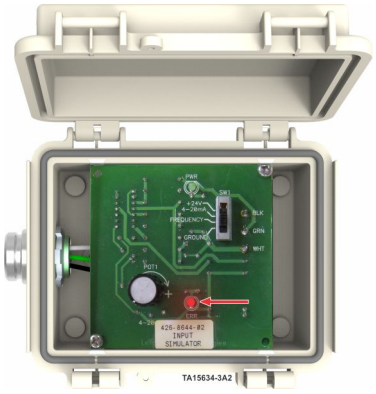


Index Pin Location

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LED’s

Two LED’s are present on the circuit board to indicate if the correct voltage polarity is supplied to the board. If GND and 24V are supplied to the tester with the correct polarity, the Green LED will illuminate. If the polarity is incorrect, the red LED will illuminate.

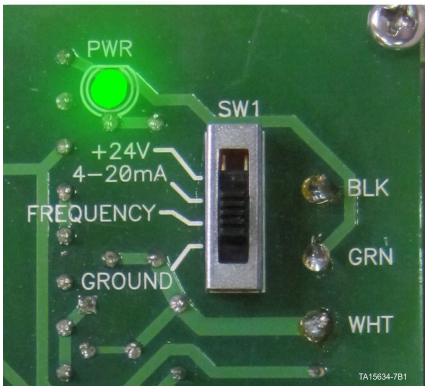
	
Correct input voltage polarity	Incorrect input voltage polarity

Four Position Switch

The output from the tester onto the signal wire is determined by the position of the four-position switch.

1. +24V
2. 4-20mA
3. Frequency
4. Ground

Figure 27: Simulator box 4 position switch



+24V Switch Position

When the switch is in the “+24V” position, the output from the tester will be +24V.

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Figure 28: LINCS simulator 24V switch position



4-20mA Switch Position

When the “4-20mA” position is selected, an adjustable 4 to 20ma signal can be output from the tester. The output signal can be adjusted from 4 to 20ma by rotating the knob labeled POT 1.

Figure 29: LINCS simulator 4–20ma switch and POT 1



Frequency Switch Position

When the “Frequency” position is selected, the output from the tester will be a fixed frequency output of approximately 1.4 to 1.7 Khz.

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Figure 30: LINCS simulator frequency switch position



Ground Switch Position

When the switch is in the “Ground” position, this will simulate the device being grounded.

Figure 31: LINCS simulator GND switch position



Instructions for Use of the Input Simulator Box

Note: The following instructions assume there is a suspected failed sensor, cable, or connection.

4-20mA Device

1. Move the switch on the Input Simulator Box to the “4-20mA” position to simulate a 4-20mA device.
2. Disconnect the Turck® cable from the suspected 4-20mA device cable or device (this includes encoders, transducers, hydraulic reservoir temperature sensors, and gear box temperature sensors).
3. Connect the cable to the Turck® connector on the Input Simulator Box.
4. Boot up LINCS II and browse channels to view the input.

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5. Observe the input reported in LINCS II while rotating the pot on the Input Simulator Box.
6. If the LINCS II input channel value varies, the pressure transducer has failed. If there is no adjustment noted in LINCS II then there is either a failed cable or Turck® box.

NOTICE

The Input Simulator Box cannot be used to test wheel motor sensors.

Frequency (Speed Sensors)

1. Move the selector switch to “Frequency” on the Input Simulator Box.
2. Disconnect the Turck® cable from the speed sensor or cabling to be tested.
3. Connect the cable to the Turck® connector on the Input Simulator Box.
4. Boot up LINCS II and browse channels to view the input.
5. If an RPM is seen on the LINCS II input channel, the speed sensor is defective. If an RPM value is not displayed, then there is either a failed cable or Turck® box.

Flow and Level Switch Test

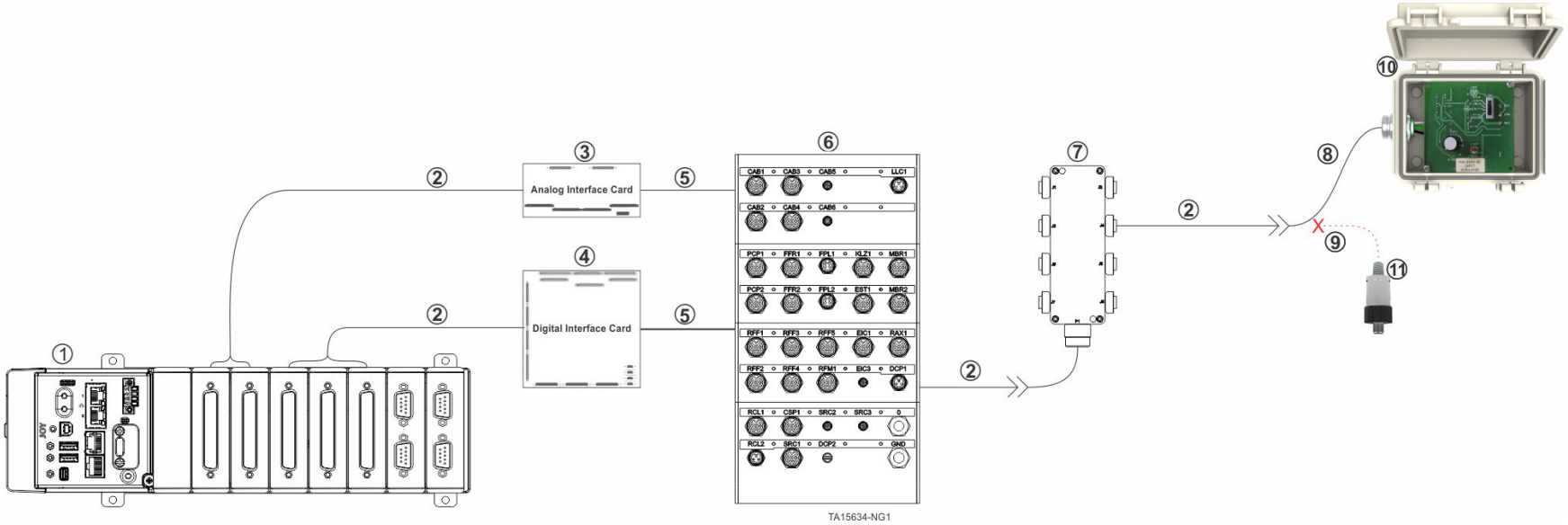
1. Move the selector switch on the Input Simulator Box to the appropriate +24V or GND position (It is important to know if the input channel is looking for a +24V or a GND signal).
2. Disconnect the Turck® cable from the switch to be tested.
3. Connect the cable to the Turck® connector on the Input Simulator Box.
4. Boot up LINCS II and browse channels to view the input.
5. View the LINCS II input channel to verify the signal is being detected properly. If the input changes state, the sensor is defective. If there is no change, then there is either a failed cable or Turck® box.

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Figure 32: LINCS simulator test box connections



1)VCU	**7)** Turck® box
2) Cable	**8)** Input Simulator Box Cable
3) Analog Interface Board	**9)** Sensor Cable
4) Digital Interface Board	**10)** Input Simulator Box
5) Wire	**11)** Sensor
6) LVCC Connectors	

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There are several different types of sensor cables that are used on the loader, depending on the type of sensor.

For example, a solenoid may have a square connector. The sensor cable being used would have a square solenoid connector on one end and a large 3-pin connector at the other end.

A transducer may have a small 4 or 5 pin round M12 style Turck® connector. The transducer sensor cable being used would have a small 4 or 5 pin connector on one end and a large 3-pin connector at the other end.

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Isolating a Master Only Converter Drive Assembly (L-1350 motor only)

The converter assemblies are scalable and so are capable of having multiple assemblies per component. Referring to the chart below, the L-1350 has one converter assembly per motor while the L-1850 and L-2350 will have two converter assemblies per motor. The generator converter assemblies will have 3, or 4 assemblies, depending on machine type.

Machine Type	Wheel Motor Converter Assemblies	Generator Converter Assemblies	Total Converter Assemblies
L-1350	4 (1 per motor)	3	7
L-1850, L-2350	8 (2 per motor)	4	12

NOTICE

- *Isolating a converter assembly should only be performed in the event that a faulty converter assembly cannot be changed out for an operational unit, and should only be completed by a qualified technician.*
- *The same procedures are used whether isolating a generator converter assembly or a motor converter assembly. Generator converter assemblies typically do not have grid connections (with the exception of L-1350's). On L-1350's, there are grids connected to both generator slave converter assemblies; therefore, if isolating a L-1350 generator converter assembly, if a grid is connected, it must be moved to an operational generator converter assembly.*

Operation of Machine with Motors and/or Converter Panels Disabled

SR drive machines are capable of operating with convertor panels and/or motors disabled.

⚠ WARNING

Operation of the machine on less than four wheel motors, or with any of the converter panels disabled, will result in a reduction in electric (dynamic) braking and could possibly lead to an overspeed on grades and/or longer stopping distances when using dynamic braking. Failure to properly employ the service brake under these conditions could lead to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

If the wheel motor or converter panel has been isolated using the proper procedure, the operators panel will display a small illuminated yellow gear cog (Drive System Abnormal icon). There are no messages when booting LINCS, starting engine, or releasing brakes. If this icon is illuminated, the operator must be aware that the machine has reduced electric braking and the operator must verify that all four service brakes are functional to stop the machine.

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Figure 33: Drive System Abnormal Icon



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Service Brakes

While the machine is capable of operating on less than four wheel motors, the service brakes on all four wheel motors must be fully functional and capable of stopping the driver and wheel whenever the machine is being operated. This means that:

- The traction motor must be installed
- The traction motor or driver cannot be altered in any fashion
- Middle pinion on 57” driver cannot be removed

⚠ WARNING

The machine should only be operated with less than four service brakes in order to move the machine away from a dangerous situation. Do not tram the machine or operate the machine in production with less than four service brakes. The service brakes must be maintained and working properly (e.g.., disks in spec, pads in spec, gaps in spec, pressures in spec, no leaks, etc.). Failure to properly inspect and maintain all four service brakes may compromise braking capability leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

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Figure 34: Example 1: B-60 on 57” Driver

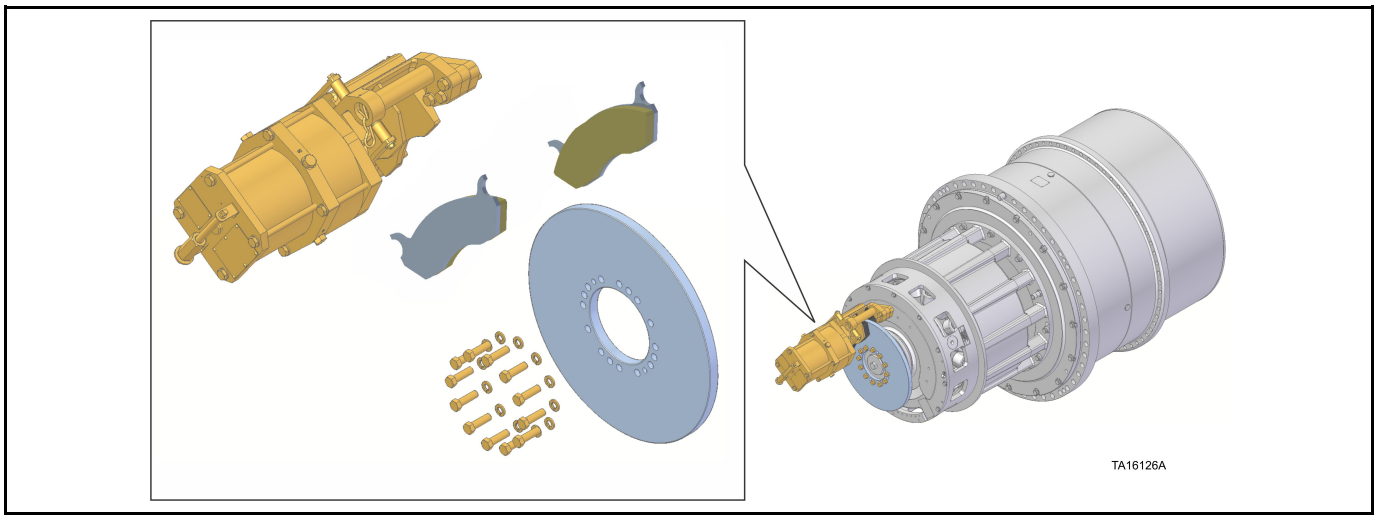
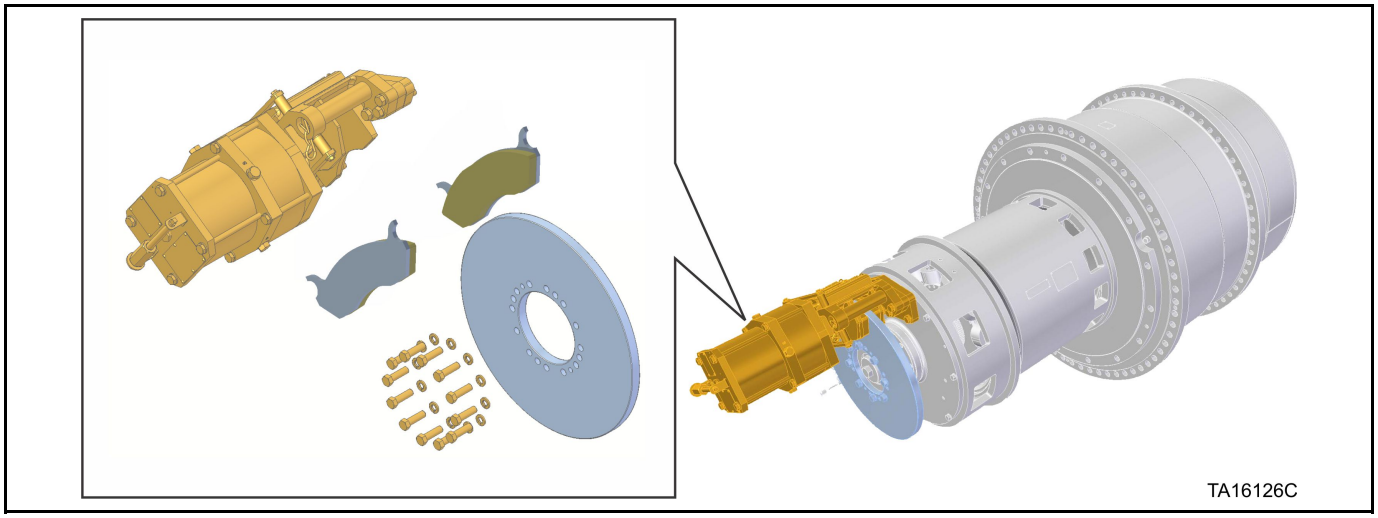


Figure 35: Example 2: B-40A on 51” Driver



Overspeed Prevention Recommendations

1. Each machine has a grade/speed chart that indicates the dynamic retarding limits of that specific machine when descending a grade. If either converter panels or motors have been disabled - the machine’s speed should be reduced when descending a grade to prevent a runaway situation.
2. Observe actual grade conditions as compared to the grade/speed chart for both loaded and unloaded conditions. The grade/speed chart is located inside the cab (refer to “Typical grade/speed chart”).
3. Reduce speed PRIOR to descending a grade.

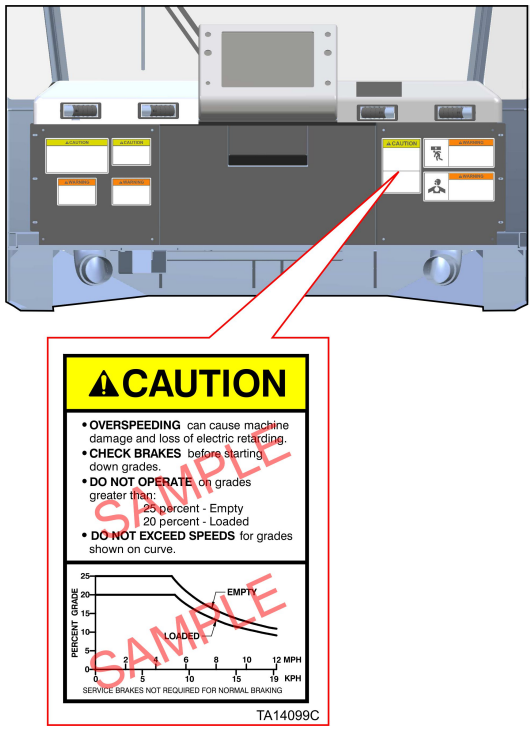
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4. As a general rule, descend a grade no faster than the speed the machine will ascend the same grade with the same load.
5. Promptly apply service brakes to slow the machine if an overspeed situation occurs.

⚠ WARNING

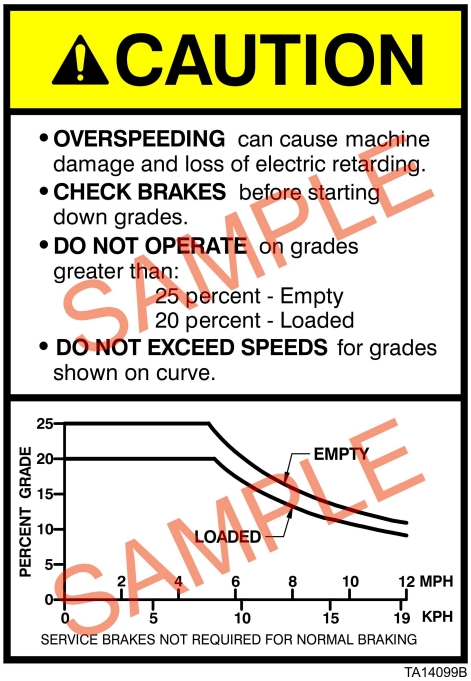
Failure to appropriately reduce the machine's speed while descending a grade with disabled converter panels and/or disabled motors can create the risk of a machine runaway leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

Figure 36: Typical grade/speed chart



NOTICE

An example of a grade/speed chart is shown here. Each type of machine is different. Refer to the grade/speed chart mounted in the operator's cab for accurate information for a specific machine.



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Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

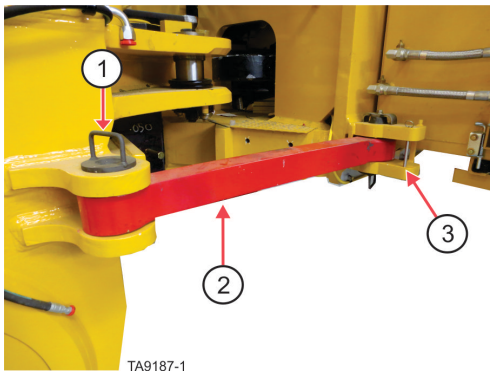
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 37: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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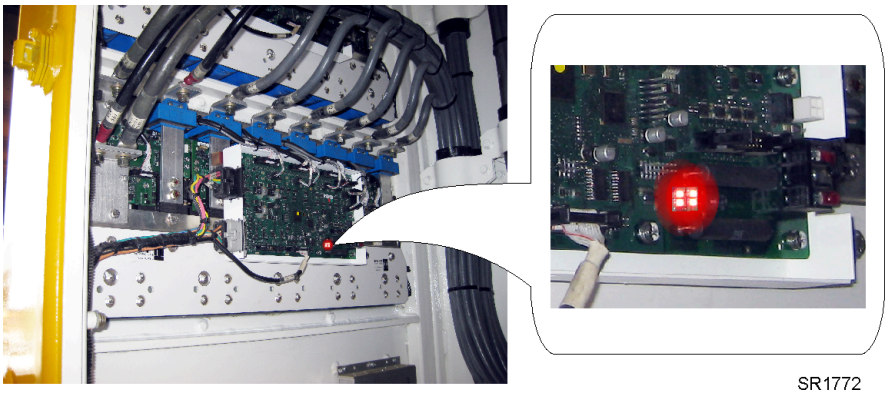
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 38: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

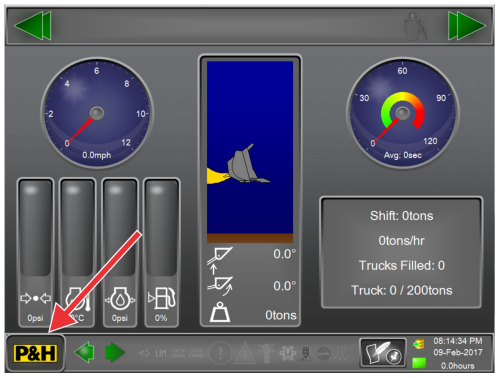
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 39: LINCS logging/monitoring menu access



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Main Menu Button

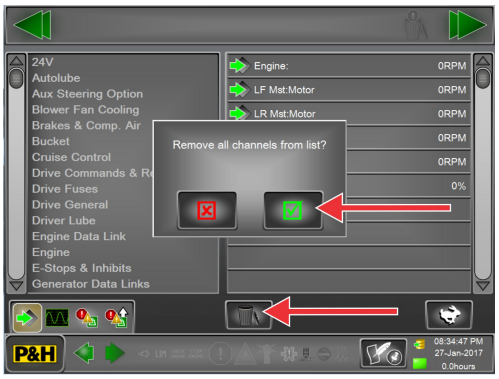


TA15639-PH

Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 40: Remove channels



TA15638a-PH

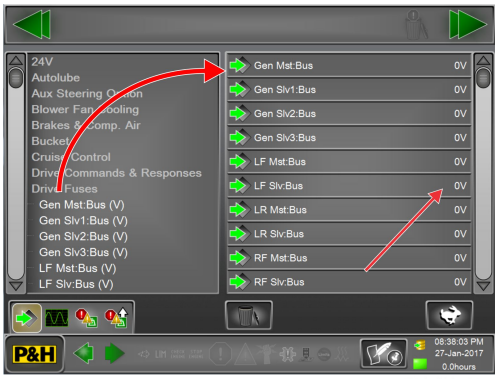
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 41: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 42: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

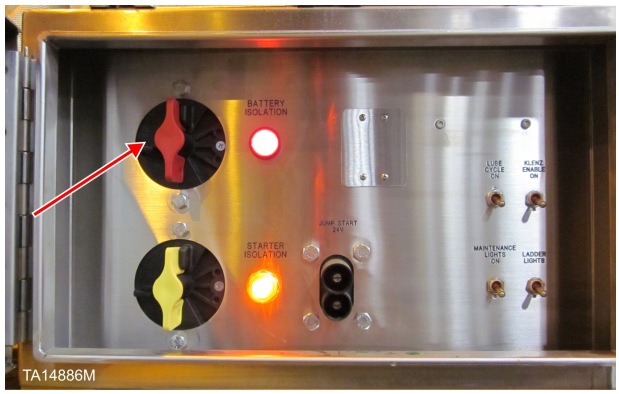
Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 43: Isolation and control switch assembly



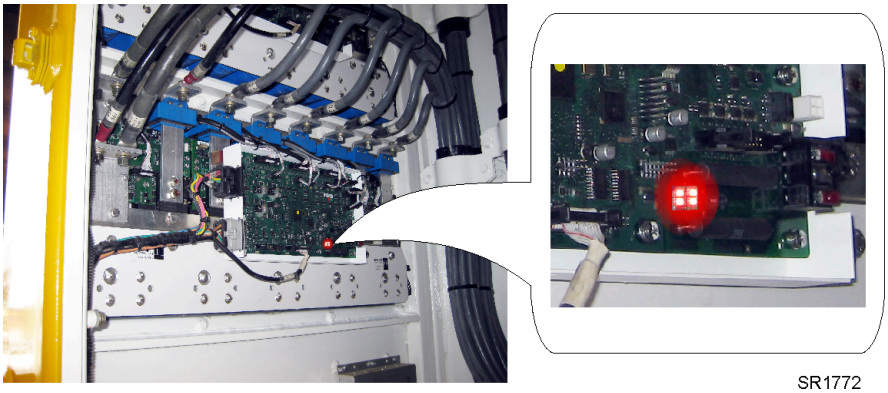


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 44: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

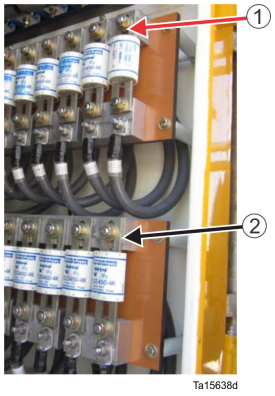
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 45: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

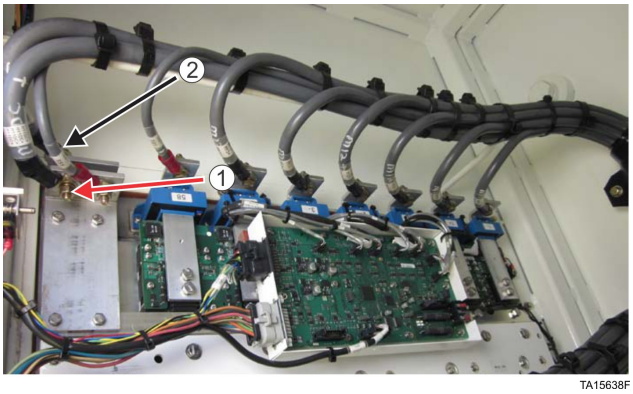
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Figure 46: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 47: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

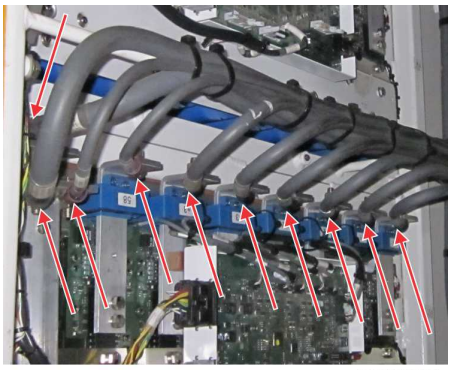
Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Isolating the Drive Assembly

1. Disconnect all cable leads (+/- 1, 2, 3; Chopper (55 & 58), and +/- DC) from the converter assembly.

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Figure 48: Converter assembly cable connections



TA15639g



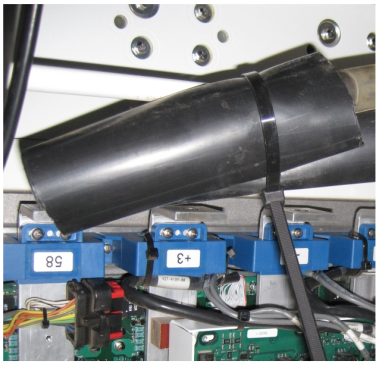
TA15639h

CAUTION

The use of two wrenches is required to prevent improper directional torque on nuts/bolts. Not doing so could cause damage to converter components.

2. Use cable ties and insulation sleeves to isolate the cables from the converter assembly.

Figure 49: Cable isolation and insulation



TA15639a

3. Remove the DC fuses (+ and -) associated with the converter assembly to be isolated. Fuses are located on the fuse assembly at the bottom of the electrical converter cabinet.

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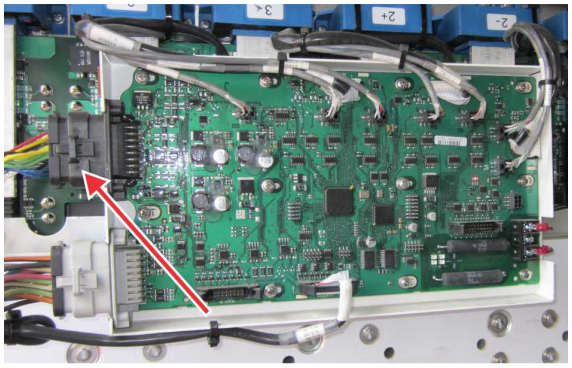
Figure 50: Fuse assemblies (L-2350 shown)



TA15639b

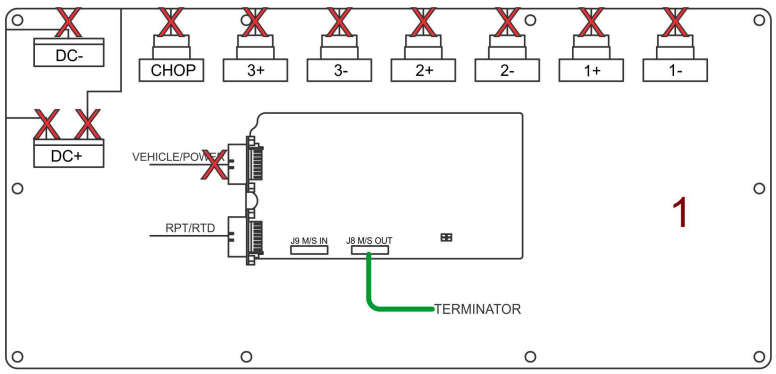
4. Disconnect the Vehicle/Power Connector (black) from the master converter assembly SR control board.

Figure 51: Vehicle/power connector



TA15640b

Figure 52: Master converter assembly disconnected

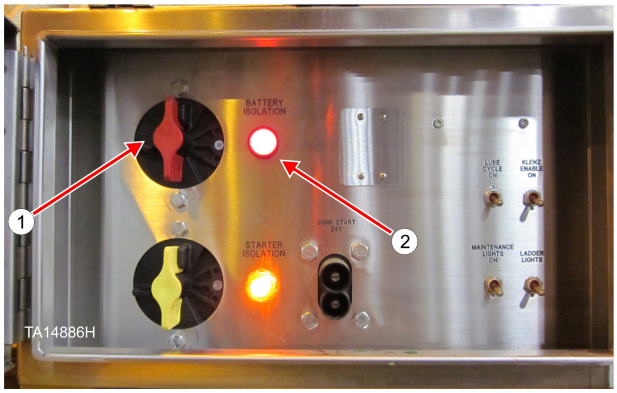


TA15640c

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5. Remove the battery box lockout and turn the Battery Isolation Switch to the ON position (the red light will illuminate to indicate 24V has been enabled).

Figure 53: Isolation and control switch assembly



1) Battery isolation switch (shown in ON position), **2)** Battery isolation indicator

6. Boot LINCS, clear miscellaneous alarms, and log in using a Maintenance level or higher user access key (I-button).
7. Navigate to the Configure Drive screen.

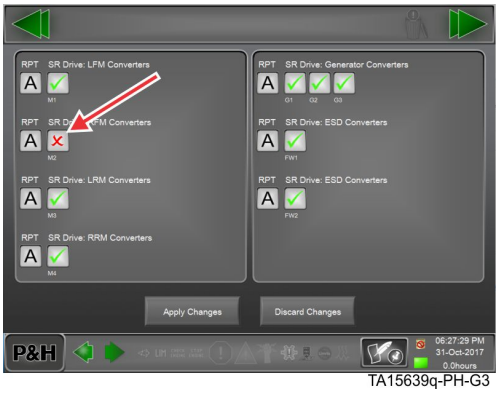
Figure 54: LINCS configure drives screen



8. Locate the appropriate converter assembly and select the green check mark to isolate the converter. The green check will change to a red X to indicate the converter has been isolated.

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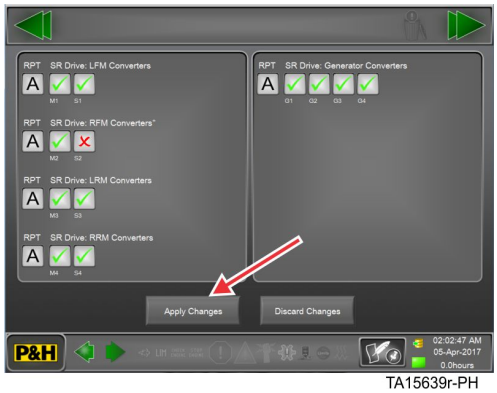
Figure 55: LRM Converter isolation (example)



TA15639q-PH-G3

9. Select Apply Changes.

Figure 56: LINCS drive configuration menu apply changes (example)



TA15639r-PH

10. Reboot LINCS.
11. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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Isolating a Master Converter Assembly with a Single or Multiple Slave Drives (motor or generator)

The converter assemblies are scalable and so are capable of having multiple assemblies per component. Referring to the chart below, the L-1350 has one converter assembly per motor while the L-1850 and L-2350 will have two converter assemblies per motor. The generator converter assemblies will have 3, or 4 assemblies, depending on machine type.

Machine Type	Wheel Motor Converter Assemblies	Generator Converter Assemblies	Total Converter Assemblies
L-1350	4 (1 per motor)	3	7
L-1850, L-2350	8 (2 per motor)	4	12

NOTICE

- *Isolating a converter assembly should only be performed in the event that a faulty converter assembly cannot be changed out for an operational unit, and should only be completed by a qualified technician.*
- *Isolating a generator converter assembly or a motor converter assembly. Generator converter assemblies typically do not have grid connections (with the exception of L-1350's). On L-1350's, there are grids connected to both generator slave converter assemblies; therefore, if isolating a L-1350 generator converter assembly, if a grid is connected, it must be moved to an operational generator converter assembly.*

Operation of Machine with Motors and/or Converter Panels Disabled

SR drive machines are capable of operating with convertor panels and/or motors disabled.

⚠ WARNING

Operation of the machine on less than four wheel motors, or with any of the converter panels disabled, will result in a reduction in electric (dynamic) braking and could possibly lead to an overspeed on grades and/or longer stopping distances when using dynamic braking. Failure to properly employ the service brake under these conditions could lead to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

If the wheel motor or converter panel has been isolated using the proper procedure, the operators panel will display a small illuminated yellow gear cog (Drive System Abnormal icon). There are no messages when booting LINCS, starting engine, or releasing brakes. If this icon is illuminated, the operator must be aware that the machine has reduced electric braking and the operator must verify that all four service brakes are functional to stop the machine.

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Figure 57: Drive System Abnormal Icon



TA16126

Service Brakes

While the machine is capable of operating on less than four wheel motors, the service brakes on all four wheel motors must be fully functional and capable of stopping the driver and wheel whenever the machine is being operated. This means that:

- The traction motor must be installed
- The traction motor or driver cannot be altered in any fashion
- Middle pinion on 57” driver cannot be removed

⚠ WARNING

The machine should only be operated with less than four service brakes in order to move the machine away from a dangerous situation. Do not tram the machine or operate the machine in production with less than four service brakes. The service brakes must be maintained and working properly (e.g.., disks in spec, pads in spec, gaps in spec, pressures in spec, no leaks, etc.). Failure to properly inspect and maintain all four service brakes may compromise braking capability leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

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Figure 58: Example 1: B-60 on 57” Driver

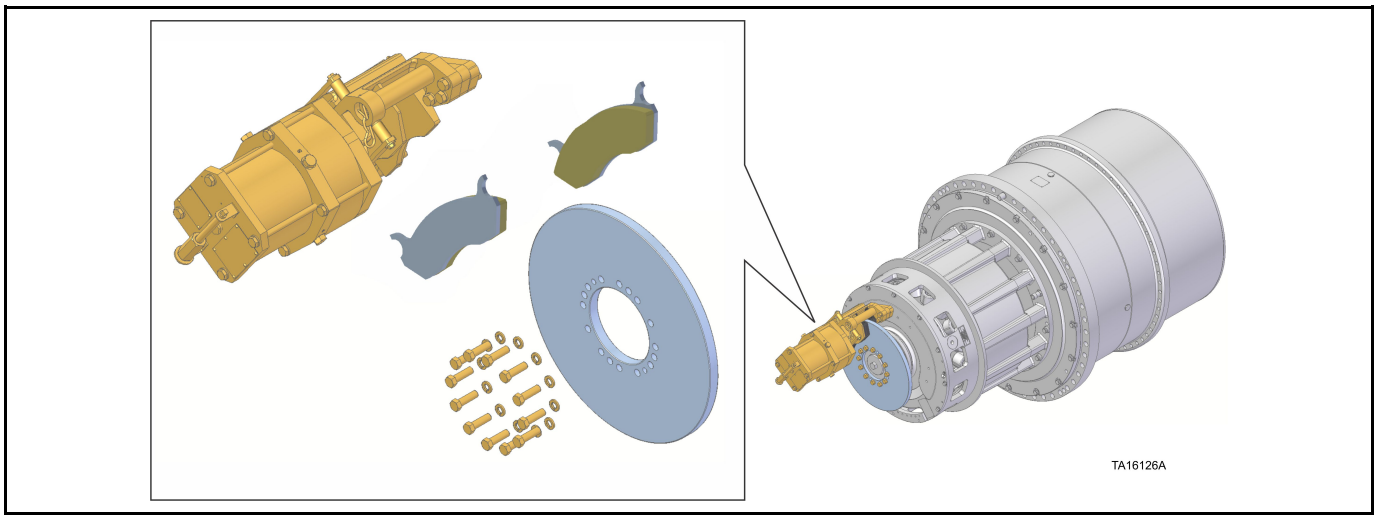
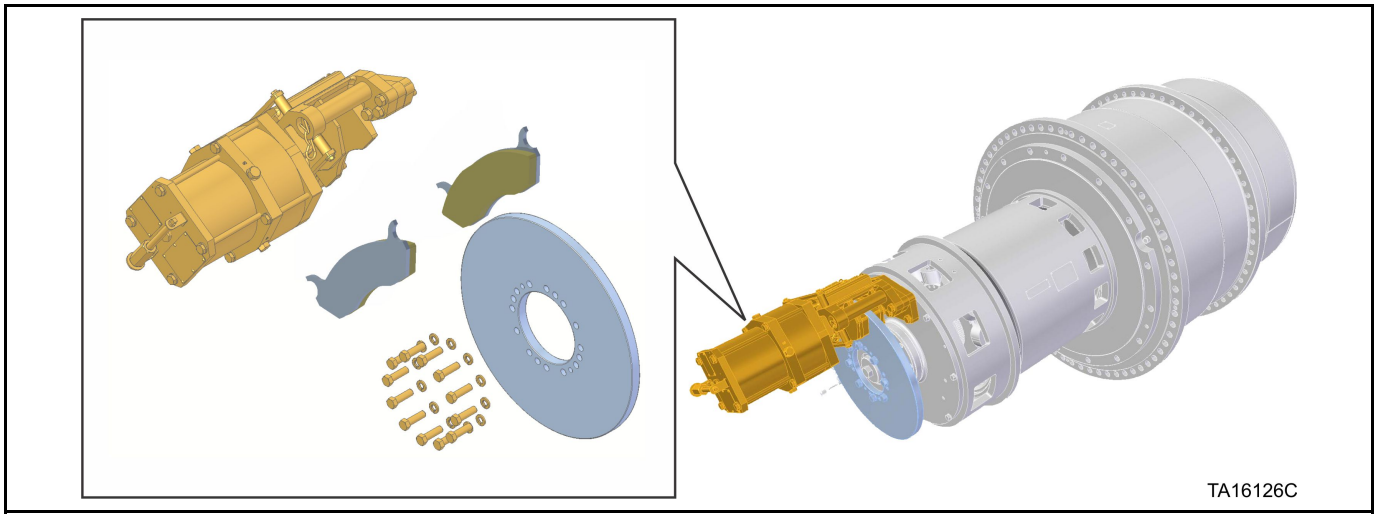


Figure 59: Example 2: B-40A on 51” Driver



Overspeed Prevention Recommendations

1. Each machine has a grade/speed chart that indicates the dynamic retarding limits of that specific machine when descending a grade. If either converter panels or motors have been disabled - the machine’s speed should be reduced when descending a grade to prevent a runaway situation.
2. Observe actual grade conditions as compared to the grade/speed chart for both loaded and unloaded conditions. The grade/speed chart is located inside the cab (refer to “Typical grade/speed chart”).
3. Reduce speed PRIOR to descending a grade.

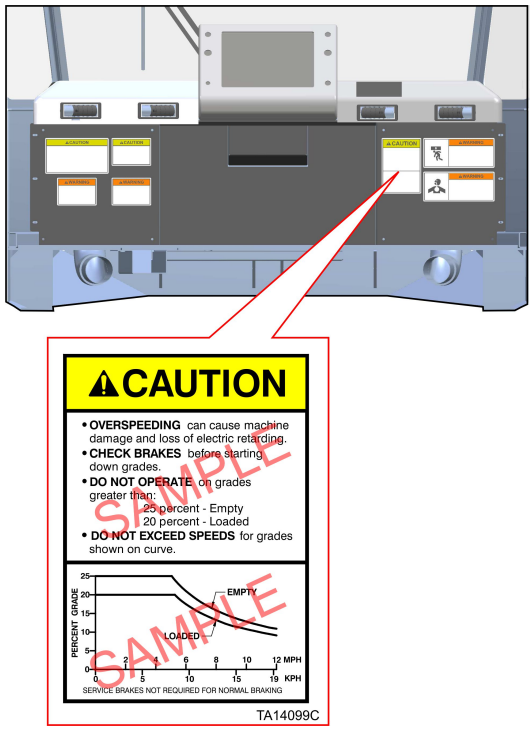
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4. As a general rule, descend a grade no faster than the speed the machine will ascend the same grade with the same load.
5. Promptly apply service brakes to slow the machine if an overspeed situation occurs.

⚠ WARNING

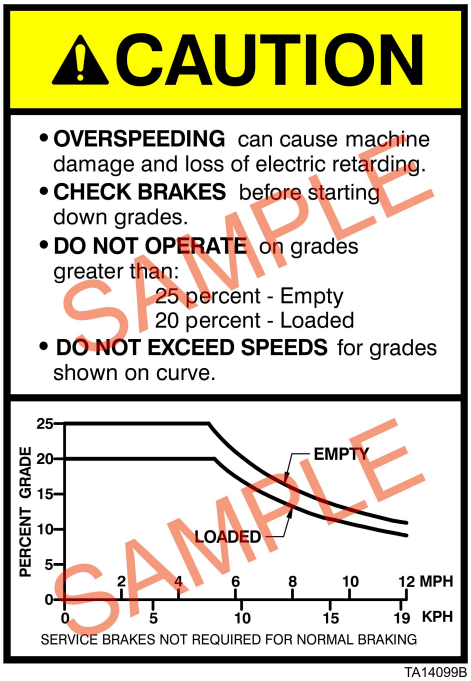
Failure to appropriately reduce the machine's speed while descending a grade with disabled converter panels and/or disabled motors can create the risk of a machine runaway leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

Figure 60: Typical grade/speed chart



NOTICE

An example of a grade/speed chart is shown here. Each type of machine is different. Refer to the grade/speed chart mounted in the operator's cab for accurate information for a specific machine.



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Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

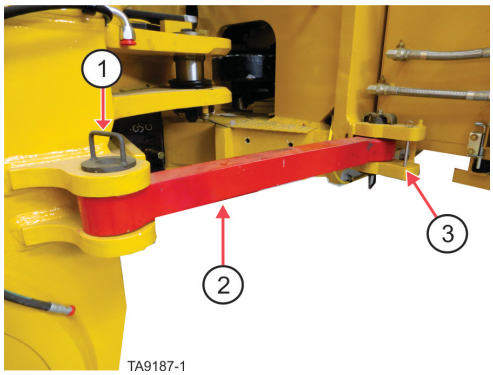
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 61: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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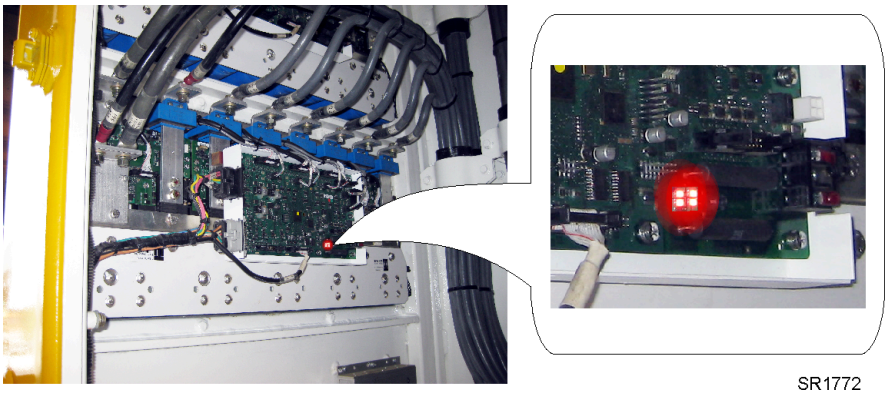
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 62: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

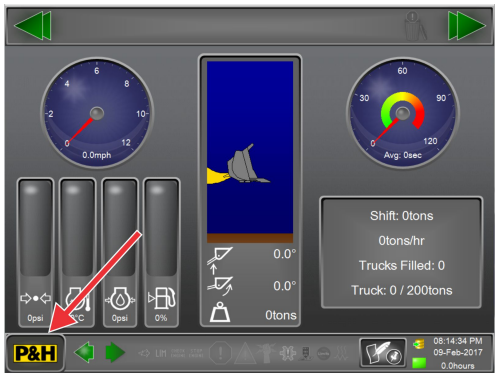
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 63: LINCS logging/monitoring menu access



TA15638-PH

Main Menu Button

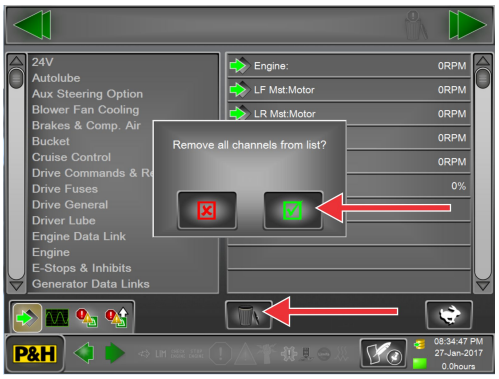


TA15639-PH

Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 64: Remove channels



TA15638a-PH

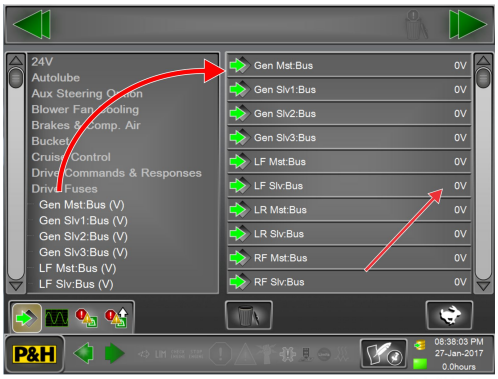
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 65: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 66: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

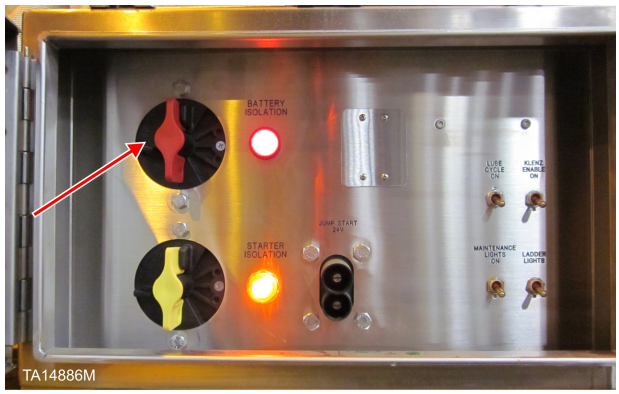
Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 67: Isolation and control switch assembly



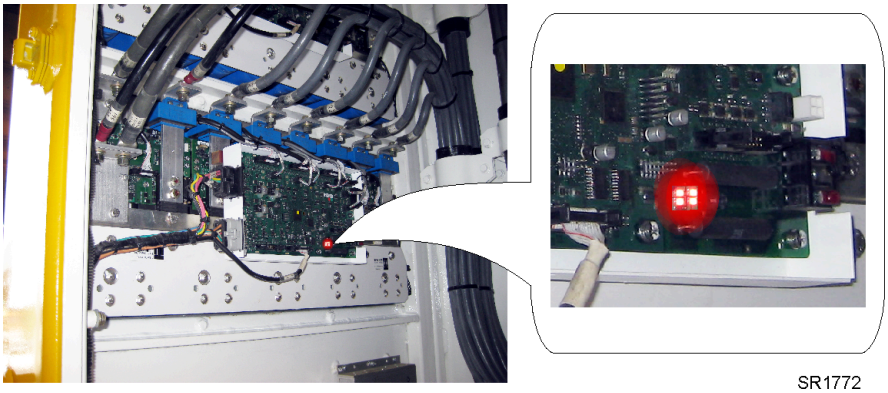


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 68: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

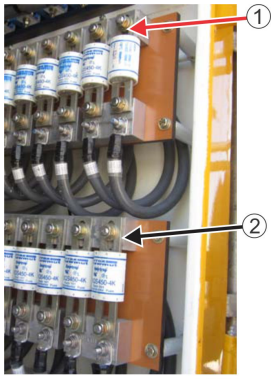
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 69: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

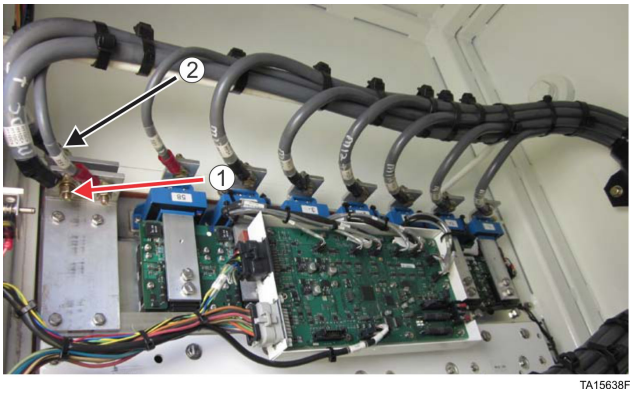
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Figure 70: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 71: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Isolating the Drive Assembly

1. Disconnect all cable leads (+/- 1, 2, 3; Chopper (55 & 58, if connected), and +/- DC) from the converter assembly.

NOTICE

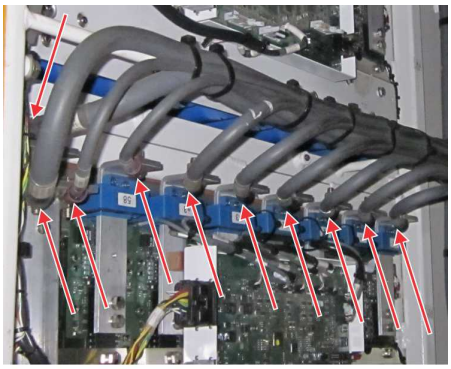
If the converter assembly being isolated is for a motor, it is not necessary to move the grid connections as the motor will be operating at half power.

