# SR Drive System Procedures

Section 06-03-05

Komatsu has made every effort to make this manual as accurate as possible based on the information available at the time of publication and printing. Continuous improvement and advancement of product design may cause changes to machines which may not have been included in this publication. Komatsu reserves the right to make changes and improvements at any time. To ensure the most current information, please contact your service center.

## Table of Contents

# List of Figures

# 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 graphic is to indicate 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.**
- **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 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 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.**
- **Risk of shock exists while performing the RPT settings. Make sure the welding unit is OFF prior to attaching the welding leads to the terminal posts and before continuing with this test procedure. Shock and equipment arcing is possible if trying to connect the welder while 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 in non compliance of this 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.**

- **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.**

**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 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.**
- **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.**

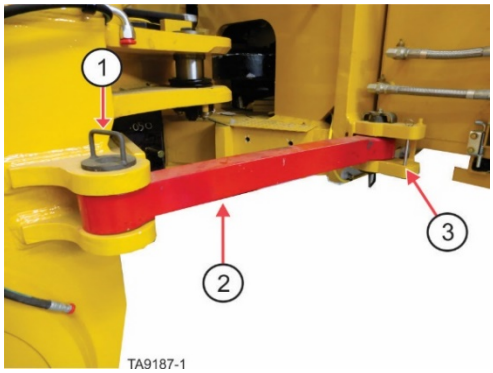
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 1. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

# 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**

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.

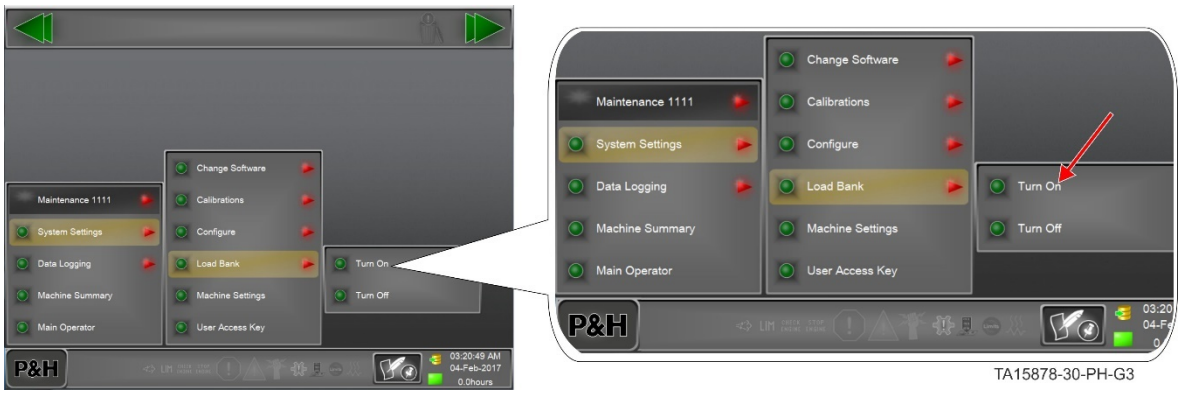



**Figure 3. Load bank on**

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

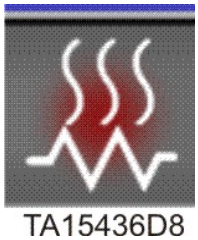



**Figure 4. Load bank icon**

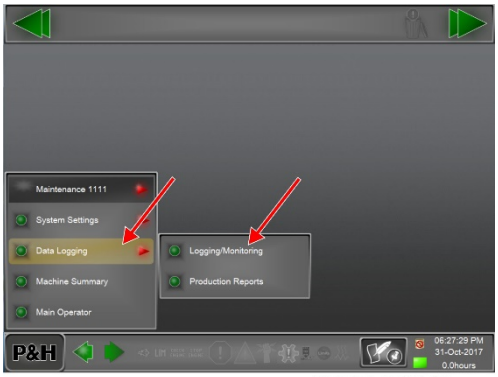
- Once Load Bank is selected the radiator fan and blower will increase in speed.

# 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



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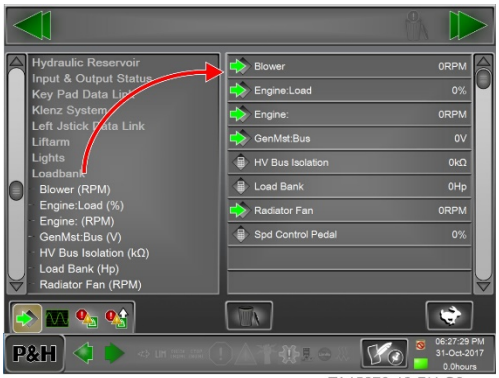

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**Figure 5. Load bank group select**

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.

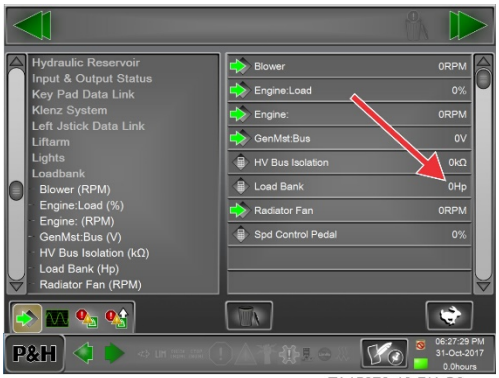

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**Figure 6. Load bank HP and load bank off**

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.

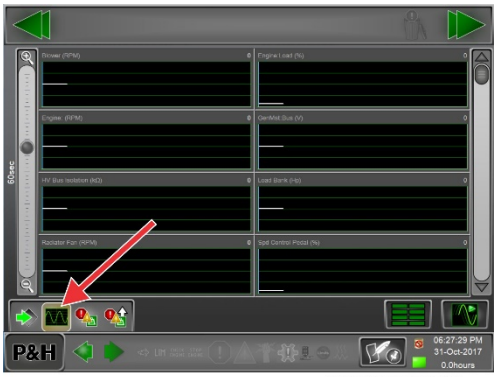


**Figure 7. Load bank channels chart view**

# 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.**

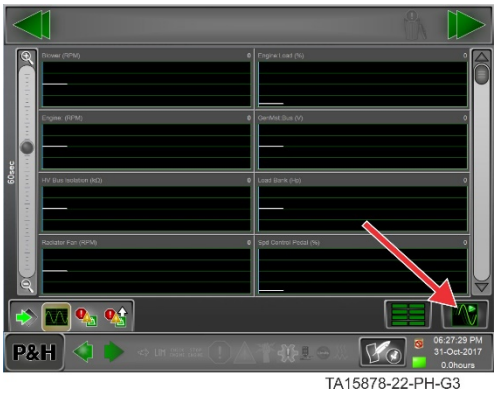


**Figure 8. Load bank channels recorded information select**

10. Select a 10sec window duration.

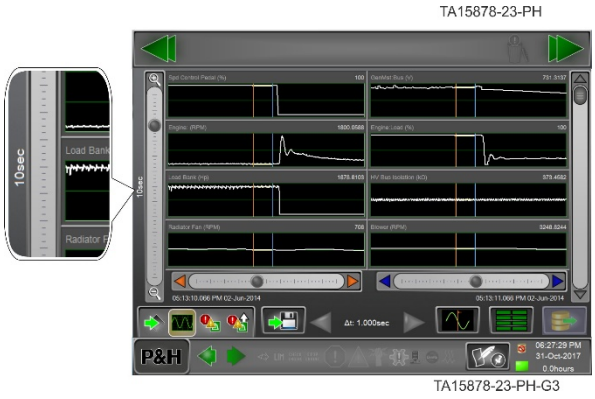


**Figure 9. 10 second window duration**

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

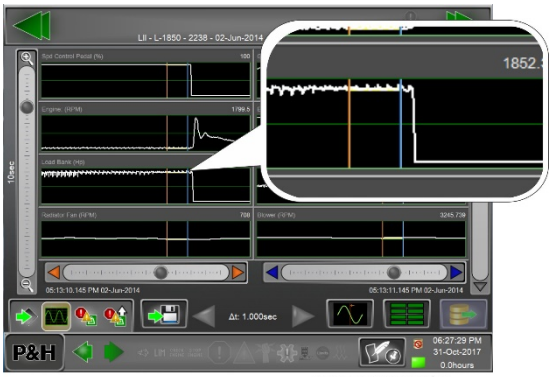

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**Figure 10. Load bank channels recorded information select**

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

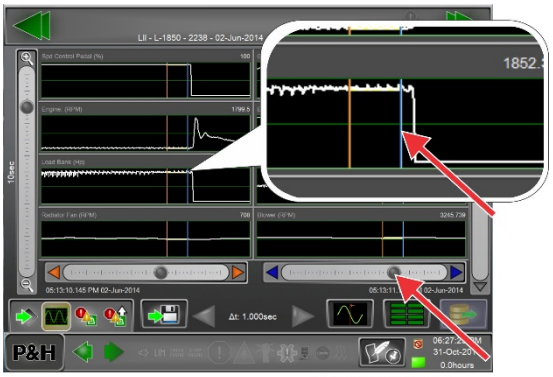

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**Figure 11. Blue marker position**