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NOTICE

The L-1350 master generator converter assembly does not have grids attached; therefore there will not be any grid cables to relocate.

Figure 72: Converter assembly cable connections



TA15639g



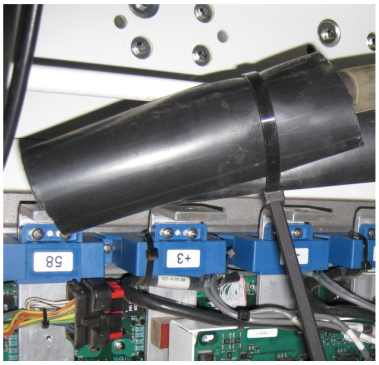
TA15639h

CAUTION

The use of two wrenches is required to prevent improper directional torque on nuts/bolts. Not doing so could cause damage to converter components.

2. Use cable ties and insulation sleeves to isolate the cables from the converter assembly.

Figure 73: Cable isolation and insulation



TA15639a

3. Remove the DC fuses (+ and -) associated with the converter assembly to be isolated. Fuses are located on the fuse assembly at the bottom of the electrical converter cabinet.

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Figure 74: Fuse assemblies (L-2350 shown)



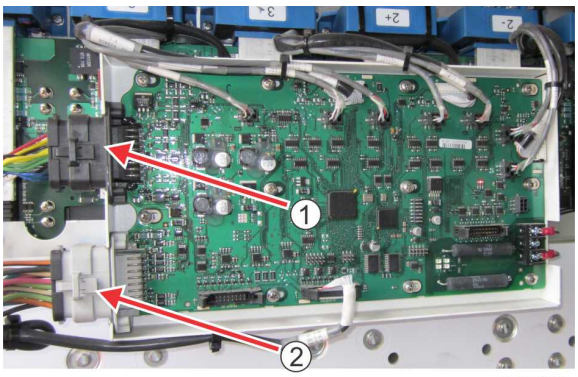
TA15639b

4. Disconnect the Vehicle/Power Connector (black) and the RPT/RTD connector (grey) from the master converter assembly SR control board.

NOTICE

Connector J-8 on the master converter assembly does not have to be removed.

Figure 75: Vehicle/power and RPT/RTD connectors



TA15639f

1.) Vehicle/Power connector **2.)** RPT/RTD connector

5. Cut the cable ties that secure the RPT/RTD connector to the master converter assembly, provide sufficient slack to reroute this connector to the next slave converter assembly in the drive.
6. Connect the RPT/RTD connector to the slave converter assembly SR control board.

NOTICE

Even though there is no longer a signal, it is a good idea to disconnect the cable from J9 on the slave converter assembly that is now acting as the master.

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Figure 76: RPT/RTD connection to slave converter assembly SR control board

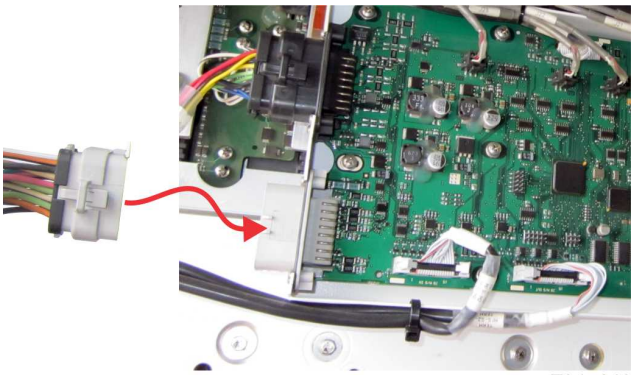
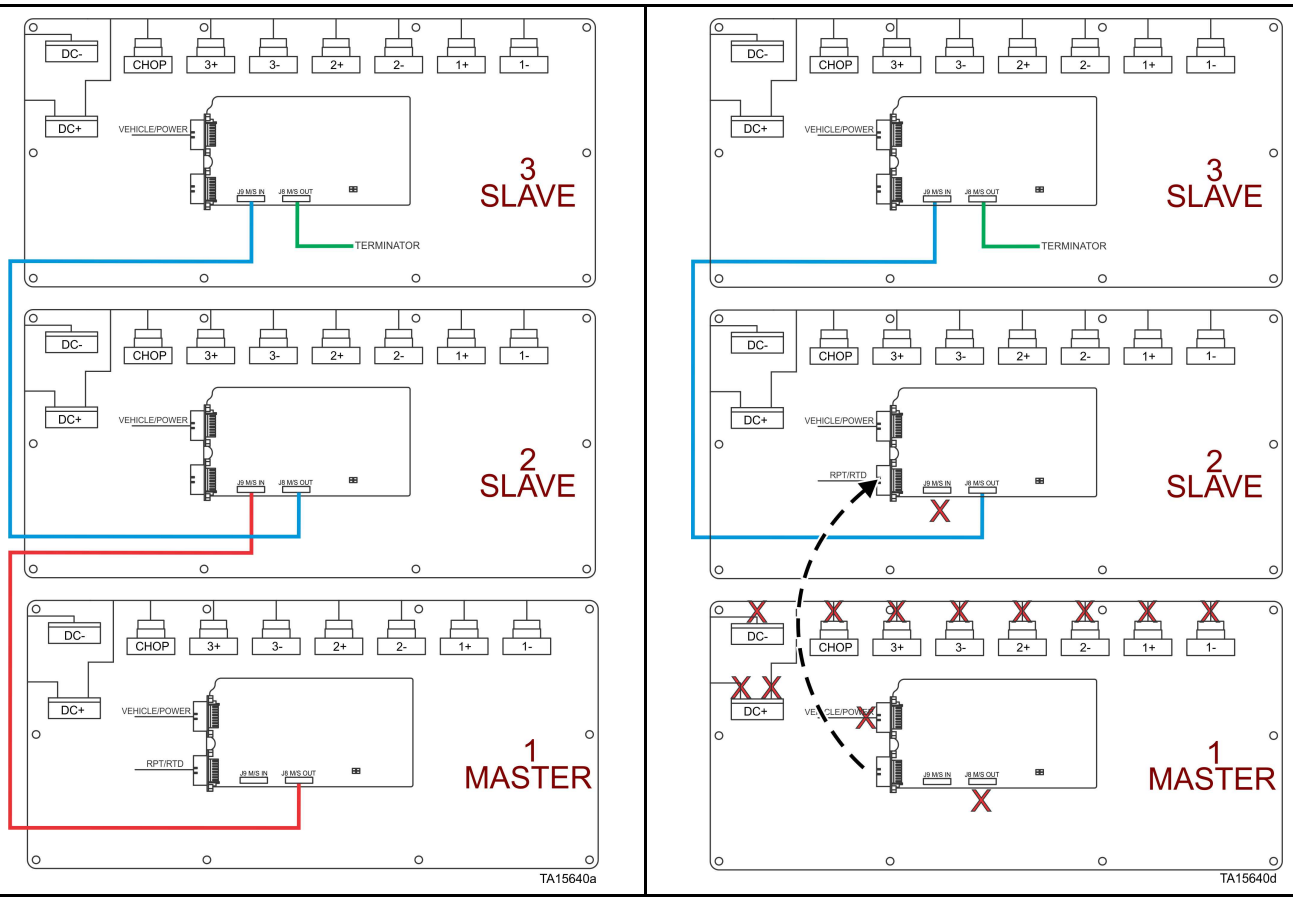


Figure 77: Isolated master connections



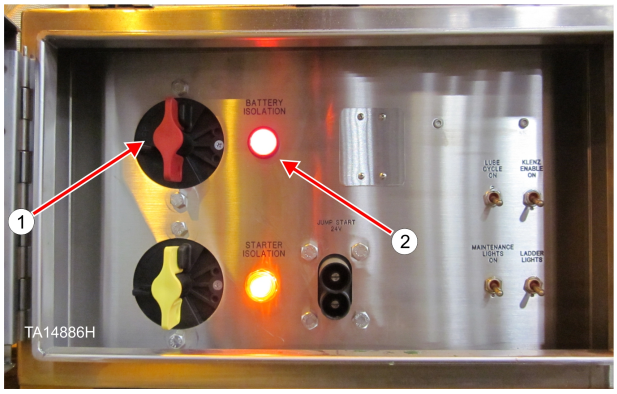
Original connections

Isolated master connections

7. Turn the Battery Isolation Switch to the ON position (the red light will illuminate to indicate 24V has been enabled).

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Figure 78: Isolation and control switch assembly



1) Battery Isolation Switch (Shown in ON position), **2)** Battery Isolation Indicator

8. Boot LINCS, clear miscellaneous alarms, and log in using a Maintenance level or higher user access key (I-button).
9. Navigate to the Configure Drive screen.

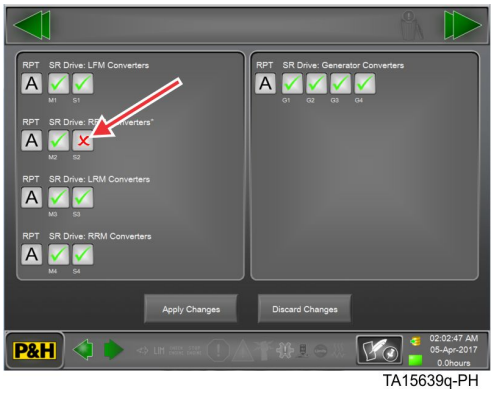
Figure 79: LINCS configuration menu



10. Locate the appropriate converter assembly and select the green check mark to reduce the number of converter assemblies on the associated drive to one less than shown on display (e.g. 2 to 1, 3 to 2, etc.). The green check will change to a red X to indicate the converter has been isolated.

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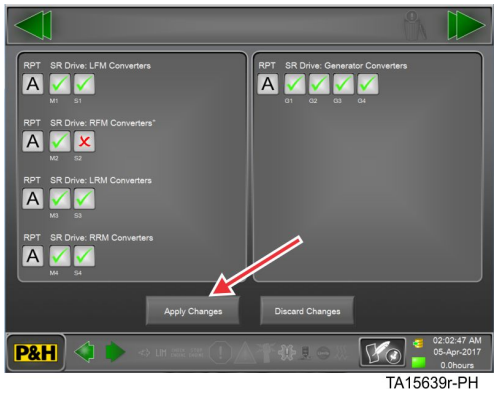
Figure 80: LINCS drive configuration menu (example)



TA15639q-PH

11. Select Apply Changes.

Figure 81: LINCS drive configuration menu apply changes (example)



TA15639r-PH

12. Reboot LINCS.
13. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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Isolating a Slave Converter Assembly in a Single Slave Drive (motor only)

The converter assemblies are scalable and so are capable of having multiple assemblies per component. Referring to the chart below, the L-1350 has one converter assembly per motor while the L-1850 and L-2350 will have two converter assemblies per motor. The generator converter assemblies will have 3, or 4 assemblies, depending on machine type.

Machine Type	Wheel Motor Converter Assemblies	Generator Converter Assemblies	Total Converter Assemblies
L-1350	4 (1 per motor)	3	7
L-1850, L-2350	8 (2 per motor)	4	12

NOTICE

- *Isolating a converter assembly should only be performed in the event that a faulty converter assembly cannot be changed out for an operational unit, and should only be completed by a qualified technician.*
- *The same procedures are used whether isolating a generator converter assembly or a motor converter assembly. Generator converter assemblies typically do not have grid connections (with the exception of L-1350's). On L-1350's, there are grids connected to both generator slave converter assemblies; therefore, if isolating a L-1350 generator converter assembly, if a grid is connected, it must be moved to an operational generator converter assembly.*

Operation of Machine with Motors and/or Converter Panels Disabled

SR drive machines are capable of operating with convertor panels and/or motors disabled.

⚠ WARNING

Operation of the machine on less than four wheel motors, or with any of the converter panels disabled, will result in a reduction in electric (dynamic) braking and could possibly lead to an overspeed on grades and/or longer stopping distances when using dynamic braking. Failure to properly employ the service brake under these conditions could lead to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

If the wheel motor or converter panel has been isolated using the proper procedure, the operators panel will display a small illuminated yellow gear cog (Drive System Abnormal icon). There are no messages when booting LINCS, starting engine, or releasing brakes. If this icon is illuminated, the operator must be aware that the machine has reduced electric braking and the operator must verify that all four service brakes are functional to stop the machine.

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Figure 82: Drive System Abnormal Icon



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Service Brakes

While the machine is capable of operating on less than four wheel motors, the service brakes on all four wheel motors must be fully functional and capable of stopping the driver and wheel whenever the machine is being operated. This means that:

- The traction motor must be installed
- The traction motor or driver cannot be altered in any fashion
- Middle pinion on 57” driver cannot be removed

⚠ WARNING

The machine should only be operated with less than four service brakes in order to move the machine away from a dangerous situation. Do not tram the machine or operate the machine in production with less than four service brakes. The service brakes must be maintained and working properly (e.g.., disks in spec, pads in spec, gaps in spec, pressures in spec, no leaks, etc.). Failure to properly inspect and maintain all four service brakes may compromise braking capability leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

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Figure 83: Example 1: B-60 on 57” Driver

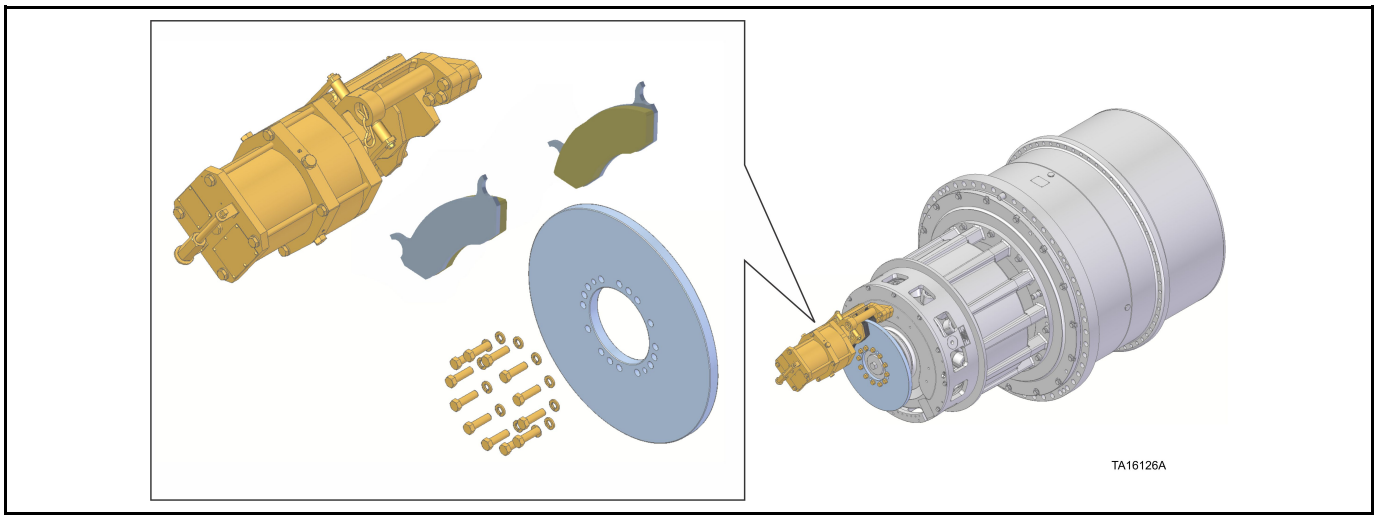
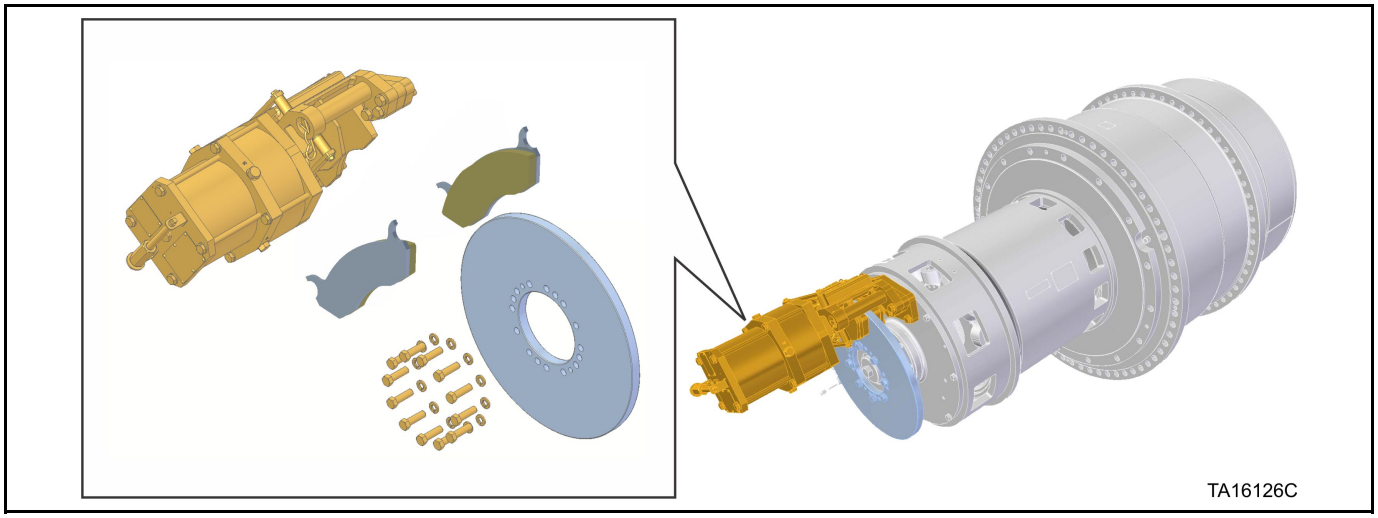


Figure 84: Example 2: B-40A on 51” Driver



Overspeed Prevention Recommendations

1. Each machine has a grade/speed chart that indicates the dynamic retarding limits of that specific machine when descending a grade. If either converter panels or motors have been disabled - the machine’s speed should be reduced when descending a grade to prevent a runaway situation.
2. Observe actual grade conditions as compared to the grade/speed chart for both loaded and unloaded conditions. The grade/speed chart is located inside the cab (refer to “Typical grade/speed chart”).
3. Reduce speed PRIOR to descending a grade.

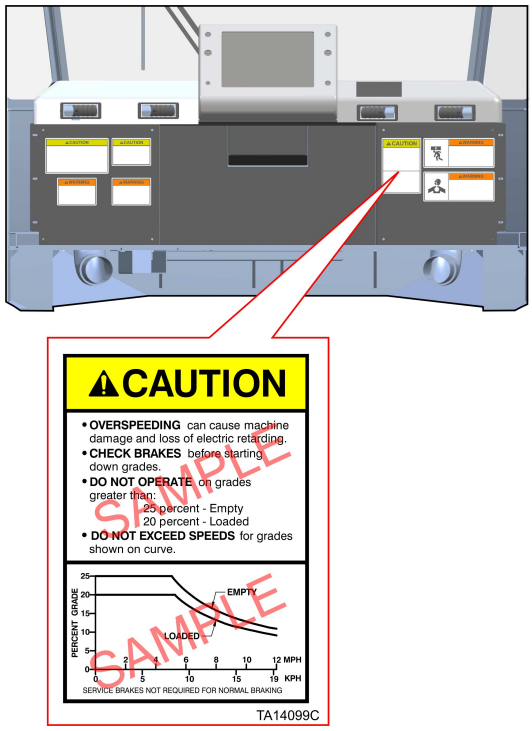
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4. As a general rule, descend a grade no faster than the speed the machine will ascend the same grade with the same load.
5. Promptly apply service brakes to slow the machine if an overspeed situation occurs.

⚠ WARNING

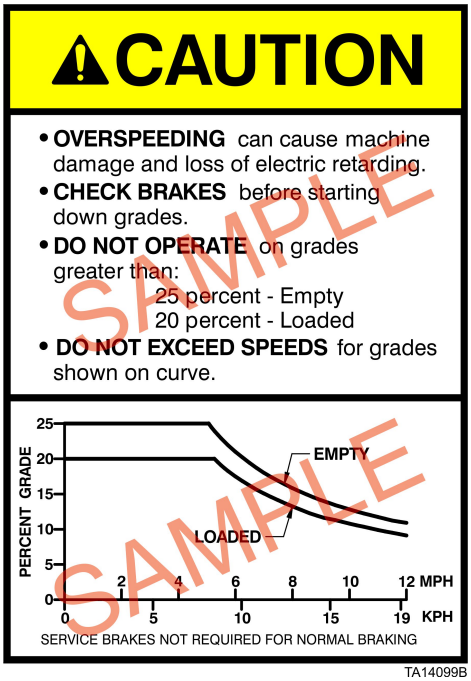
Failure to appropriately reduce the machine's speed while descending a grade with disabled converter panels and/or disabled motors can create the risk of a machine runaway leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

Figure 85: Typical grade/speed chart



NOTICE

An example of a grade/speed chart is shown here. Each type of machine is different. Refer to the grade/speed chart mounted in the operator's cab for accurate information for a specific machine.



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Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

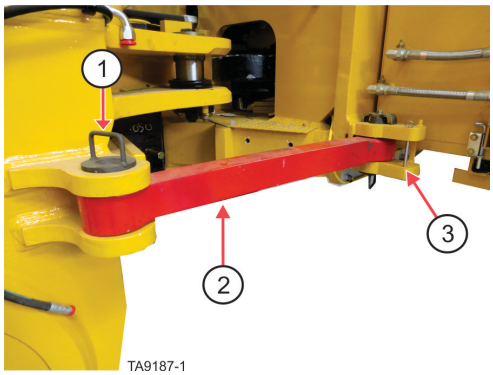
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 86: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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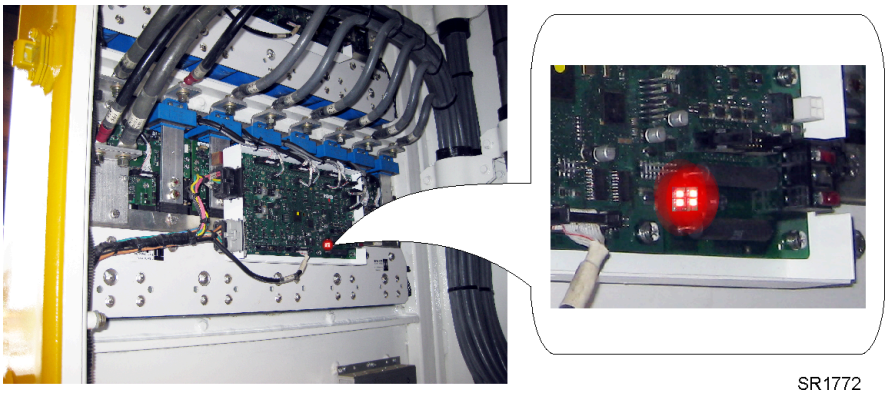
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 87: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

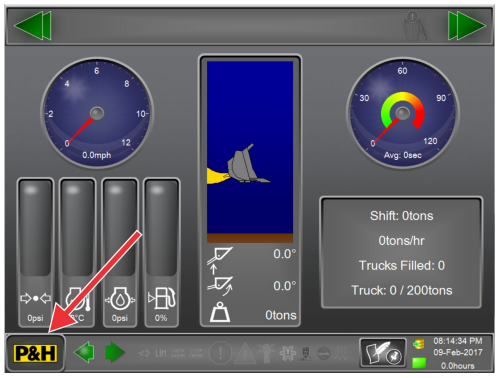
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 88: LINCS logging/monitoring menu access



TA15638-PH

Main Menu Button

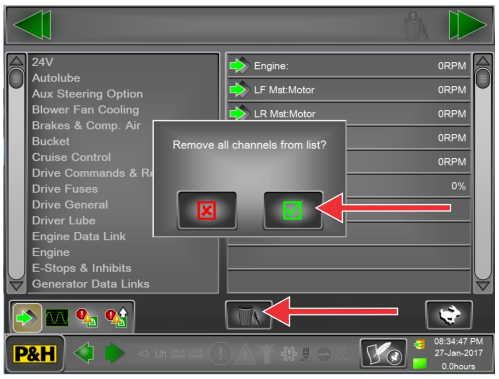


TA15639-PH

Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 89: Remove channels



TA15638a-PH

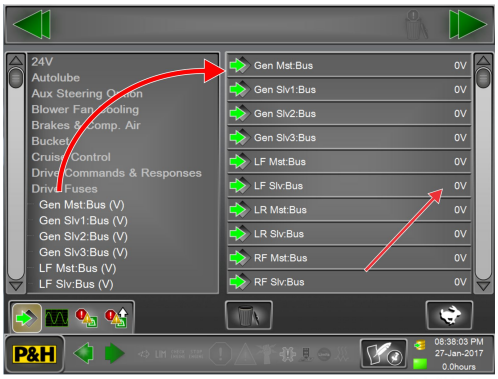
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 90: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 91: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 92: Isolation and control switch assembly

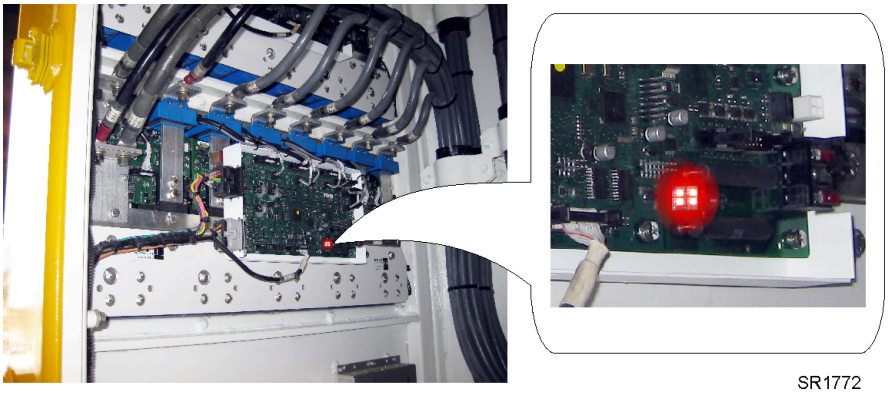


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 93: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

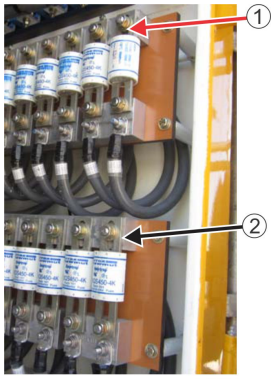
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 94: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

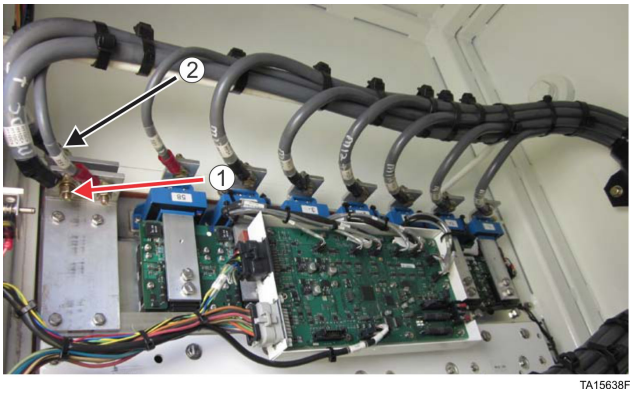
 © 2019 Komatsu Mining Corp. All rights reserved.

Figure 95: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 96: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Isolating the Drive Assembly

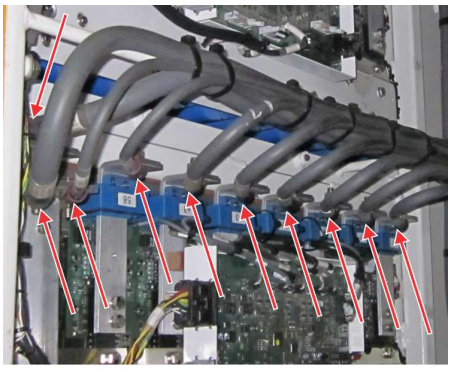
1. Disconnect all cable leads (+/- 1, 2, 3; Chopper (55 & 58, if connected), +/- DC) from the converter assembly.

NOTICE

If the converter assembly being isolated is for a motor, it is not necessary to move the grid connections as the motor will be operating at half power.

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Figure 97: Converter assembly cable connections



TA15639g



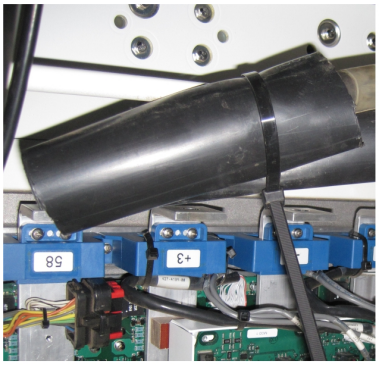
TA15639h

CAUTION

The use of two wrenches is required to prevent improper directional torque on nuts/bolts. Not doing so could cause damage to converter components.

2. Use cable ties and insulation sleeves to isolate the cables from the converter assembly.

Figure 98: Cable isolation and insulation



TA15639a

3. Remove the DC fuses (+ and -) associated with the converter assembly to be isolated. Fuses are located on the fuse assembly at the bottom of the high voltage cabinet.

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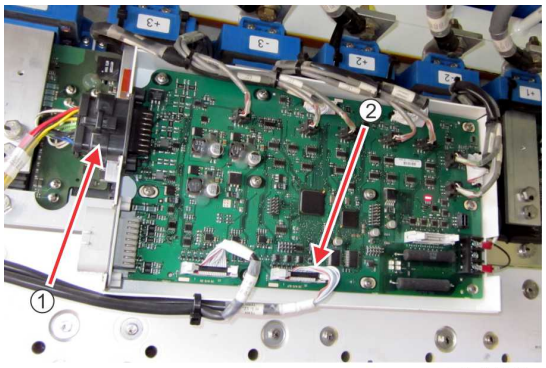
Figure 99: Fuse assemblies (L-2350 shown)



TA15639b

4. Disconnect the Vehicle/Power Connector (black) and the terminator cable from the master/slave out connector (J-8) on the SR control board of the slave converter assembly.

Figure 100: SR control board



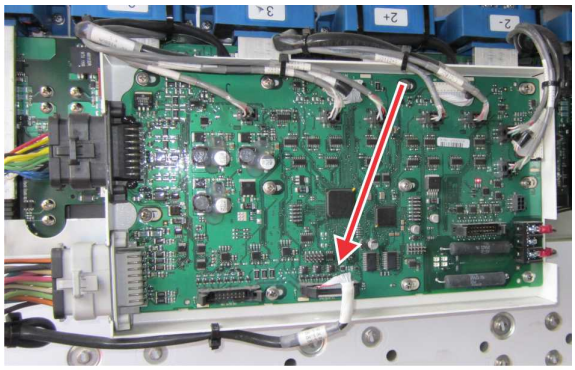
TA15640g

1) Vehicle/Power Connector, **2)** Master/Slave Out Connector (J-8)

5. Disconnect the cable connected to the master converter assemblies Master/Slave Out connector (J-8) and connect the terminator cable, located in the wire bundle, into connector J-8 of the master SR control board.

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Figure 101: SR control board – terminator cable

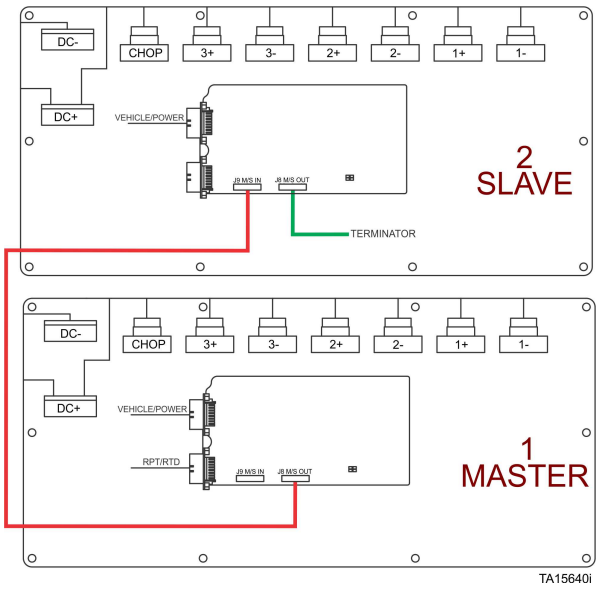


TA15640h

NOTICE

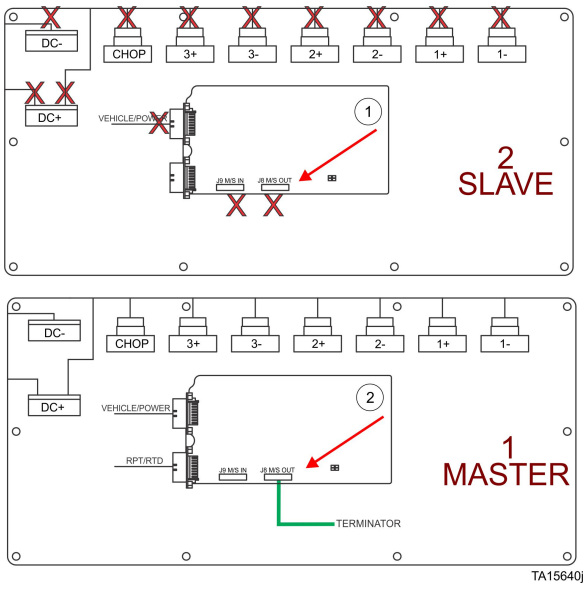
There is a terminator cable routed with each cable bundle. This cable does not have to be re-routed from the slave converter assemblies.

Figure 102: Isolated single slave connections



TA15640i

Original Connections



TA15640j

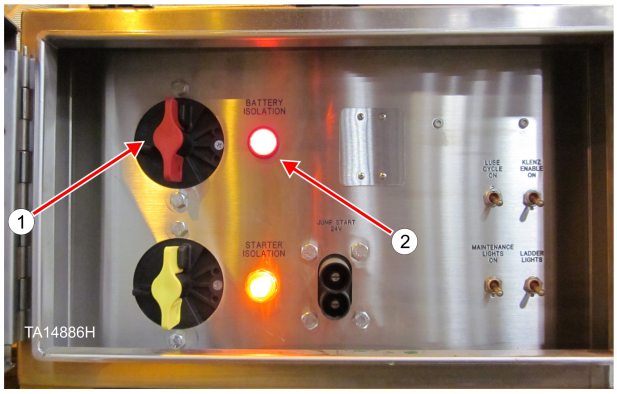
1.) Remove Terminator **2.)** Attach Terminator

Isolated Slave Connections

6. Turn the Battery Isolation Switch to the ON position (the red light will illuminate to indicate 24V has been enabled).

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Figure 103: Isolation and control switch assembly



1) Battery Isolation Switch (shown in ON position), **2)** Battery Isolation Indicator

7. Boot LINCS, clear miscellaneous alarms, and log in using a Maintenance level or higher user access key (I-button).
8. Navigate to the Configure Drive screen

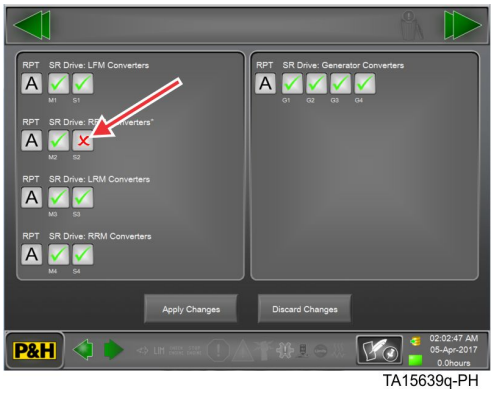
Figure 104: LINCS configuration menu



9. Locate the appropriate converter assembly and select the green check mark to reduce the number of converter assemblies on the associated drive to one less than shown on display (e.g. 2 to 1, 3 to 2, etc.). The green check will change to a red X to indicate the converter has been isolated.

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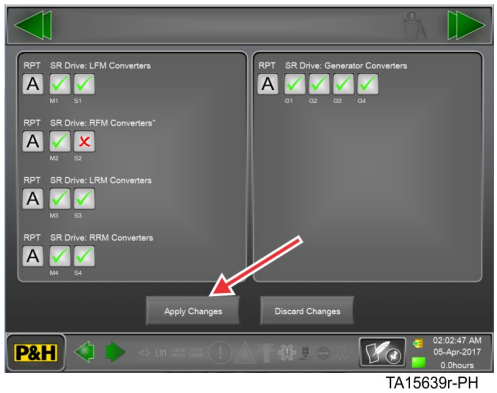
Figure 105: LINCS drive configuration menu (example)



TA15639q-PH

10. Select Apply Changes.

Figure 106: LINCS drive configuration menu apply changes (example)



TA15639r-PH

11. Reboot LINCS.

12. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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Isolating a Slave Converter Assembly in a Multiple Slave Drive (generator only)

The converter assemblies are scalable and so are capable of having multiple assemblies per component. Referring to the chart below, the L-1350 has one converter assembly per motor while the L-1850 and L-2350 will have two converter assemblies per motor. The generator converter assemblies will have 3, or 4 assemblies, depending on machine type.

Machine Type	Wheel Motor Converter Assemblies	Generator Converter Assemblies	Total Converter Assemblies
L-1350	4 (1 per motor)	3	7
L-1850, L-2350	8 (2 per motor)	4	12

NOTICE

- *Isolating a converter assembly should only be performed in the event that a faulty converter assembly cannot be changed out for an operational unit, and should only be completed by a qualified technician.*
- *The same procedures are used whether isolating a generator converter assembly or a motor converter assembly. Generator converter assemblies typically do not have grid connections (with the exception of L-1350's). On L-1350's, there are grids connected to both generator slave converter assemblies; therefore, if isolating a L-1350 generator converter assembly, if a grid is connected, it must be moved to an operational generator converter assembly.*

Operation of Machine with Motors and/or Converter Panels Disabled

SR drive machines are capable of operating with convertor panels and/or motors disabled.

⚠ WARNING

Operation of the machine on less than four wheel motors, or with any of the converter panels disabled, will result in a reduction in electric (dynamic) braking and could possibly lead to an overspeed on grades and/or longer stopping distances when using dynamic braking. Failure to properly employ the service brake under these conditions could lead to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

If the wheel motor or converter panel has been isolated using the proper procedure, the operators panel will display a small illuminated yellow gear cog (Drive System Abnormal icon). There are no messages when booting LINCS, starting engine, or releasing brakes. If this icon is illuminated, the operator must be aware that the machine has reduced electric braking and the operator must verify that all four service brakes are functional to stop the machine.

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Figure 107: Drive System Abnormal Icon



Service Brakes

While the machine is capable of operating on less than four wheel motors, the service brakes on all four wheel motors must be fully functional and capable of stopping the driver and wheel whenever the machine is being operated. This means that:

- The traction motor must be installed
- The traction motor or driver cannot be altered in any fashion
- Middle pinion on 57” driver cannot be removed

⚠ WARNING

The machine should only be operated with less than four service brakes in order to move the machine away from a dangerous situation. Do not tram the machine or operate the machine in production with less than four service brakes. The service brakes must be maintained and working properly (e.g.., disks in spec, pads in spec, gaps in spec, pressures in spec, no leaks, etc.). Failure to properly inspect and maintain all four service brakes may compromise braking capability leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

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Figure 108: Example 1: B-60 on 57” Driver

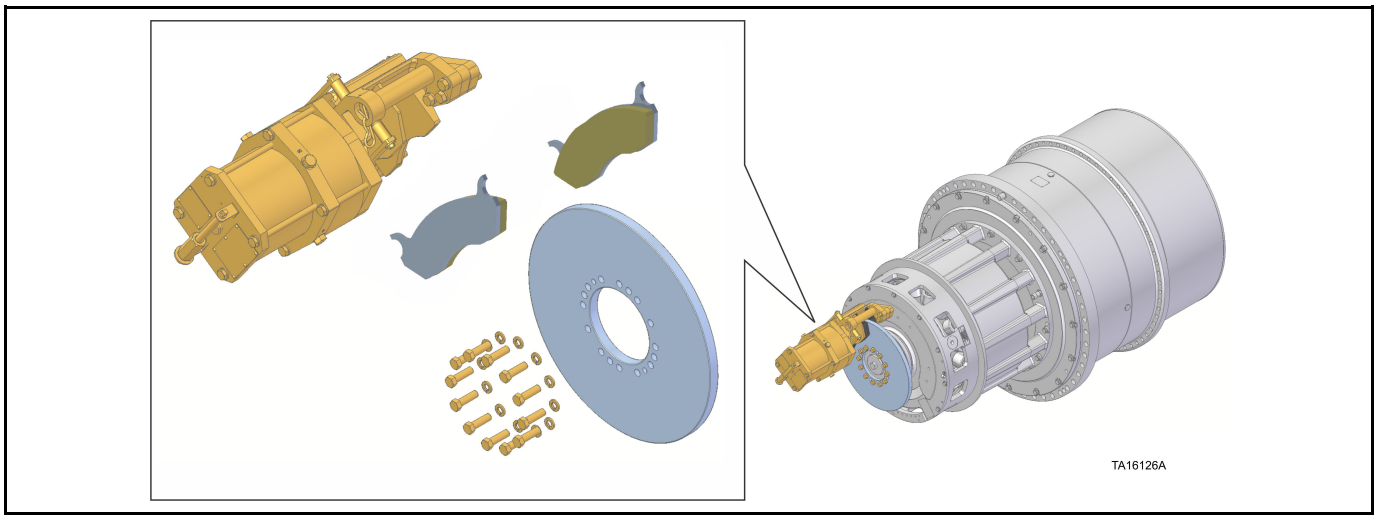
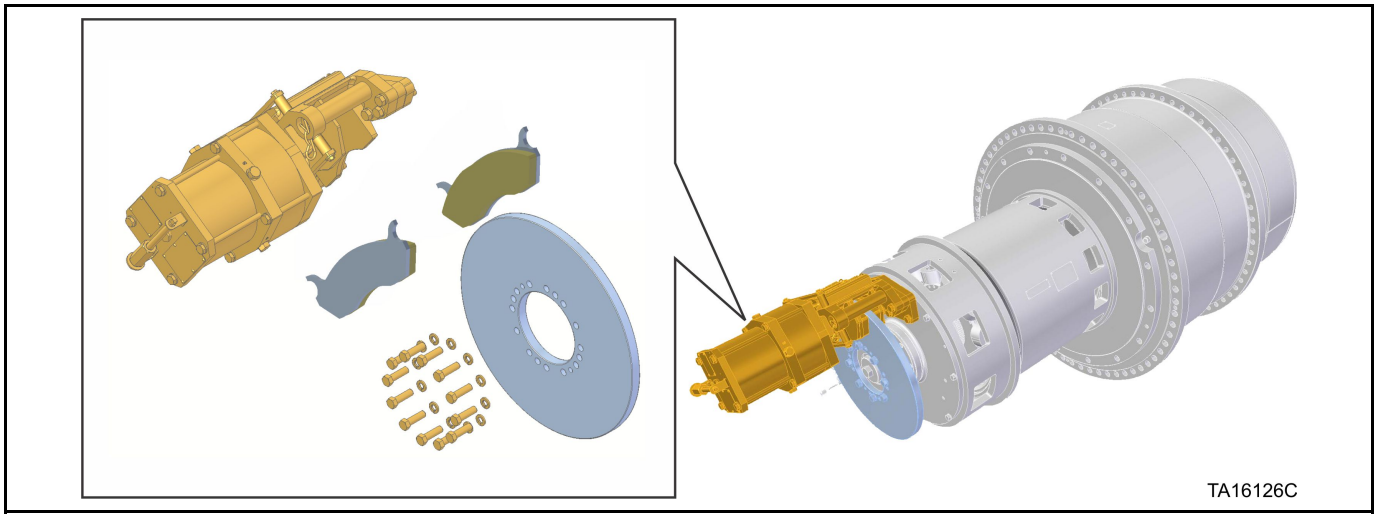


Figure 109: Example 2: B-40A on 51” Driver



Overspeed Prevention Recommendations

1. Each machine has a grade/speed chart that indicates the dynamic retarding limits of that specific machine when descending a grade. If either converter panels or motors have been disabled - the machine’s speed should be reduced when descending a grade to prevent a runaway situation.
2. Observe actual grade conditions as compared to the grade/speed chart for both loaded and unloaded conditions. The grade/speed chart is located inside the cab (refer to “Typical grade/speed chart”).
3. Reduce speed PRIOR to descending a grade.

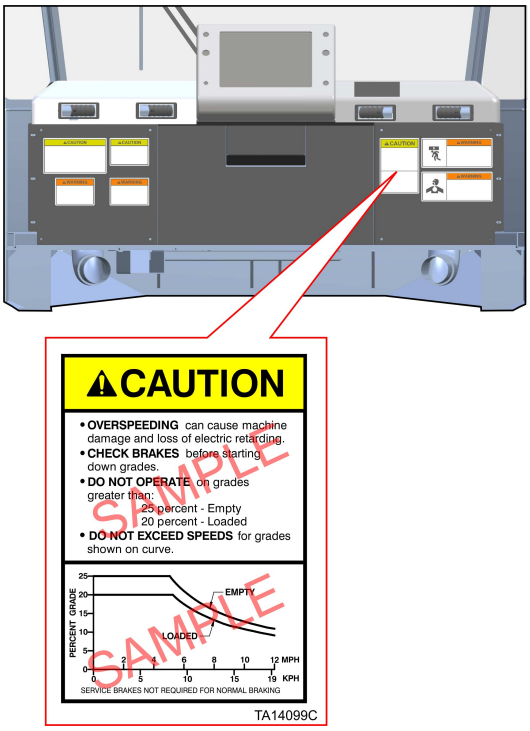
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4. As a general rule, descend a grade no faster than the speed the machine will ascend the same grade with the same load.
5. Promptly apply service brakes to slow the machine if an overspeed situation occurs.

⚠ WARNING

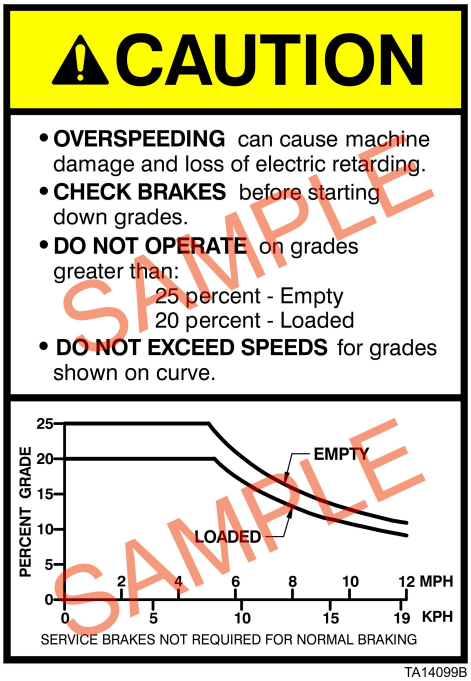
Failure to appropriately reduce the machine's speed while descending a grade with disabled converter panels and/or disabled motors can create the risk of a machine runaway leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

Figure 110: Typical grade/speed chart



NOTICE

An example of a grade/speed chart is shown here. Each type of machine is different. Refer to the grade/speed chart mounted in the operator's cab for accurate information for a specific machine.