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

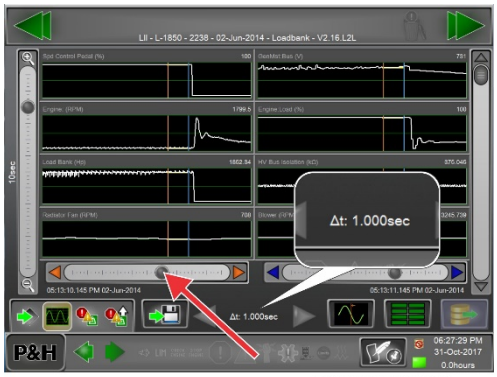

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**Figure 12. Red marker Δt at 1sec**

14. Select the display value to $\overline{X}$ (average).


**Figure 13. Display value set to average**

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

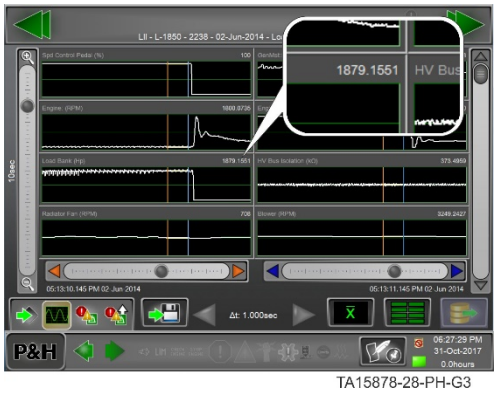



**Figure 14. Load bank (HP)**

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.

# 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.**

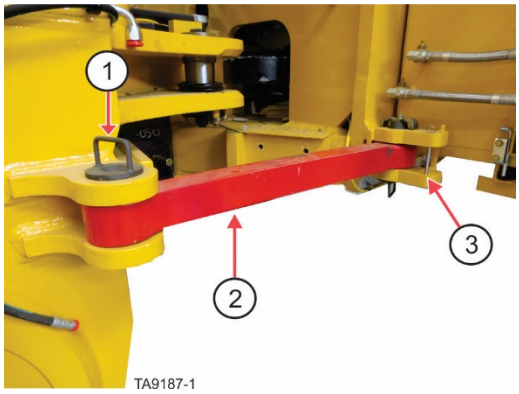
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 15. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

## 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 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.**

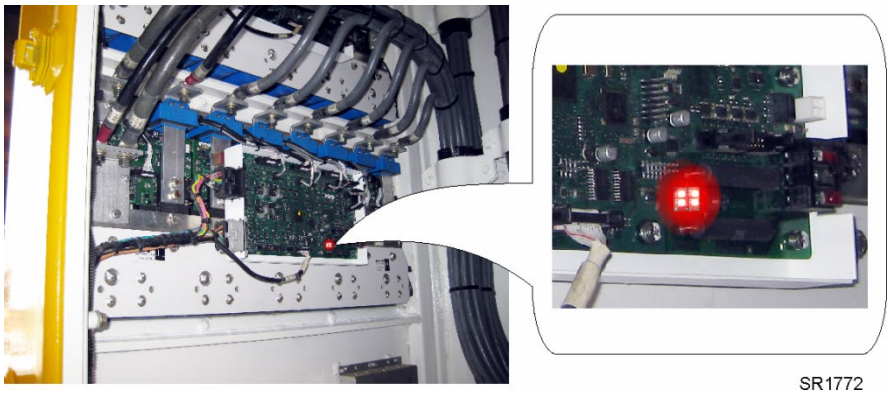



**Figure 16. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

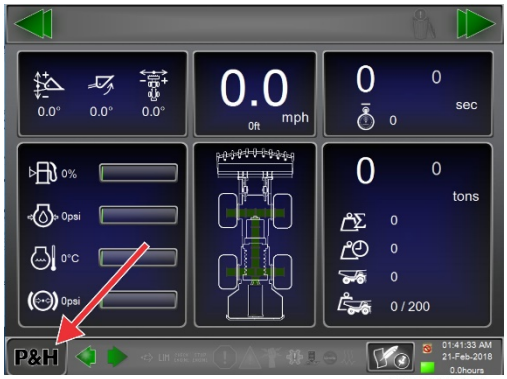
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

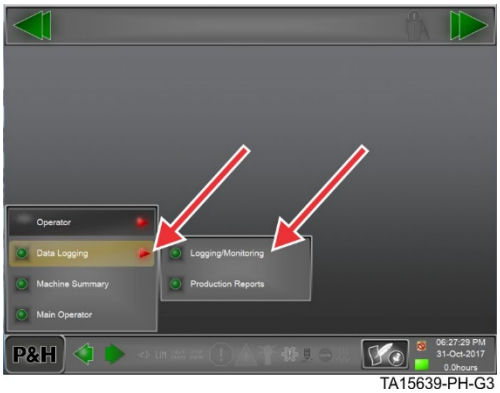
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.




**Main Menu Button**




**Data Logging & Logging/Monitoring**

**Figure 17. LINCS logging/monitoring menu access**

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

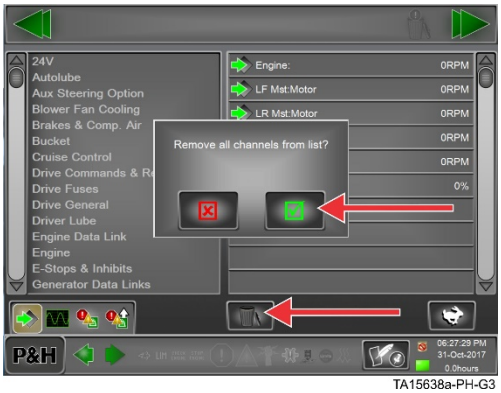



**Figure 18. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

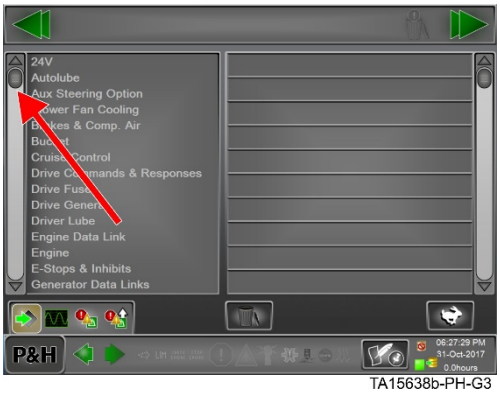



**Figure 19. Left hand scroll**

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

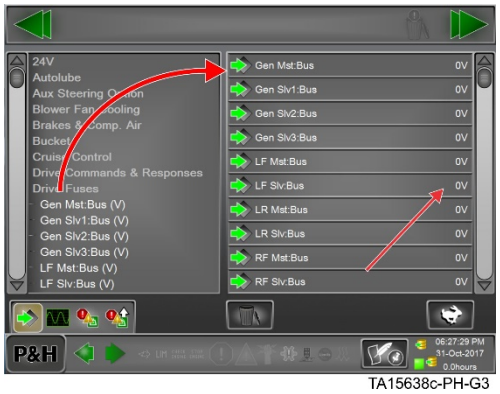



**Figure 20. Bus voltage indication**

6. 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.**

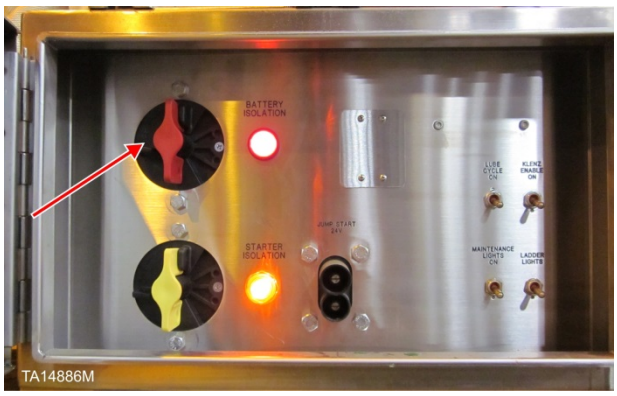
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 21. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