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Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

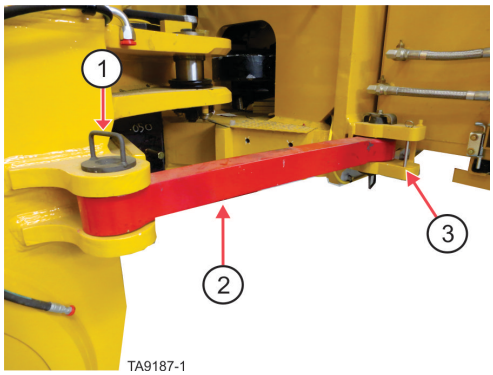
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 111: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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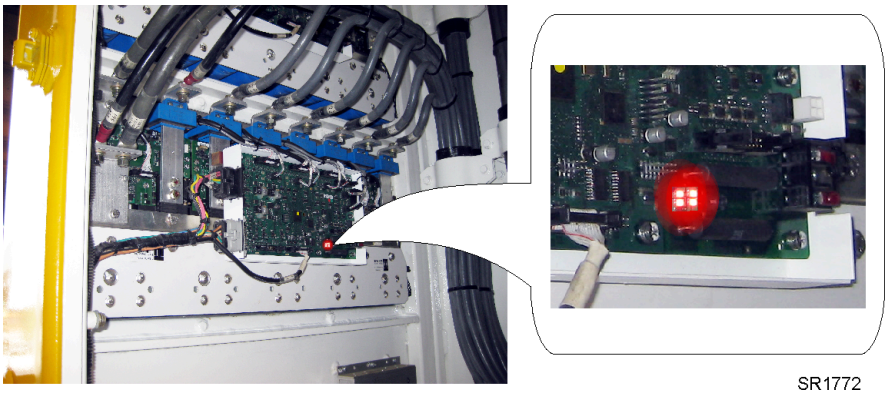
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 112: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

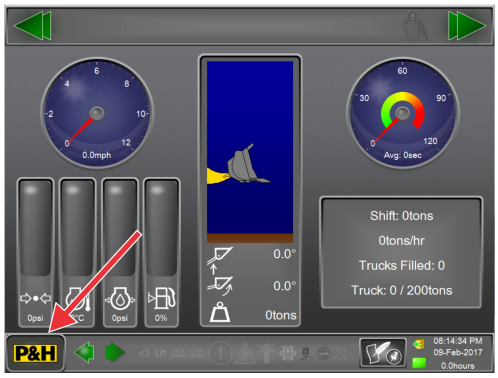
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 113: LINCS logging/monitoring menu access



TA15638-PH

Main Menu Button

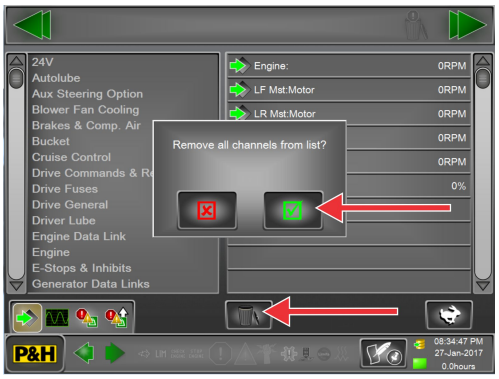


TA15639-PH

Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 114: Remove channels



TA15638a-PH

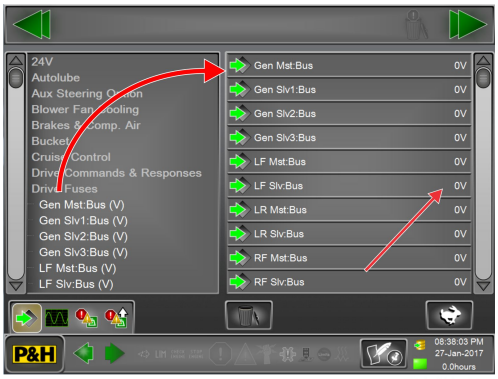
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 115: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 116: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

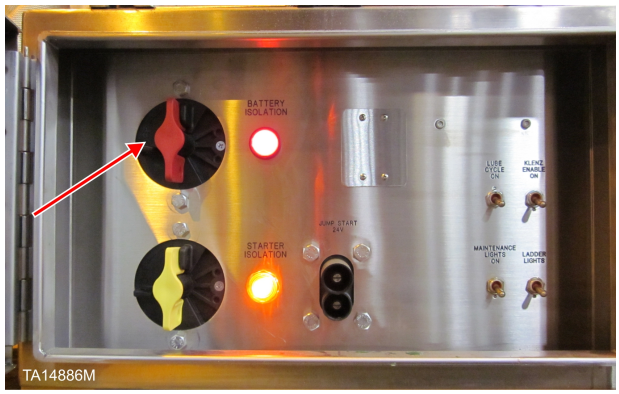
Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 117: Isolation and control switch assembly



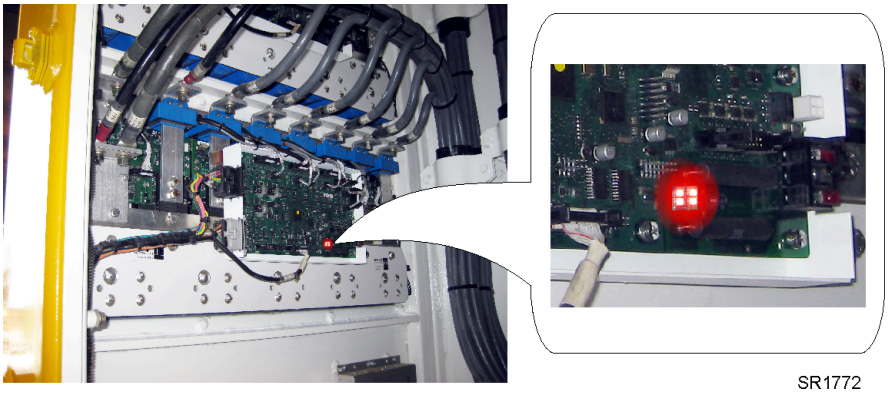


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 118: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

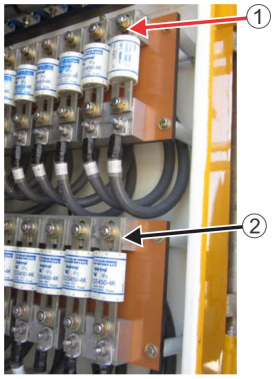
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 119: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

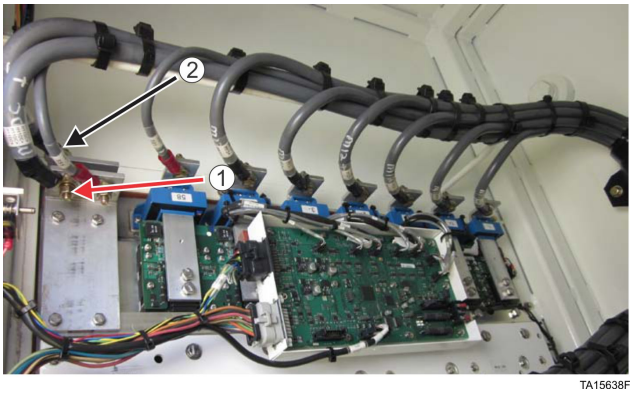
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Figure 120: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 121: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

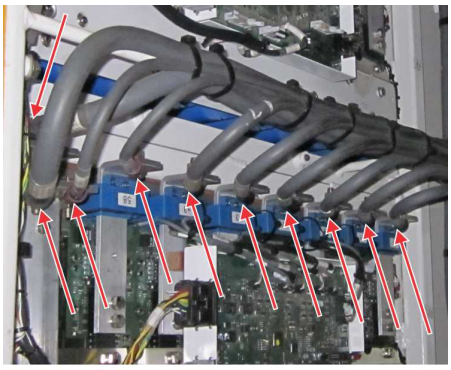
Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Isolating the Drive Assembly

1. Disconnect all cable leads (+/- 1, 2, 3; Chopper (55 & 58, if connected), +/- DC) from the converter assembly.

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Figure 122: Converter assembly cable connections



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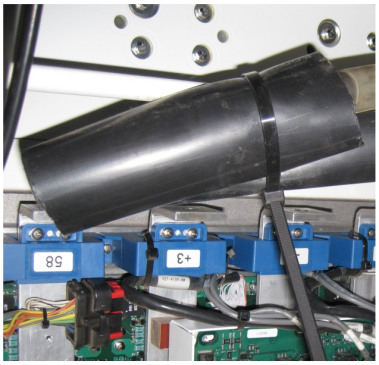
TA15639h

CAUTION

The use of two wrenches is required to prevent improper directional torque on nuts/bolts. Not doing so could cause damage to converter components.

2. Use cable ties and insulation sleeves to isolate the cables from the converter assembly.

Figure 123: Cable isolation and insulation



TA15639a

3. Remove the DC fuses (+ and -) associated with the converter assembly to be isolated. Fuses are located on the fuse assembly at the bottom of the high voltage cabinet.

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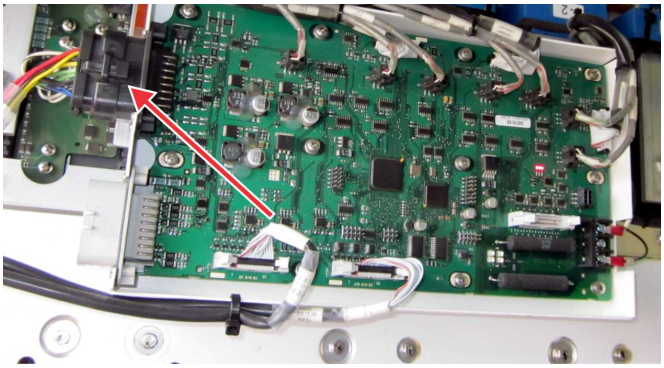
Figure 124: Fuse assembly (L-2350 shown)



TA15639b

4. Disconnect the Vehicle/Power Connector (black) from the SR control board.

Figure 125: SR control board slave converter assembly



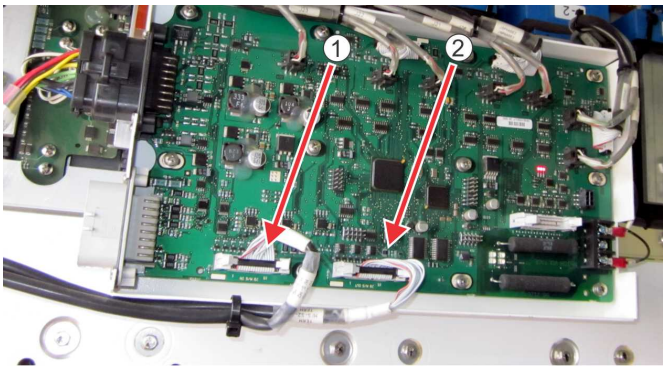
TA15640k

5. Isolating slave converter assembly:

   a. **If the slave converter assembly is NOT the last converter assembly in the drive:** Disconnect the existing cable that runs from the isolated slave unit (J8) to the next slave unit (J9). Disconnect the cable from the master/slave in connector (J9), cut the securing cable ties and reroute to the next converter assembly in the drive (refer to figure 'Isolating Non-Terminating Slave Assembly').

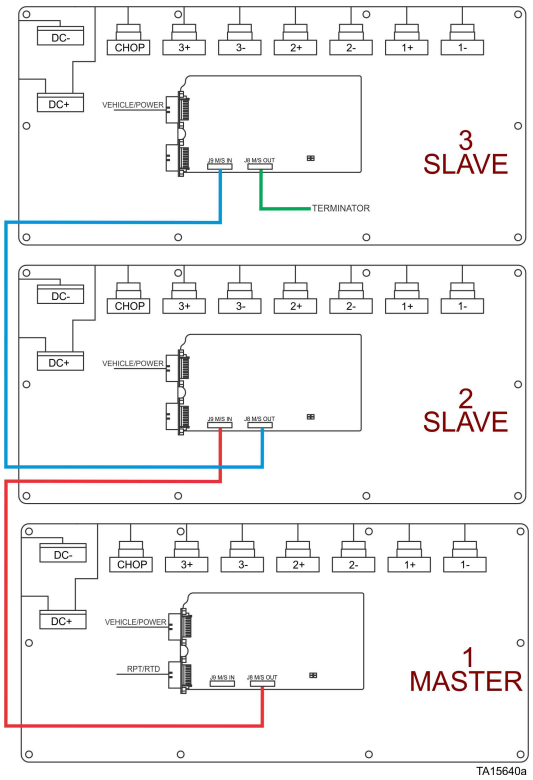
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Figure 126: Master/slave connectors

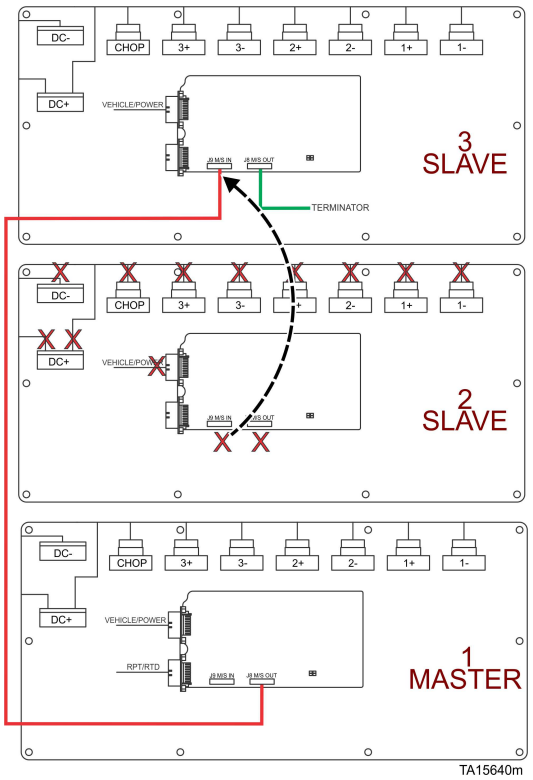


1) Master/Slave IN J9, **2)** Master/Slave OUT J8

Figure 127: Isolating non-terminating slave assembly



Original Connections

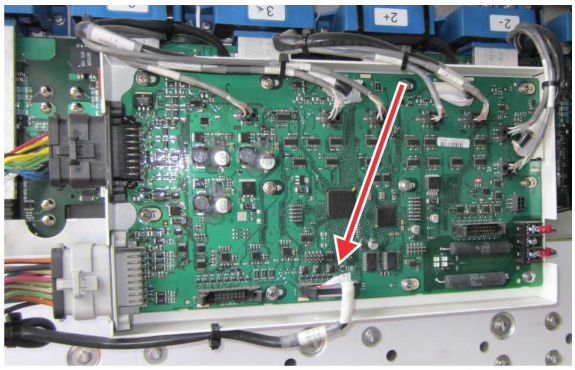


Isolated Slave Connections when slave converter assembly is not the last converter assembly in the drive

b. Slave converter assembly is the last converter assembly in the drive: Remove the terminator cable from master/slave out connector (J8) and relocate the terminator cable to the previous converter assembly in the drive (refer to figure ‘Isolating Terminating Slave Assembly’).

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Figure 128: SR control board – terminator cable

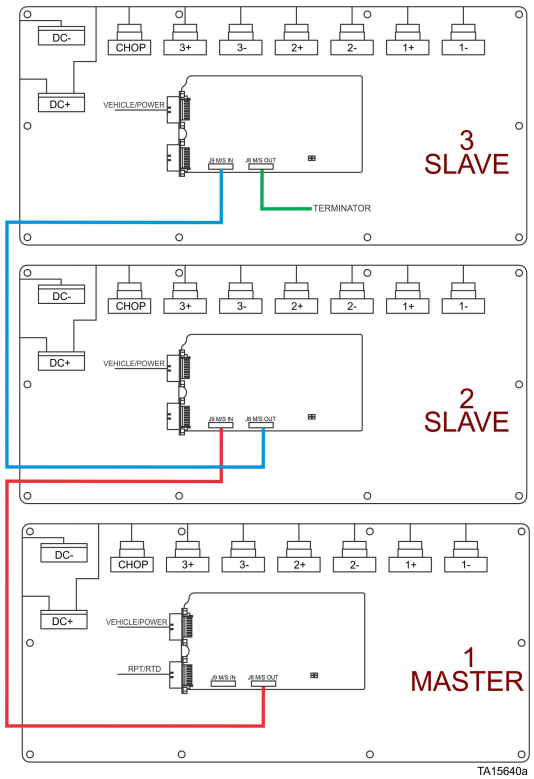


TA15640h

NOTICE

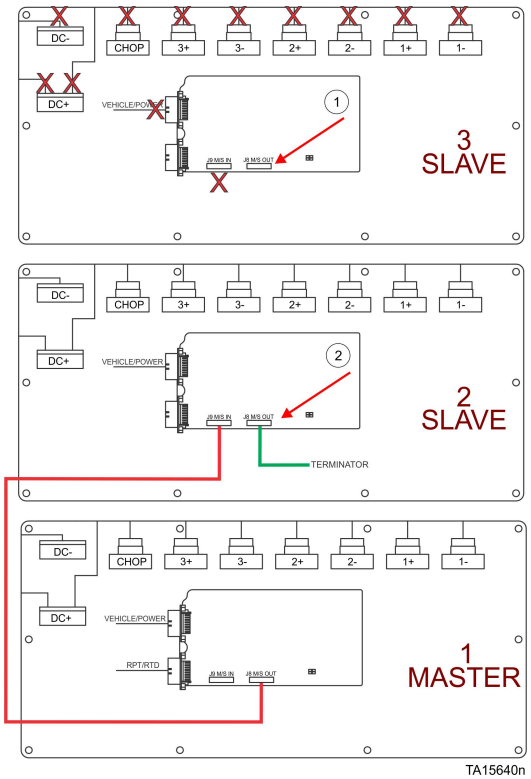
There is a terminator cable routed with each cable bundle. This cable does not have to be re-routed from the slave converter assemblies.

Figure 129: Isolating terminating slave assembly



TA15640a

Original Connections



TA15640n

1) Remove Terminator**2)** Attach Terminator

Isolated Slave Connections – Slave converter assembly is last converter assembly in drive

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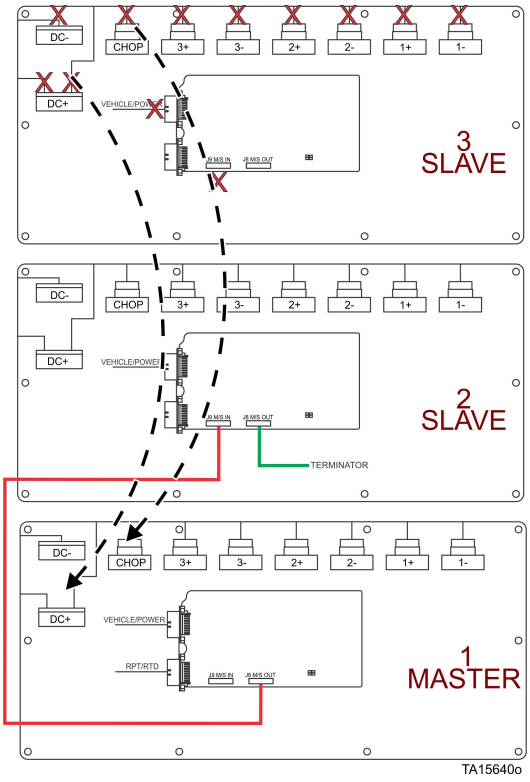
NOTICE

If the converter assembly being isolated is for an L-1350 slave converter assembly, the grid connections must be moved to the master converter assembly.

⚠ WARNING

Reduced electric (dynamic) braking may result if the grid connections (55 and 58) are not relocated from the isolated generator converter assembly to an operational generator converter assembly. Relocate the grid connections to an operational generator converter assembly before operating the machine. Operation of the machine without relocation of the grid connections will result in the electric (dynamic) braking being reduced causing reduced operating speeds while digging, longer stopping times, and the higher potential for over speed on grades.

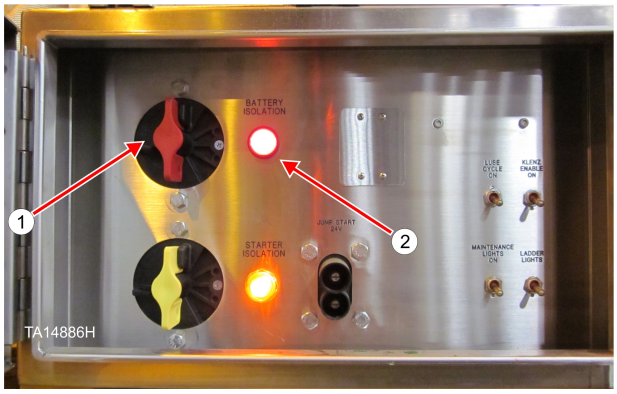
Figure 130: L-1350 grid cable relocation



6. Turn the Battery Isolation Switch to the ON position (the red light will illuminate to indicate 24V has been enabled).

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Figure 131: Isolation and control switch assembly



1.) Battery Isolation Switch (shown in ON position), **2)** Battery Isolation Indicator

7. Boot LINCS, clear miscellaneous alarms, and log in using a Maintenance level or higher user access key (I-button).
8. Navigate to the Configure Drive screen

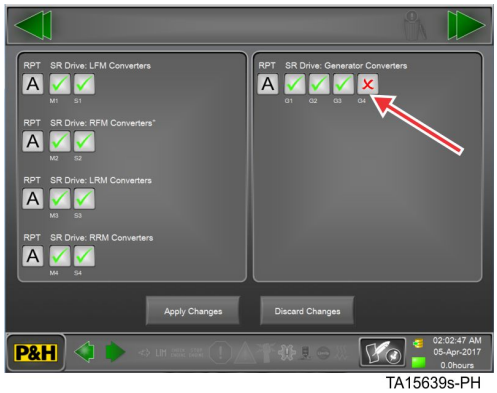
Figure 132: LINCS configuration menu



9. Locate the appropriate converter assembly and select the green check mark to reduce the number of converter assemblies on the associated drive to one less than shown on display (e.g. 2 to 1, 3 to 2, etc.). The green check will change to a red X to indicate the converter has been isolated.

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Figure 133: LINCS drive configuration generator converter isolation (example)



TA15639s-PH

10. Select Apply Changes

Figure 134: LINCS drive configuration generator converter apply changes (example)



TA15639t-PH

11. Reboot LINCS.

12. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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Transporting a Converter Assembly

Damage can occur to the converter assembly during field assembly and commissioning, from contact during maintenance, during removal from the loader for warranty or repair, and especially during transportation within the mine and between mines and repair centers.

While the panels are designed to withstand the rigors of the application, they contain electronic control components which always require a reasonable amount of care to avoid damage.

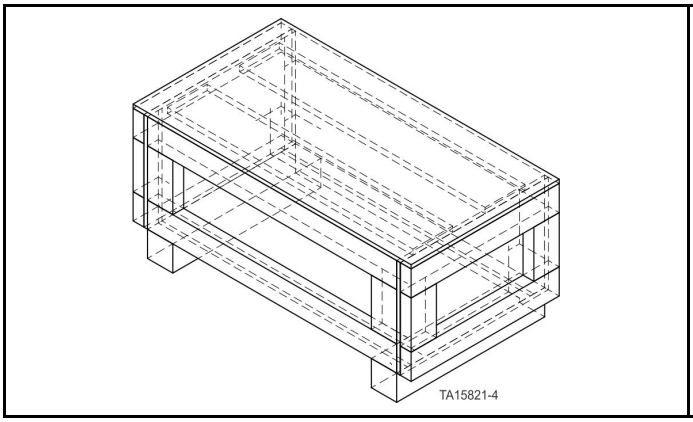
1) Handle with care! – Always lift panels by the frame and take care not to bump or scrape the control boards.

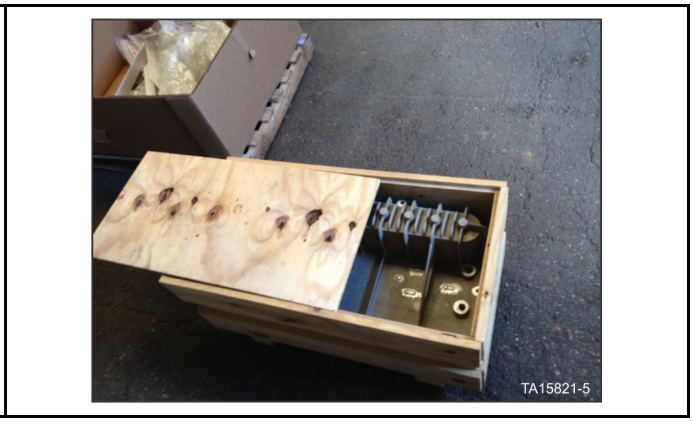
2) Minimize contact – While installed on the machine, there are no preventative maintenance (PM) activites required for the panels, so entering the panel cabinet to clean, inspect, or touch the panels is generally not necessary. Troubleshooting panels is generally accomplished using information from fault screens and data downloads. When entering the high voltage (power converter) cabinet to remove, install, or troubleshoot, never climb on components.

3) Always use an approved shipping container – resting a panel unsupported with control side down will almost always create stress-related damage. Loading the panel in a box with other components that can contact the panels while being bumped around in transit is a very common source of damage. Contamination from dust and debris and a variety of material can largely be eliminated by using the approved container.

The use of a transportation box (P/N R1040981) is the only approved method for shipping / transporting converter panels. Transportation boxes are required when transporting panels from the loader to the shop, and when returning panels to a service center or the factory. Failure to use this transport box can result in additional rebuild costs. Drawings of this box are available on request. For more information, contact your local Komatsu Service Center.

Figure 135: Converter assembly transportation container





CAUTION

Never climb on or grasp any electrical equipment, modules, cable leads, frames, etc. in the high voltage (electrical converter) cabinet. Equipment damage can occur.

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Converter Assembly Replacement

Safety Preparations

⚠ WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

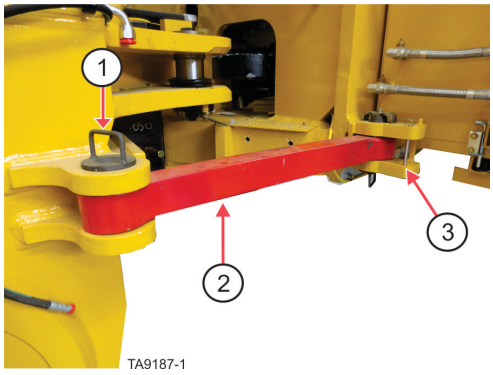
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

⚠ WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 136: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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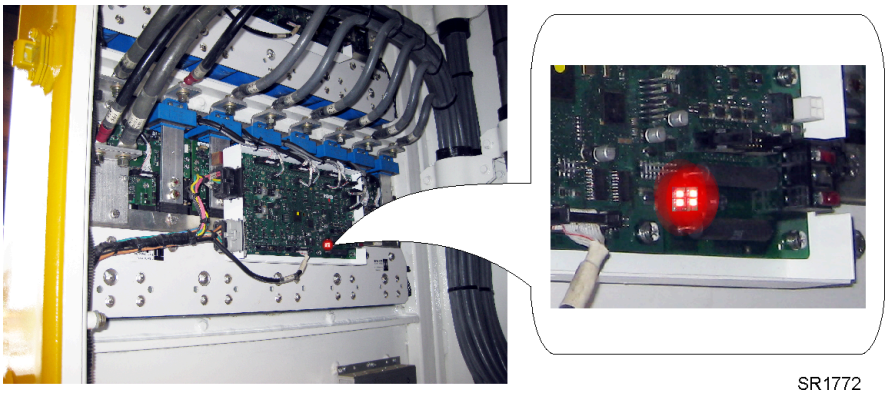
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 137: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

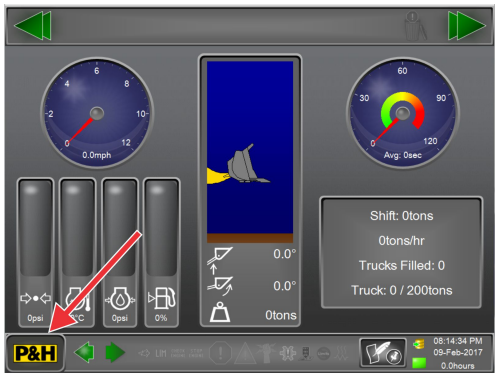
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 138: LINCS logging/monitoring menu access



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Main Menu Button

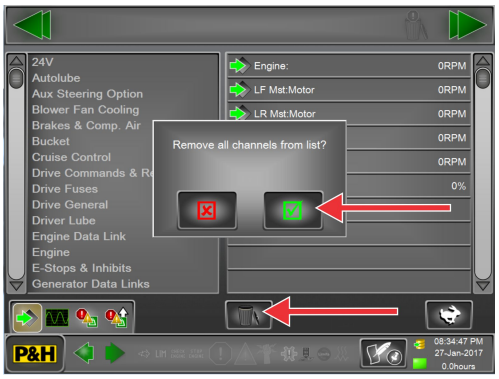


TA15639-PH

Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 139: Remove channels



TA15638a-PH

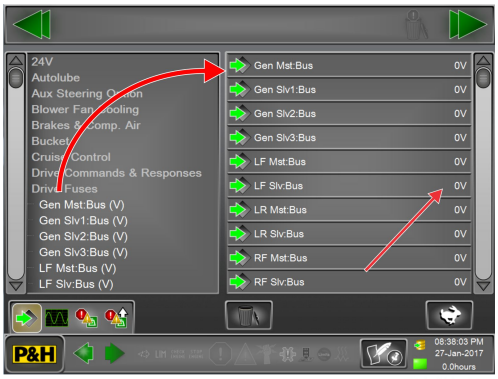
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 140: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 141: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

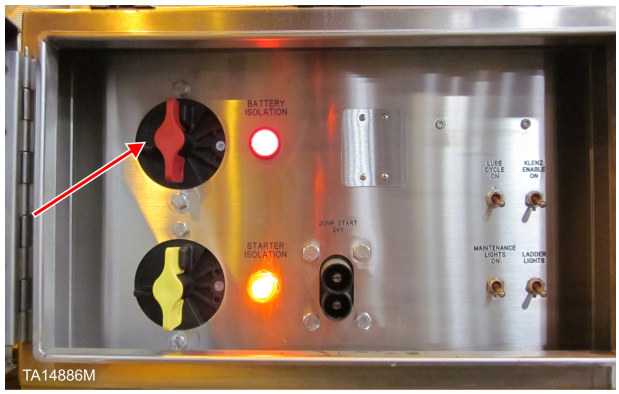
Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 142: Isolation and control switch assembly



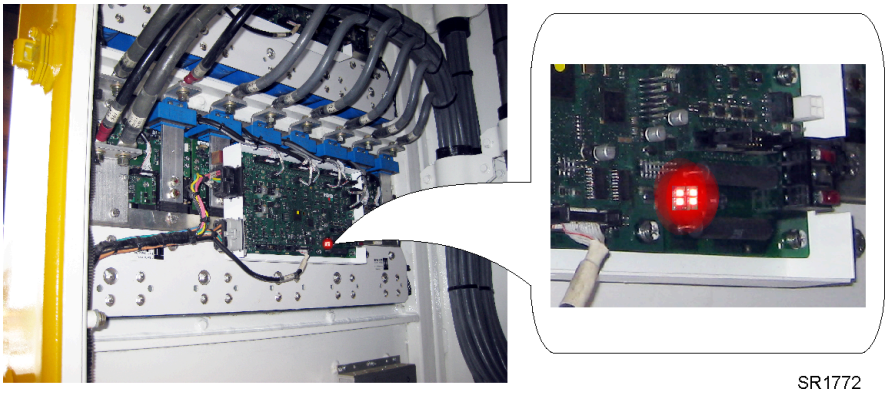


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 143: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

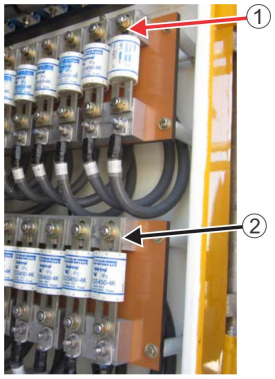
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 144: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

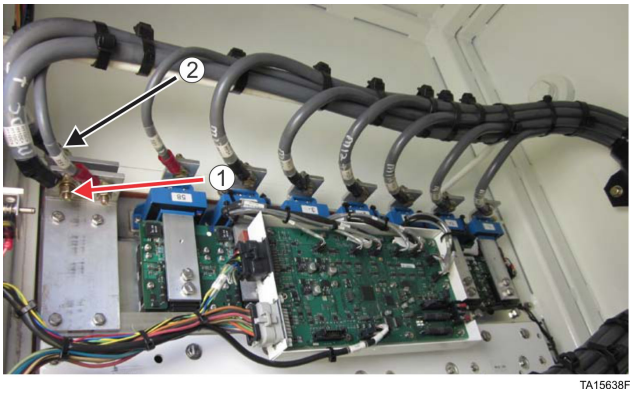
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Figure 145: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 146: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Removing A Converter Assembly

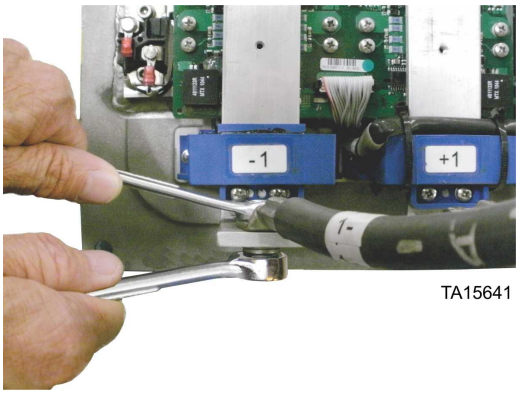
1. Disconnect motor cable leads (+/-1, 2,3), chopper cables (55X and 58X) (if attached), and +/- bus cables from assembly.

CAUTION

The use of two wrenches is required to prevent improper directional torque on nuts/bolts. Not doing so could cause damage to converter components.

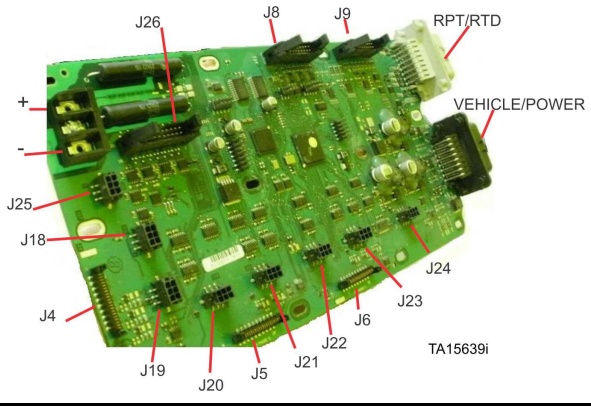
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Figure 147: Cable removal



2. Disconnect the following cables/connectors from the converter assembly SR control board:
   - RPT/RTD connecter (Master convertor assembly only).
   - Vehicle/Power connector.
   - J-8
   - J-9 (Slave converter assembly only)
   - +/- Bus voltage wires

Figure 148: SR control board connections



NOTICE

Make sure there are no cable ties holding any cables to the casing around the SR control board. These must all be removed in order to fully remove the converter assembly.

3. Close the coolant supply valve.

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Figure 149: Coolant supply valve



TA15641a

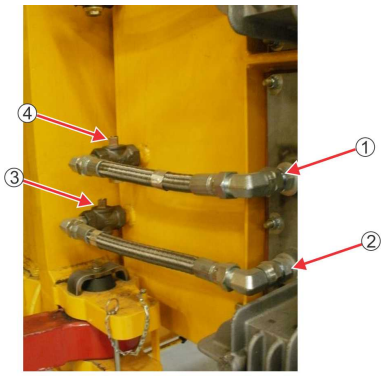
4. If the machine has a similar valve for coolant return, close it as well.

NOTICE

Some machines have a check valve instead of a coolant return valve.

5. Disconnect the coolant supply and return hoses from the converter assembly.

Figure 150: Coolant lines



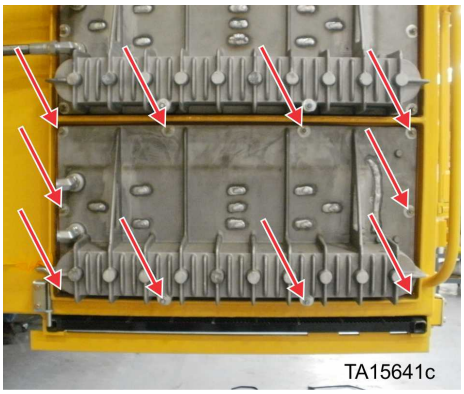
TA15641b

1) Supply hose, **2)** Return hose, **3)** Return valve, **4)** Supply valve

6. Remove the nuts from the outside of the converter assembly.

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Figure 151: Converter assembly outside nuts



7. Remove the converter assembly from the electrical converter cabinet.

⚠ CAUTION

Crush hazard exists. Using improper lifting techniques or inadequate equipment could cause the load to fall and crush. Removal or installation of the converter assembly is a two man lift, or ideally a lifting device such as a come-along or a crane suitably rated for the weight of the component may be used. If using a lifting device, be certain that the lifting devices are firmly attached to the component being lifted. Keep all persons clear of the area when lifting, lowering or moving the component being removed or installed.

NOTICE

A converter assembly weighs approximately 125 pounds (57kg). A crane or come-along can be used to assist in the removal or installation of the converter assembly. All safety precautions for using the tool must be observed.

Figure 152: Removing converter assembly using lifting device



8. Remove the gasket seal from the cabinet if it did not come off with the converter assembly.
9. Clean or replace the gasket seal and clean the mating surface on the electrical converter cabinet.

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Installing A Converter Assembly

⚠ CAUTION

Crush hazard exists. Using improper lifting techniques or inadequate equipment could cause the load to fall and crush. Removal or installation of the converter assembly is a two man lift, or ideally a lifting device such as a come-along or a crane suitably rated for the weight of the component may be used. If using a lifting device, be certain that the lifting devices are firmly attached to the component being lifted. Keep all persons clear of the area when lifting, lowering or moving the component being removed or installed.

NOTICE

A converter assembly weighs approximately 125 pounds (57kg). A crane or come-along can be used to assist in the removal or installation of the converter assembly. All safety precautions for using the tool must be observed.

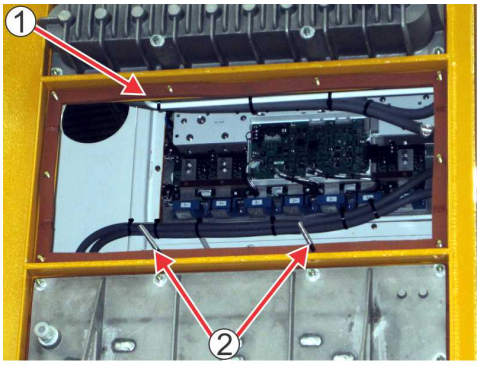
1. Install the gasket seal.

CAUTION

Make sure the gasket seal is properly in place prior to securing panel. Improper seal may result in water and dust penetration.

2. Using the guide rods, install the converter assembly.

Figure 153: Gasket seal & guide rods



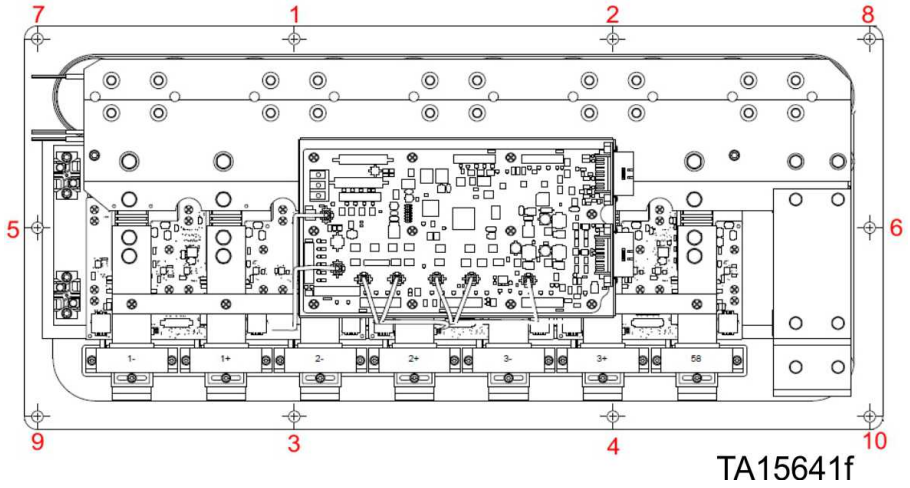
TA15641e

1) Gasket seal, **2)** Guide rods

3. Install nuts on outside of converter assembly.
4. Torque nuts to 8 ft-lbs (11 N-M) using proper sequence.

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Figure 154: Torque sequence

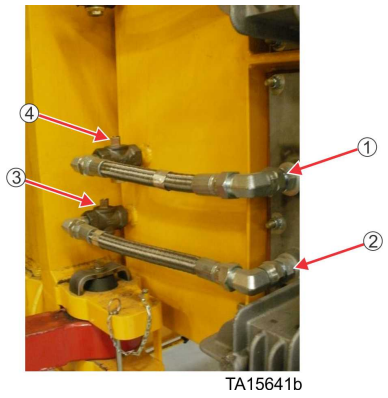


NOTICE

Torque using the above sequence at specified value until no movement is noticed on each nut. Repeat sequence as many times as necessary to ensure torque.

5. Use RTV/Silicon on outside of converter assembly to provide a waterproof seal.
6. Connect the coolant supply and return lines to the converter assembly.

Figure 155: Coolant lines (shown with valve on supply and return)



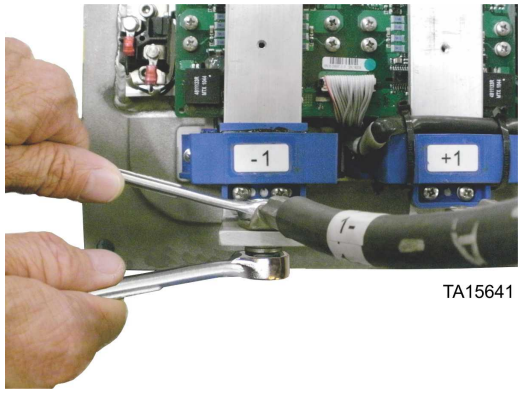
1) Supply hose, **2)** Return hose, **3)** Return valve, **4)** Supply valve

7. Open the coolant supply valve.
8. If applicable, open the coolant return valve.
9. Check the system for leaks.
10. Verify coolant level in surge and reservoir.

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11. Install the motor cable leads (+/-1, 2,3), chopper cables (55x and 58x) (if attached), and +/- bus cables from assembly.

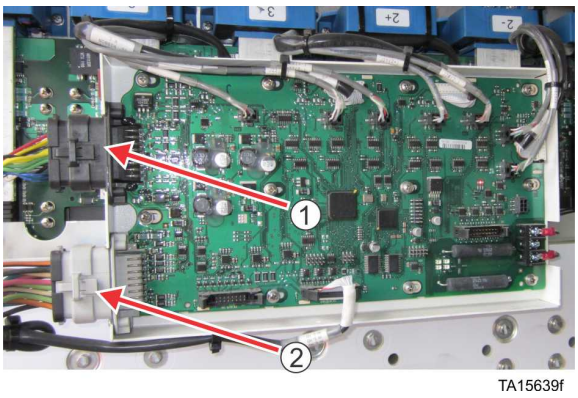
Figure 156: Cable installation



12. Install the RPT/RTD cable (if applicable).

13. Install the Vehicle/Power cable.

Figure 157: Vehicle/power and RPT/RTP connectors



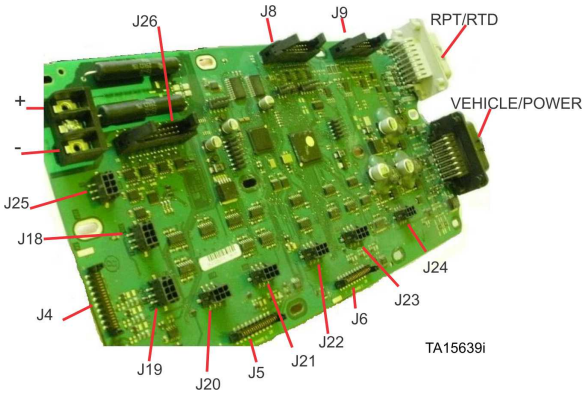
1) Vehicle/Power connector, **2)** RPT/RTD Connector

14. Install cable to connector J-8.

15. Install cable connector/terminator into J-9 (if applicable).

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Figure 158: SR control board connections



NOTICE

If the converter assembly is part of a Master/Slave package, the current sharing test must be performed.

16. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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SR Control Board Connectors

Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

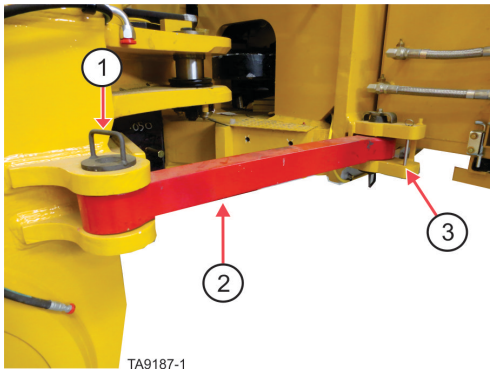
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 159: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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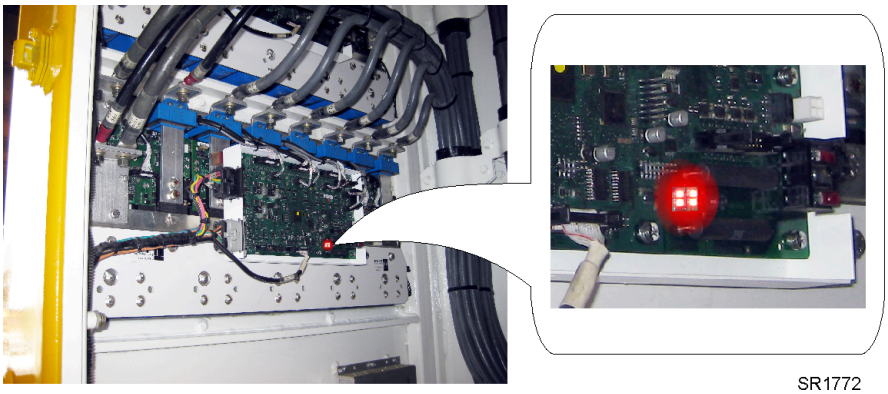
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 160: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

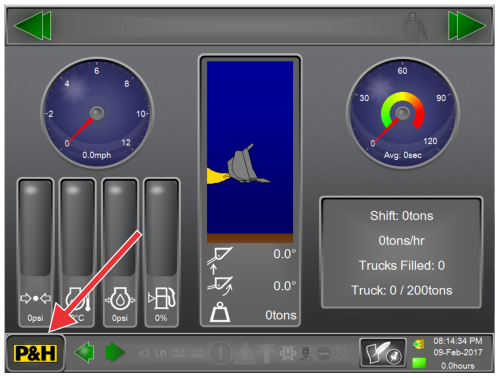
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 161: LINCS logging/monitoring menu access



TA15638-PH

Main Menu Button

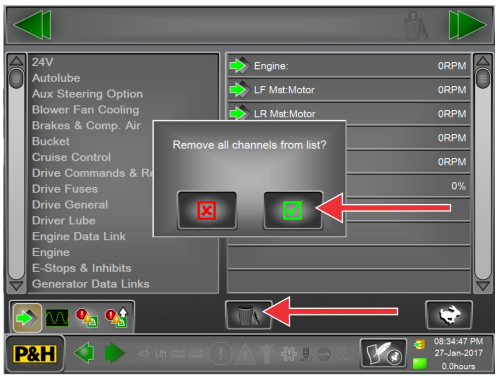


TA15639-PH

Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 162: Remove channels



TA15638a-PH

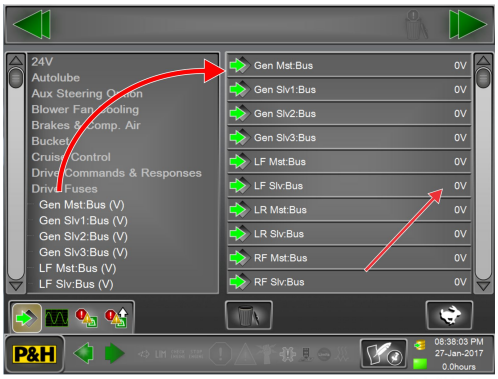
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 163: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 164: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 165: Isolation and control switch assembly

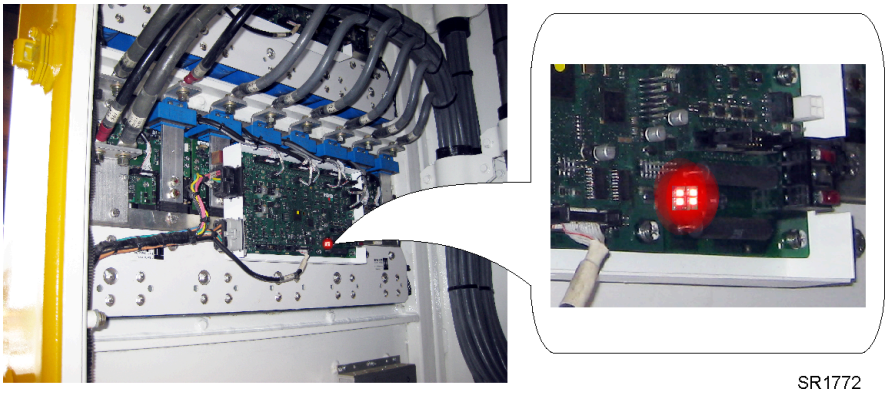


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 166: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

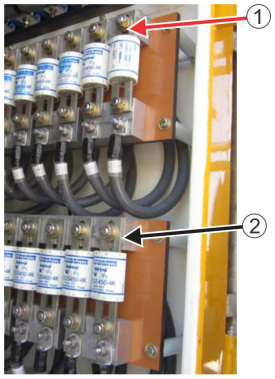
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 167: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

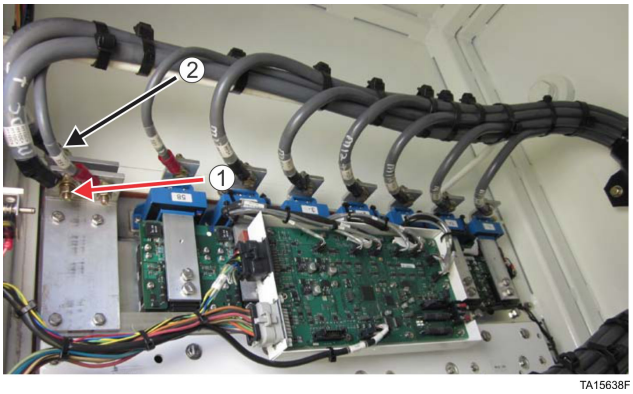
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Figure 168: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 169: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

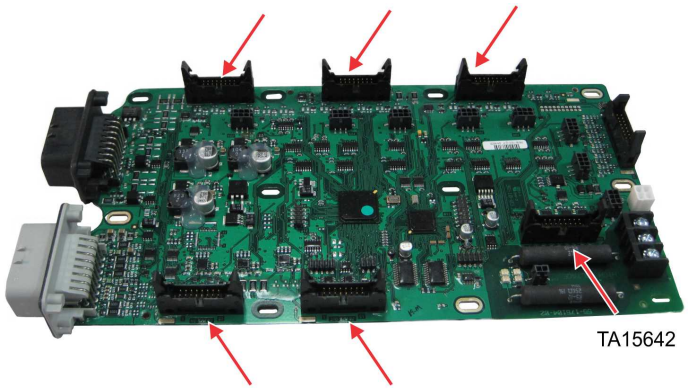
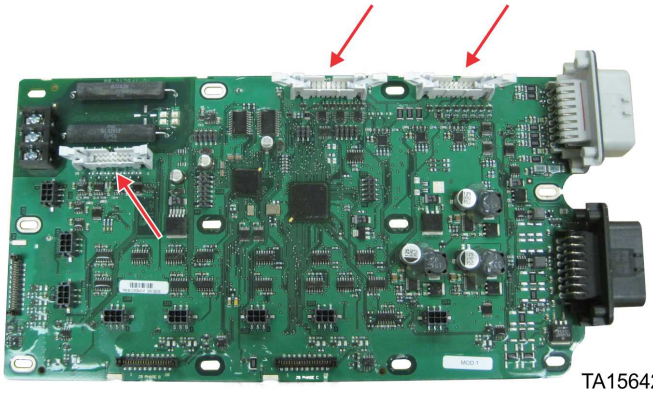
Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Modifying Connectors

Due to component obsolescence, connectors on SR Control Boards and converter harnesses may not match. If this issue arises, a slight modification of the harness connector can eliminate the problem.