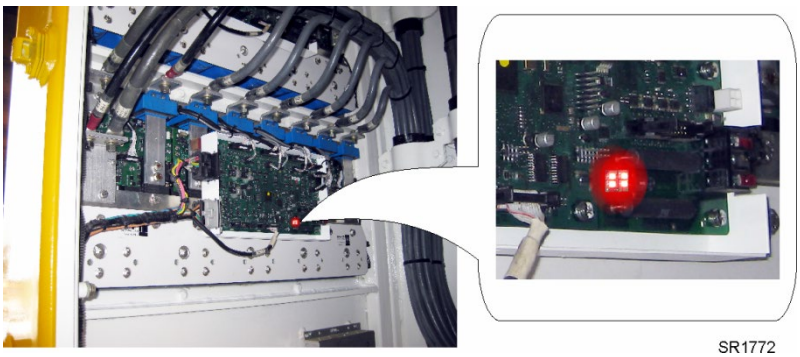



**Figure 22. Bus voltage LED array on SR control board**

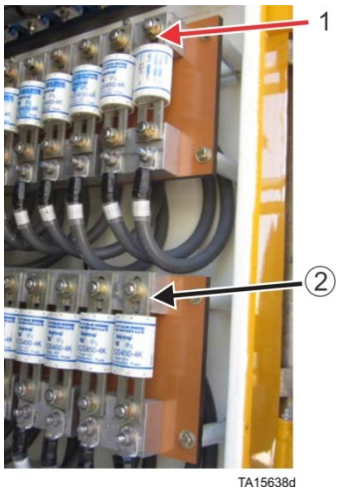
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 23. Main bus bars**

## 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.

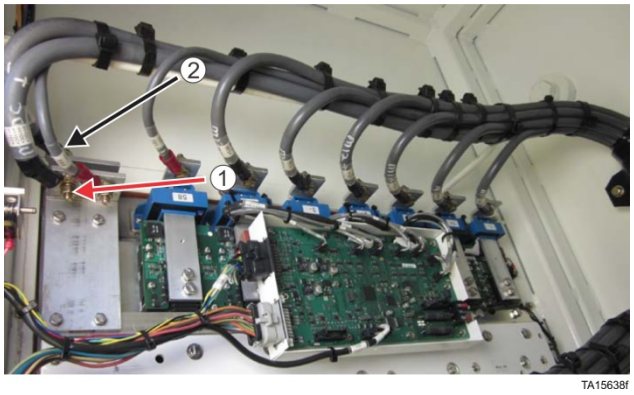
# NOTICE

**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.


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

**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)**

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# KESS Discharge Procedure

The KESS (Kinetic Energy Storage System) is composed of one or more ESD's (Energy Storage Device), converter panels, and fuses, controlled by the Vehicle Control Unit (VCU).

If the KESS is not discharged, the ESD can continue to rotate for two hours once the machine has been shut down.

Before performing any work procedures on the KESS system, verify the ESD is not rotating. Verification can be accomplished by using the LINCS II software to view the ESD RPM.

The purpose of the KESS discharge procedure is to dissipate potential energy so that the KESS system components may be serviced or repaired. If for any reason, the KESS cannot be discharged, service on the machine must be delayed for two hours, giving the ESD time to come to a complete stop.

## ⚠WARNING

**Shock hazard exists on the components of the KESS system. Perform the KESS discharge procedure to remove stored energy from the KESS system and bring the ESD to a stop. Once the ESD has stopped, perform the Bus Discharge Verification Procedure. Failure to do so may result in electrical shock or other injury.**

## Safety Preparations

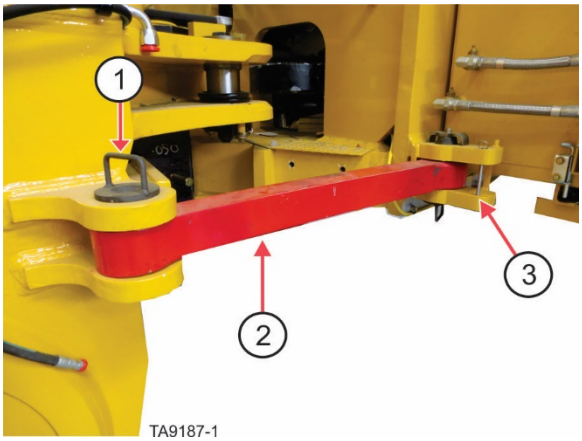
## ⚠WARNING

**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.**

**a.** Stop the wheel loader on flat level ground.
**b.** Move the frame lock to the locked position so that the frame cannot be steered.
**c.** 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.**




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

**Shown in locked position**

**Figure 26. Frame Lock**

**d.** Set bucket flat and level on the ground.

**e.** Set the parking brakes.

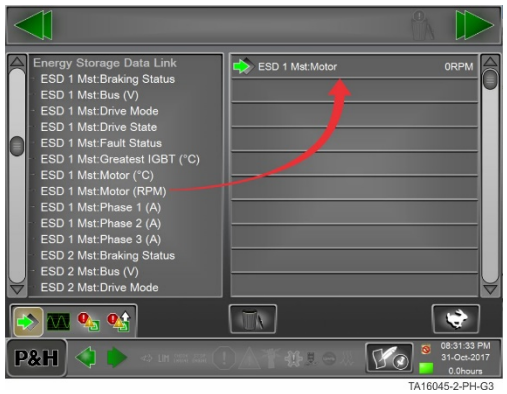
# KESS Discharge Procedure


**Figure 27. Operators Screen – KESS at 60%**

Discharging the KESS should be done before shutting the machine down by performing the following steps:

1. Ensure Park Brake is SET
2. Place machine at LO Throttle
3. LINCS II Screen

a. Select Main Menu button
b. Select Data Logging
c. Select Logging/Monitoring
d. Select Energy Storage Data Link
e. Move ESD 1 Mst:Motor (RPM) and ESD 2 Mst:Motor (RPM) to right column by clicking and dragging



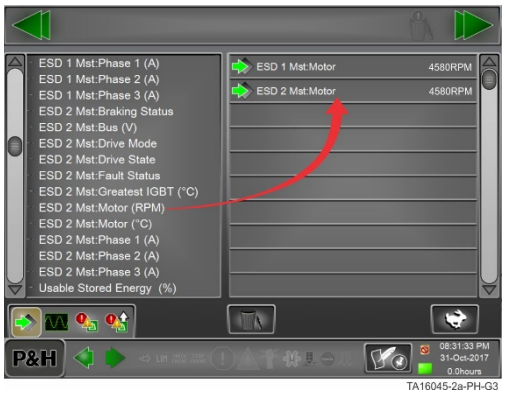




**Figure 28. ESD Motor Channel Select**

4. Press the Drive Enable Switch


**Figure 29. Drive Enable Switch**

5. The ESD Mst:Motor RPM will start to decline and will reach 0 RPM in approximately 35 seconds.

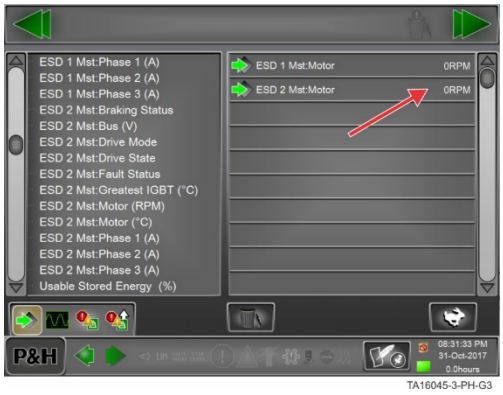



**Figure 30. ESD Motor RPM**

6. Shut down the machine as normal.

# 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).

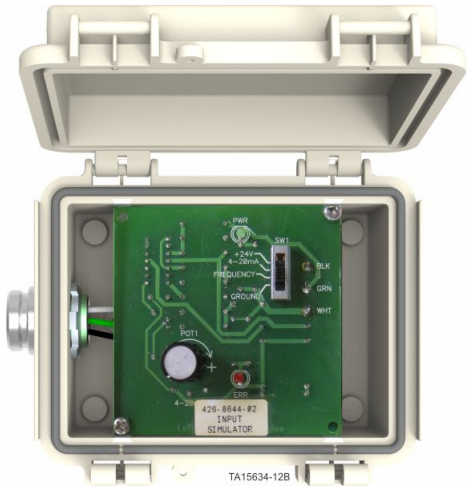




**Figure 31. LINCS II Input Simulator Box**

## 3-Pin Connector

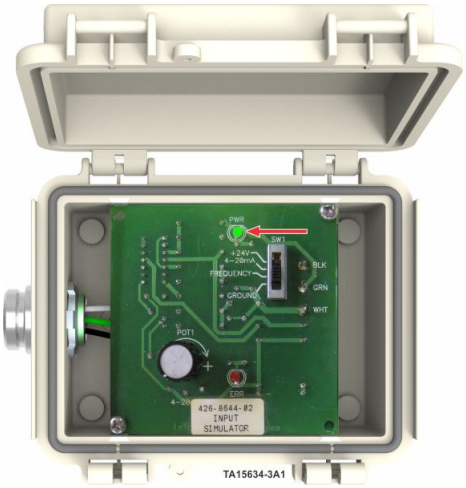
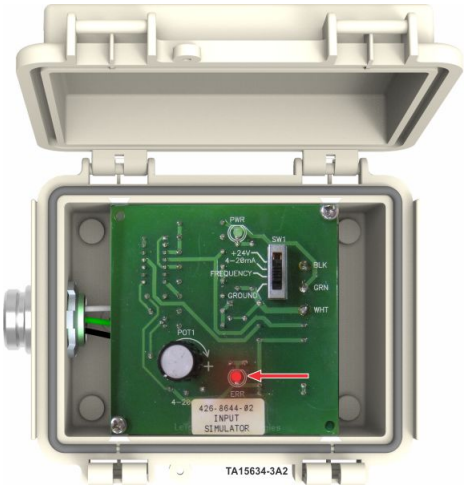
The Input Simulator Box has a 3-pin connector on one end of the enclosure which is used to attach the tester to the appropriate Turck® connecter. The connector has a green GND wire (pin 1), a black signal wire (pin 2), and a white 24V wire (pin 3).