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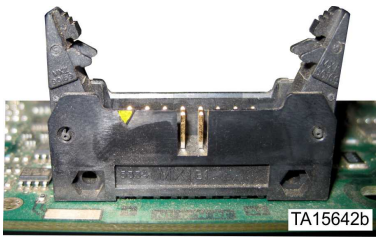
Figure 170: SR control boards

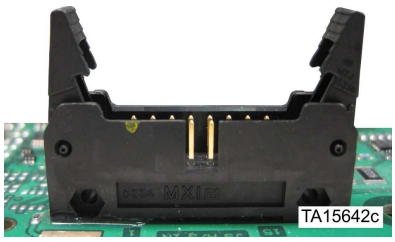
 TA15642	425-9164
 TA15642a	427-2143

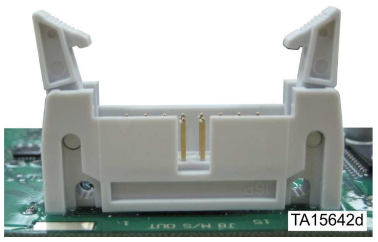
- On control board P/N 425-9164, this connector is used on the IGBT gate drive connections (J4, J5, J6, and J7), M/S OUT (J8), M/S IN (J9), and the diagnostic port (J26).
- On control board P/N 427-2143, this connector is used on M/S OUT (J8), M/S IN (9), and the diagnostic port (J26).

There are three different varieties of the board mounted connector and two different varieties of the harness connector.

Figure 171: SR control board connectors


TA15642b

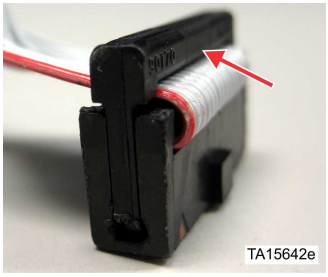
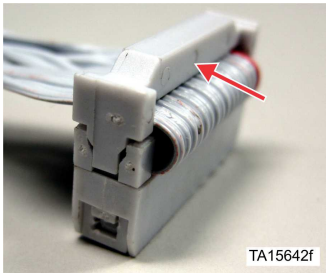

TA15642c


TA15642d

In general, the black harness connector is compatible with all three varieties of board connectors. The white harness connector only fits readily into the white board mounted connector.

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Figure 172: Harness connectors

	
Strain relief on original harness	Strain relief on new harness

The strain relief on the white harness connector has tabs on each end which interfere with the latches of the black board mounted connector.

Figure 173: Original connector with original wire harness

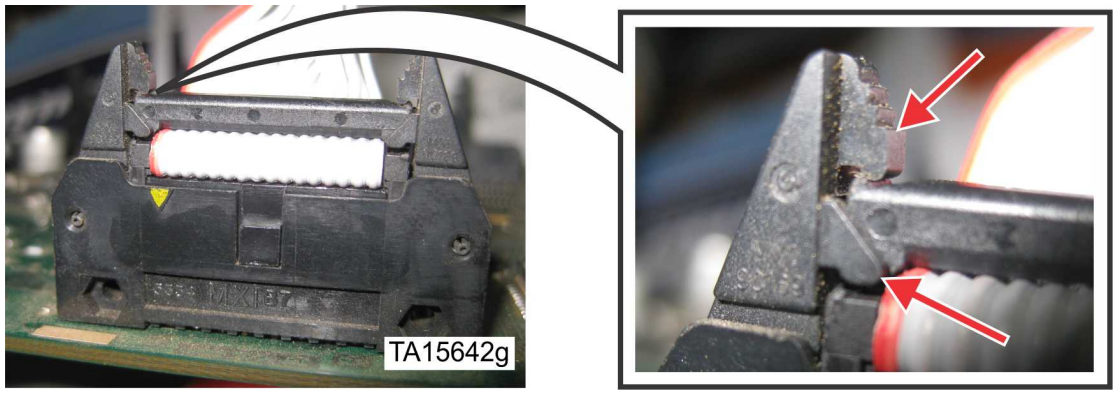
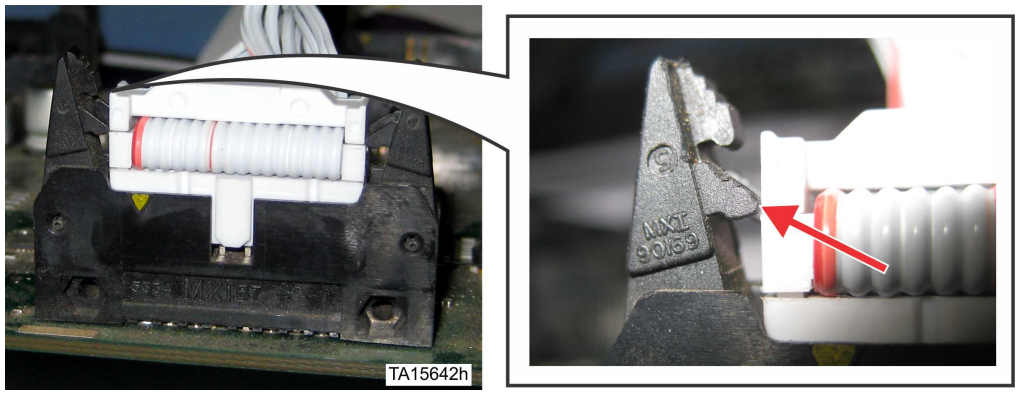


Figure 174: Original connector with new wire harness

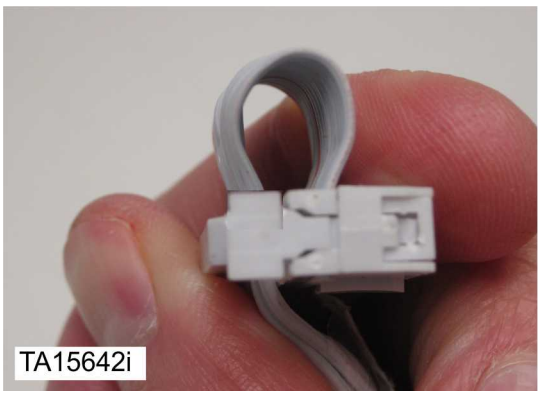


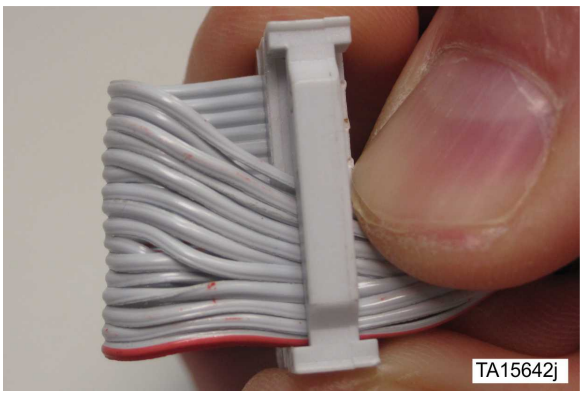
The new harness connector can be made to fit all SR Control Board connectors by performing the following modification.

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1. Push the harness cable through the strain relief on the connector.
2. Slide the harness cable to one side.

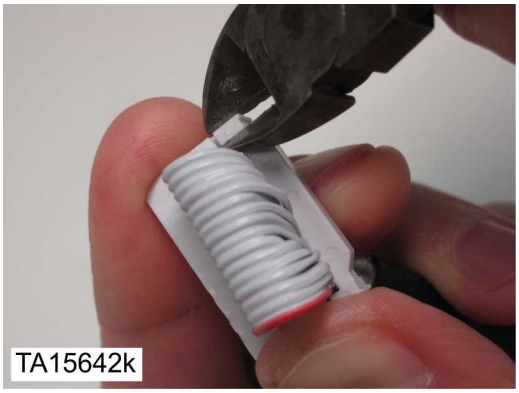
Figure 175: Harness wire

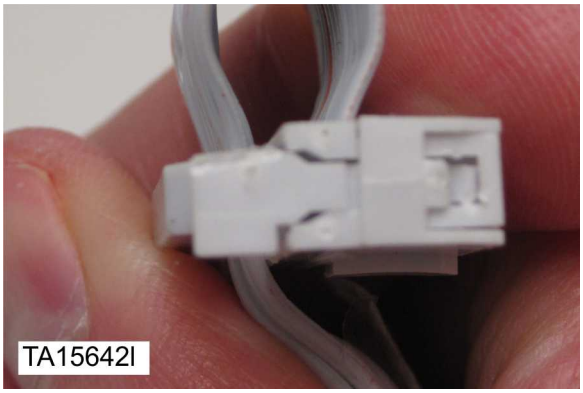




3. Cut the tabs off of the strain relief part of the connector on all four sides using a small pair of cutters.

Figure 176: Connector tabs cut





4. Pull the harness cable back through the strain relief.

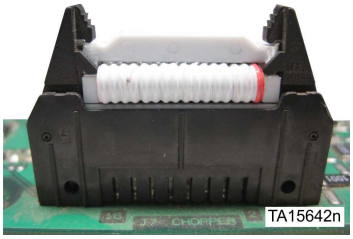
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Figure 177: Modified harnes connector

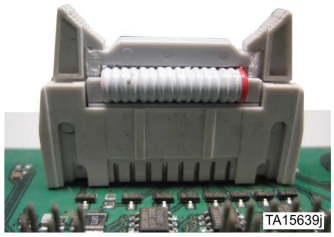


5. Harness connector can now be inserted into any of the SR Control Board connectors.

Figure 178: Connectors with modified harness connector







6. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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Replacing an SR Control Board

Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

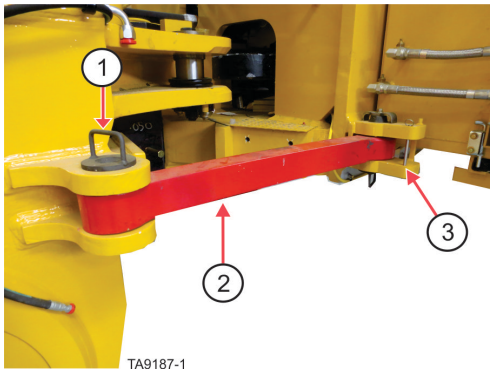
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 179: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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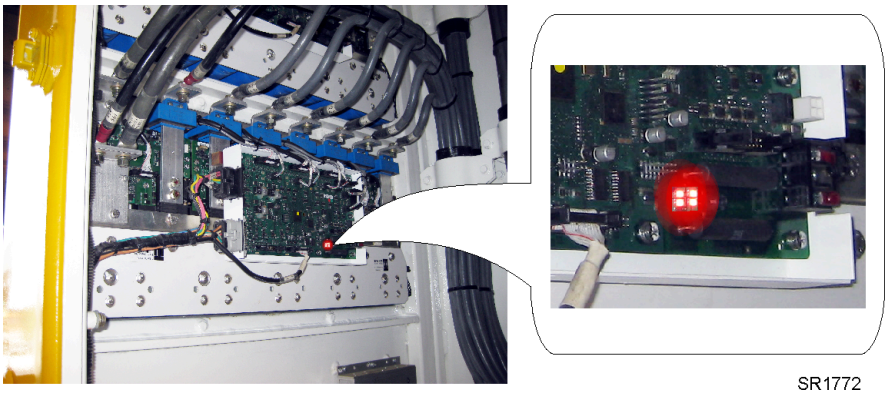
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 180: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

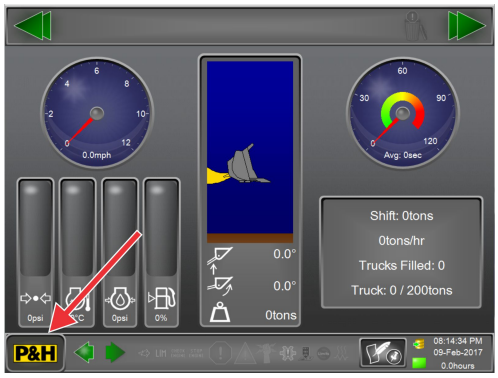
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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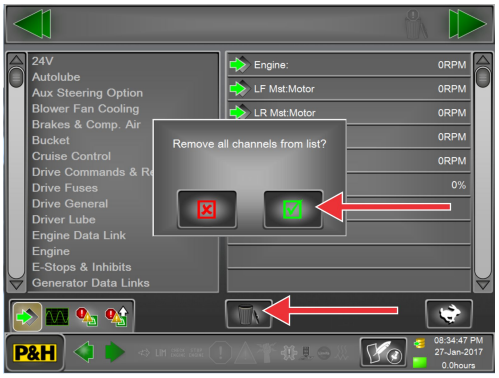
Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 181: LINCS logging/monitoring menu access

 TA15638-PH	 TA15639-PH
Main Menu Button	Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 182: Remove channels



TA15638a-PH

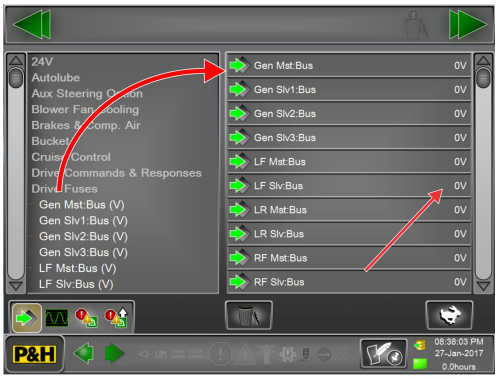
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 183: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 184: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 185: Isolation and control switch assembly

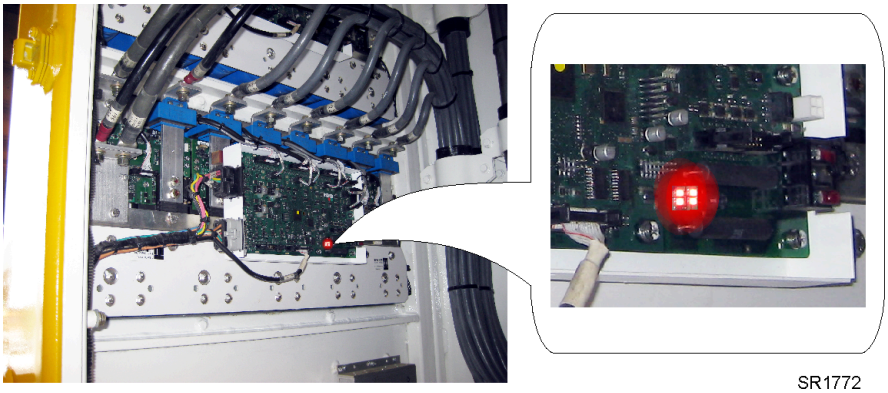


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 186: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

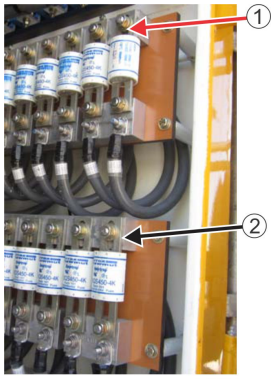
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 187: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

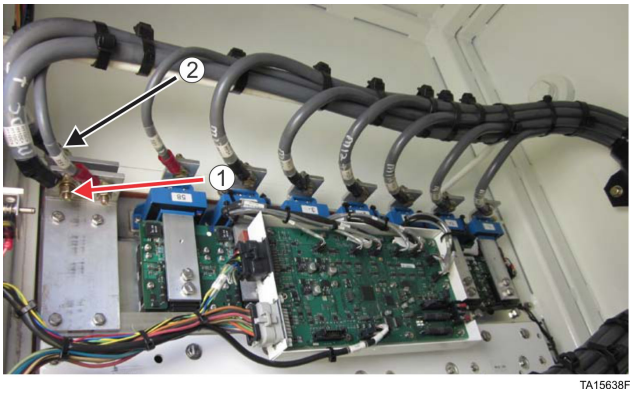
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Figure 188: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 189: Converter assembly bus connections (front of cabinet)



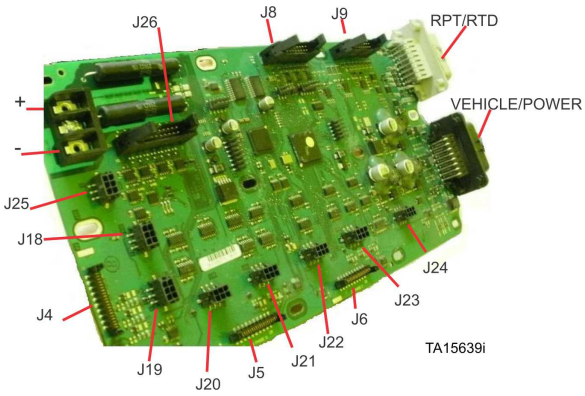
1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

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Removing an SR Control Board

Figure 190: SR control board connections



NOTICE

RPT/RTD Connector is only used on converter assemblies designated as the Master. J-9 Connector is only used on converter assemblies designated as slave assemblies.

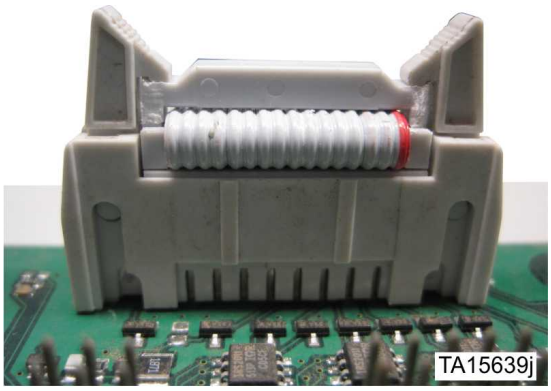
1. If panel is mounted on a machine, perform the Bus Discharge Verification Procedure as detailed previously in this document.
2. Disconnect the Vehicle/Power connector.
3. Disconnect the RPT/RTD connector (if applicable).
4. Disconnect cable from J8.
5. Disconnect cable from J9 (if applicable).
6. Disconnect cables from J18 through J24.
7. Disconnect phase cables J4 through J6.

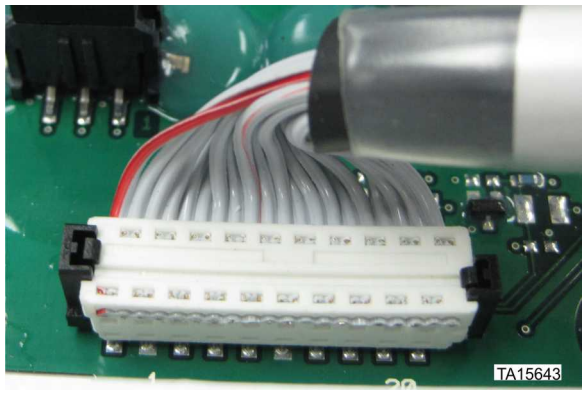
NOTICE

There are two different types of connectors used on the Phase connections (J4, J5, & J6). The external latch type can be disconnected by depressing the two latches on either side of the connector. The internal latch type requires the use of an extractor tool to release the latches and remove the cable connector.

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Figure 191: Phase connectors



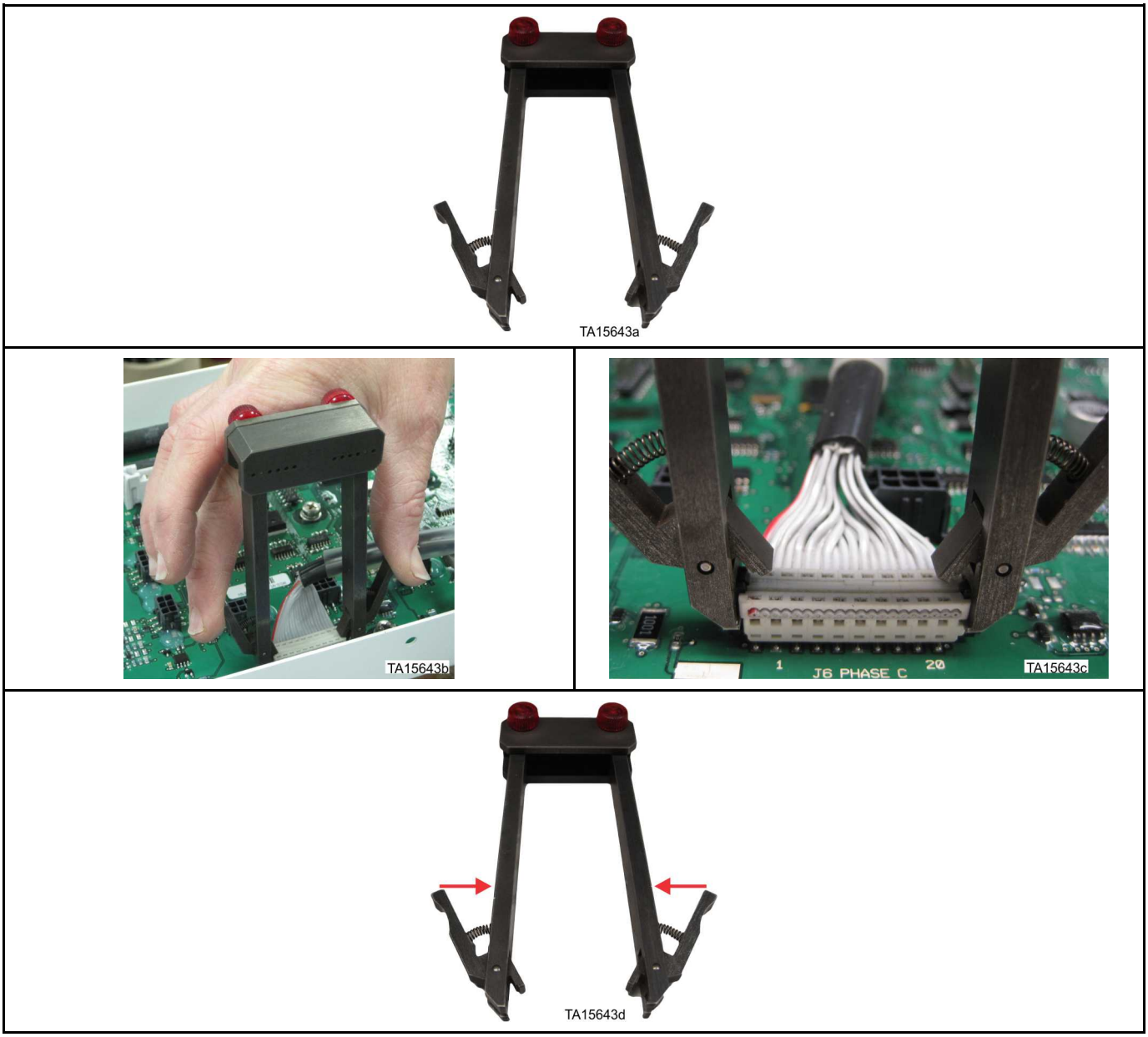


CAUTION

Use care when using the extractor tool to prevent damage to the connector and/or the Control Board.

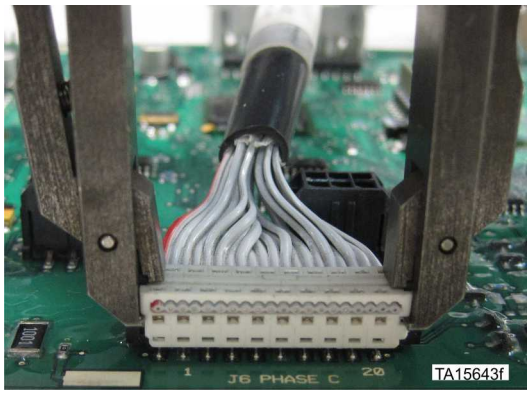
© 2019 Komatsu Mining Corp. All rights reserved.

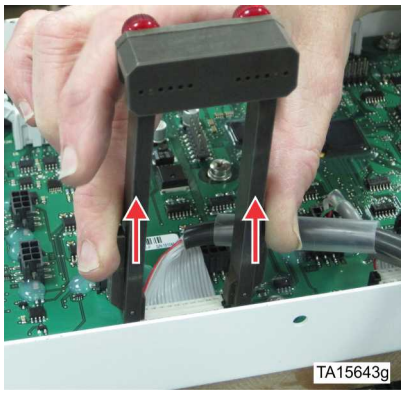
Figure 192: Extractor tool use



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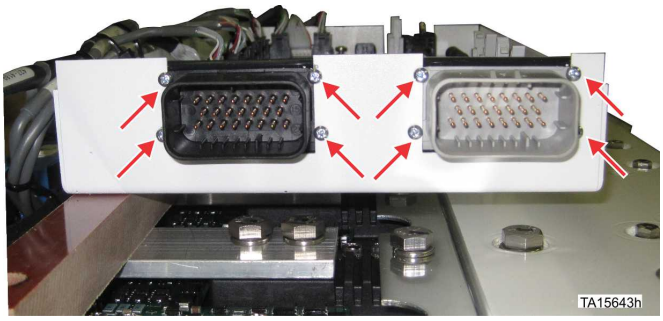


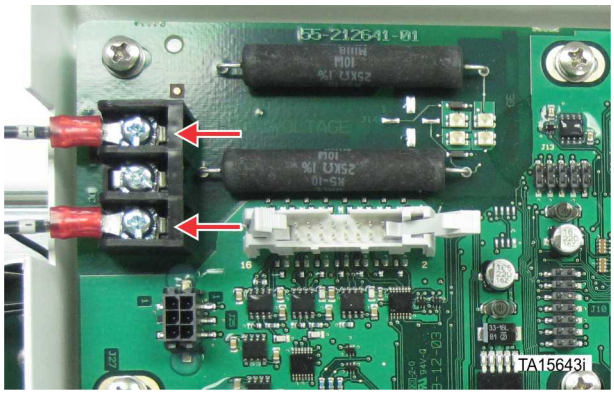




8. Remove mounting screws for RPT/RTD and Vehicle Power connectors.
9. Disconnect + and – terminals.

Figure 193: Connector mounting and + / – terminal screws





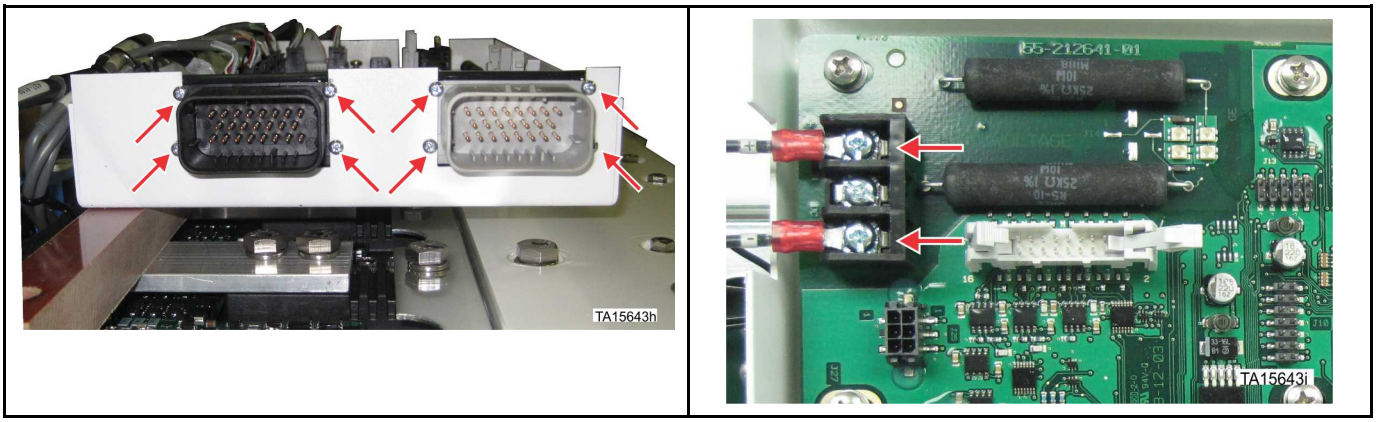
10. Remove all control board mounting screws and remove board from PCB mount box.

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Installing an SR Control Board

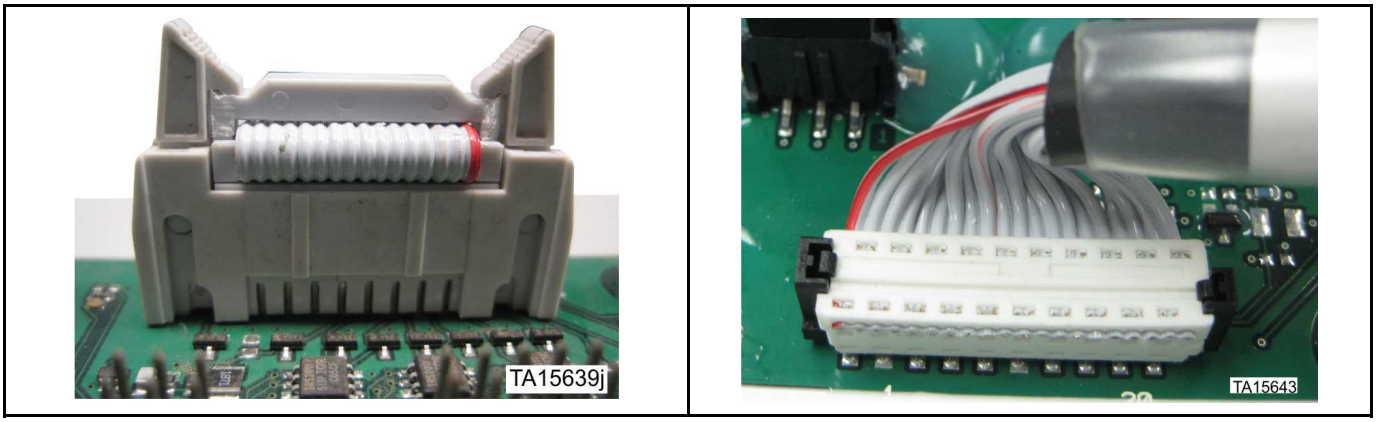
1. Install the control board in the PCB mount box and install the mounting screws.
2. Connect the wires to the + and – terminals.
3. Install the mounting screws for the RPT/RTD and Vehicle Power Connectors.

Figure 194: Connector mounting and + / – terminal screws



4. Install phase connectors A, B, C making sure the connectors are properly aligned before seating in the connector.

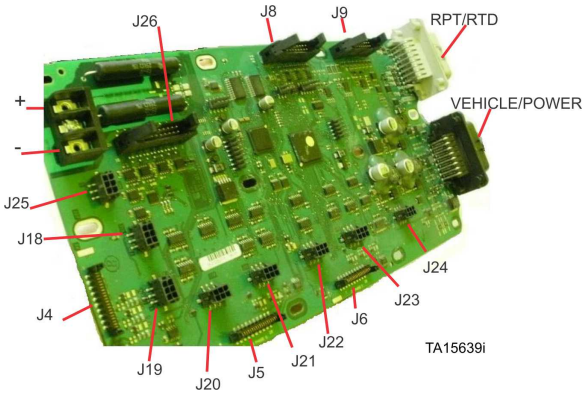
Figure 195: Phase connectors



5. Install connectors J18 through J24.

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Figure 196: SR Control board connections



6. Install connector J9 (if panel designated as slave package).
7. Install connector J8.
8. Install RPT/RTD connector (if panel designated as master package).
9. Install Vehicle Power connector.
10. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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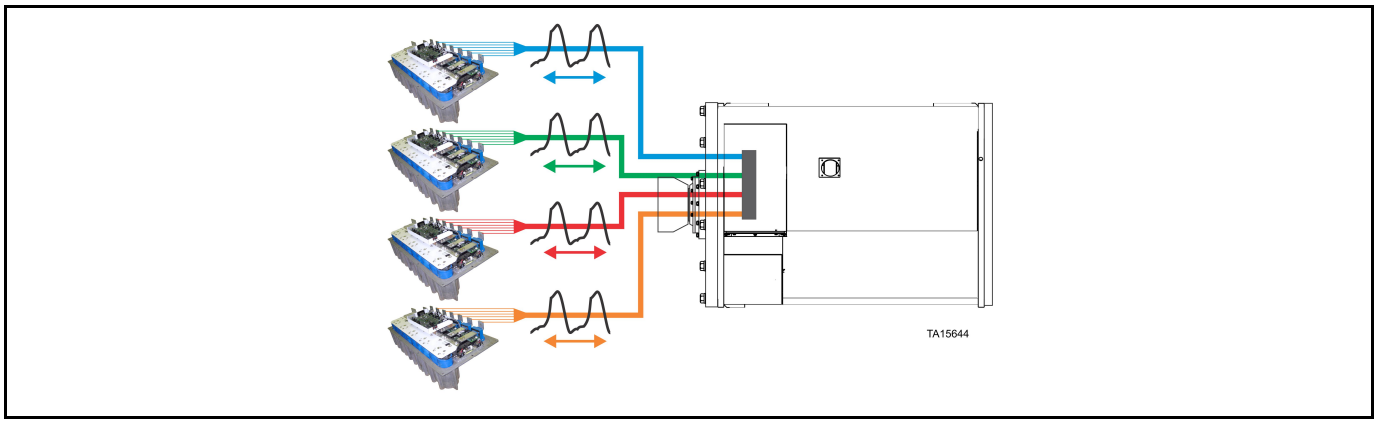
Generator Current Sharing Test

The generator current sharing test should be performed whenever a parallel converter package or a generator is changed or replaced and during initial machine build.

The Generation2 machines use a common panel design. On generators and larger motors these panels are used in parallel to provide sufficient current capacity for the component.

This test must be performed for all three phases (01, 02, and 03).

Figure 197: Parallel panels for generators (qty varies depending on model)



Items Required

Item	Part Number	Quantity	
		1350	1850/2350
Data Acquisition Board	426-2070	3	4
BNC to BNC Cable 20’	427-4379	3	4

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Master/Slave Harness 71-1/4”	425-9332	3	4
Four Channel Oscilloscope Specs: 4 Channel Bandwidth 200 Mhz Real Time Sample 2.5GS/s 1000V Fluke 190-240 Series II or equivalent  	427-4378	1	1

The following Current Sharing Test Kit is available, the quantities shown are for the number of Test Kits needed for each machine model.

Item	Part Number	Quantity
		1350/1850/2350
Current Sharing Test Kit Test Kit Contents: 2 ea. P/N 426-2070 Data Acquisition Boards 2 ea. P/N 425-9332 Master/Slave harnesses 71-1/4” 2 ea. P/N 427-4379 BNC to BNC cables 20’	427-8381	2

Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine’s starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

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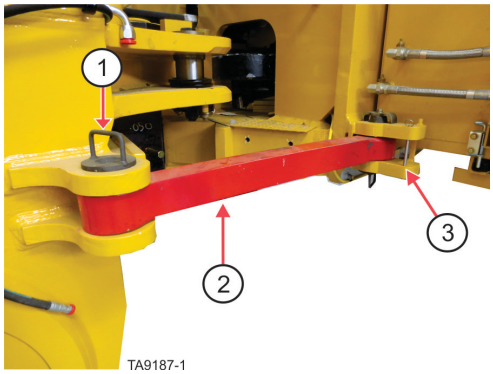
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 198: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

Bus Discharge Verification Procedure

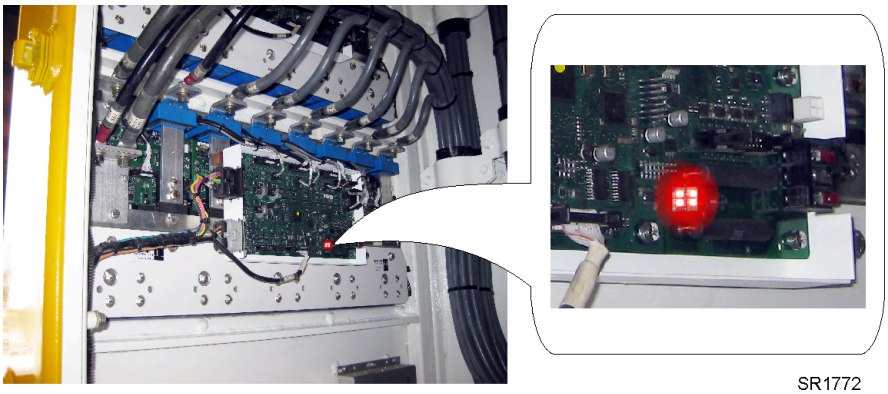
Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

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Figure 199: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

Before You Begin

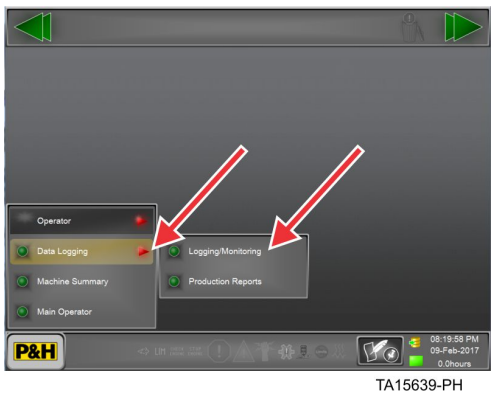
Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 200: LINCS logging/monitoring menu access



Main Menu Button

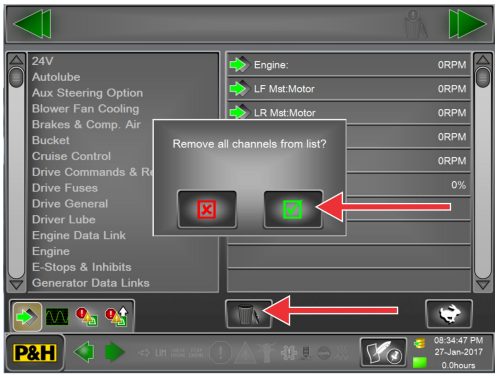


Data Logging & Logging/Monitoring

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Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 201: Remove channels



TA15638a-PH

Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 202: Left hand scroll

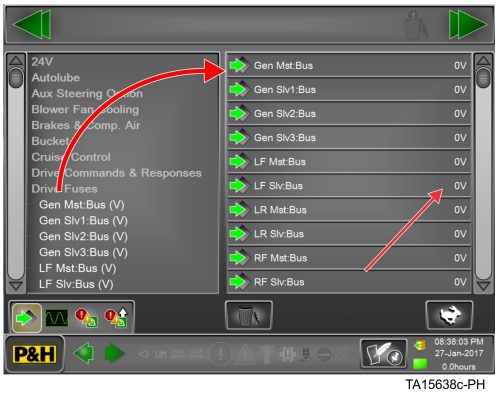


TA15638b-PH

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Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 203: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

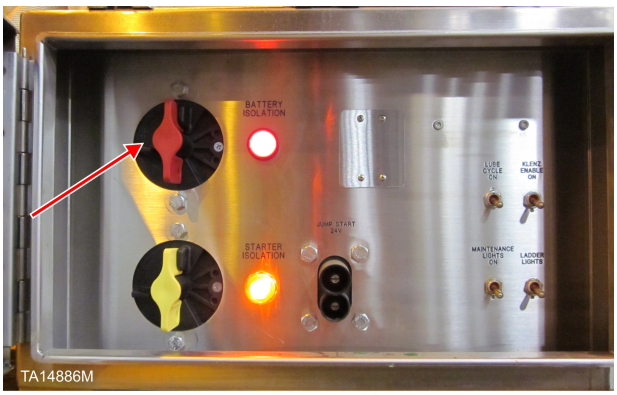
Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 204: Isolation and control switch assembly





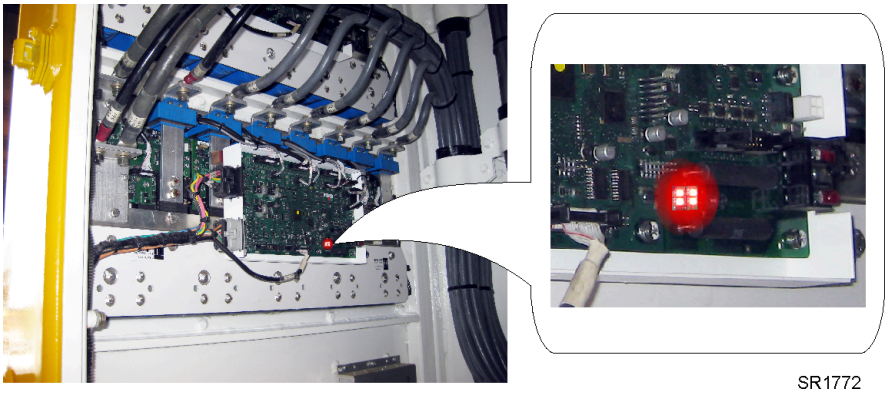
Isolate the battery and lockout the machine

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- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 205: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

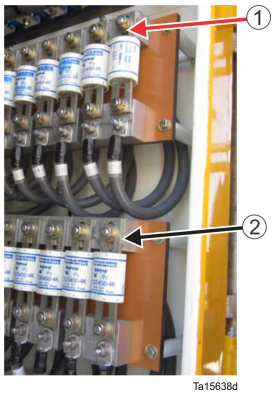
Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

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Figure 206: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

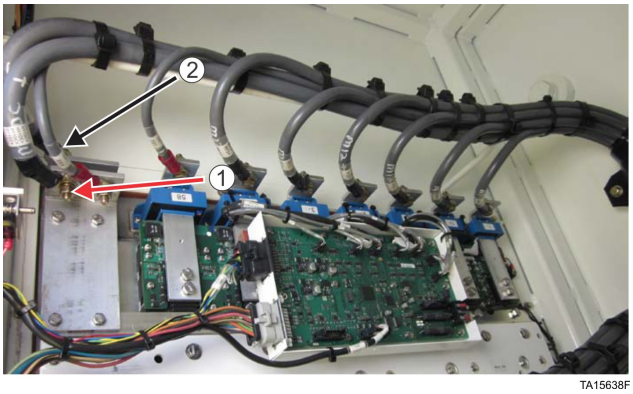
Figure 207: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

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Figure 208: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Hardware Configuration

NOTICE

The Master Converter Assembly is used as the primary trace and is compared to all the Slave Converter Assemblies with which it shares loads.

1. Make sure jumpers are set correctly on each of the Data Acquisition Board:

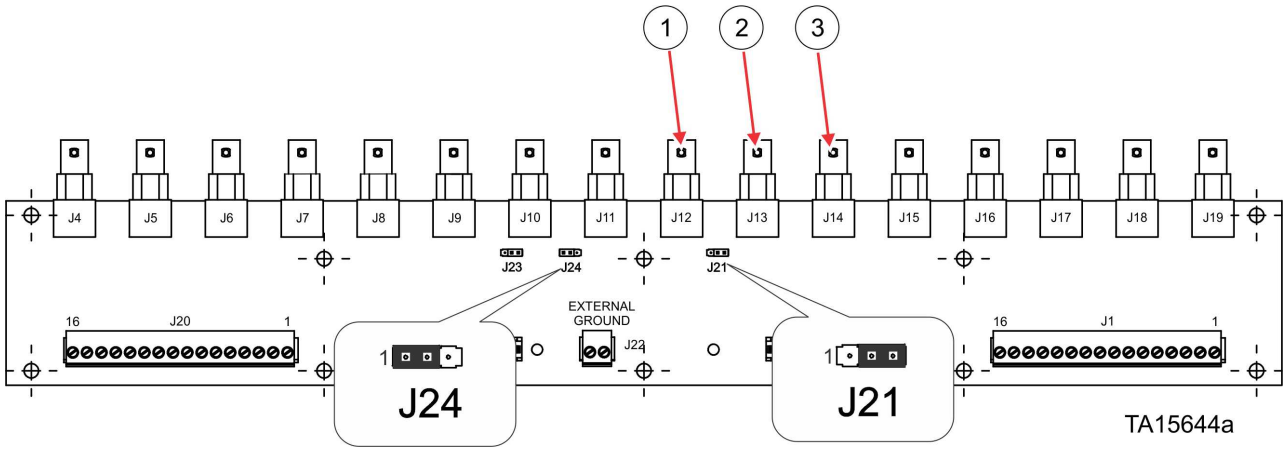
Jumper	Setting
J21	Jumper Pins 2 & 3
J23	Not Applicable
J24	Jumper Pins 1 & 2

NOTICE

A Data Acquisition Board is necessary for each panel under test (one for the Master and one for each Slave being compared).

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Figure 209: Data acquisition board jumpers and Phase connections



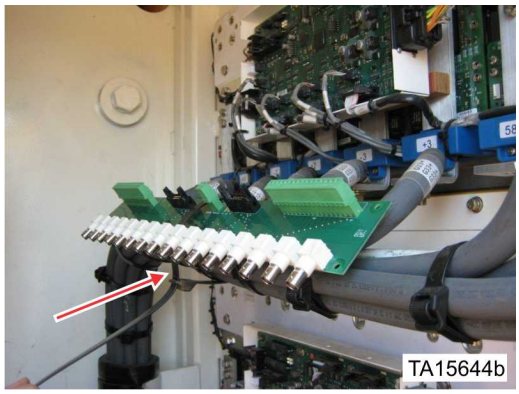
1) Phase 01, **2)** Phase 02, **3)** Phase 03

2. Secure each Data Acquisition Board to the metal cable support rods inside the electrical converter cabinet using cable ties.

CAUTION

Make sure that each Data Acquisition Board is mounted in such a way that it will not make contact with any electrical components while the machine is being operated. Also, make sure that none of the test leads from the oscilloscope make contact with unused electrical test points or connectors. Shorts or arcs may occur if Data Acquisition Board comes in contact with converter assembly or other electrical components.

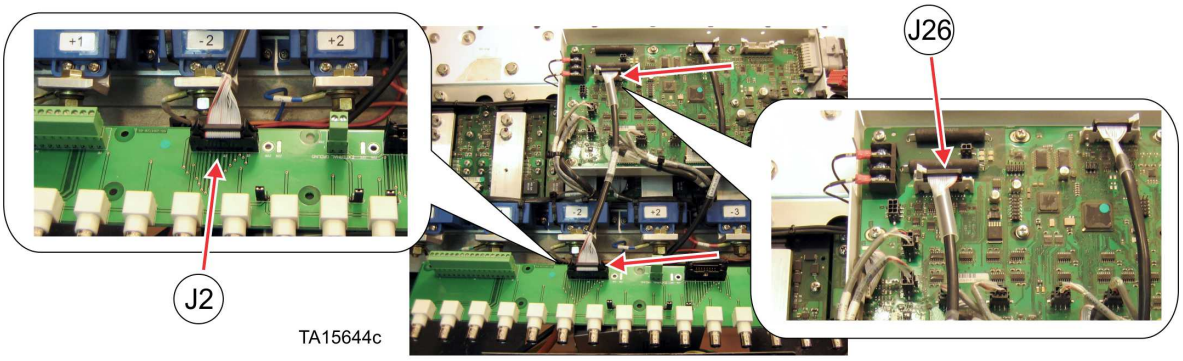
Figure 210: Data acquisition board



3. Connect a ribbon cable from each Data Acquisition Board J2 to the appropriate Converter Assembly SR Control Board connector J26.