**Index Pin Location**

# LED’s

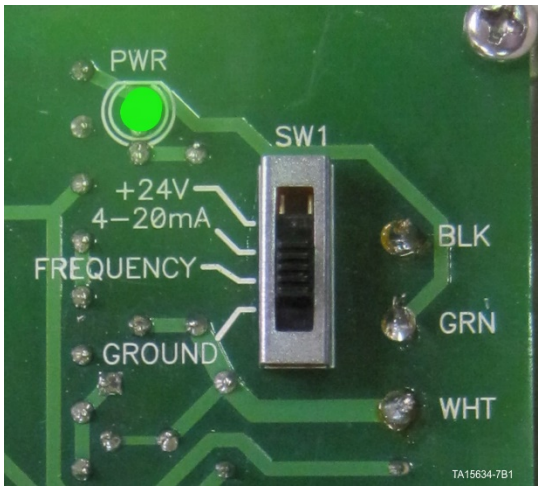
Two LED’s are present on the circuit board to indicate if the correct voltage polarity is supplied to the board. If GND and 24V are supplied to the tester with the correct polarity, the Green LED will illuminate. If the polarity is incorrect, the red LED will illuminate.

| | |
|---|---|
|   |   |
| **Correct input voltage polarity** | **Incorrect input voltage polarity** |

# Four Position Switch

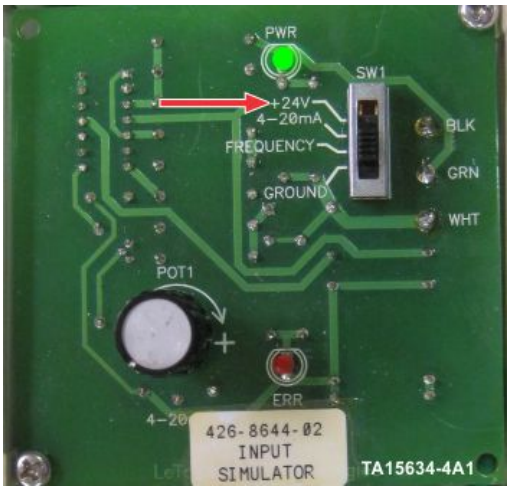
The output from the tester onto the signal wire is determined by the position of the four-position switch.

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



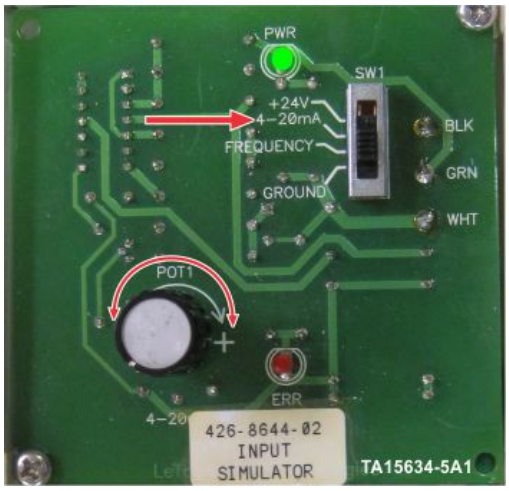
## +24V Switch Position

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



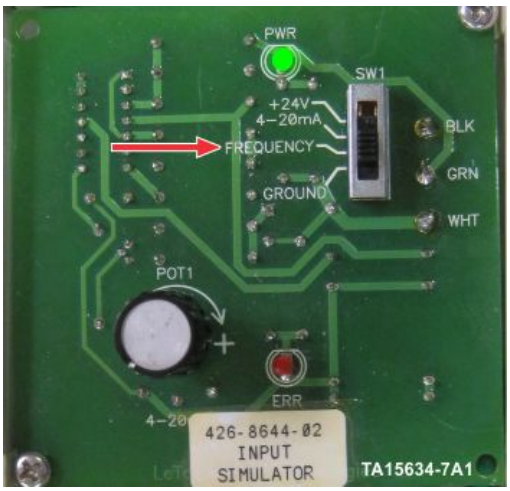

## 4-20mA Switch Position

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.