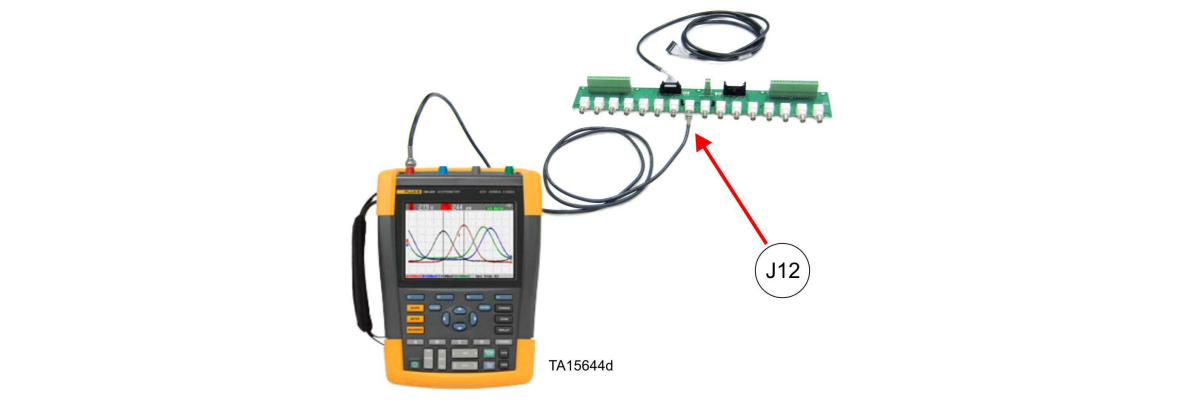
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Figure 211: Ribbon cable connection



4. Using a BNC to BNC cable, connect J12 from the Data Acquisition Board connected to the Master Converter Assembly to channel one of the oscilloscope.

Figure 212: Oscilloscope BNC connection (reference only)



5. Using a second BNC to BNC cable, connect J12 from the Data Acquisition Board connected to the Slave Converter Assembly to channel two of the oscilloscope.

NOTICE

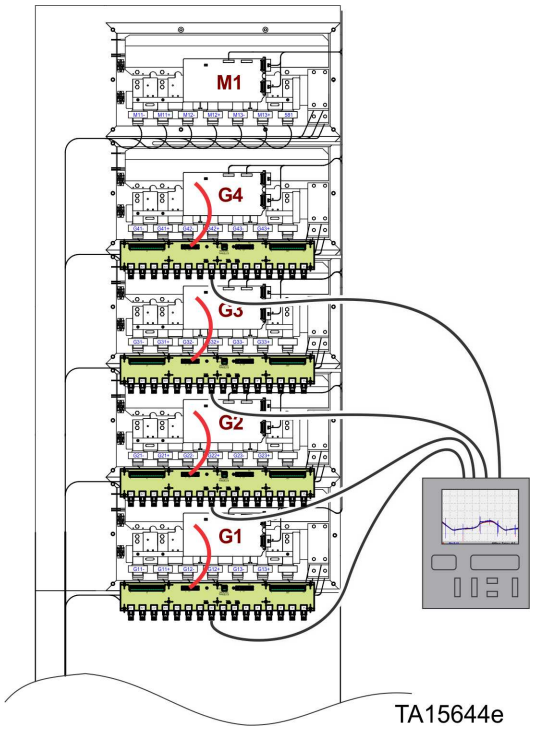
If comparing more than two Converter Assemblies, it is recommended that a four channel oscilloscope be used so that all of the Assemblies can be compared at the same time.

NOTICE

The Master Converter Assembly will be used as the primary trace and compared to all the slave converter assemblies with which it is load sharing.

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Figure 213: Oscilloscope connection (L-1850/L-2350 depicted)



Oscilloscope Configuration

1. Set oscilloscope to 2V/div and 400µs/div.
2. Set scaling to 1:1 (BNC cables have no scaling circuitry).
3. Position all channels so that the waveforms for each panel are on top of each other.

Figure 214: Oscilloscope setup



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Test Procedure

CAUTION

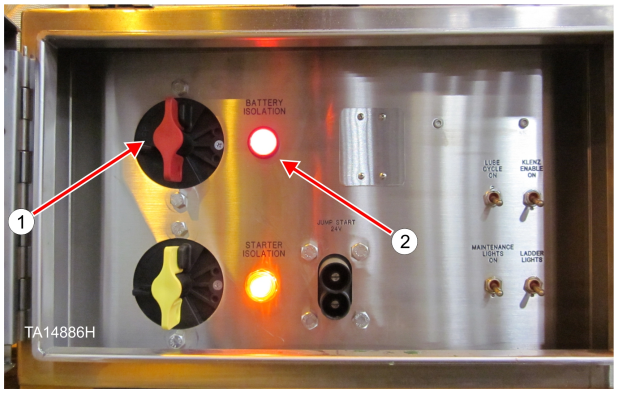
The electrical converter cabinet door must remain open for this test to prevent damage to the BNC cables. The cabinet door interlocks must be bypassed locally.

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation II SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

1. Remove the battery box lockout and turn the Battery Isolation Switch to the ON position (the red light will illuminate to indicate 24V has been enabled).

Figure 215: Isolation and control switch assembly



1) Battery isolation switch (shown in ON position), **2)** Battery isolation indicator

2. Boot LINCS and log in with a maintenance level access or greater.
3. Start the machine.
   - Follow all local rules and regulations for machine startup.
4. Set the machine engine at high throttle and make sure the drive power is energized (all four LED's are illuminated).

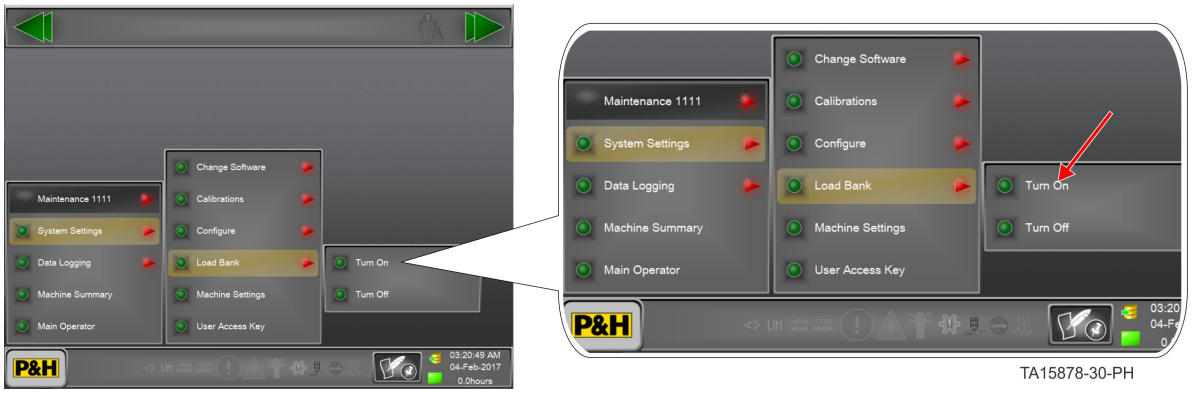
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Figure 216: Drive switch power button LED's illuminated



5. Place the machine in Load Bank Mode.

Figure 217: Load bank mode select



CAUTION

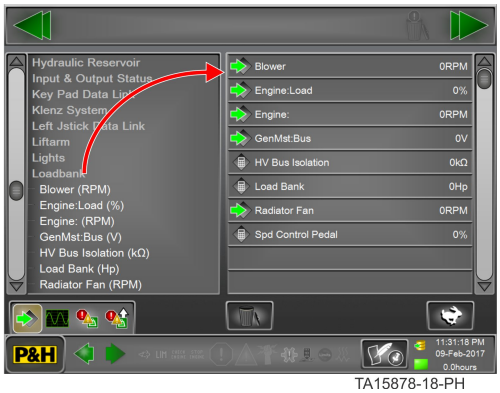
Limit commanded current to approximately 20 seconds to prevent damage to the electrical grids. If additional Load Bank tests are required, wait at least 60 seconds before repeating the test.

NOTICE

It is recommended that the operator observe the load bank selection under the Data Logging – Logging/Monitoring menu selection. This screen will allow the operator to see Percent Engine Load, Horsepower, and Bus voltage.

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Figure 218: Data logging – logging/monitoring menu



TA15878-18-PH

6. Apply full foot pot command for loading (the converter assemblies will be firing significant amounts of current through the grids, with the foot pot fully applied).
7. While the machine is at 100% load and with the scope trace visible, adjust the timing and amplitude if necessary for the best possible resolution and hold (save) the waveform for a visual comparison.
8. Release the foot pot and set the machine engine at low throttle and make sure the drive power has been disabled (all four LED's off).

Figure 219: Drive switch power button LED's off

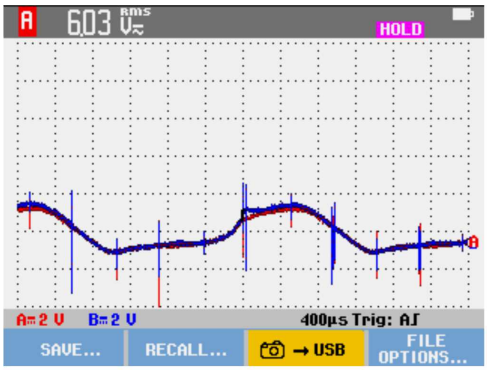


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9. Review the held (saved) waveform on the oscilloscope. The waveforms for all channels should be very close to the same in timing and amplitude.

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Figure 220: Drive switch power button LED's off



TA15644k

NOTICE

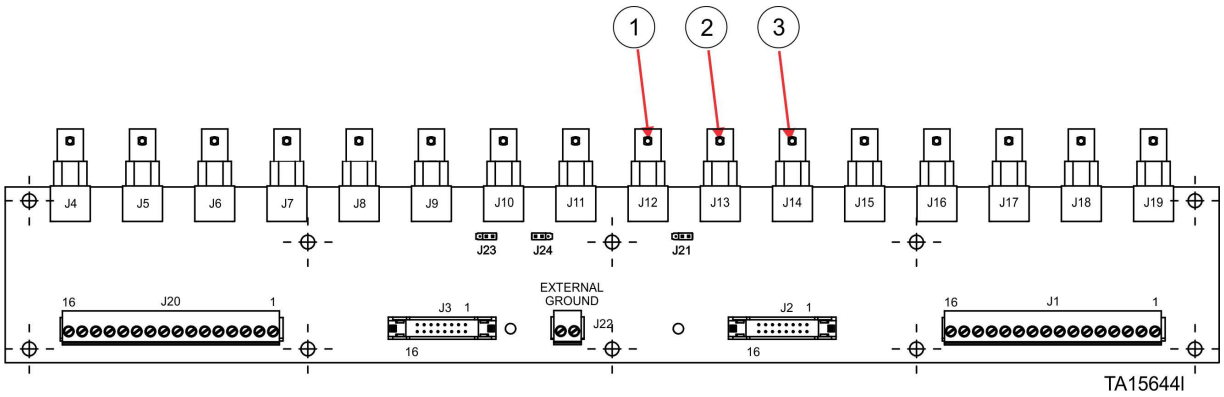
If significant discrepencies are noticed on the waveforms, wiring, wiring layout, and cable ends should be thoroughly examined (for example, loose connections, wires layed out incorrectly, too much Penetrox on cable connections, improper crimps). Questions regarding the quality of the observed traces should be directed towards Komatsu Product Support.

⚠ WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation II SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

10. Repeat the test procedure for J13 (phase 02) and J14 (phase 03).

Figure 221: Phase connections on data acquisition board



TA15644l

1) Phase 01, **2)** Phase 02, **3)** Phase 03

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11. Upon completion of test, remove all test equipment from machine.

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation II SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

12. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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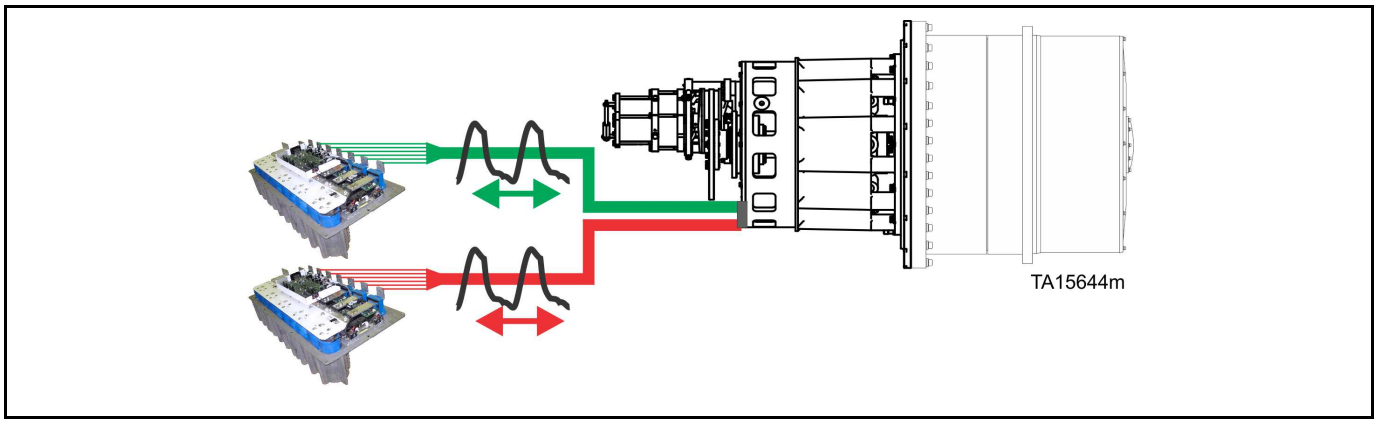
Motor Current Sharing Test(L-1850/L-2350)

The motor current sharing test should be performed whenever a parallel converter package or a B60 motor is changed or replaced and during initial machine build.

The Generation2 machines use a common panel design. On generators and larger motors these panels are used in parallel to provide sufficient current capacity for the component.

This test must be performed for all three phases (01, 02, and 03).

Figure 222: Parallel panels for B60 motor



⚠ WARNING

Risk of fatal shock by contact in the electrical cabinet or possibility of falling is possible. High voltage will be present in the electrical cabinet and the vehicle will be moving while performing this test procedure. High voltage will be present when the red LED's are lit. Do not stand on walk-way or in electrical cabinet during this test. All personel must be clear of vehicle or secure in the operators cab while conducting this test. Risk of fatal shock or falling may result if in non compliance to this warning.

Items Required

Item	Part Number	Quantity	
		1350	1850/2350
Data Acquisition Board	426-2070	3	4
BNC to BNC Cable 20'	427-4379	3	4

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Master/Slave Harness 71-1/4”	425-9332	3	4
Four Channel Oscilloscope Specs: 4 Channel Bandwidth 200 Mhz Real Time Sample 2.5GS/s 1000V Fluke 190-240 Series II or equivalent  	427-4378	1	1

The following Current Sharing Test Kit is available, the quantities shown are for the number of Test Kits needed for each machine model.

Item	Part Number	Quantity
		1350/1850/2350
Current Sharing Test Kit Test Kit Contents: 2 ea. P/N 426-2070 Data Acquisition Boards 2 ea. P/N 425-9332 Master/Slave harnesses 71-1/4” 2 ea. P/N 427-4379 BNC to BNC cables 20’	427-8381	2

Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine’s starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

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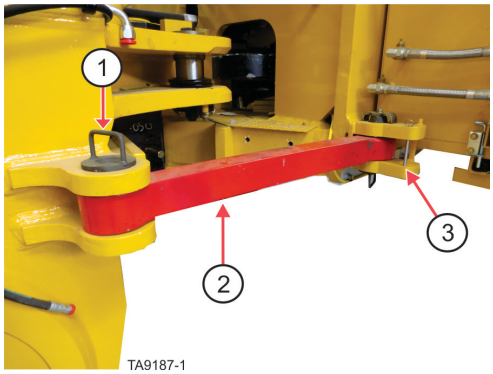
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 223: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

Bus Discharge Verification Procedure

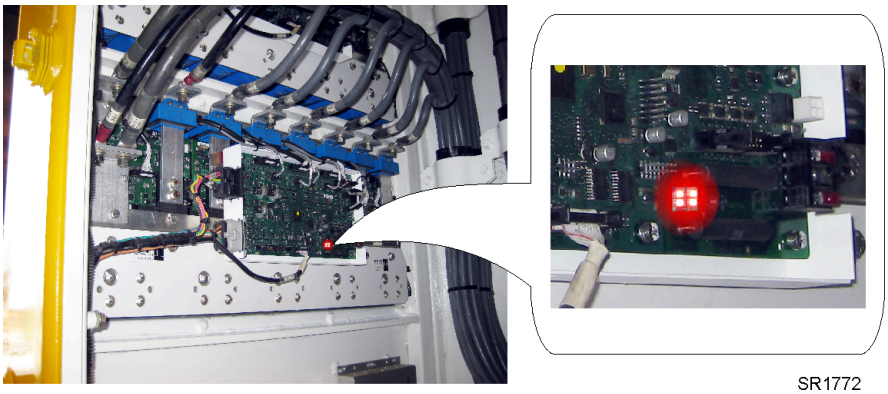
Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

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Figure 224: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

Before You Begin

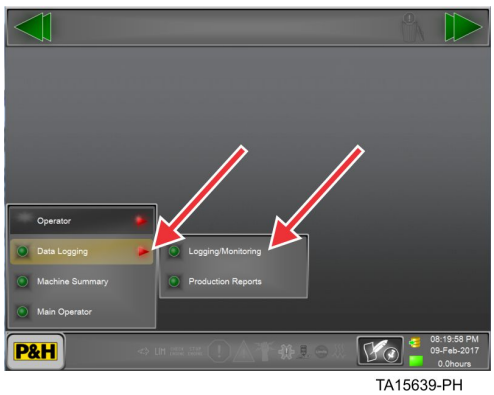
Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 225: LINCS logging/monitoring menu access



Main Menu Button

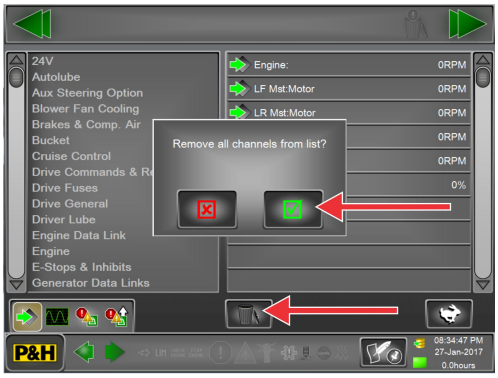


Data Logging & Logging/Monitoring

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Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 226: Remove channels



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Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 227: Left hand scroll

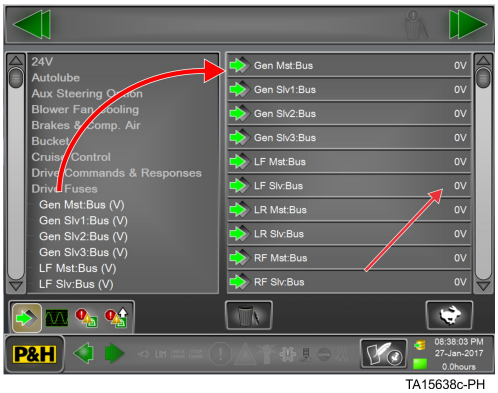


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Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 228: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

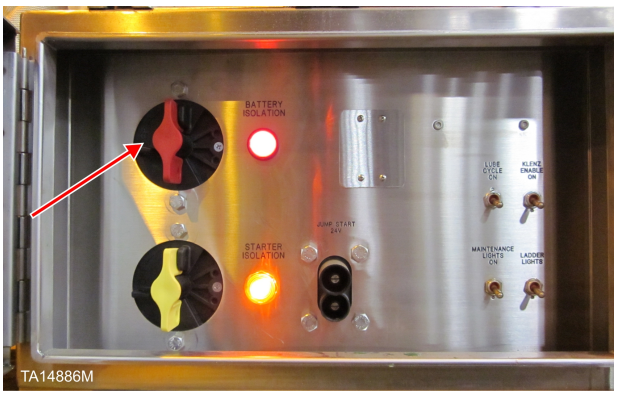
Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 229: Isolation and control switch assembly





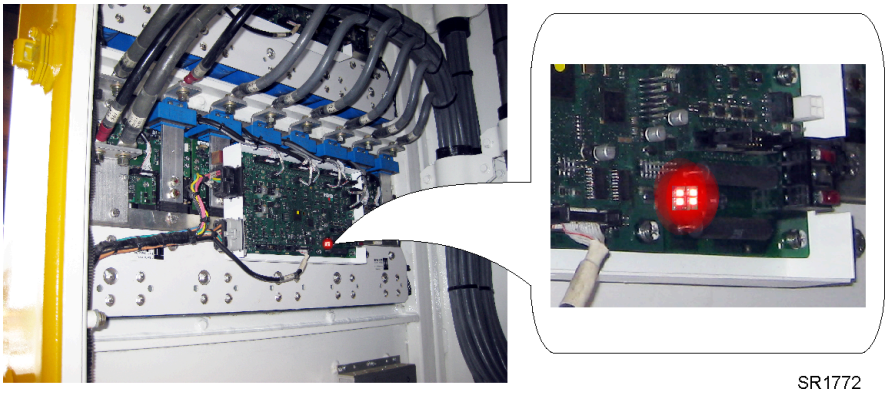
Isolate the battery and lockout the machine

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- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 230: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

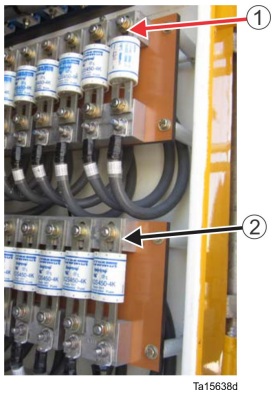
Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

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Figure 231: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

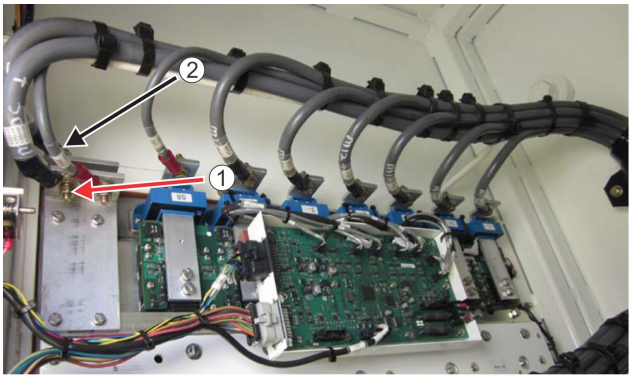
Figure 232: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

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Figure 233: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Hardware Configuration

NOTICE

The Master Converter Assembly is used as the primary trace and is compared to all the Slave Converter Assemblies with which it shares loads.

1. Make sure jumpers are set correctly on the Data Acquisition Board:

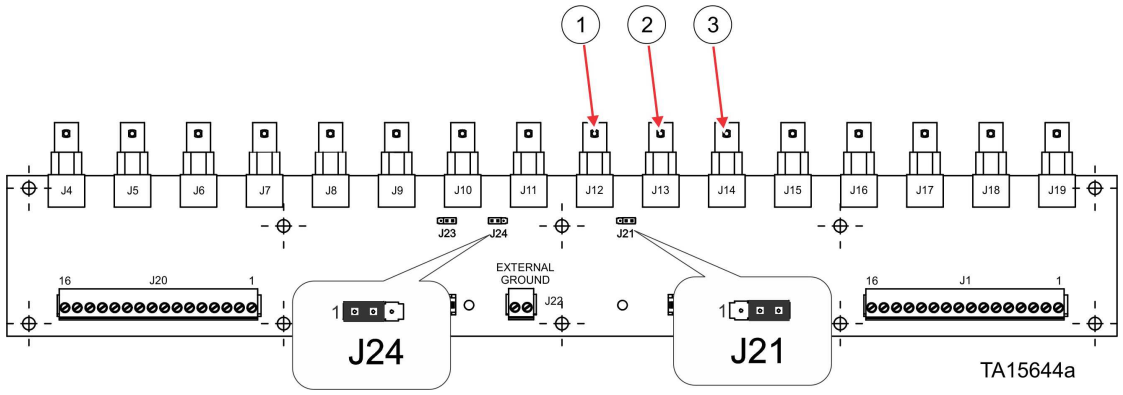
Jumper	Setting
J21	Jumper Pins 2 & 3
J23	Not Applicable
J24	Jumper Pins 1 & 2

NOTICE

Follow this procedure for each Data Acquisition Board being connected.

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Figure 234: Data acquisition board jumpers and Phase connections



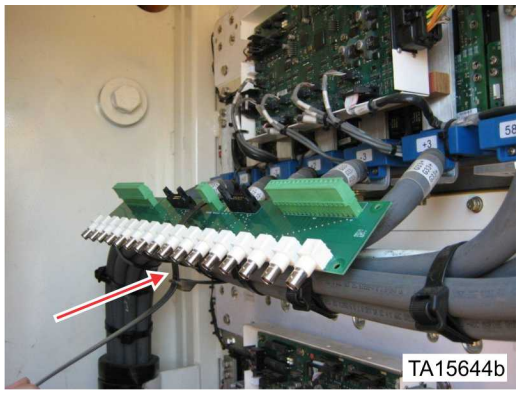
1) Phase 01, **2)** Phase 02, **3)** Phase 03

2. Secure the Data Acquisition Boards to the metal cable support rods inside the electrical converter cabinet using cable ties.

CAUTION

Make sure that each Data Acquisition Board is mounted in such a way that it will not make contact with any electrical components while the machine is being operated. Also, make sure that none of the test leads from the oscilloscope make contact with unused electrical test points or connectors. Shorts or arcs may occur if Data Acquisition Board comes in contact with converter assembly or other electrical components.

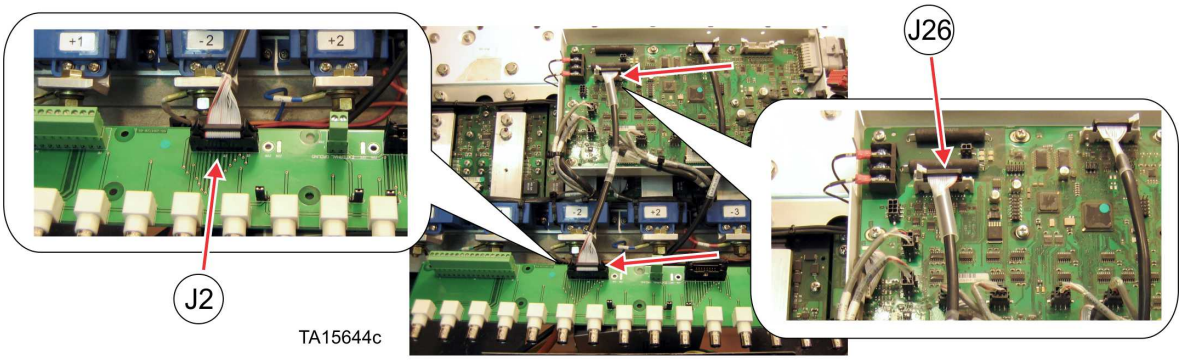
Figure 235: Data acquisition board



3. Connect a ribbon cable from the Data Acquisition Board J2 to the Converter Assembly SR Control Board connector J26.

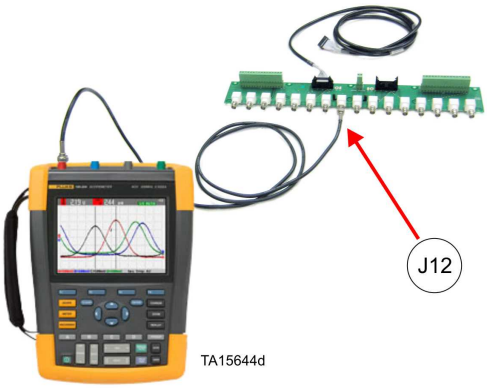
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Figure 236: Ribbon cable connection



4. Using a BNC to BNC cable, connect J12 from the Data Acquisition Board on the Master Converter Assembly to channel one on the oscilloscope.

Figure 237: Oscilloscope BNC connection (reference only)



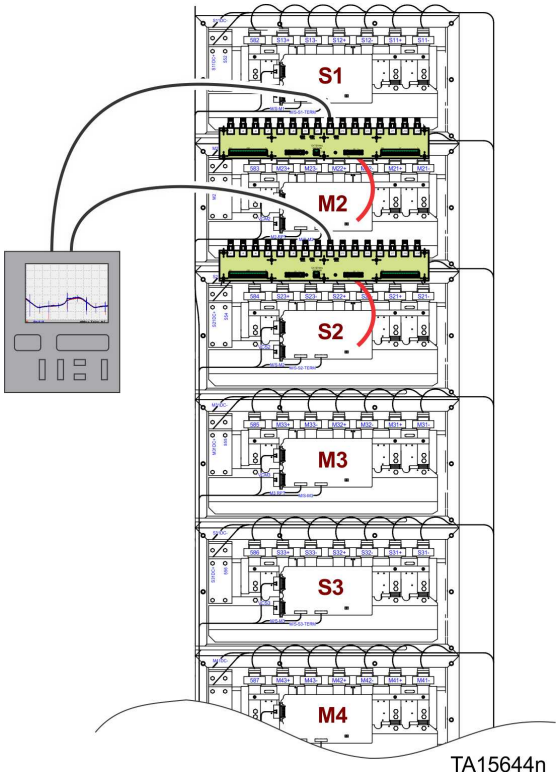
5. Use a second BNC to BNC cable to connect J12 from the Data Acquisition Board connected to the Slave Converter Assembly to be compared to channel two on the oscilloscope.

NOTICE

The Master Converter Assembly will be used as the primary trace and compared to all the slave converter assemblies with which it is load sharing.

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Figure 238: Data acquisition board



Oscilloscope Configuration

1. Set oscilloscope to 2V/div and 400µs/div.
2. Set scaling to 1:1 (BNC cables have no scaling circuitry).
3. Position all channels so that the waveforms for each panel are on top of each other.

Figure 239: Oscilloscope setup



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Test Procedure

NOTICE

The motor current sharing test requires the machine perform full-speed reversals. The engine must be running at high throttle with the drive system energized for this test.

⚠ WARNING

Risk of crush hazard and collision may occur as the loader will be run at full speed in both forward and reverse. Make sure the loader is in an area where there is ample space in front and behind the machine. Make sure all personnel are a safe distance away from the loader. Failure to perform test in adequate area may result in incomplete test or risk of collision or crush hazard.

CAUTION

Make sure that all test equipment is set up in a manner to prevent contact with electrical components while the machine is moving. Failure to do so may result in electrical ars or shorts in the electrical cabinet.

CAUTION

The electrical converter cabinet door must remain open for this test to prevent damage to the BNC cables. The cabinet door interlocks must be bypassed locally and the cabinet door should be securely latched open. Failure to secure the door may result in damage to the test equipment.

NOTICE

The door can be securely latched open by pulling the walk-way grating on the cabinet out at least two feet and securing the door to the handrail.

⚠ WARNING



Risk of fatal shock by contact in the electrical cabinet or possibility of falling is possible. High voltage will be present in the electrical cabinet and the vehicle will be moving while performing this test procedure. High voltage will be present when the red LED's are lit. Do not stand on walk-way or in electrical cabinet during this test. All personnel must be clear of vehicle or secure in the operators cab while conducting this test. Risk of fatal shock or falling may result if in non compliance to this warning.

1. Boot LINCS and log in with a maintenance level access or greater.
2. Start the machine.
3. Set the machine engine at high throttle and make sure the drive power is energized (all four LED's are illuminated).

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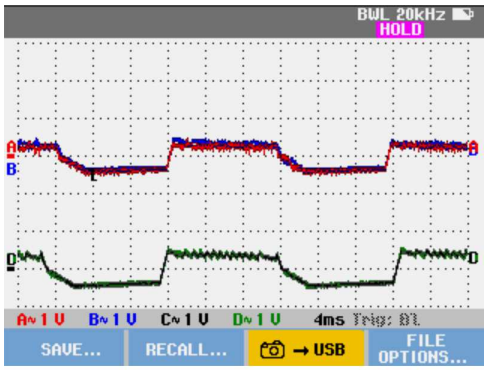
Figure 240: Drive switch power button LED's illuminated



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4. Release the park brake and fully accelerate the machine to maximum speed and perform several full-speed reversals.
5. Once enough data has been gathered, bring the machine to a complete stop.
6. Review the held (saved) waveform on the oscilloscope. The waveforms for all channels should be very close to the same in timing and amplitude.

Figure 241: Good waveforms



TA15644o

NOTICE

If significant discrepencies are noticed on the waveforms, wiring, wiring layout, and cable ends should be thoroughly examined (for example, loose connections, wires layed out incorrectly, too much Penetrox on cable connections, improper crimps. If replacing a B60 motor, check that motor leads inside the axle are connected properly, improper connections may cause continuous current sharing issues). Questions regarding the quality of the observed traces should be directed towards Komatsu Product Support.

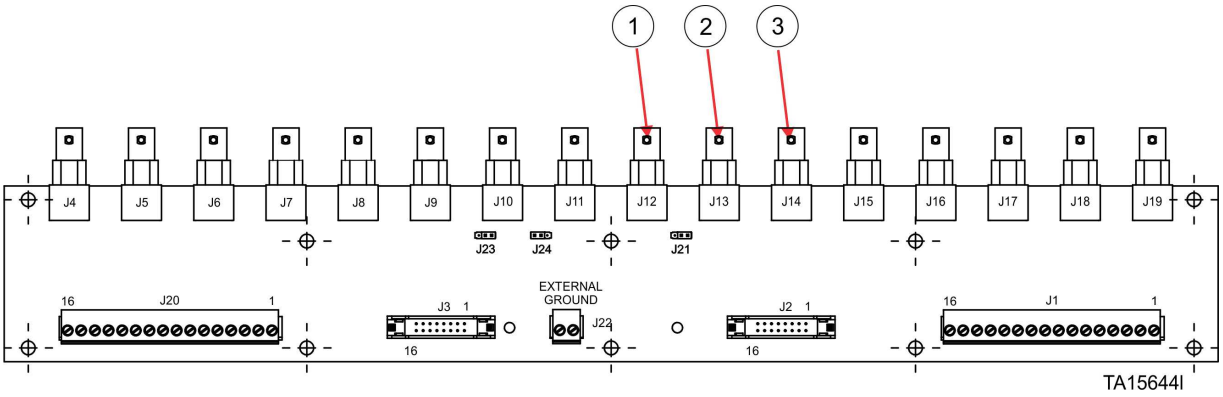
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⚠ WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation II SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

7. Duplicate the waveform procedure for J13 (phase 02) and J14 (phase 03).

Figure 242: Phase connections on data acquisition board



1) Phase 01, **2)** Phase 02, **3)** Phase 03

8. Upon completion of test, remove all test equipment from machine.

⚠ WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation II SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

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Wheel Motor Isolation

NOTICE

If a motor or planetary drive has mechanical damage, such as failed bearings or broken teeth, the motor or planetary drive must be replaced before the machine is moved or additional damage will occur. If the motor or planetary drive does not have mechanical damage, then the motor may be isolated and the machine operated.

Operation of Machine with Motors and/or Converter Panels Disabled

SR drive machines are capable of operating with convertor panels and/or motors disabled.

⚠ WARNING

Operation of the machine on less than four wheel motors, or with any of the converter panels disabled, will result in a reduction in electric (dynamic) braking and could possibly lead to an overspeed on grades and/or longer stopping distances when using dynamic braking. Failure to properly employ the service brake under these conditions could lead to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

If the wheel motor or converter panel has been isolated using the proper procedure, the operators panel will display a small illuminated yellow gear cog (Drive System Abnormal icon). There are no messages when booting LINCS, starting engine, or releasing brakes. If this icon is illuminated, the operator must be aware that the machine has reduced electric braking and the operator must verify that all four service brakes are functional to stop the machine.

Figure 243: Drive System Abnormal Icon



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Service Brakes

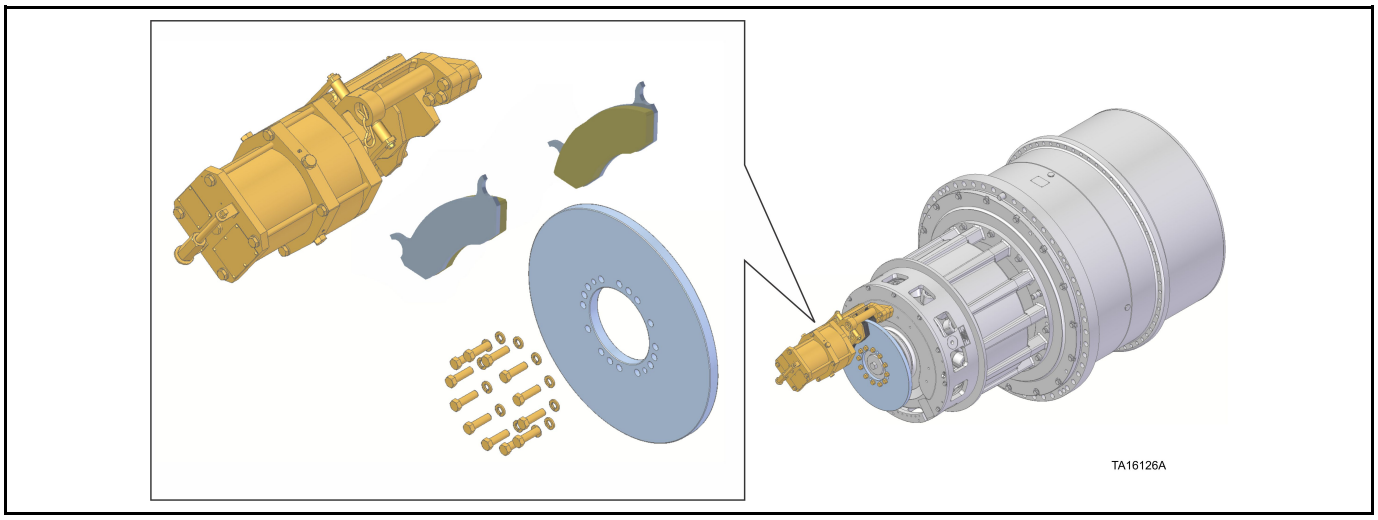
While the machine is capable of operating on less than four wheel motors, the service brakes on all four wheel motors must be fully functional and capable of stopping the driver and wheel whenever the machine is being operated. This means that:

- The traction motor must be installed
- The traction motor or driver cannot be altered in any fashion
- Middle pinion on 57” driver cannot be removed

WARNING

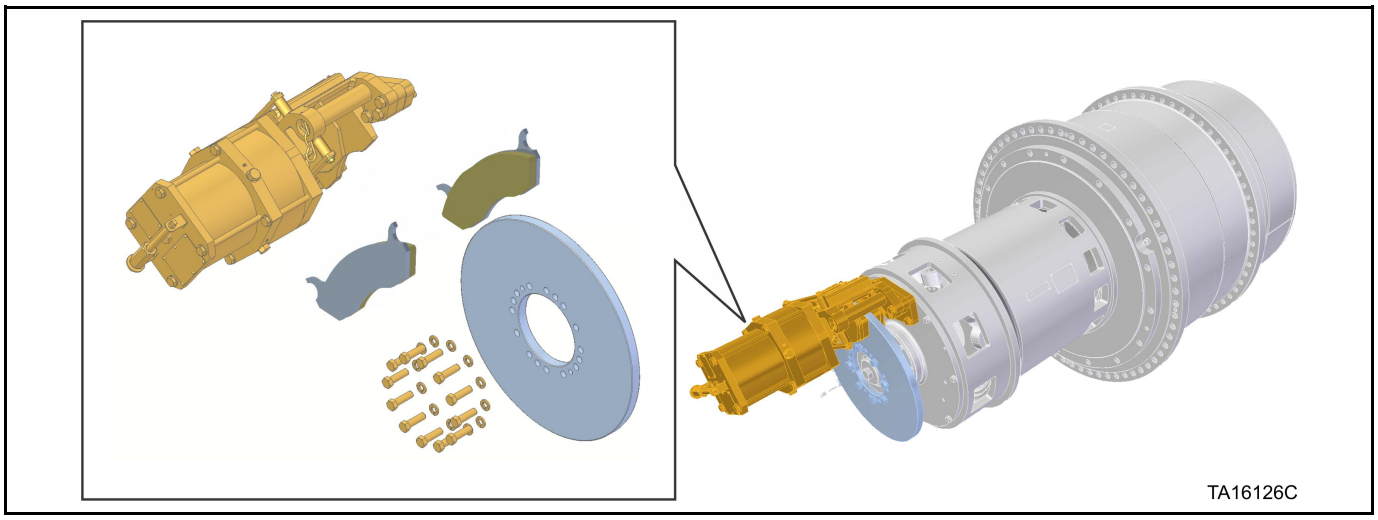
The machine should only be operated with less than four service brakes in order to move the machine away from a dangerous situation. Do not tram the machine or operate the machine in production with less than four service brakes. The service brakes must be maintained and working properly (e.g.., disks in spec, pads in spec, gaps in spec, pressures in spec, no leaks, etc.). Failure to properly inspect and maintain all four service brakes may compromise braking capability leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

Figure 244: Example 1: B-60 on 57” Driver



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Figure 245: Example 2: B-40A on 51” Driver



Overspeed Prevention Recommendations

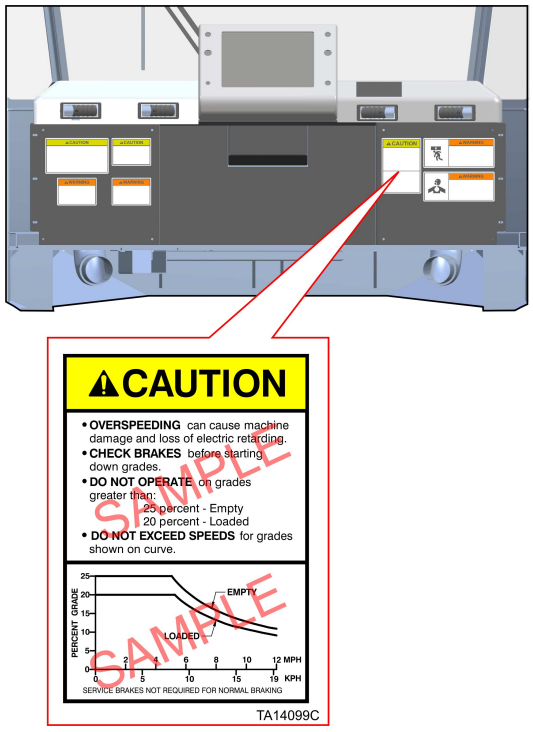
1. Each machine has a grade/speed chart that indicates the dynamic retarding limits of that specific machine when descending a grade. If either converter panels or motors have been disabled - the machine’s speed should be reduced when descending a grade to prevent a runaway situation.
2. Observe actual grade conditions as compared to the grade/speed chart for both loaded and unloaded conditions. The grade/speed chart is located inside the cab (refer to “Typical grade/speed chart”).
3. Reduce speed PRIOR to descending a grade.
4. As a general rule, descend a grade no faster than the speed the machine will ascend the same grade with the same load.
5. Promptly apply service brakes to slow the machine if an overspeed situation occurs.

⚠ WARNING

Failure to appropriately reduce the machine’s speed while descending a grade with disabled converter panels and/or disabled motors can create the risk of a machine runaway leading to the loss of machine control which poses an impact hazard to nearby personnel that may result in death or serious personal injury, as well as substantial equipment damage.

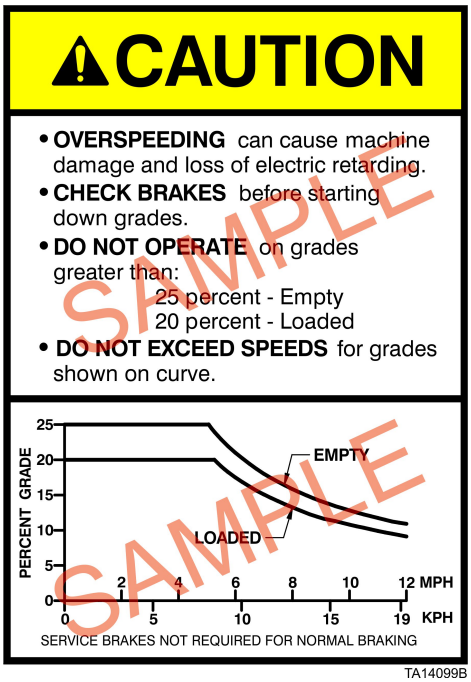
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Figure 246: Typical grade/speed chart



NOTICE

An example of a grade/speed chart is shown here. Each type of machine is different. Refer to the grade/speed chart mounted in the operator's cab for accurate information for a specific machine.



Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

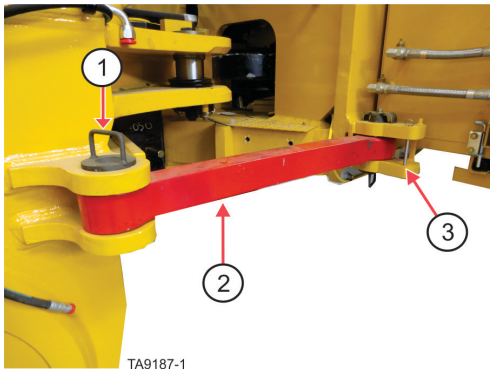
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Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 247: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

Isolating the Wheel Motor (software)

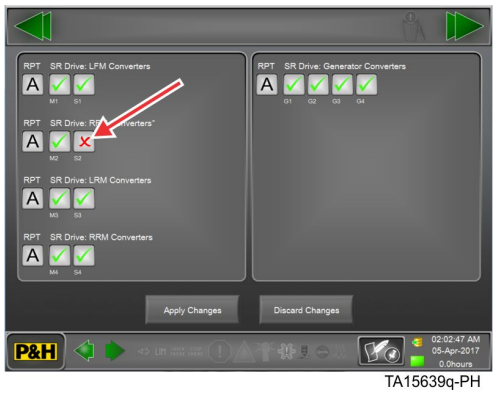
1. In LINCS, log on with a Maintenance key (or higher).
2. Navigate to the System Settings >Configure >Drives screen.

Figure 248: System settings – configure – drives

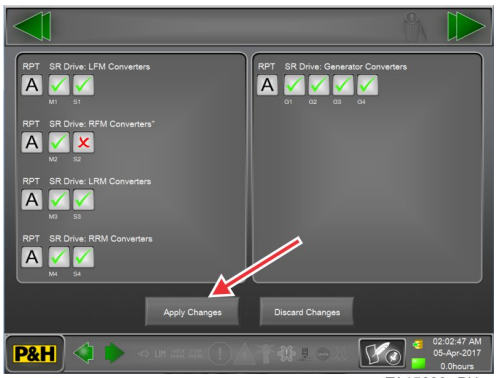


3. Locate the appropriate converter assembly and select the green check mark to isolate the converter. The green check will change to a red X to indicate the converter has been isolated.
4. Select Apply Changes

Figure 249: Drive isolation select



TA15639q-PH



TA15639r-PH

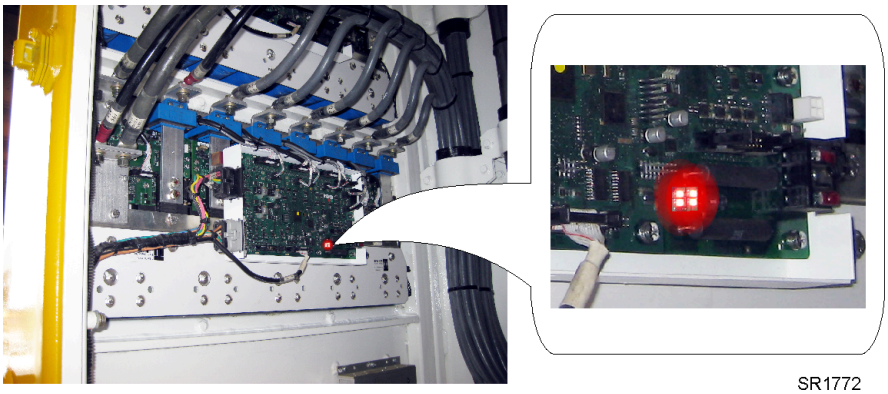
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 250: Converter assembly bus LED's


SR1772

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There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

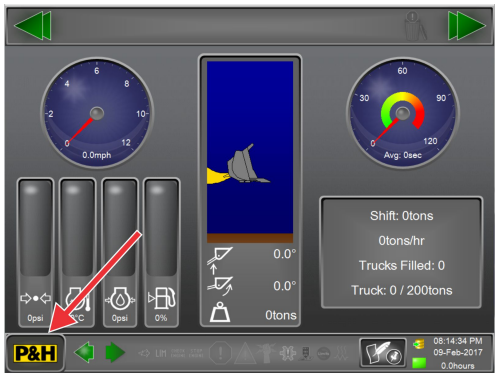
In Cab Verification Using LINCS II Display

Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 251: LINCS logging/monitoring menu access



TA15638-PH

Main Menu Button

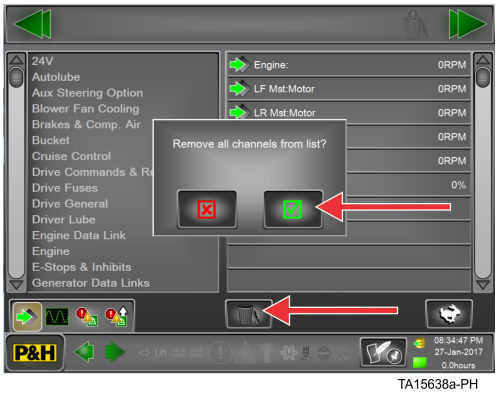


TA15639-PH

Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 252: Remove channels



TA15638a-PH

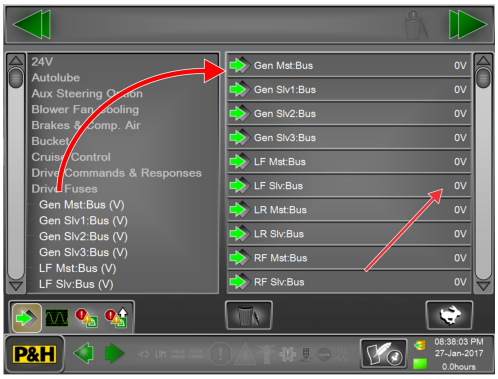
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 253: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 254: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 255: Isolation and control switch assembly

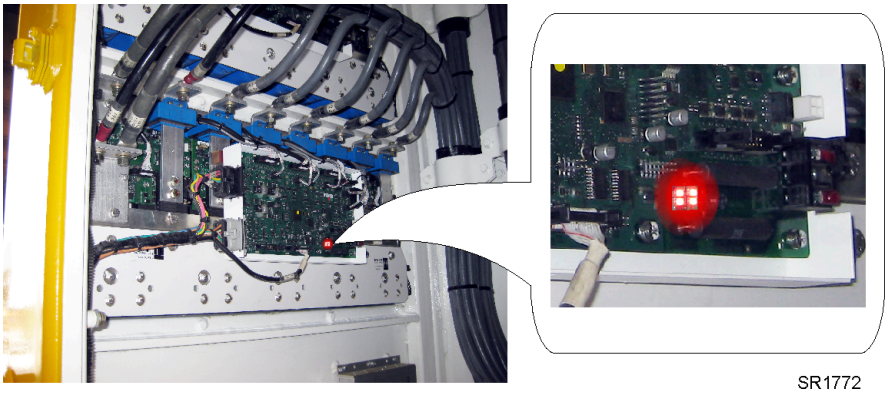


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 256: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

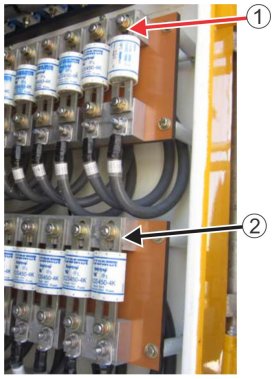
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 257: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

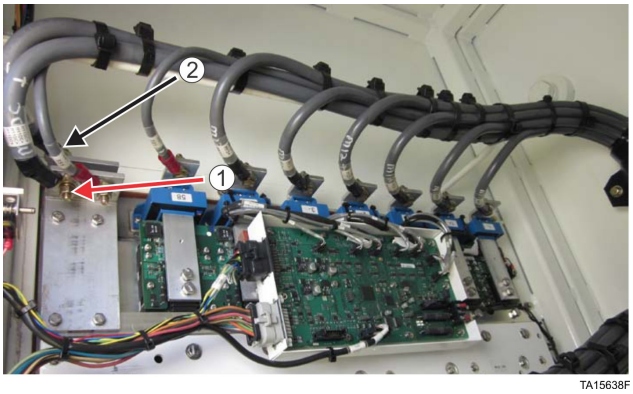
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Figure 258: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 259: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Isolating the Wheel Motor (hardware)

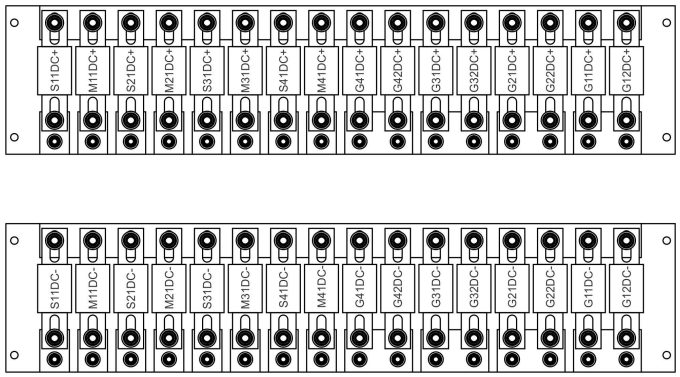
1. Remove the DC bus fuses, all phases (+ & -) for the appropriate wheel motor (located in the electrical converter cabinet).

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Figure 260: Fuse assemblies (L-2350 shown)



TA15639b



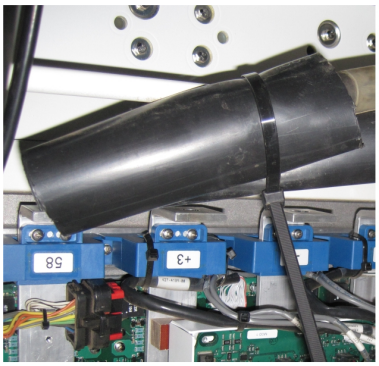
TA15639l

2. Remove any associated grid cables (58) from the Master and Slave (if applicable) converter assemblies that are connected to the motor being isolated. Use cable ties and insulation sleeves to isolate the cables from the converter assembly. Motor phase leads can be left connected on the converter assemblies.

NOTICE

Motor leads will be disconnected in the appropriate axle. Do not remove from converter assemblies.

Figure 261: Grid cable (58) isolation

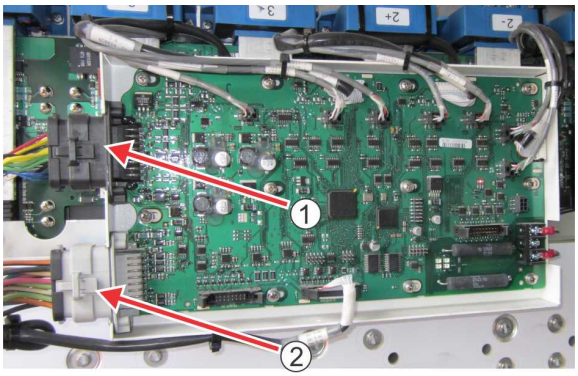


TA15639a

3. Disconnect the RPT/RTD and Vehicle/Power connectors from the SR control board on the master converter assembly.

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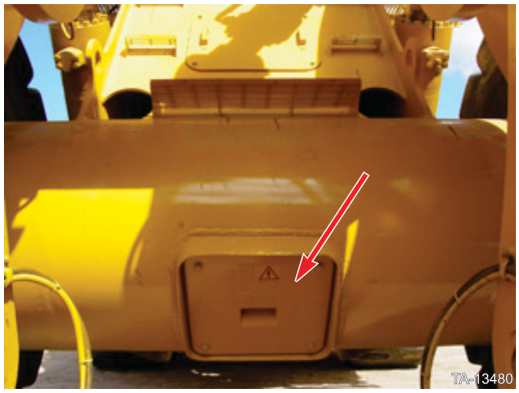
Figure 262: Vehicle/power and RPT/RTP connectors



1) Vehicle/power connector, **2)** RPT/RTD connector

4. Remove the appropriate axle cover.

Figure 263: Axle cover (front axle shown)



5. In the axle, disconnect the appropriate phase cable leads (at the apples) coming from the drive converter assemblies for the motor being isolated.

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Figure 264: Motor connections in axle



NOTICE

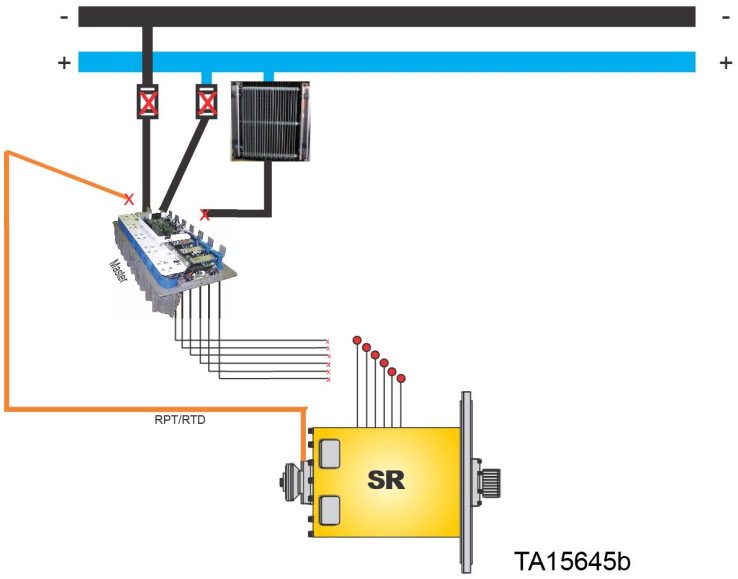
It is not necessary to disconnect the cable leads running from the apples to the motor. It is only necessary to disconnect the leads at the apple running to the converter assembly.

6. Electrically isolate and secure the cable leads coming from the drive converter assemblies.

CAUTION

The machine will be running with these cables disconnected. Make sure they are properly insulated and secure. Failure to insulate and secure may result in component or machine damage due to shorts, arcs, or equipment damage.

Figure 265: Motor isolation



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7. Re-install the axle cover.
8. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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Fuse Replacement Procedure

This procedure should be used when removing/replacing the DC bus fuses on a Generation 2 machine.

NOTICE

The fuse must be checked with the fuse removed from the system.

Safety Preparations

⚠ WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

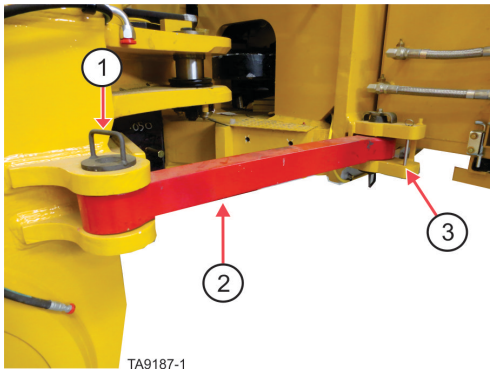
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

⚠ WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 266: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

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Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

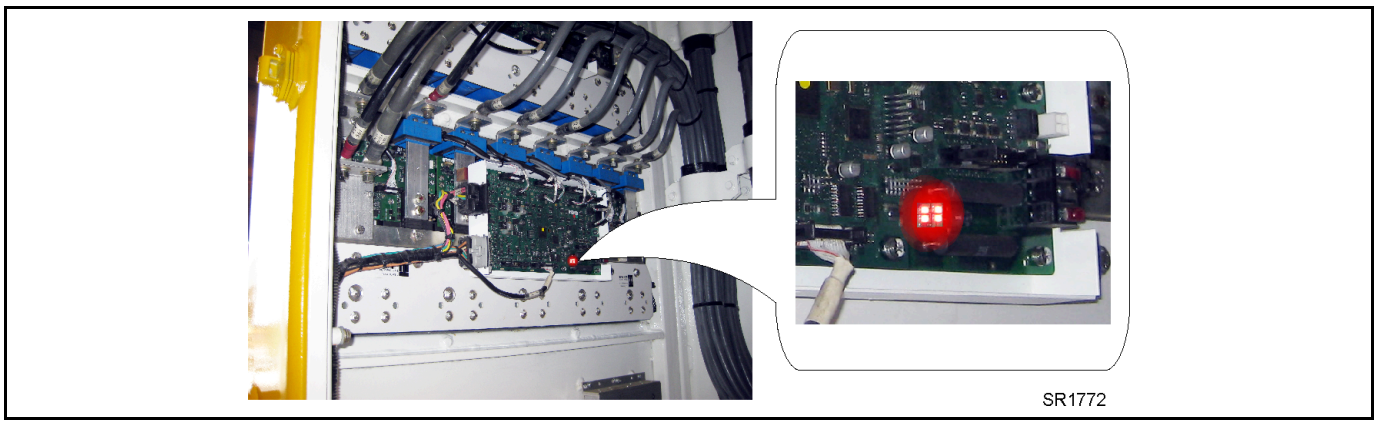
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 267: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

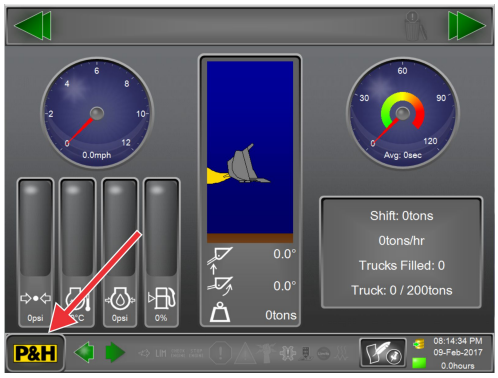
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 268: LINCS logging/monitoring menu access



TA15638-PH

Main Menu Button

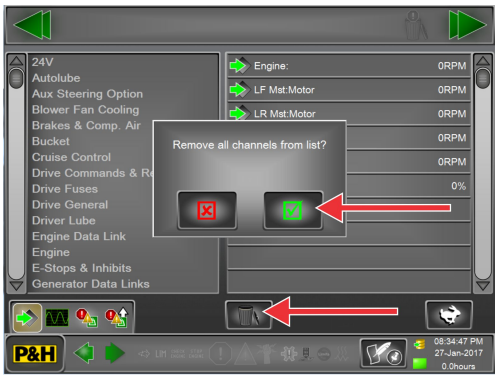


TA15639-PH

Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 269: Remove channels



TA15638a-PH

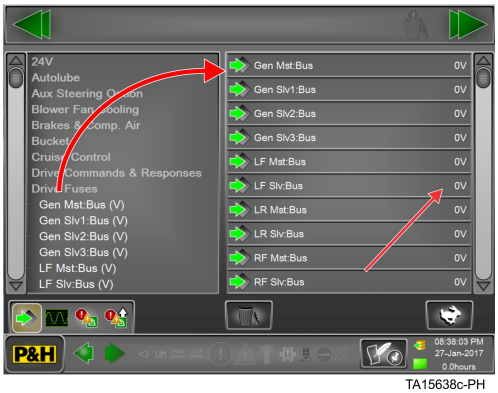
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 270: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 271: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

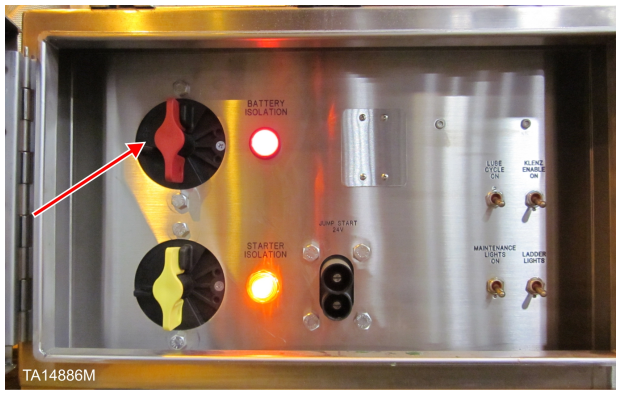
Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 272: Isolation and control switch assembly



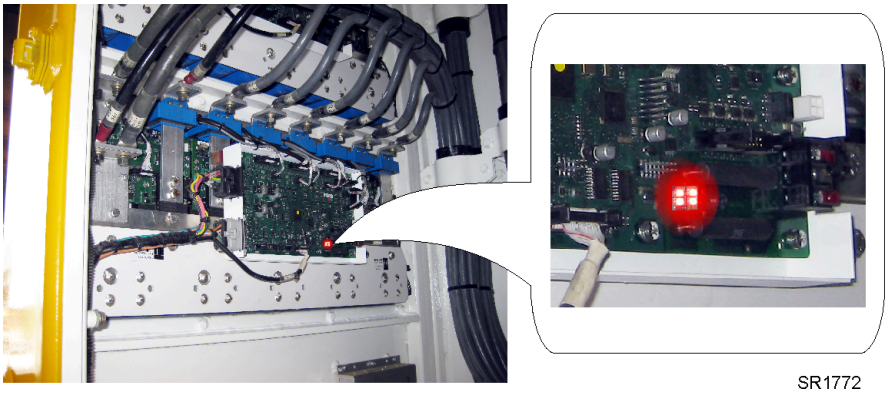


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 273: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

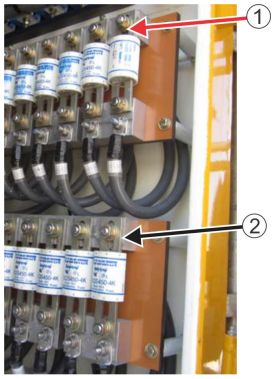
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 274: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

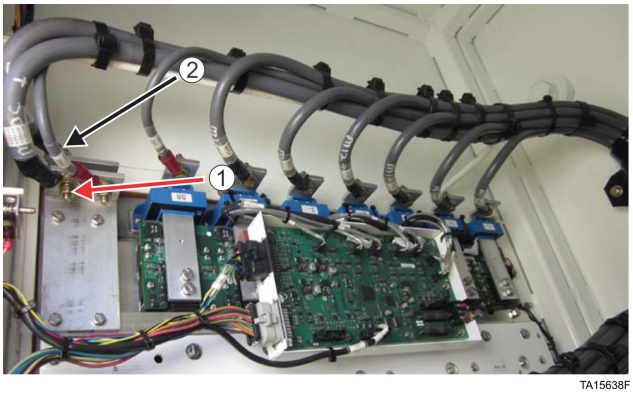
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Figure 275: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 276: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Replacing a Fuse

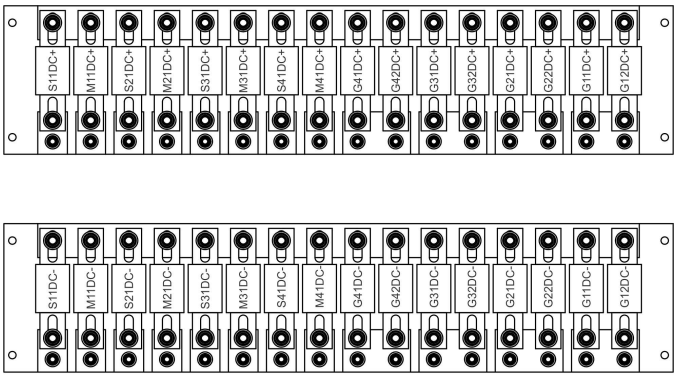
1. Using a ¾” wrench, remove the two nuts and associated hardware from both the + and – fuses.

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Figure 277: Fuse assemblies



L-2350 Fuse Panels



L-2350 Fuse Assembly

2. Remove and replace the fuses. Make sure replacement fuses have proper current ratings.

NOTICE

- *When replacing fuses, always replace both the (+) and (-) fuses at the same time.*
- *Generators: Generator converter assemblies have four fuses per panel. If one fuse is defective it is necessary to replace all four fuses related to the converter assembly.*
- *Motors: Depending on the machine, the motor may have both a Master and a Slave converter assembly. Each of these assemblies have two fuses. If one of the fuses is defective, it is only necessary to replace the two fuses related to the assembly with the defective fuse.*

3. Torque the nuts to 20 ft-lbs (27 N-m)

CAUTION

The hardware used to retain the fuses is stainless and any replacement hardware must also be stainless. Torque numbers must not be exceeded or damage to components may result.

4. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.
5. Reboot LINCS
6. Test machine for proper operation.

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Switching RPT Set

Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

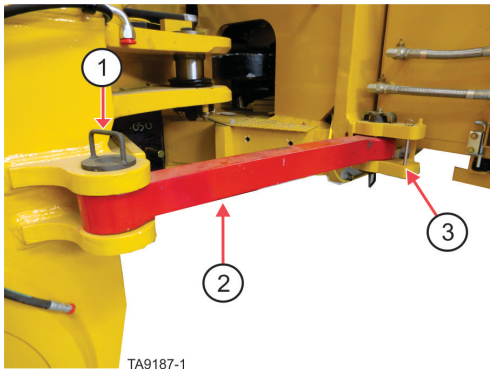
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 278: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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Switching the RPT Set

1. Log in to LINCS with a Maintenance level key or higher.
2. Navigate to System Settings > Configure > Drives.

Figure 279: LINCS screen

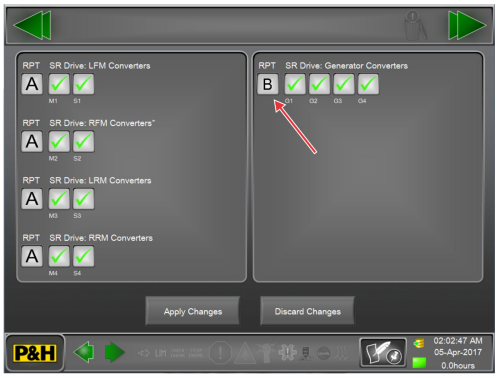


TA15646-1-PH

1) System settings, **2)** Configure, **3)** Drives

3. On the appropriate motor/generator, swap the RPT set by selecting the RPT to be changed.. The RPT set will switch from the active set to the unused set (A to B or B to A).

Figure 280: Selecting RPT B set on Generator Converter



TA15646-2-PH

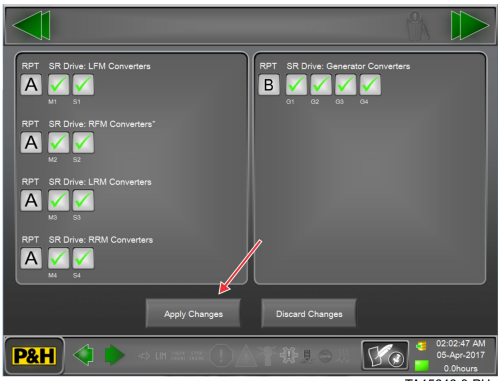
4. Select 'Apply Changes'.

NOTICE

The RPT LED's on the control card are only connected to RPT set A. If the A set fails, and via software the B set is selected to be used, the LED's on the control panel will still be connected to set A.

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Figure 281: Apply changes to set RPT set



TA15646-3-PH

5. Reboot LINCS to activate changes.
6. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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RPT Setting Procedure G100/200 Generators

Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

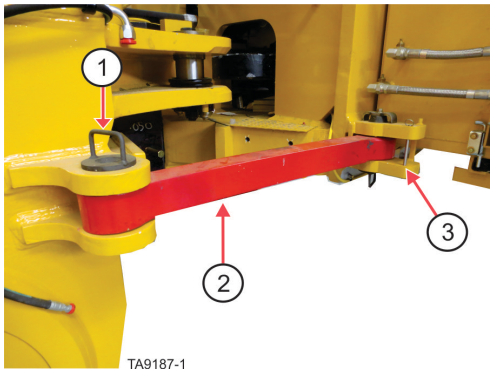
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 282: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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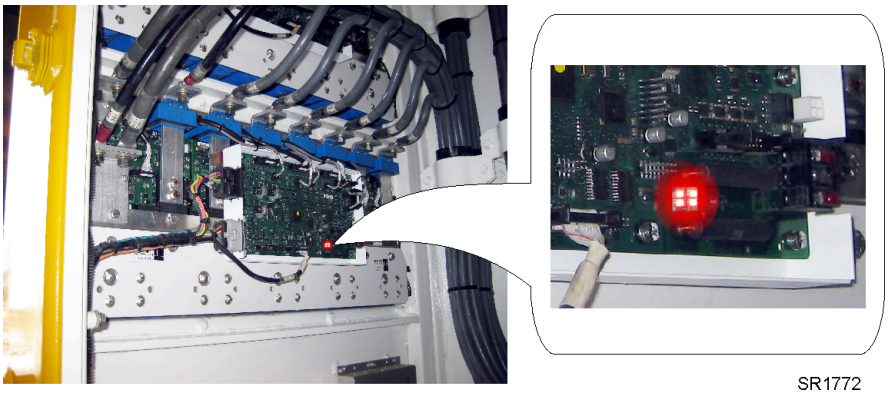
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 283: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

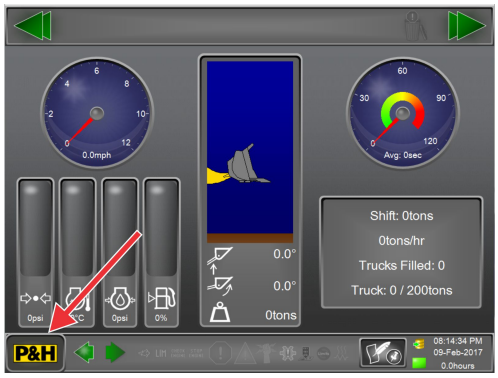
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 284: LINCS logging/monitoring menu access



TA15638-PH

Main Menu Button

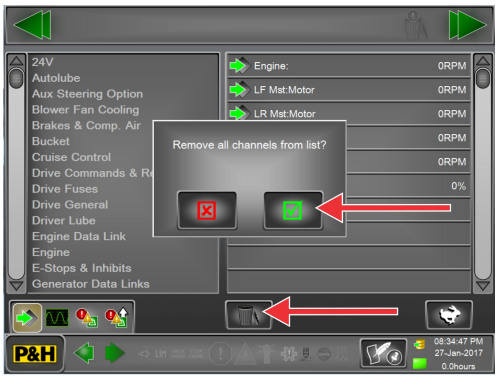


TA15639-PH

Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 285: Remove channels



TA15638a-PH

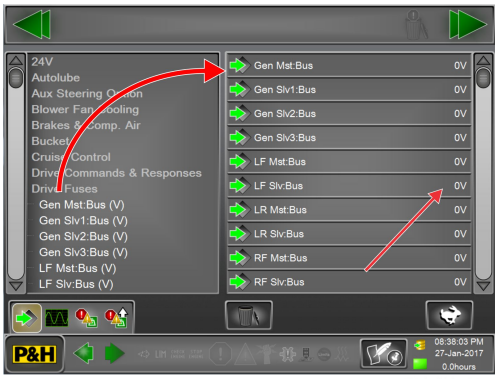
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 286: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 287: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 288: Isolation and control switch assembly

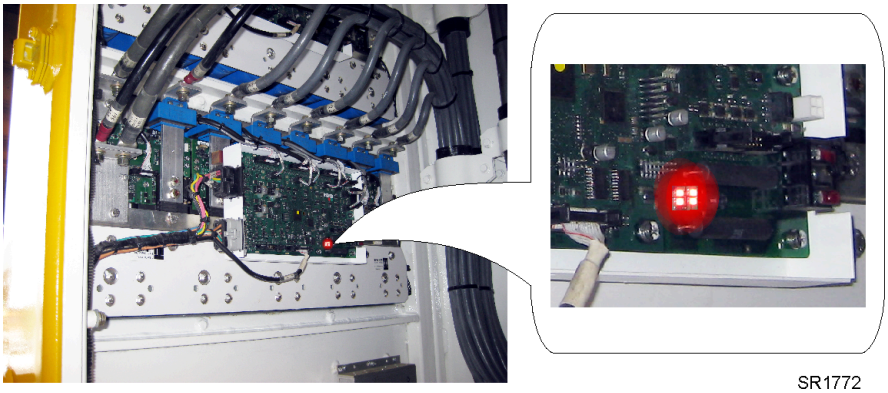


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 289: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

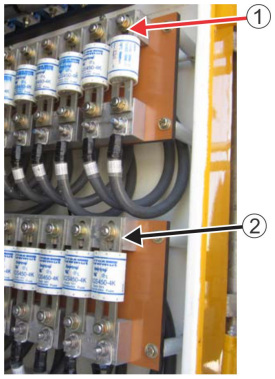
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 290: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

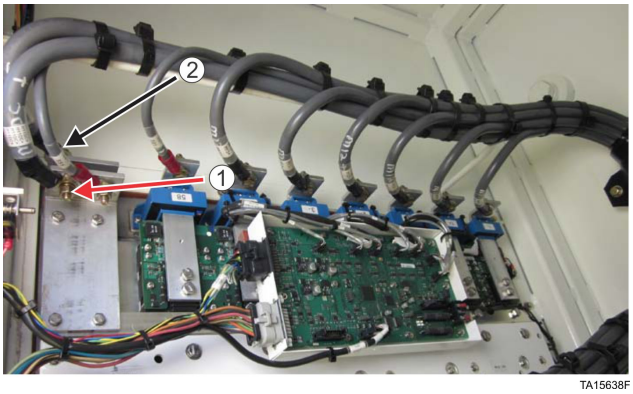
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Figure 291: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 292: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Adjusting the RPT:

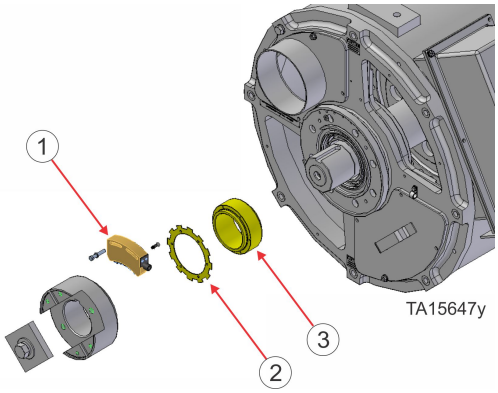
NOTICE

This procedure requires turning the rotor in order to test the LED's. This is accomplished by rotating the engine crankshaft.

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Items Required

Figure 293: RPT, shutter and outer race

Item	Part Number
RPT/RTD Tester or RPT/RTD tester in hard case	427-0151 or 428–6485
Test Cable RPT/RTD	427-2153
Power Cable RPT/RTD Tester	427-2154
DC Power Source (9VDC, 12VDC, +24VDC — >1A)	N/A
70 Amp DC Current Supply (for free turning motors or generators)	N/A
½" drive X 1-1/2 inch socket 1/2 drive extension ½" driver flex handle	N/A
Hook meter – for 70A DC current	N/A
600A DC Current Supply (for generators connected to engine)	N/A
	
1) RPT assembly, **2)** Shutter, **3)** Outer race	

NOTICE

The outer race is an interference fit on the shaft and does not align to the rotor. Alignment is performed by adjusting the RPT assembly.

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NOTICE

Previous to connecting the RPT/RTD test card, the LED's can be tested by applying 12VDC to the card. At this time all LED's will be OFF, if any are ON, there is a potential problem with the test card. If all LED's are OFF, move SW1 on the tester card to position 1 and LED set 1 will come ON. Move SW1 switch to position 2 and LED set 1 will go OFF and set 2 will come ON. Move SW1 switch to position 3 and LED set 2 will go go OFF and set 3 will come ON. Return the switch to the OFF position. Again, if any of these steps do not work, there is a potential problem with the test card.

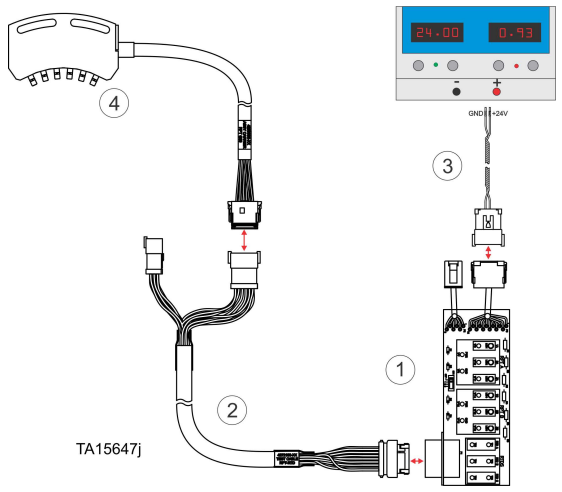
1. Visually inspect the shutter for bent tabs or damage prior to adjusting the RPT. Repair or replace as necessary.
2. Attach the 23 pin female connector on the Test Cable to the 23 pin male connector on the RPT/RTD Tester Card.
3. Attach the power cable RPT/RTD Tester to the 12 pin male connector on the RPT/RTD Tester Card.
4. Connect the Ground and 24V leads on the Power Cable RPT/RTD Tester to a +24VDC power supply.

NOTICE

The drive shaft must be disconnected in order to allow the alignment of the rotor.

5. Disconnect the drive shaft at the generator end.

Figure 294: RPT tester card and cables



1) RPT/RTD tester card

2) Test cable RPT/RTD

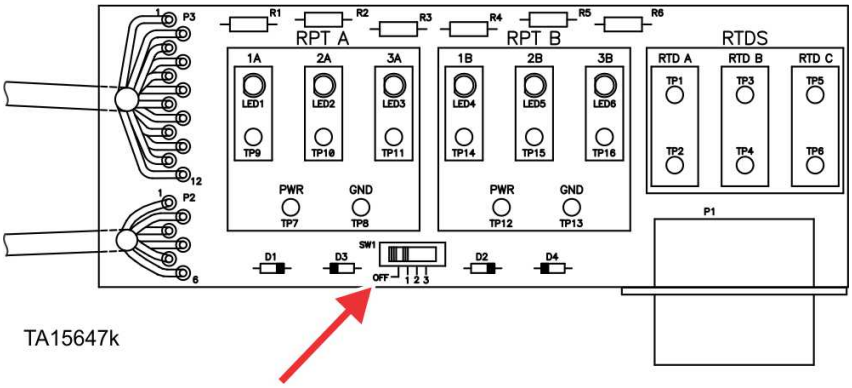
3) Power cable RPT/RTD tester

4) RPT carrier assembly

6. Plug the RPT carrier cable into the 12 pin connector located on the RPT/RTD test cable.
7. Make sure SW1 on RPT/RTD Tester card is switched to OFF.

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Figure 295: Tester card (SW1 OFF)



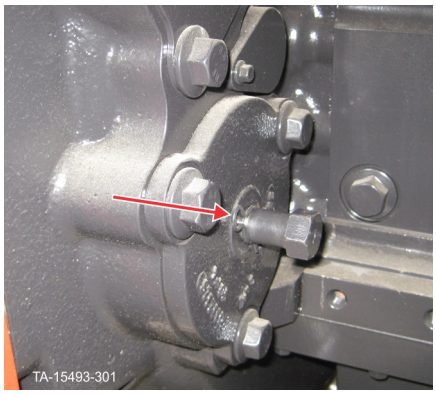
8. Turn on the DC power supply and check to see that at least one of the RPT LED's illuminates.

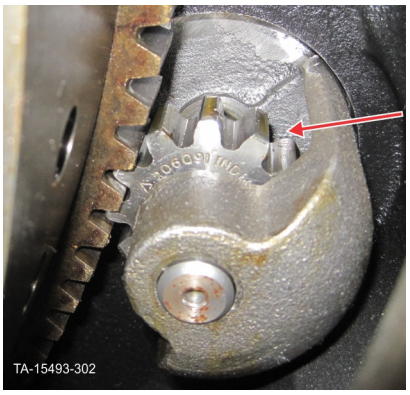
NOTICE

If none of the LED's illuminate, rotate the rotor a small amount. If no LED's are illuminated after rotating the rotor it will be necessary to troubleshoot/replace the RPT carrier and/or the test card. The rotor can be rotated by rotating the engine crankshaft as detailed below. Make sure power is present at the test card.

Crankshaft rotation procedure for Teir 1 and Teir 2 Cummins Engine

Figure 296: Cummins engine rotation tool





Cummins Engine engine rotation tool, retainer ring, and internal gear

1. Remove the retainer ring from the engine rotation tool. (The tool is normally held in the out position with a retainer ring so that it does no contact he flexplate gear, it is also spring loaded to keep it away from the flexplate gear).
2. On completion of procedure, pull the spring loaded shaft to the out position and reinstall the retainer ring.

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NOTICE

If rotation tool not installed on engine, consult your local Cummins dealer.

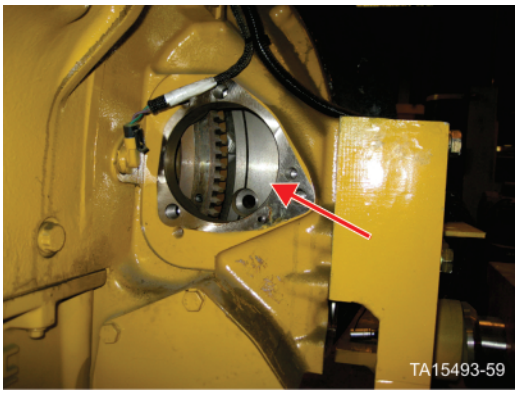
Crankshaft rotation procedure for Teir 1 and Teir 2 Detroit Engine

Rotating the Engine Crankshaft with Manual Drive Gear

1. Remove the starter from the rear of the engine.

Figure 297: Remove starter





NOTICE

Commercial tool is available from Detroit dealers. Contact your Detroit dealer for more information.

2. Install the engine rotation tool.

Figure 298: Detroit engine rotation tool





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Figure 299: Rotating engine crankshaft with manual drive gear



3. On completion of procedure, remove the rotation tool from the engine.

CAUTION

Engine damage may occur if engine rotation tool is not removed after each use. Remove engine rotation tool and install starter before running engine. Gear tooth and casing damage is possible.

NOTICE

The remainder of the RPT test includes the use of a DC current supply capable of outputting 600 Amps. All safety precautions must be followed while working with this equipment.

⚠ WARNING

Risk of shock exists while performing the RPT settings. Make sure the DC current supply unit is OFF prior to attaching the leads to the terminal posts and before continuing with this test procedure. Shock and equipment arcing is possible if trying to connect the DC current supply while the unit is powered on.

Setting Phase 3

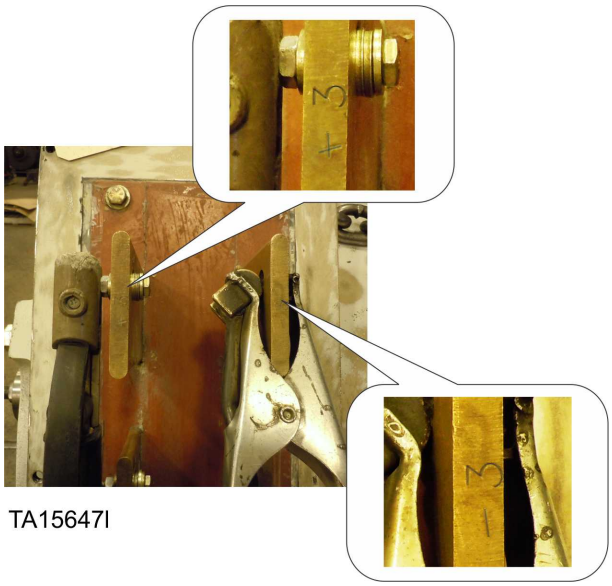
1. Attach the DC current supply leads to phase 3 + and – terminal posts.
2. Set the DC current supply to 600 Amps and energize phase 3.

NOTICE

Depending on the size of the DC current supply leads, it may be necessary to attach a bolt to the terminal post in order to provide a good clamp location.

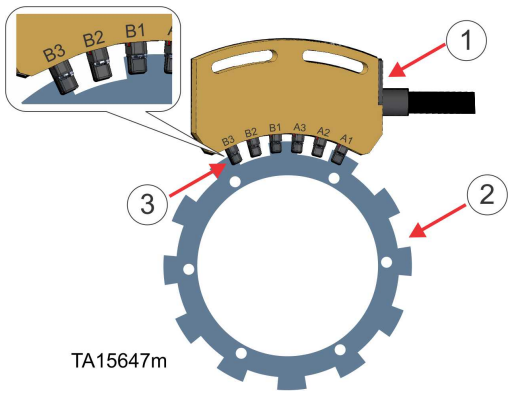
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Figure 300: Phase terminal posts



3. With phase 3 energized, the rotor will rotate to align with the phase 3 stator poles.
4. Adjust the RPT carrier so that one of the shutter tabs aligns to RPT B3 as shown. Both the 3B and 3A LED's should now be lit on the RPT Tester, if not, adjust the RPT carrier until both LED's are ON.

Figure 301: Shutter aligned to RPT



1) RPT carrier

2) RPT shutter

3) Shutter aligned to RPT B3

Figure 302: Tester card Phase 3 LED's

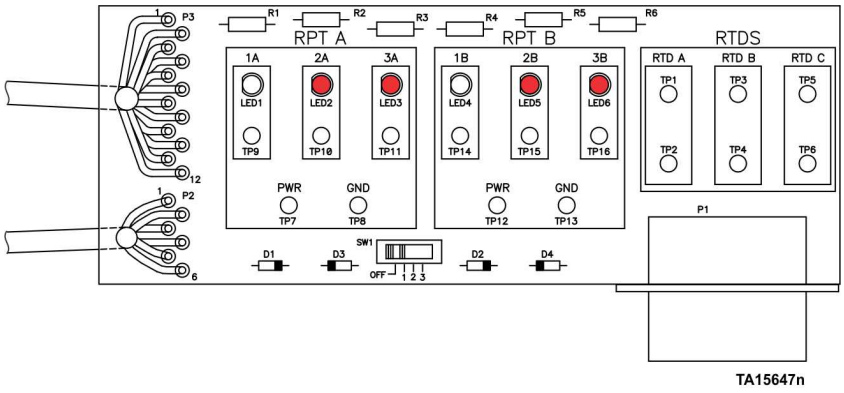
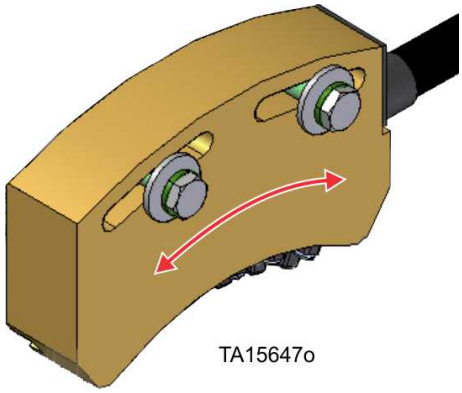


Figure 303: RPT adjustment



NOTICE

There are two mounting positions for the RPT carrier, if unable to align to the shutter, move the RPT carrier to the alternate position.

5. Turn the rotor slightly in the counter clockwise direction and allow the rotor to return to its aligned position.

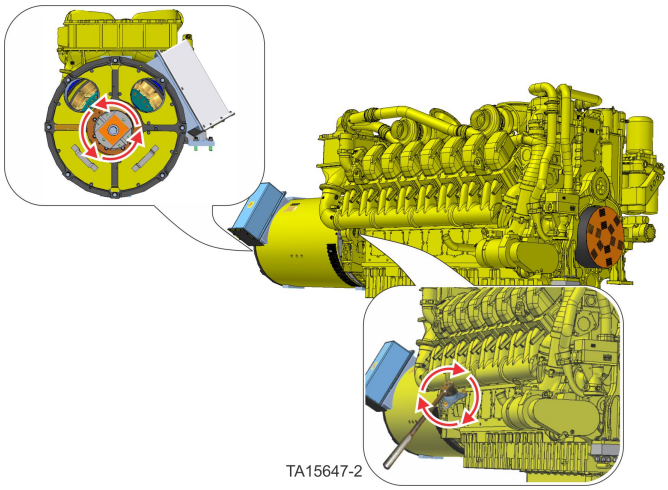
NOTICE

It will be necessary to turn the DC current supply off in order to rotate the rotor. Rotate the rotor slightly and then turn the DC current supply back on and ensure the rotor returns to its aligned position.

The rotation tool must be rotated clockwise in order to turn the rotor counter clockwise.

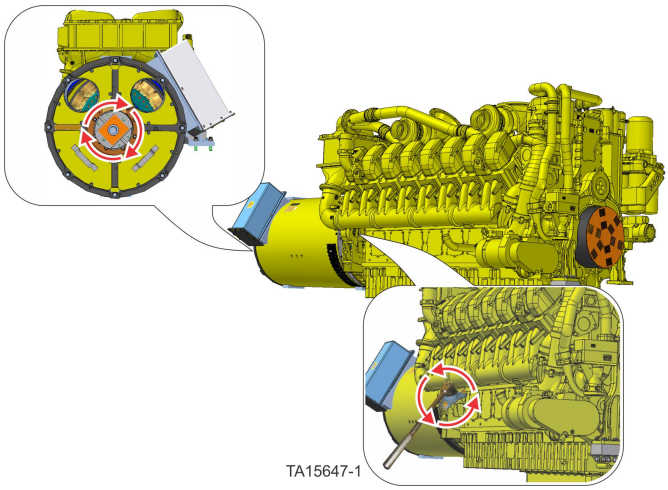
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Figure 304: Counter clockwise alignment



6. Verify that both 3B and 3A LED's remain ON.
7. If the LED's turn OFF, loosen the RPT carrier bolts and adjust the carrier slightly in the clockwise direction. Tighten the carrier bolts.
8. Repeat the test until both LED's remain ON as the rotor returns to the aligned position.
9. Turn the rotor slightly in the clockwise direction and allow the rotor to return to its aligned position.

Figure 305: Clockwise alignment



10. Verify that both 3B and 3A LED's turn OFF.
11. If the LED's stay ON, loosen the RPT carrier bolts and adjust the carrier slightly in the counter clockwise direction. Tighten the carrier bolts.

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12. Repeat the test until both LED's remain OFF.
13. Once the LED's remain OFF, perform the COUNTER CLOCKWISE test again to make sure the RPT carrier is still in alignment for the counter clockwise position.

Setting Phase 2

Step 1: Turn OFF the DC current supply unit and move the leads to phase 2 + and – terminal posts.

⚠ WARNING

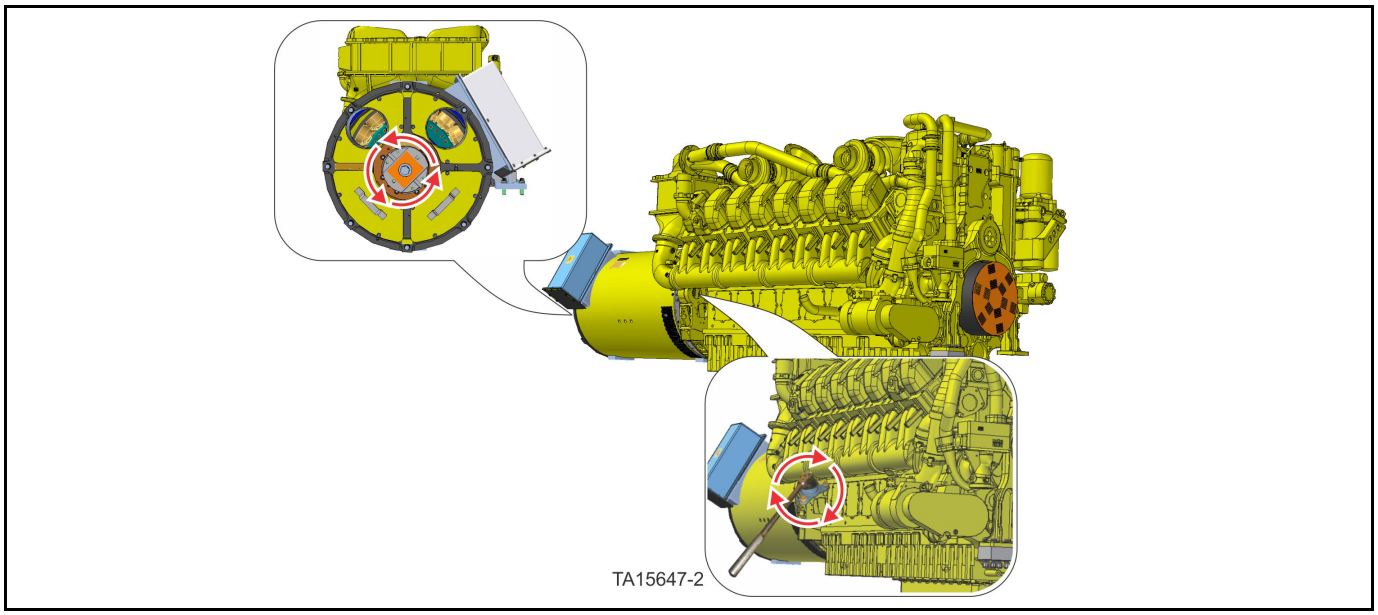
Risk of shock exists while performing the RPT settings. Make sure the DC current supply unit is OFF prior to removing or attaching the leads to the terminal posts and before continuing with this test procedure. Shock and equipment arcing is possible if trying to connect the DC current supply while the unit is powered on.

Step 2: Make sure the DC current supply is set to 600 Amps and energize phase 2.

Step 3: With phase 2 energized, the rotor will rotate to align with the phase 2 stator poles.

Step 4: Turn the rotor slightly in the counter clockwise direction and allow the rotor to return to its aligned position.

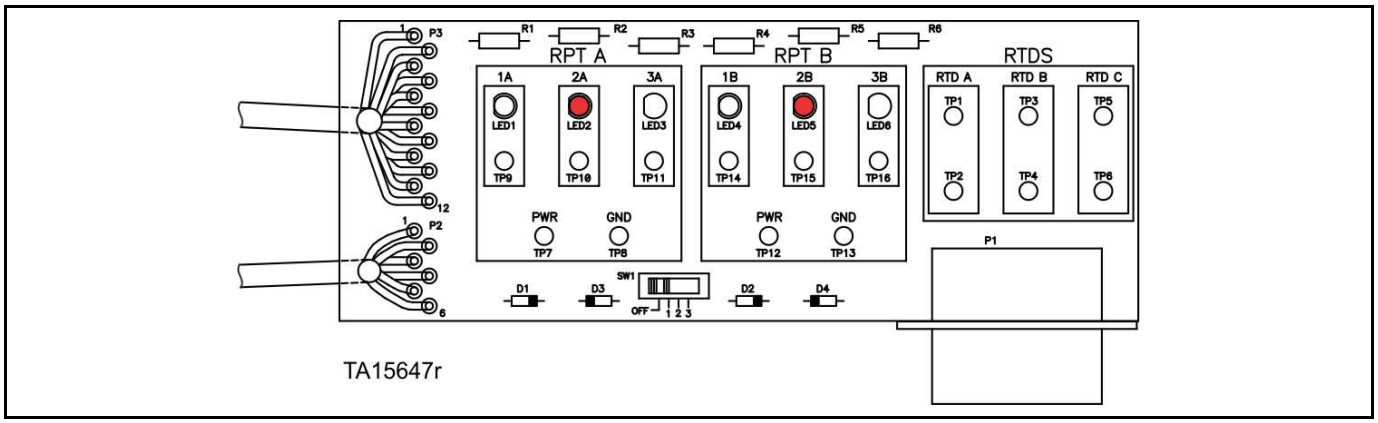
Figure 306: Counter clockwise alignment



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Step 5: Verify that both 2B and 2A LED's are now ON.

Figure 307: Tester card Phase 2 LED's

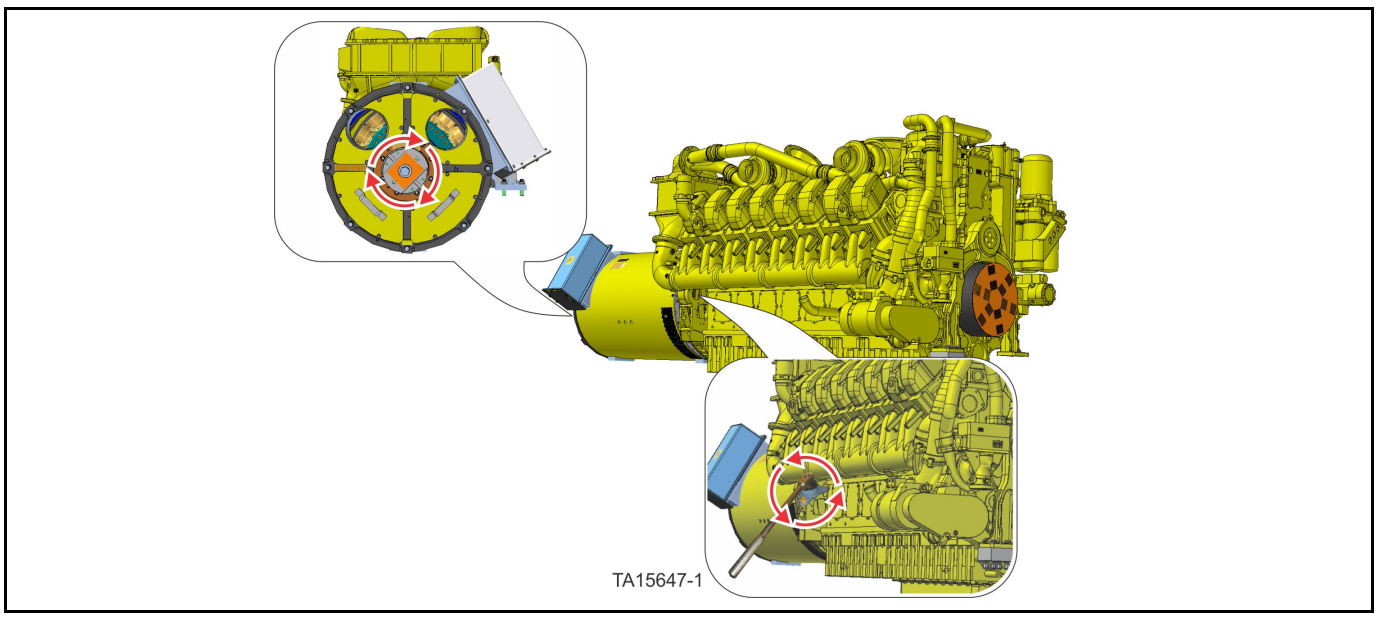


Step 6: If the LED's do not turn ON, loosen the RPT carrier and adjust slightly in the clockwise direction.

Step 7: Repeat the test until both LED's turn ON.

Step 8: Turn the rotor slightly in the clockwise direction and allow the rotor to return to its aligned position.

Figure 308: Clockwise alignment



Step 9: Verify that both 2B and 2A LED's are now OFF.

Step 10: If the LED's do not turn OFF, loosen the RPT carrier and adjust slightly in the counter clockwise direction.

Step 11: Repeat the test until both LED's are now OFF.

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Step 12: Once the LED's remain OFF, perform the COUNTER CLOCKWISE test again to make sure the RPT carrier is still in alignment for the counter clockwise position.

Step 13: If any adjustments had to be made to the RPT carrier during phase 2 testing, re-perform the test for phase 3.

Step 14: Once phase 2 and 3 are properly aligned, remove one RPT carrier mounting bolt and apply Loctite 2760 or equivalent.

Step 15: Re-install and torque this bolt to 18 ft-lbs (24 Nm).

Step 16: Remove the other mounting bolt and perform the same process.

Step 17: Upon completion of procedure, follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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RPT Setting Procedure B40A Motor

NOTICE

It will be necessary to lift (jack) the wheel motor in order to set the RPT (the motor will have to be rotated). All applicable safety procedures must be followed.

Safety Preparations

⚠ WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

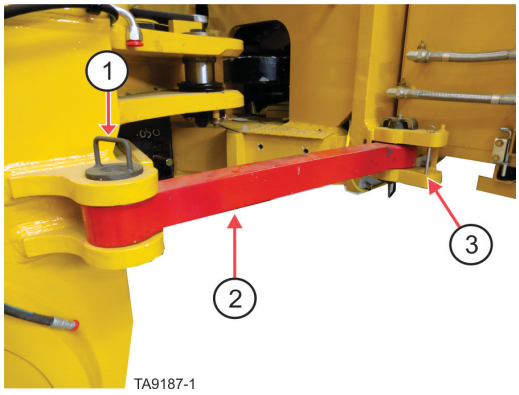
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Chock the wheels that will not be rotated.

⚠ WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 309: Frame lock in locked position



1)Retaining pin for locked position, **2)** Frame lock - shown in locked position,**3)** Retaining pin bracket for un-locked position

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Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

WARNING

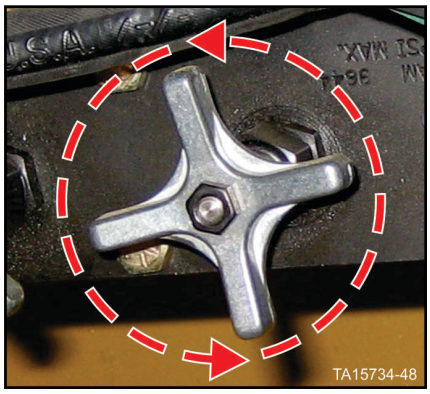
Crush hazard exists if all personnel are not cleared from around the bucket and lift arm area before using the hydraulic hoist and bucket pilot pressure bleed down valves to relieve pressure from the hoist and bucket pilot circuit. Clear all personnel from the area around the bucket and lift arms before operating hydraulic hoist and bucket pilot pressure bleed down valves. Using the hydraulic bleed down valves could result in some movement of the lift arms and bucket which could cause injury or death.

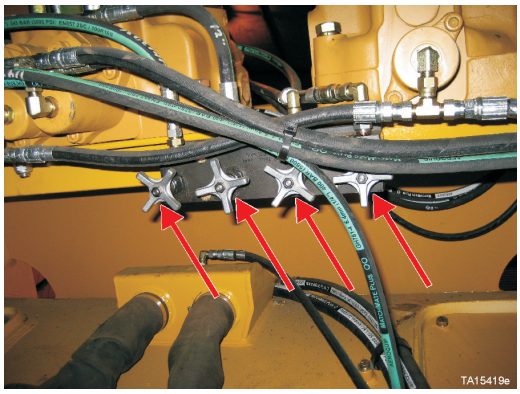
Step 6: Use the hydraulic pressure bleed down valves located in the front frame on the right side of the front opening to bleed any stored pressure in the hoist and bucket cylinders.

Step 7: Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.

Step 8: Open the valve completely and leave it open during this procedure.

Figure 310: Pressure bleed down valves





Bus Discharge Verification Procedure

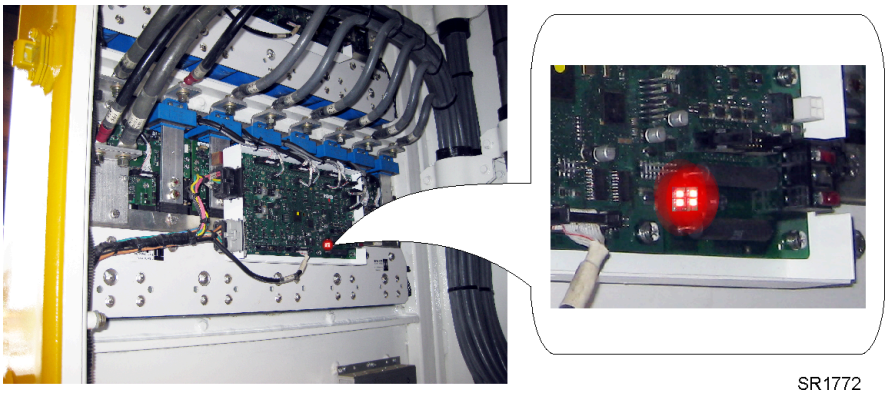
Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

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Figure 311: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

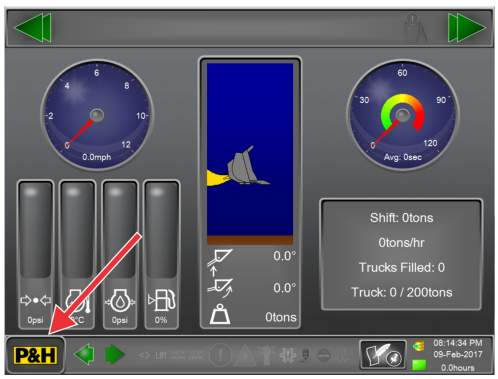
In Cab Verification Using LINCS II Display

Before You Begin

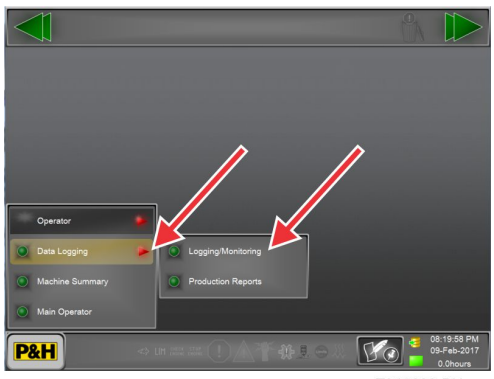
Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 312: LINCS logging/monitoring menu access



Main Menu Button

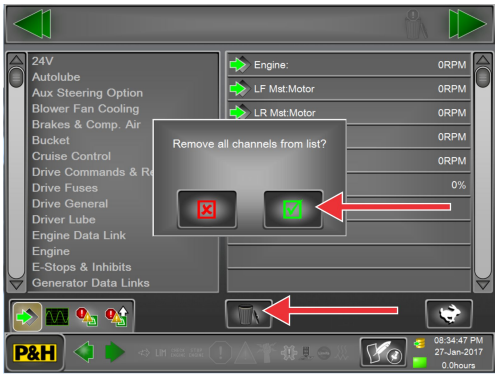


Data Logging & Logging/Monitoring

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Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 313: Remove channels



TA15638a-PH

Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 314: Left hand scroll

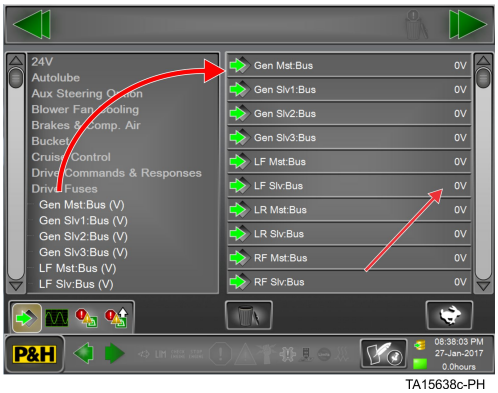


TA15638b-PH

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Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 315: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

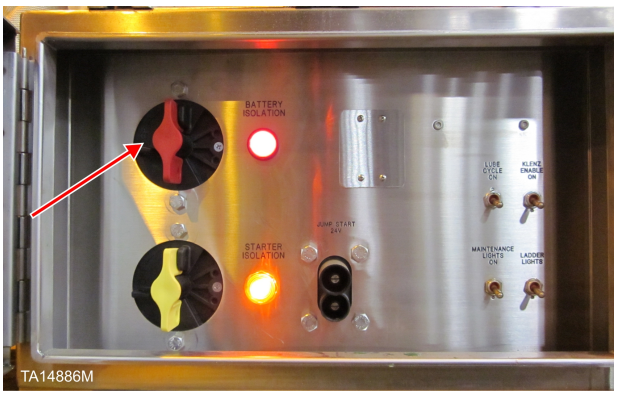
Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 316: Isolation and control switch assembly



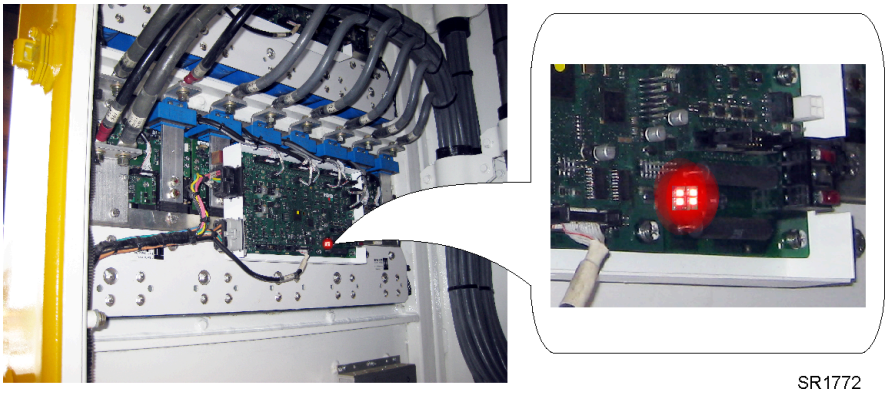


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 317: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

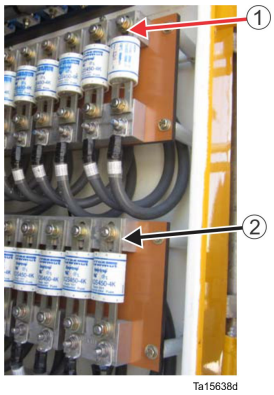
Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

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Figure 318: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

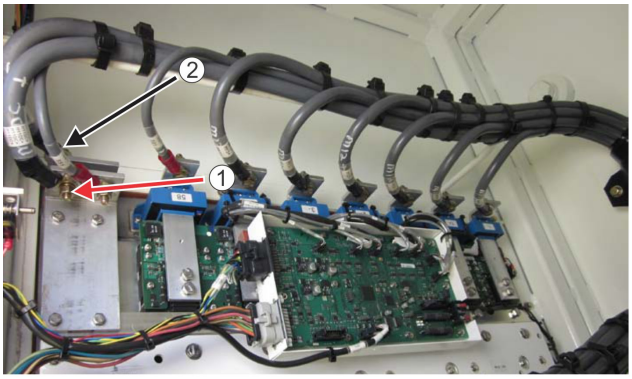
Figure 319: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

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Figure 320: Converter assembly bus connections (front of cabinet)



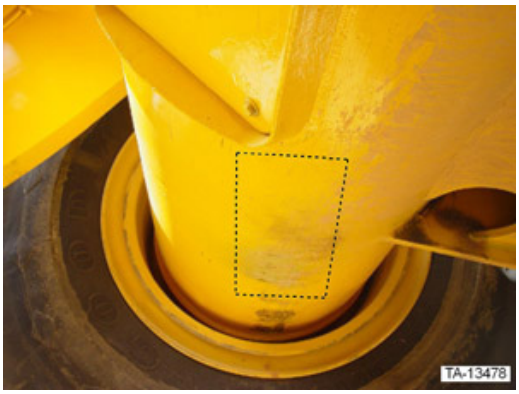
1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

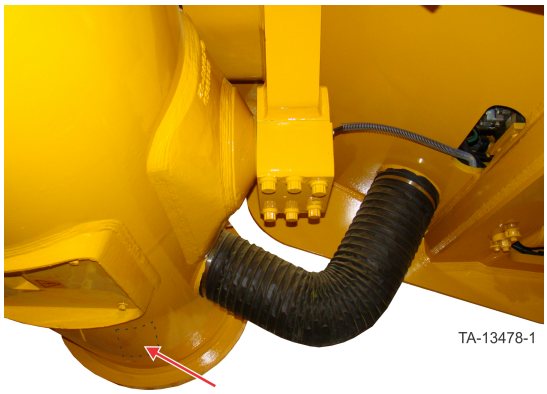
Jacking the Machine

1. Jack the appropriate wheel motor to a height where the wheel motor can be rotated.

Figure 321: Front and rear axle jacking and jack stand placement location (typical)



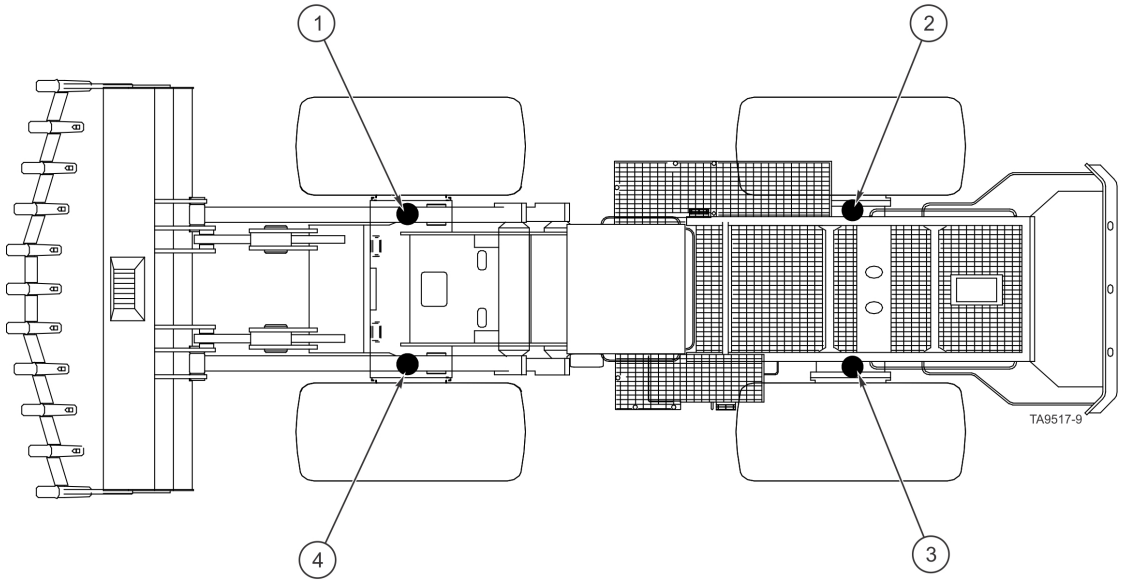
Front axle (typical)



Rear axle (typical)

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Figure 322: Recommended jack stand placement locations (typical all models)



1) Right front jacking point **2)** Right rear jacking point **3)** Left front jacking point **4)** Left rear jacking point

	Front Frame Each Pair Of Points (1) (4)	Rear Frame Each Pair Of Points (2) (3)
L-1350	111,000 lb. (50,348 kg) Total 222,000 lb. (100,698 kg)	84,000 lb. (38,102 kg) Total 168,000,(76,203 kg)
L-1850	154,000 lb. (69,853 kg) Total 308,000 lb. (139,706 kg)	104,000 lb. (47,173 kg) Total 208,000,(94,347 kg)
L-2350	172,000 lb. (78,017 kg) Total 344,000 lb. (156,036 kg)	126,000 lb. (57,152 kg) Total 252,000,(114,305 kg)

NOTICE

The use of self locking jacks is recommended.

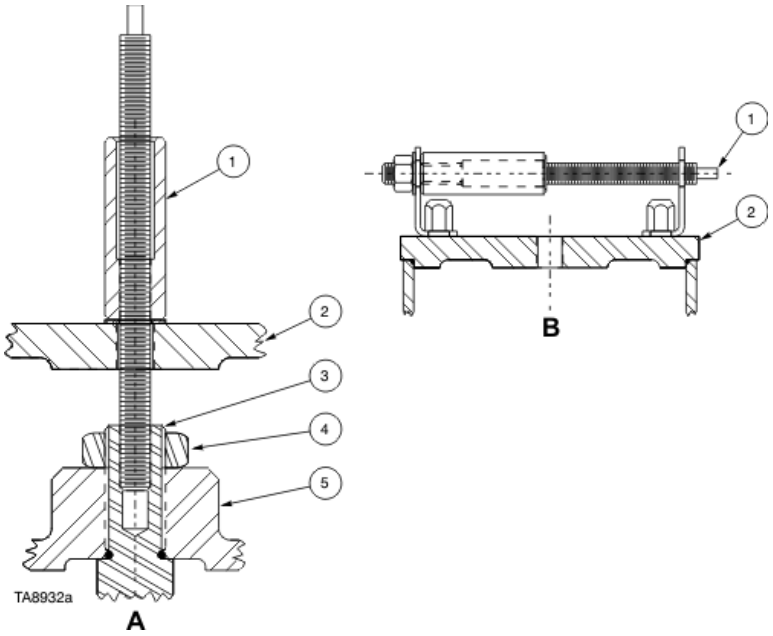
2. Ensure the appropriate motor brakes are fully released and caged using the jack rod supplied with the brakes.

NOTICE

Use jack bolt attached to top of brake caliper to release brake. Ensure the motor brake is fully released and caged using the jack rod supplied with the brakes.

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Figure 323: Rod installation for releasing brake



A View with jack rod installed

B View with jack rod stored on actuator top plate

1. Special tool – p/n 423-9175 & 423-9176
2. Actuator top plate
3. Cylinder rod
4. Jam nut
5. Piston

⚠ WARNING

Struck by or crushing hazard exists if jack rod not bottomed into the threaded recess in cylinder rod. Jack rod must be bottomed into threaded recess in cylinder rod. Use flats on jack rod to tighten and keep it from screwing out of rod when turned counterclockwise. Failure to bottom Jack rod into threaded recess in cylinder rod may result in the release of stored energy (spring tension), resulting in serious injury or death.

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Figure 324: View of jack rod installed in brake cylinder



Adjusting the RPT:

NOTICE

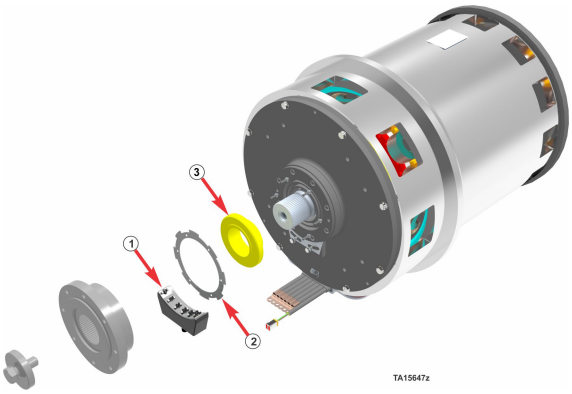
This procedure requires turning the rotor in order to test the LED's. This is accomplished by rotating the brake disk.

Items Required

Item	Part Number
RPT/RTD Tester or RPT/RTD tester in hard case	427-0151 or 428–6485
Test Cable RPT/RTD	427-2153
Power Cable RPT/RTD Tester	427-2154
DC Power Source (9VDC, 12VDC, +24VDC — >1A)	N/A
70 Amp DC Current Supply (for free turning motors or generators)	N/A
½" drive X 1-1/2 inch socket 1/2 drive extension ½" driver flex handle	N/A
Hook meter – for 70A DC current	N/A

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Figure 325: RPT, Shutter and outer race



1) RPT assembly, **2)** Shutter, **3)** Outer race seal

NOTICE

The outer race is an interference fit on the shaft and does not align to the rotor. Alignment is performed by adjusting the RPT assembly.

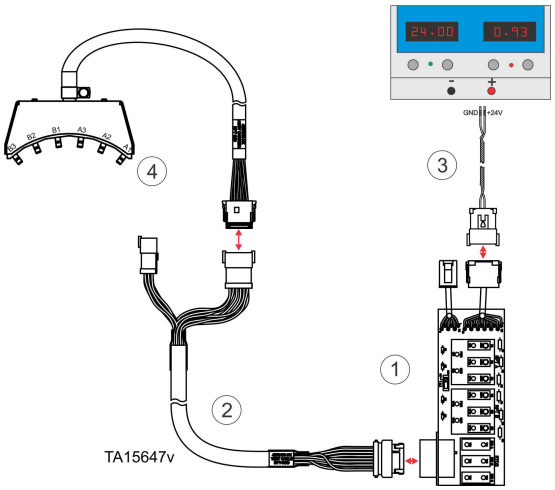
NOTICE

Previous to connecting the RPT/RTD test card, the LED's can be tested by applying 12VDC to the card. At this time all LED's will be OFF, if any are ON, there is a potential problem with the test card. If all LED's are OFF, move SW1 on the tester card to position 1 and LED set 1 will come ON. Move SW1 switch to position 2 and LED set 1 will go OFF and set 2 will come ON. Move SW1 switch to position 3 and LED set 2 will go go OFF and set 3 will come ON. Return the switch to the OFF position. Again, if any of these steps do not work, there is a potential problem with the test card.

1. Visually inspect the shutter for bent tabs or damage prior to adjusting the RPT. Repair or replace as necessary.
2. Attach the 23 pin female connector on the Test Cable to the 23 pin male connector on the RPT/RTD Tester Card.
3. Attach the power cable RPT/RTD Tester to the 12 pin male connector on the RPT/RTD Tester Card.
4. Connect the Ground and 24V leads on the Power Cable RPT/RTD Tester to a +24VDC power supply.

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Figure 326: RPT Tester card and cables



1.) RPT/RTD Tester card

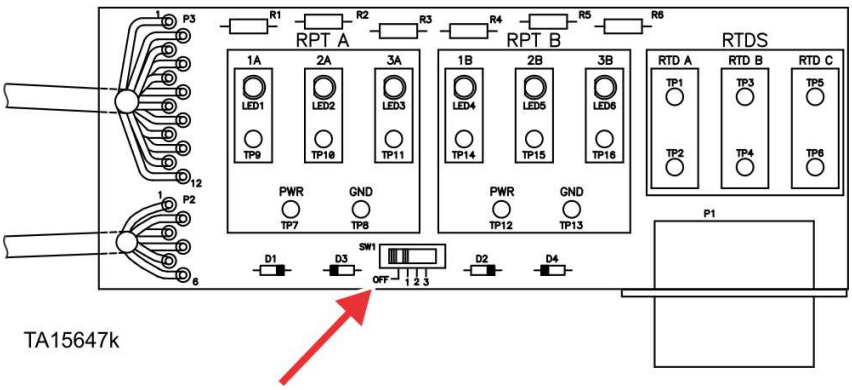
2.) Test cable RPT/RTD

3.) Power cable RPT/RTD tester

4.) RPT carrier assembly

5. Plug the RPT carrier cable into the 12 pin connector located on the RPT/RTD Test cable.
6. Make sure SW1 on RPT/RTD Tester card is switched to OFF.

Figure 327: Tester card (SW1 OFF)



7. Turn on the DC power supply and check to see that at least one of the RPT LED's illuminates.

NOTICE

If none of the LED's illuminate, rotate the rotor a small amount. If no LED's are illuminated after rotating the rotor it will be necessary to troubleshoot/replace the RPT carrier and/or the test card. Make sure power is present at the test card.

NOTICE

The remainder of the RPT test includes the use of a DC current source capable of outputting at least 70 Amps. All safety precautions must be followed while working with this equipment.

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⚠ WARNING

Risk of shock exists while performing the RPT settings. Make sure the DC current source unit is OFF prior to attaching the leads to the terminal posts and before continuing with this test procedure. Shock and equipment arcing is possible if trying to connect the DC current source while unit is powered on.

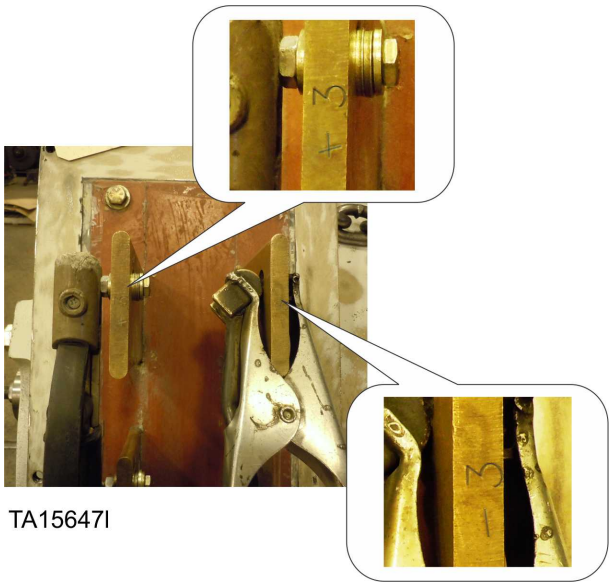
Setting Phase 3

1. Attach the DC current supply leads to phase 3 + and – terminal posts.
2. Set the DC current supply to 600 Amps and energize phase 3.

NOTICE

Depending on the size of the DC current supply leads, it may be necessary to attach a bolt to the terminal post in order to provide a good clamp location.

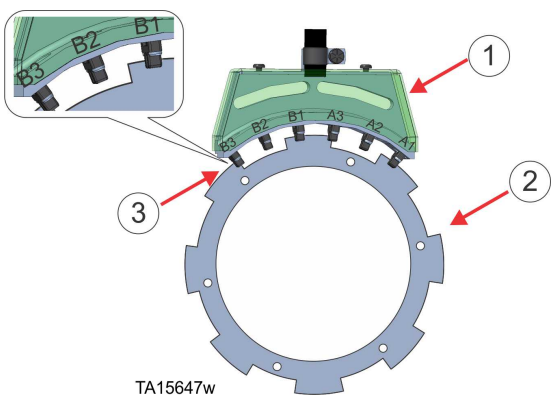
Figure 328: Phase terminal posts



3. With phase 3 energized, the rotor will rotate to align with the phase 3 stator poles.
4. Adjust the RPT carrier so that one of the shutter tabs aligns to RPT B3 as shown. Both the 3B and 3A LED's should now be lit on the RPT Tester, if not, adjust the RPT carrier until both LED's are ON.

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Figure 329: Shutter alignment to RPT



a. RPT carrier
b. RPT shutter
c. Shutter aligned to RPT B3

Figure 330: Tester card Phase 3 LED's

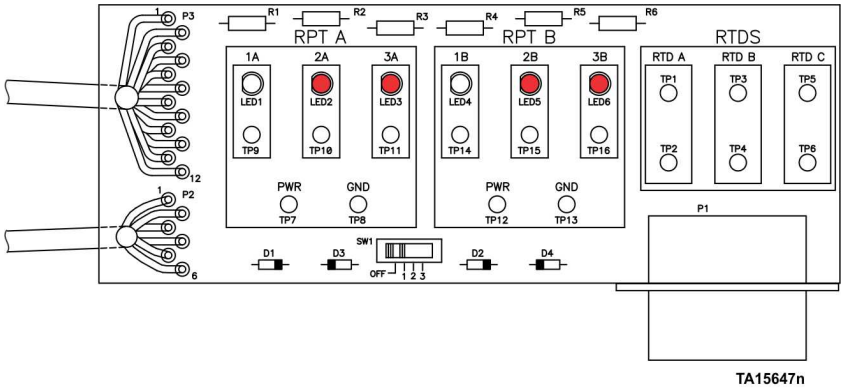
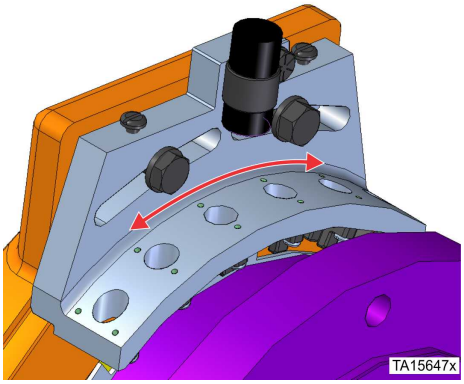


Figure 331: RPT adjustment



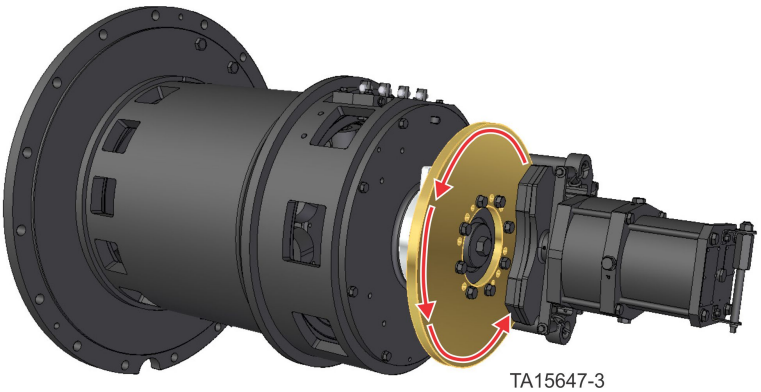
5. Turn the rotor slightly in the counter clockwise direction and allow the rotor to return to its aligned position.

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NOTICE

It will be necessary to turn the DC current supply off in order to rotate the rotor. Rotate the rotor slightly by turning the brake disk, then turn the DC current supply back on and ensure the rotor returns to its aligned position.

Figure 332: Counter clockwise alignment

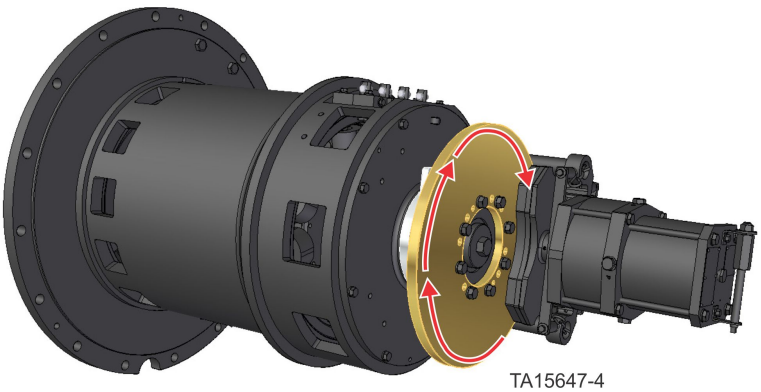


6. Verify that both 3B and 3A LED's remain ON.
7. If the LED's turn OFF, loosen the RPT carrier bolts and adjust the carrier slightly in the clockwise direction. Tighten the carrier bolts.
8. Repeat the test until both LED's remain ON as the rotor returns to the aligned position.
9. Turn the rotor slightly in the clockwise direction and allow the rotor to return to its aligned position.

NOTICE

It will be necessary to turn the DC current supply off in order to rotate the rotor. Rotate the rotor slightly by turning the brake disk, then turn the DC current supply back on and ensure the rotor returns to it aligned position.

Figure 333: Clockwise alignment



10. Verify that both 3B and 3A LED's turn OFF.

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11. If the LED's stay ON, loosen the RPT carrier bolts and adjust the carrier slightly in the counter clockwise direction. Tighten the carrier bolts.
12. Repeat the test until both LED's remain OFF.
13. Once the LED's remain OFF, perform the COUNTER CLOCKWISE test again to make sure the RPT carrier is still in alignment for the counter clockwise position.

Setting Phase 2

1. Turn OFF DC current supply unit and move leads to phase 2 + and – terminal posts.

⚠ WARNING

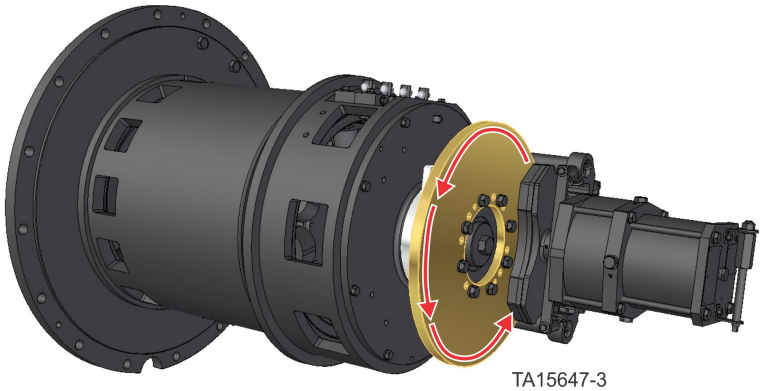
Risk of shock exists while performing the RPT settings. Make sure the DC current supply is OFF prior to removing or attaching the leads to the terminal posts and before continuing with this test procedure. Shock and equipment arcing is possible if trying to connect the DC current supply while theunit is powered on.

2. Make sure the DC current supply is set to 70 Amps and energize phase 2.
3. With phase 2 energized, the rotor will rotate to align with the phase 2 stator poles.
4. Turn the rotor slightly in the counter clockwise direction and allow the rotor to return to its aligned position.

NOTICE

It will be necessary to turn the DC current supply off in order to rotate the rotor. Rotate the rotor slightly by turning the brake disk, then turn the DC current supply back on and ensure the rotor returns to its aligned position.

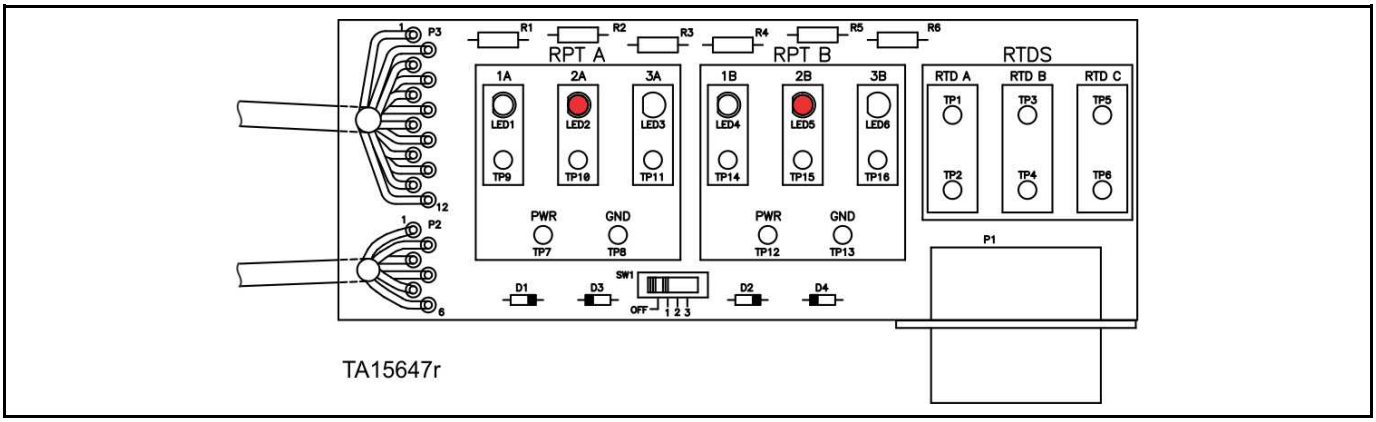
Figure 334: Counter clockwise alignment



5. Verify that both 2B and 2A LED's are now ON.

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Figure 335: Tester card Phase 2 LED's

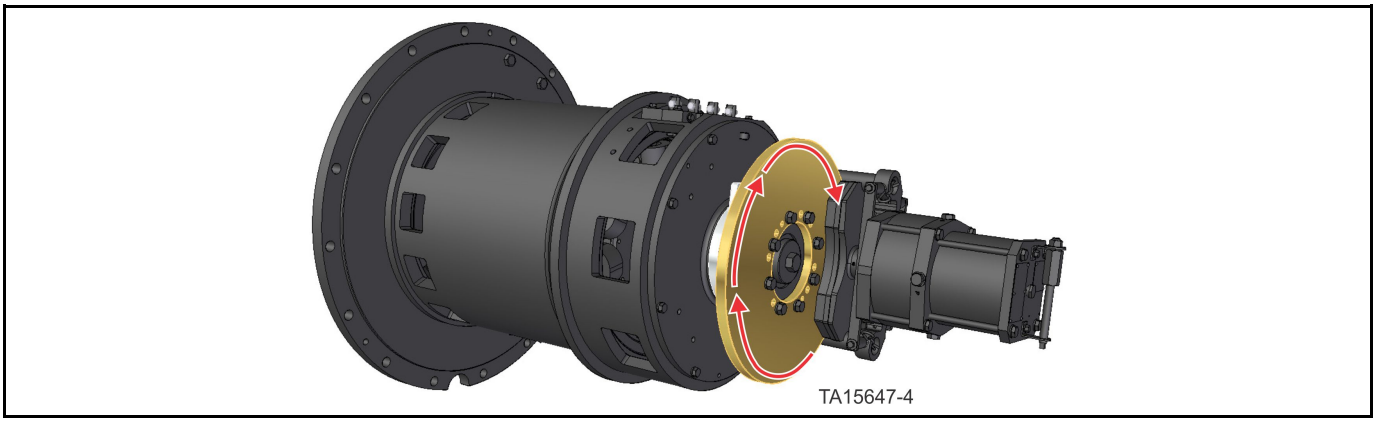


6. If the LED's do not turn ON, loosen the RPT carrier and adjust slightly in the clockwise direction.
7. Repeat the test until both LED's turn ON.
8. Turn the rotor slightly in the clockwise direction and allow the rotor to return to its aligned position.

NOTICE

It will be necessary to turn the DC current supply off in order to rotate the rotor. Rotate the rotor slightly by turning the brake disk, then turn the DC current supply back on and ensure the rotor returns to its aligned position.

Figure 336: Clockwise alignment



9. Verify that both 2B and 2A LED's are now OFF.
10. If the LED's do not turn OFF, loosen the RPT carrier and adjust slightly in the counter clockwise direction.
11. Repeat the test until both LED's are now OFF.
12. Once the LED's remain OFF, perform the COUNTER CLOCKWISE test again to make sure the RPT carrier is still in alignment for the counter clockwise position.
13. If any adjustments had to be made to the RPT carrier during phase 2 testing, re-perform the test for phase 3.

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14. Once phase 2 and 3 are properly aligned, remove one RPT carrier mounting bolt and apply Loctite 2760 or equivalent.
15. Re-install and torque this bolt to 33 ft-lbs (45 Nm).
16. Remove the other mounting bolt and perform the same process.
17. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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RPT Setting Procedure B60 Motor

Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

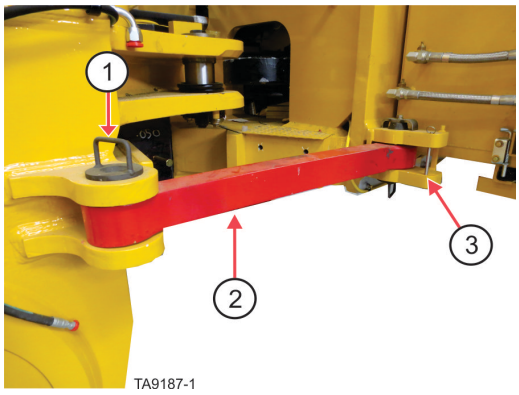
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Chock the wheels that will not be rotated.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 337: Frame lock in locked position



1)Retaining pin for locked position, **2)** Frame lock - shown in locked position,**3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

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Step 5: Set the parking brakes.

WARNING

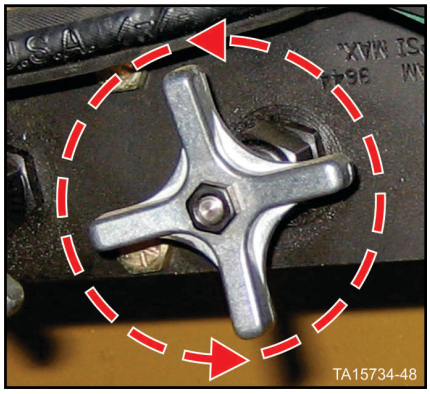
Crush hazard exists if all personnel are not cleared from around the bucket and lift arm area before using the hydraulic hoist and bucket pilot pressure bleed down valves to relieve pressure from the hoist and bucket pilot circuit. Clear all personnel from the area around the bucket and lift arms before operating hydraulic hoist and bucket pilot pressure bleed down valves. Using the hydraulic bleed down valves could result in some movement of the lift arms and bucket which could cause injury or death.

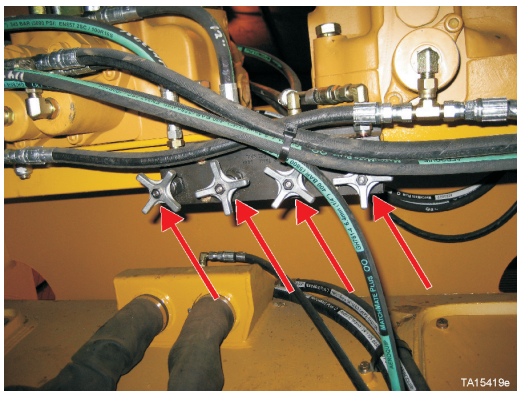
Step 6: Use the hydraulic pressure bleed down valves located in the front frame on the right side of the front opening to bleed any stored pressure in the hoist and bucket cylinders.

Step 7: Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.

Step 8: Open the valve completely and leave it open during this procedure.

Figure 338: Pressure bleed down valves





Bus Discharge Verification Procedure

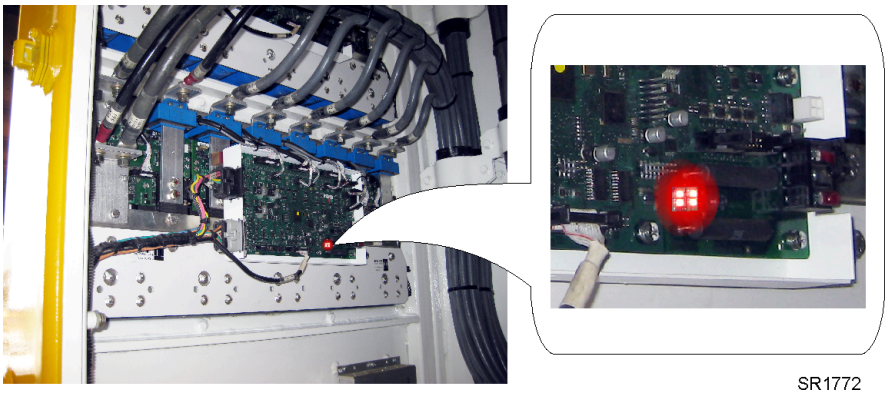
Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

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Figure 339: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

Before You Begin

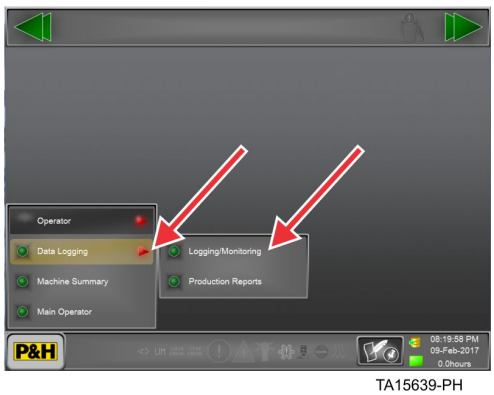
Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 340: LINCS logging/monitoring menu access



Main Menu Button

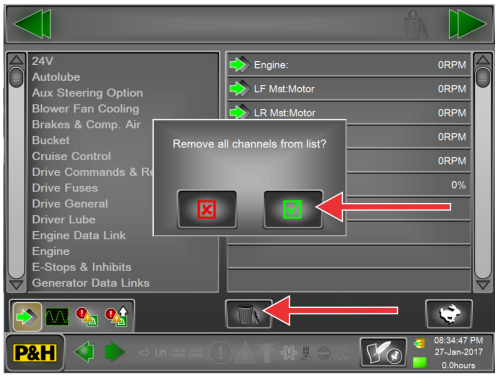


Data Logging & Logging/Monitoring

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Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 341: Remove channels



TA15638a-PH

Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 342: Left hand scroll

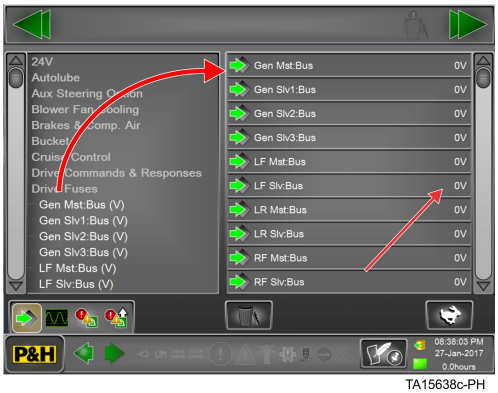


TA15638b-PH

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Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 343: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

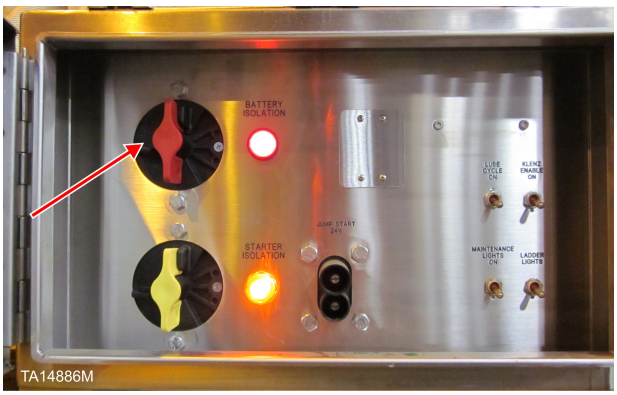
Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 344: Isolation and control switch assembly



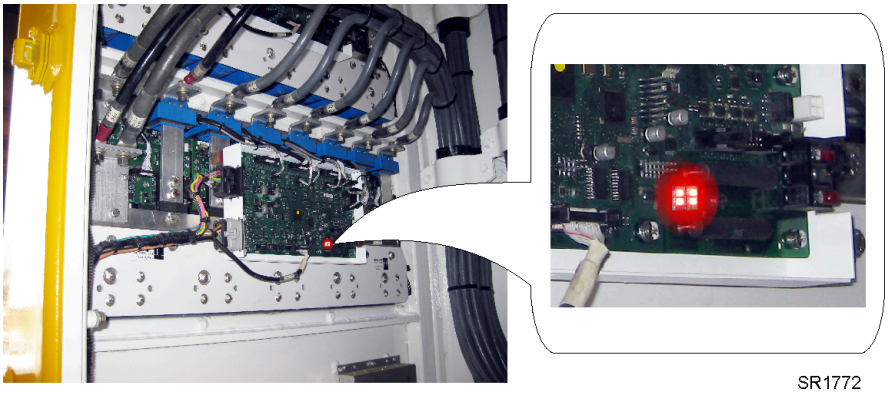


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 345: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

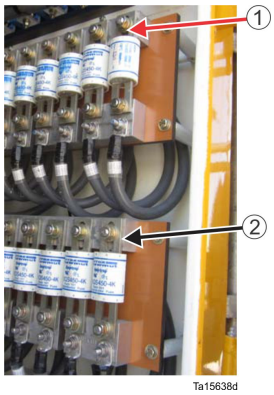
Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

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Figure 346: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

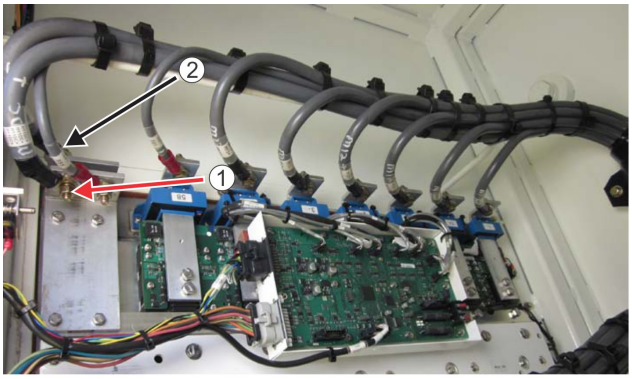
Figure 347: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

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Figure 348: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

Middle Pinion Removal and Replacement - Model 57 Planetary Drive

In the Model 57 planetary drive, the second reduction gear is center-hung between two bearings with a splined interface between this gear and the middle pinion. The splined interface enables the middle pinion to be removed so that the rotor can be turned without jacking the machine.

To remove the middle pinion, perform the following procedure:

Step 1: Remove axle access covers.

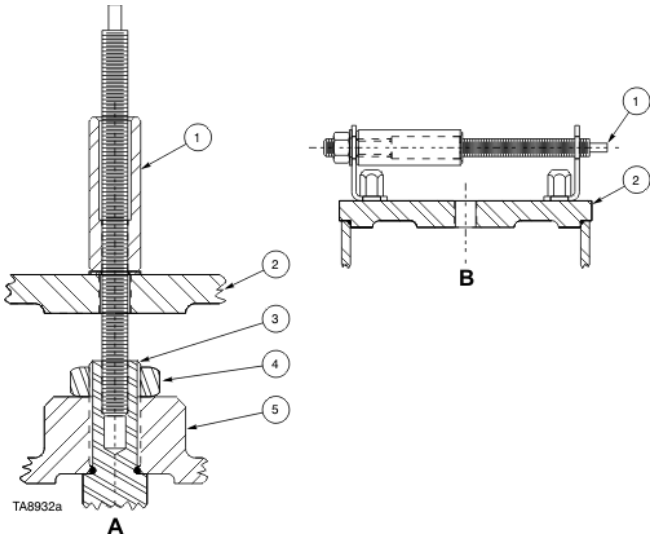
Step 2: Release brake on the electric traction motor. Releasing the brake will enable the planetary drive to be turned, as needed, to free the meshing teeth of the middle pinion from those of the countershaft gears.

NOTICE

Use jack bolt, attached to top of brake caliper, to release brake. Ensure the motor brake is fully released and caged using the jack rod supplied with the brakes.

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Figure 349: Rod installation for releasing brake



A	View with jack rod installed
B	View with jack rod stored on actuator top plate
1.	Special tool – p/n 423-9175 & 423-9176
2.	Actuator top plate
3.	Cylinder rod
4.	Jam nut
5.	Piston

⚠ WARNING

Struck by or crushing hazard exists if jack rod not bottomed into the threaded recess in cylinder rod. Jack rod must be bottomed into threaded recess in cylinder rod. Use flats on jack rod to tighten and keep it from screwing out of rod when turned counterclockwise. Failure to bottom Jack rod into threaded recess in cylinder rod may result in the release of stored energy (spring tension), resulting in serious injury or death.

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Figure 350: View of jack rod installed in brake cylinder



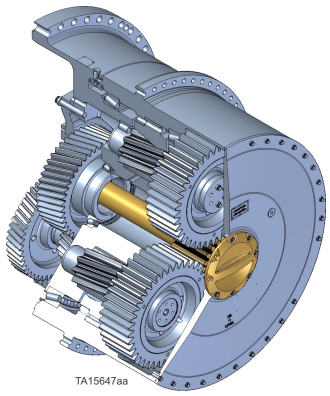
Step 3: Drain planetary drive.

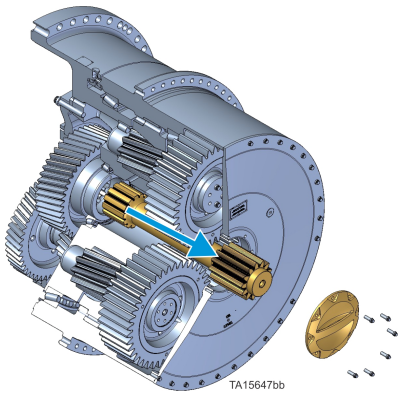
- Follow all local rules and regulations to catch the oil drained from the drive.

Step 4: Remove the inspection plate located in the center of the planetary drive's cover structure.

Step 5: Attach middle pinion removal hub P/N 423-4752 to the middle pinion with one 3/4" - 10 x 2.75" (3/4" - 10 x 69.85 mm) UNC bolt (refer to illustration "Middle Pinion Removal and Replacement").

Figure 351: Middle pinion removal/replacement model 57





Step 6: Attach middle pinion removal arm P/N 423-4753 to the removal hub with eight 1" - 8 x 3.5" UNC bolts.

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Step 7: Attach a fiber-lifting sling securely around the pinion removal arm and hoist the pinion from the planetary drive with a suitable hoist.

⚠ CAUTION

Crush hazard exists. The middle pinion weighs approximately 200 lbs (91 kgs). Use caution when removing and replacing the middle pinion. The removal arm will provide a balancing point when hoisting the pinion to and from the planetary drive, if the lifting sling is positioned against the mounting face of the removal arm, as shown in illustration “Middle Pinion Removal and Replacement". Maintain a firm grasp on the removal arm at all times while hoisting the pinion. An unsecured pinion may cause crushing or other injuries.

Step 8: Cover and store the pinion in a dust free environment until reinstallation in the driver.

Remove Brake Cylinder and Brake Disk

NOTICE

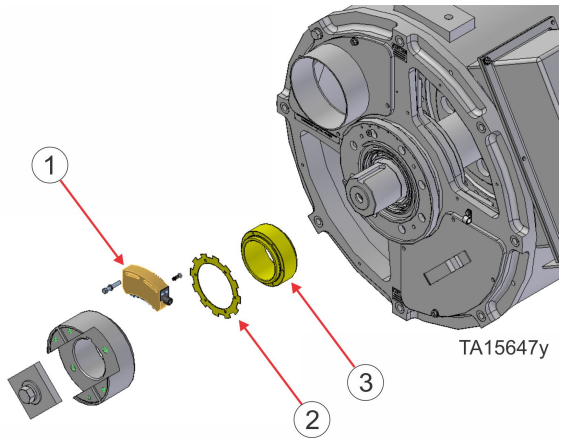
In order to access the RPT it will be necessary to remove both the brake cylinder and the brake hub. Follow all applicable precautions in the removal of these parts.

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Adjusting the RPT:

Items Required

Figure 352: RPT, shutter and outer race

Item	Part Number
RPT/RTD Tester	427-0151
Test Cable RPT/RTD	427-2153
Power Cable RPT/RTD Tester	427-2154
DC Power Source (+24VDC)	
1-1/2 inch socket (1/2 inch or larger extension and flex handle)	
70 Amp DC Current Supply	
	
1) RPT assembly, **2)** Shutter, **3)** Outer race	

NOTICE

The outer race is an interference fit on the shaft and does not align to the rotor. Alignment is performed by adjusting the RPT assembly.

NOTICE

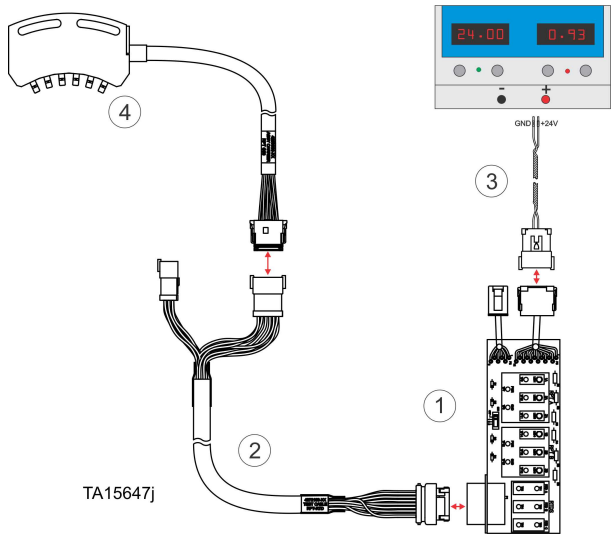
Previous to connecting the RPT/RTD test card, the LED's can be tested by applying 12VDC to the card. At this time all LED's will be OFF, if any are ON, there is a potential problem with the test card. If all LED's are OFF, move SW1 on the tester card to position 1 and LED set 1 will come ON. Move SW1 switch to position 2 and LED set 1 will go OFF and set 2 will come ON. Move SW1 switch to position 3 and LED set 2 will go go OFF and set 3 will come ON. Return the switch to the OFF position. Again, if any of these steps do not work, there is a potential problem with the test card.

1. Visually inspect the shutter for bent tabs or damage prior to adjusting the RPT. Repair or replace as necessary.
2. Attach the 23 pin female connector on the Test Cable to the 23 pin male connector on the RPT/RTD Tester Card.
3. Attach the power cable RPT/RTD Tester to the 12 pin male connector on the RPT/RTD Tester Card.

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4. Connect the Ground and 24V leads on the Power Cable RPT/RTD Tester to a +24VDC power supply.

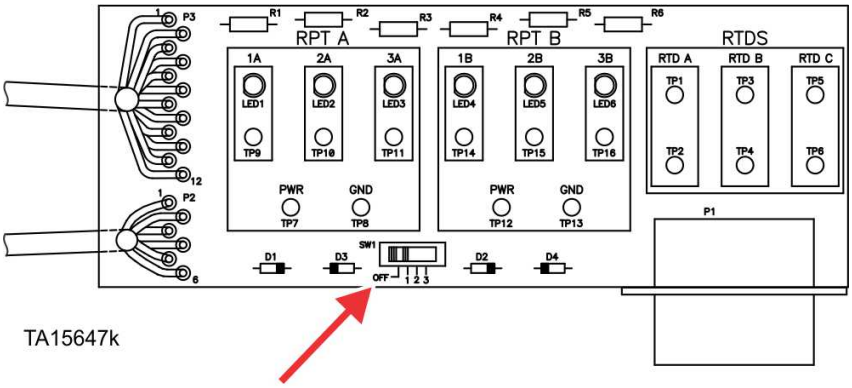
Figure 353: RPT tester card and cables



a. RPT/RTD tester card
b. Test cable RPT/RTD
c. Power cable RPT/RTD tester
d. RPT carrier assembly

5. Plug the RPT carrier cable into the 12 pin connector located on the RPT/RTD test cable.
6. Make sure SW1 on RPT/RTD Tester card is switched to OFF.

Figure 354: Tester card (SW1 OFF)



7. Turn on the DC power supply and check to see that at least one of the RPT LED's illuminates.

NOTICE

If none of the LED's illuminate, rotate the rotor a small amount. If no LED's are illuminated after rotating the rotor it will be necessary to troubleshoot/replace the RPT carrier and/or the test card. Make sure power is present at the test card.

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NOTICE

The remainder of the RPT test includes the use of a DC current supply capable of outputting at least 70 Amps. All safety precautions must be followed while working with this equipment.

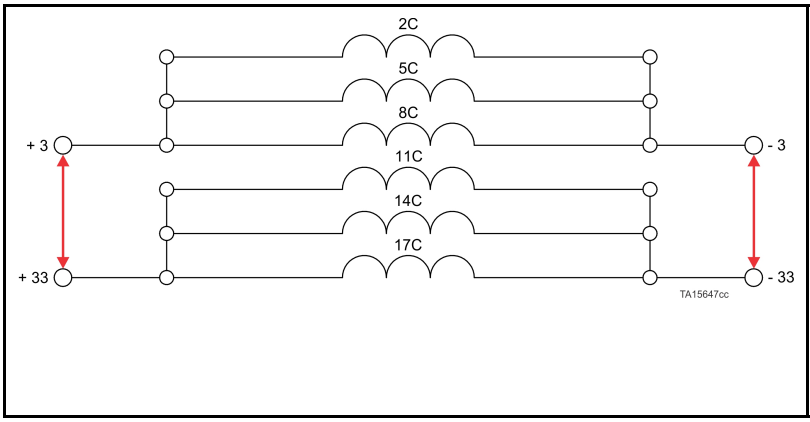
⚠ WARNING

Risk of shock exists while performing the RPT settings. Make sure the DC current supply is OFF prior to attaching the DC current supply leads to the terminal posts and before continuing with this test procedure. Fatal shock and equipment arcing is possible if trying to connect the DC current supply while unit is powered on.

Setting Phase 3

1. Disconnect cables 3+, 3-, 33+ and 33-.
2. Attach one lead of the 70 Amp current supply to cables 3+ and 33+, attach the other lead of the current supply to cables 3- and 33-.
3. Set the current supply to 70 Amps and energize phase 3.

Figure 355: Phase cable connections





4. With phase 3 energized, the rotor will rotate to align with the phase 3 stator poles.
5. Rotate the RPT carrier so that one of the shutter tabs aligns to RPT 3B as shown in the following illustration. Both the 3A and 3B LED's should now be lit on the RPT Tester, if not, adjust the RPT carrier until both LED's just come ON.

NOTICE

To assist with proper alignment, make sure that LED's 2A and 2B are also lit. This will indicate that the sensors are aligned to the proper side of the shutter.

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Figure 356: RPT adjustment

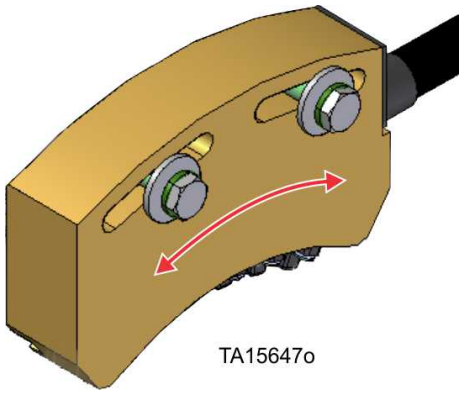


Figure 357: Shutter aligned to RPT

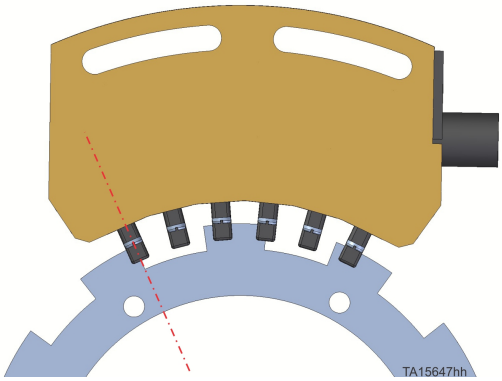
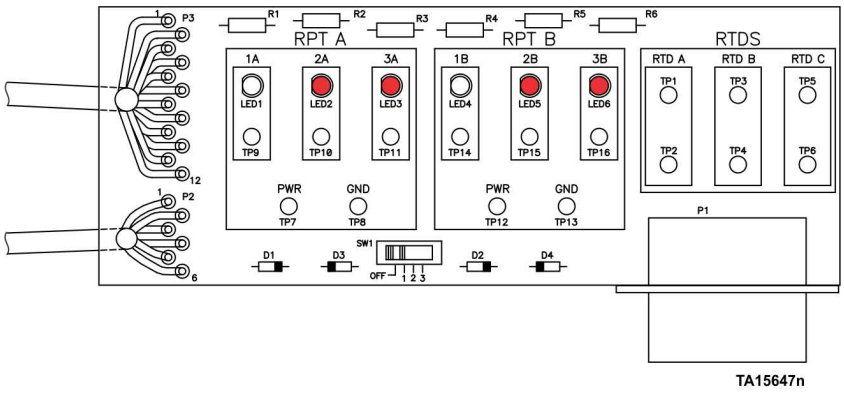


Figure 358: Tester card Phase 3 LED's RPT aligned



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Figure 359: Shutter incorrectly aligned to RPT

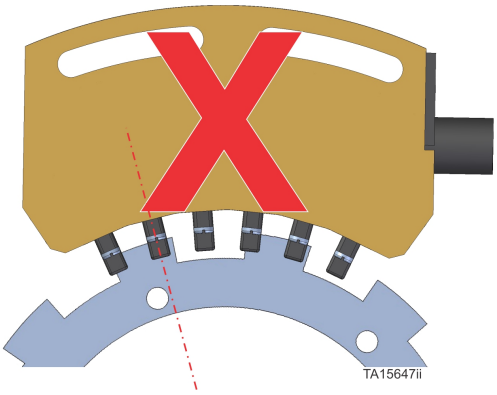
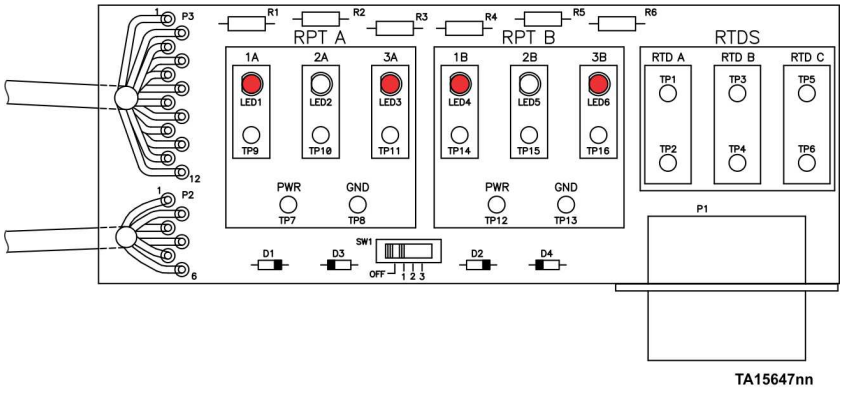
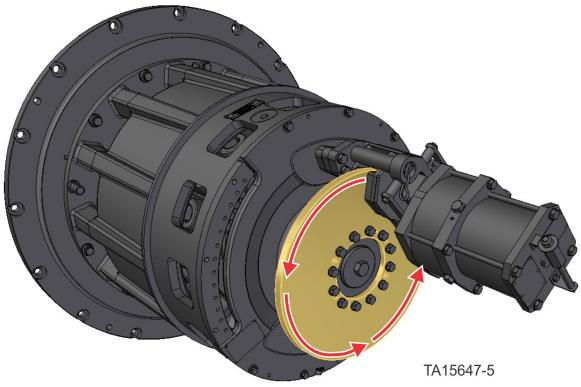


Figure 360: Tester card Phase 3 LED's RPT incorrectly aligned



6. Turn the rotor slightly in the counter clockwise direction and allow the rotor to return to its aligned position.

Figure 361: Counter clockwise alignment

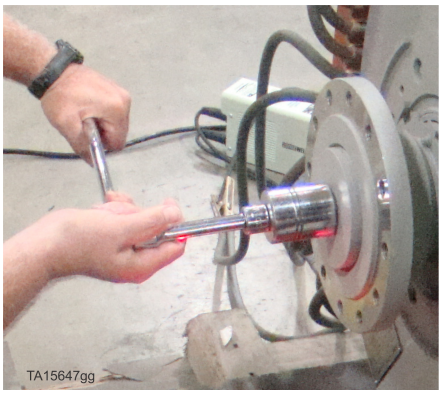


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NOTICE

The use of a 1-1/2 inch socket with 1/2 inch extension and flex handle is suitable for turning the rotor when current is applied to the motor.

Figure 362: Turning rotor with socket and flex handle



7. Verify that both 3A and 3B LED's remain ON.
8. If the LED's turn OFF, loosen the RPT carrier bolts and adjust the carrier slightly in the clockwise direction. Tighten the carrier bolts.

NOTICE

If the RPT bolts are hand tight, a rubber mallot can be used to reposition the RPT carrier by gently tapping on the RPT assembly.

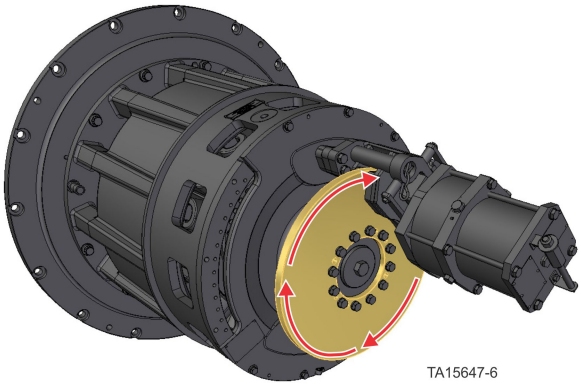
Figure 363: RPT adjusting



9. Repeat the test until both LED's remain ON as the rotor returns to the aligned position.
10. Turn the rotor slightly in the clockwise direction until both LED's 3A and 3B turn OFF, allow the rotor to return to its aligned position.

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Figure 364: Clockwise alignment



11. Verify that both 3A and 3B LED's remain OFF.
12. If the LED's come back ON, loosen the RPT carrier bolts and adjust the carrier slightly in the counter clockwise direction. Tighten the carrier bolts.
13. Repeat the test until both LED's remain OFF.
14. Once the LED's remain OFF, perform the COUNTER CLOCKWISE test again to make sure the RPT carrier is still in alignment for the counter clockwise position.
15. Turn current supply OFF.

Setting Phase 2

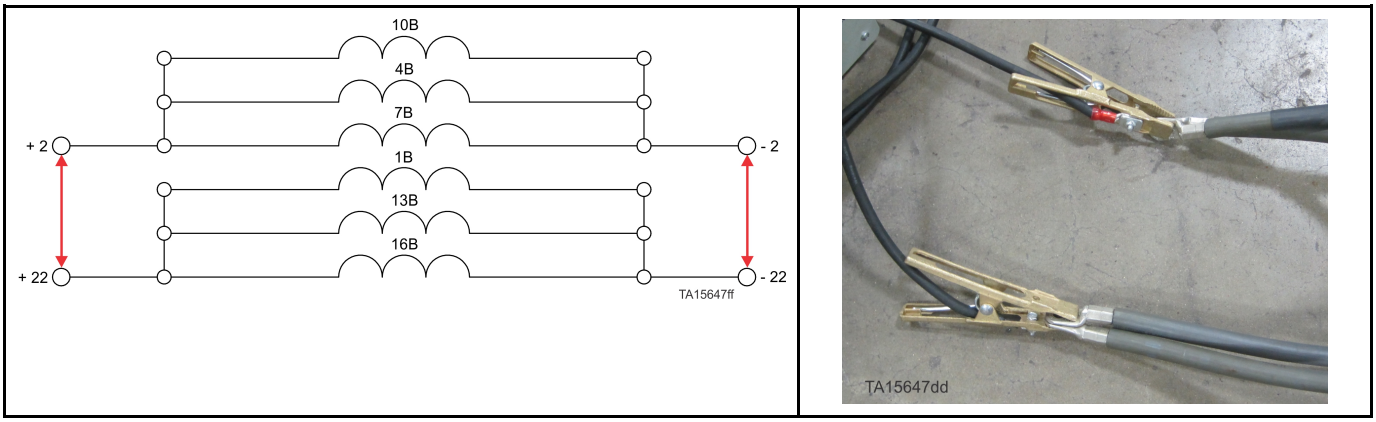
WARNING

Risk of shock exists while performing the RPT settings. Make sure the DC current supply is OFF prior to removing or attaching the leads to the terminal posts and before continuing with this test procedure. Fatal shock and equipment arcing is possible if trying to connect the DC current supply while unit is powered on.

1. With the current supply turned OFF, disconnect cables 2+, 2-, 22+, and 22-.
2. Attach one lead of the 70 Amp current supply to cables 2+ and 22+, attach the other lead of the current supply to cables 2- and 22-.
3. Set the DC current supply to 70 Amps and energize phase 2.

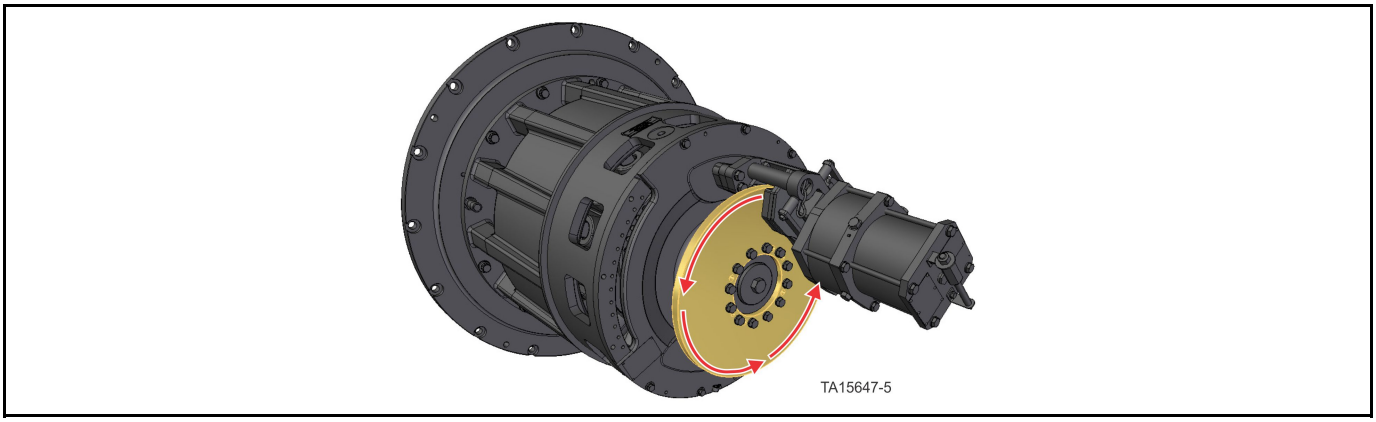
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Figure 365: Phase cable connections



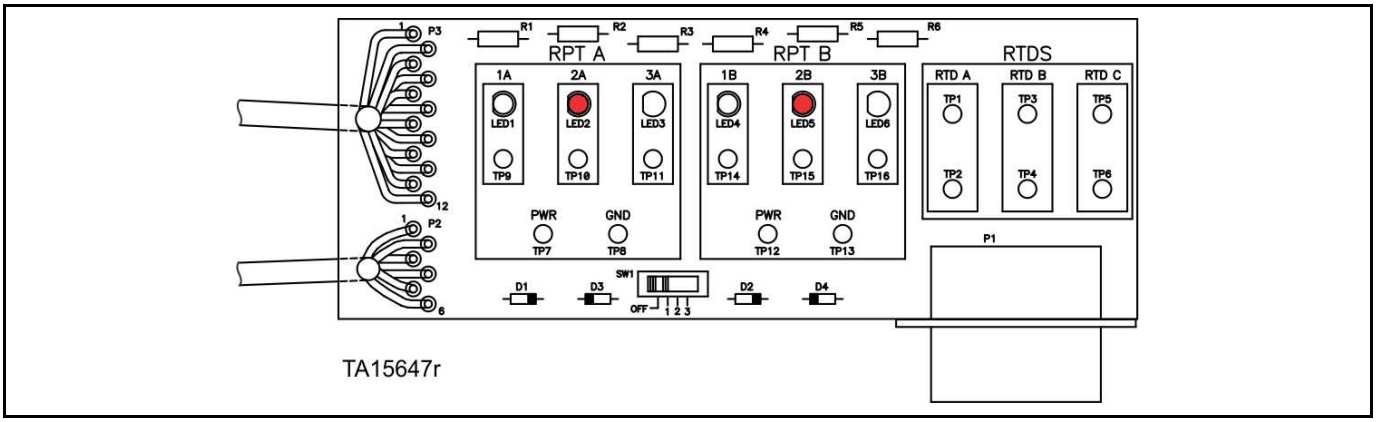
4. With phase 2 energized, the rotor will rotate to align with the phase 2 stator poles.
5. Turn the rotor slightly in the counter clockwise direction and allow the rotor to return to its aligned position.

Figure 366: Counter clockwise alignment



6. Verify that both 2B and 2A LED's are ON.

Figure 367: Tester card Phase 2 LED's



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7. Turn the rotor slightly in the clockwise direction until both LED's 2A and 2B turn OFF, allow the rotor to return to its aligned position.

Figure 368: Clockwise alignment

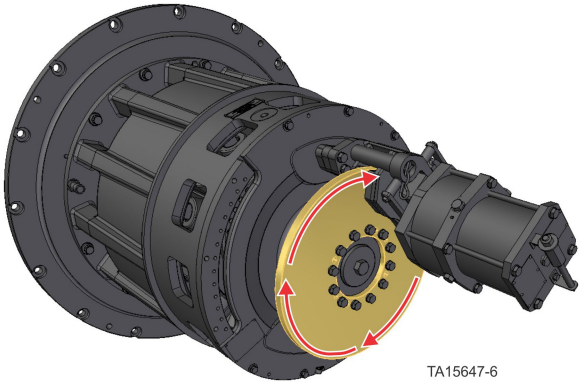
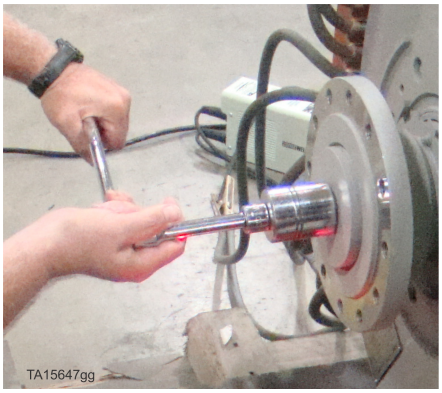


Figure 369: Turning rotor with socket and flex handle



8. Verify that both 2A and 2B LED's remain OFF.
9. Once phase 2 and 3 are properly aligned, remove one RPT carrier mounting bolt and apply Loctite 2760 or equivalent.
10. Re-install and torque this bolt to 18 ft-lbs (24 Nm).
11. Remove the other mounting bolt and perform the same process.
12. Disconnect the current supply and reconnect all motor leads.

Middle Pinion Reinstall

The middle pinion is reinstalled into the planetary drive by reversing the removal instructions.

Step 1: Be sure the pinion is clean and free of rust prior to installation.

Step 2: Attach removal hub and removal arm.

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Step 3: Lubricate the splines and gear teeth with NLGI #2 lithium based grease.

Step 4: Attach fiber-lifting sling to removal arm and hoist pinion into position in the planetary drive. It may be necessary to reposition the pinion until the teeth on the splined end match the countershaft gear teeth until the pinion slides into place in the splined interface of the second reduction gear. The pinion has approximately 1/8” (3.175 mm) endplay between the pinion thrust face retainer plate and the motor pinion thrust face retainer plate and the inspection plate.

Step 5: Remove hub and arm and replace inspection plate.

Step 6: Refill planetary drive with oil.

Step 7: Reset brake on electric traction motor.

Step 8: Move frame lock to unlocked position.

Step 9: Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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Replacing the Fault Isolation Monitor

Safety Preparations

WARNING

Crush hazards are possible if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. Serious personal injury or death could occur if the machine is started or moves while any type of work process is being conducted on the machine.

Step 1: Stop the wheel loader on flat level ground.

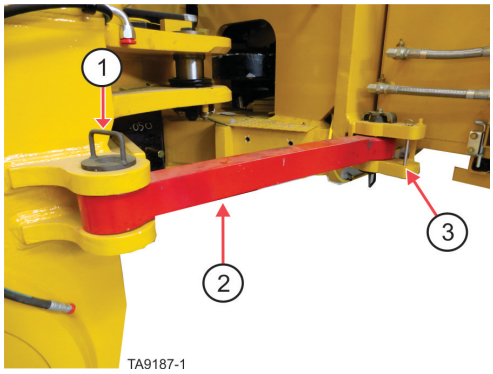
Step 2: Move the frame lock to the locked position so that the frame cannot be steered.

Step 3: Place wheel chocks in front and behind each wheel.

WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

Figure 370: Frame Lock — Gen 2 Frame in locked position



1) Retaining pin for locked position, **2)** Frame lock - shown in locked position, **3)** Retaining pin bracket for un-locked position

Step 4: Set bucket flat and level on the ground.

Step 5: Set the parking brakes.

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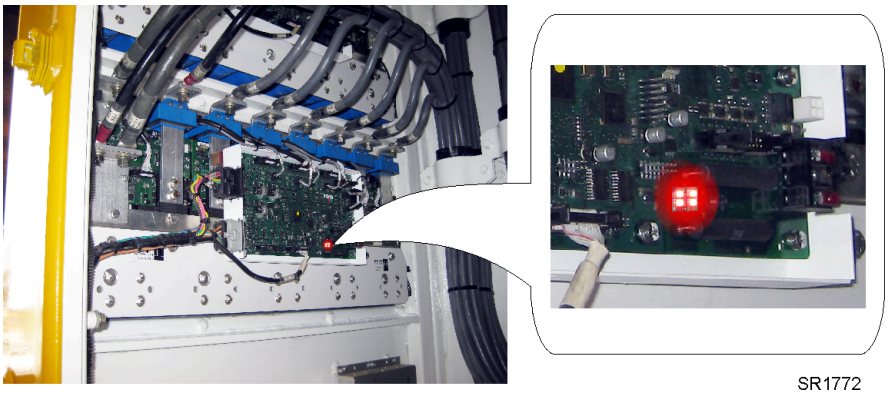
Bus Discharge Verification Procedure

Converter Bus Voltage

WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

Figure 371: Converter assembly bus LED's



There are three different methods that are combined to verify when it is safe to enter the electrical cabinet. All three methods are required in order to assure that the system is properly discharged.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

In Cab Verification Using LINCS II Display

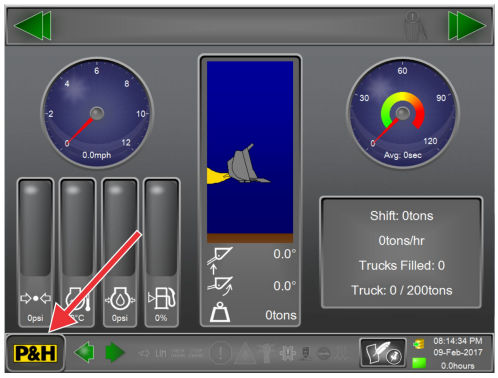
Before You Begin

Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

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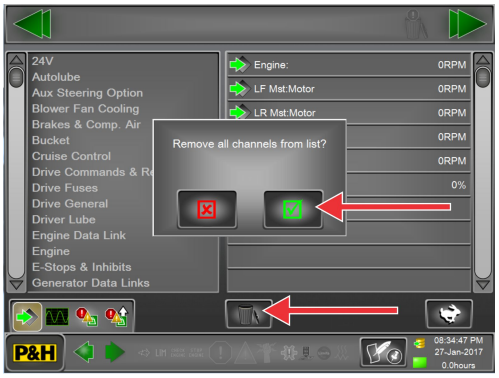
Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 372: LINCS logging/monitoring menu access

 TA15638-PH	 TA15639-PH
Main Menu Button	Data Logging & Logging/Monitoring

Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 373: Remove channels



TA15638a-PH

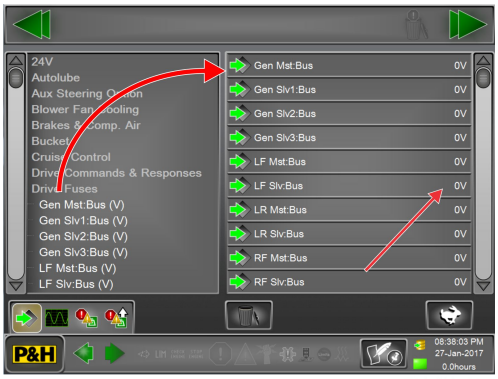
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 374: Left hand scroll



Step 4: Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

Figure 375: Bus voltage indication



Step 5: Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

Step 6: Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

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To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

Figure 376: Isolation and control switch assembly

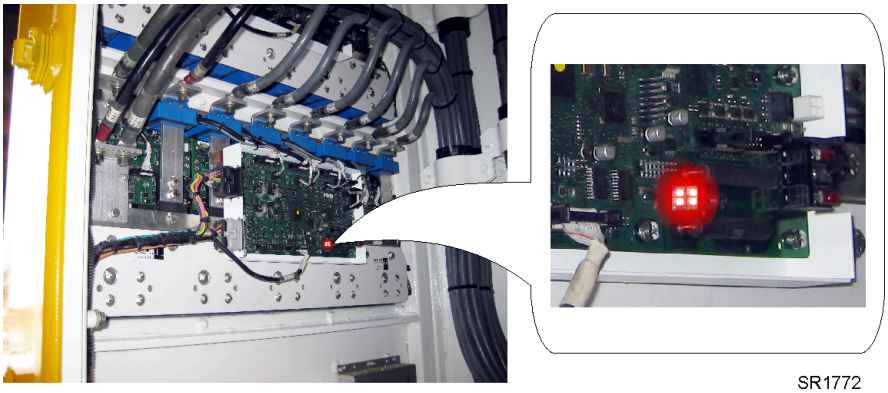


Isolate the battery and lockout the machine

- The SR electrical converter cabinet door can now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

Figure 377: Bus voltage LED array on SR control board



Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

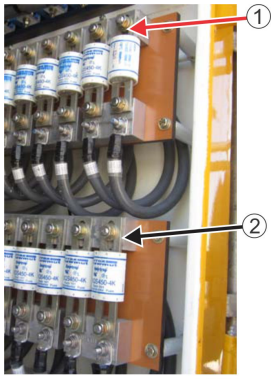
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Step 1: Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.

Figure 378: Main bus bars



1) Positive bus bar, **2)** Negative bus bar

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

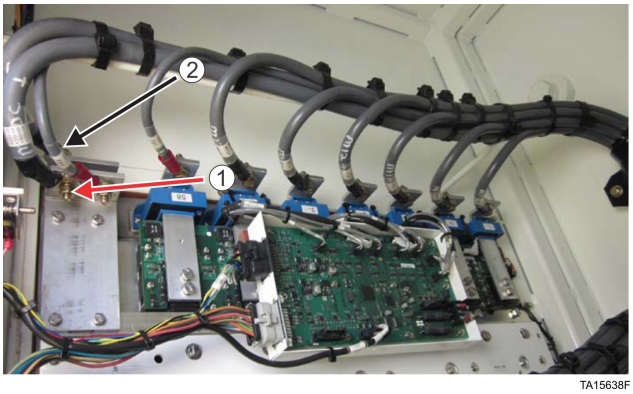
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Figure 379: Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 380: Converter assembly bus connections (front of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Once verified that bus voltage does not exist, entry into the electrical cabinet, axles, and grid area are permissible.

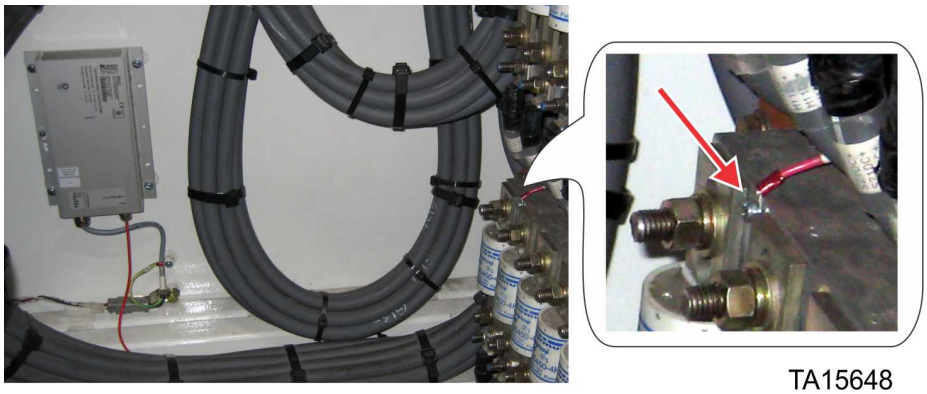
Removal and Replacement

This procedure is to be used when replacing the entire Fault Isolation Assembly (Komatsu P/N 425-9354).

1. Perform the **Bus Discharge Verification Procedure** as detailed previously in this document.
2. Remove the Sense wire from the negative bus bar.

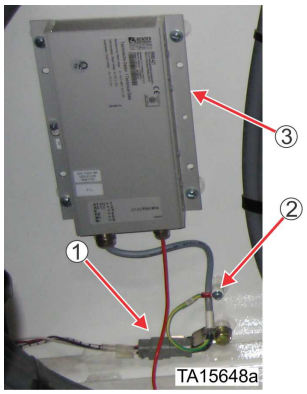
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Figure 381: Sense wire connection negative bus bar



3. Unplug the 6-pin Deutch connector.
4. Remove the ground connector.
5. Remove and replace the fault isolation monitor.

Figure 382: Isolation monitor connections



1) 6-pin Deutch connector, **2)** Ground connector, **3)** Isolation monitor

6. Connect the 6-pin Deutch connector.
7. Connect the ground connector. Make sure there is no paint or other material on this connection.
8. Connect the Sense wire to the negative bus bar.

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Low Impedance Test

WARNING

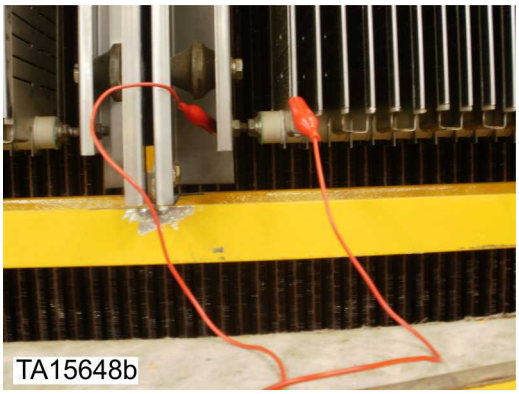
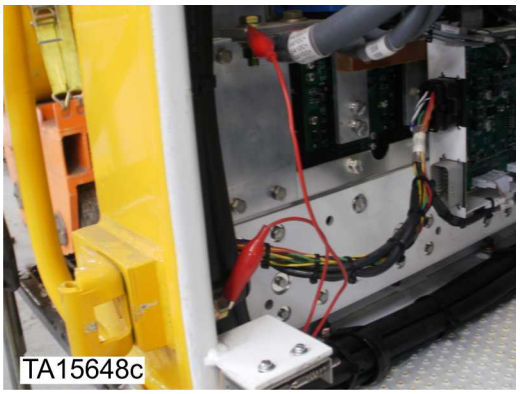
Risk of shock by contact of the braking grids is possible. Do not open the door over the braking grids or touch anything on the grids when the engine is running or the converter panel bus LED's are glowing red in the electrical cabinet. Do not touch or enter these areas unless the engine has been shut down and the bus discharge procedure has been followed. Do not manually hold the wire to the grids as this may provide a potential path for electricity. Electrical shock or other serious injury may result in in non compliance of this warning.

WARNING

Risk of shock by contact in the electrical cabinet or on the braking grids is possible. High voltage may be present in the electrical cabinet and on the braking grids. Prior to performing a stand alone Low Impedance Test without replacing the Fault Isolation Monitor, complete the Bus discharge Verification Procedure, as detailed previously in this document, before attaching any wires in the electrical converter cabinet on on the grids. Electrical shock or other serious injury may result if in non compliance of this warning.

1. With the battery disconnect open, create a short by connecting a wire with clips from frame ground to a grid (alternatively, a wire with clips may be placed in the electrical converter cabinet from the + or – bus bar to ground).

Figure 383: Isolation monitor ground test

 TA15648b	 TA15648c
Frame to Grid	Frame to Bus

2. Close the battery disconnect.
3. Boot LINCS.
4. After approximately 10 seconds, LINCS should display a condition of "Bus Isolation Resistance Low".

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Figure 384: Bus isolation resistance low fault



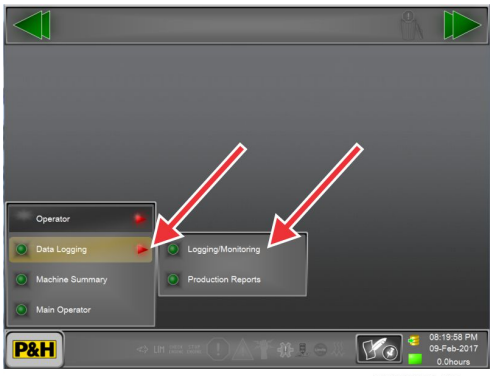
TA15648d-JOY

5. If the Bus Isolation Fault does not occur, perform the following:
   - Navigate to Data Logging, Logging/Monitoring.
   - Scroll down and select Loadbank.
   - Scroll down and drag HV Bus Isolation (kΩ) to the right hand side of the screen.
   - If HV Bus Isolation resistance is not 0 or close to 0 Ω's, the wire used for shorting may not be making proper contact.

WARNING

Risk of shock by contact of the braking grids is possible. Do not open the door over the braking grids or touch anything on the grids when the engine is running or the converter panel bus LED's are glowing red in the electrical cabinet. Do not touch or enter these areas unless the engine has been shut down and the bus discharge procedure has been followed. Do not manually hold the wire to the grids as this may provide a potential path for electricity. Electrical shock or other serious injury may result in non compliance of this warning.

Figure 385: HV bus isolation resistance reading



TA15639-PH



TA15648f-PH

6. Once test has been completed, shut down LINCS and follow Bus Discharge Procedure.

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7. Remove the wire used to short the grid or High Voltage bus.
8. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

High Impedance/Cable Fail Test

NOTICE

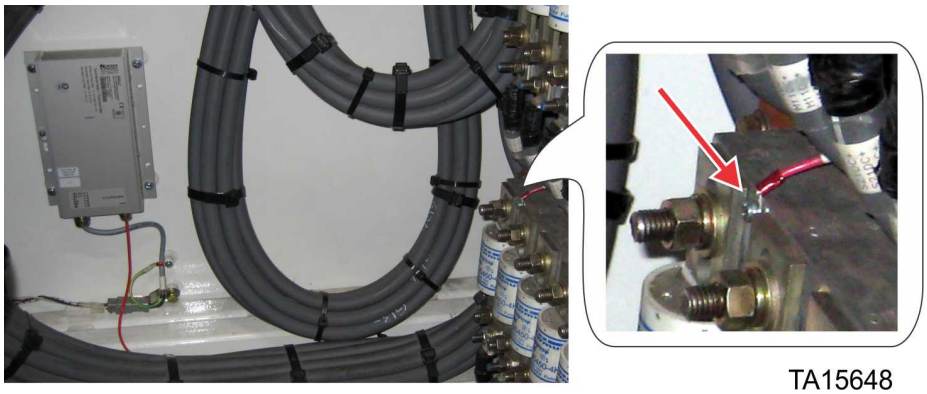
If performing a stand alone High Impedance/Cable Fail Test without replacing the Fault Isolation Monitor, perform the Bus Discharge Verification Procedure, as detailed previously in this document, before removing any wires in the electrical converter cabinet.

⚠ WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation II SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

1. In the electrical converter cabinet, remove the sense wire from the negative bus bar.

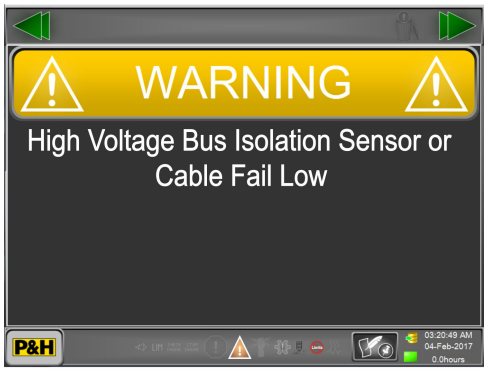
Figure 386: Sense wire connection negative bus bar



2. Close the battery disconnect and boot LINCS.
3. In approximately 10 minutes, LINCS should generate a warning that there is a HV Bus Isolation Monitor Cable or Sensor failure.

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Figure 387: HV bus isolation sensor or cable fail



TA15648e-PH

4. Once test has been completed, shut down LINCS and follow the Bus Discharge Procedure.

⚠ WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation II SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

5. Connect the sense wire back to the negative bus bar.
6. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

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