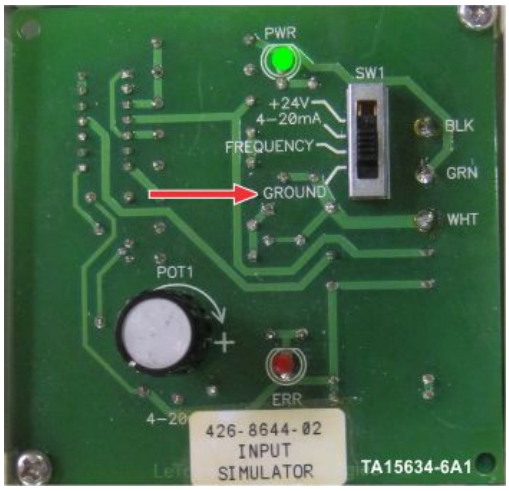
## Frequency Switch Position

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.




## Ground Switch Position

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



# 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.
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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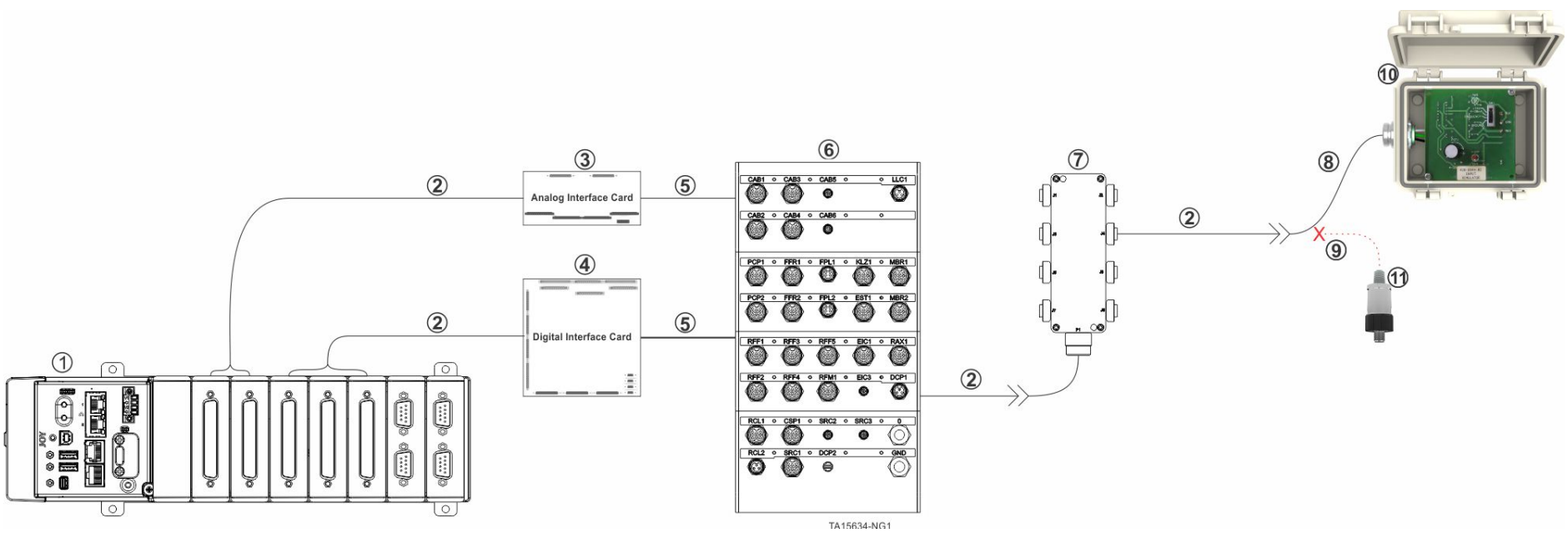


**Sensor Input Simulator Box connection**

| | |
|---|---|
| **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 | |

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/ESD 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 | KESS Converter Assemblies | Generator Converter Assemblies | Total Converter Assemblies |
|---|---|---|---|---|
| L-1350 | 4 (1 per motor) | 2 (1 per ESD) | 3 | 9 |
| L-1850, L-2350 | 8 (2 per motor) | NA | 4 | NA |

## 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

## ⚠ WARNING

**SR drive machines must not be operated with less than four wheel motors or with any of the converter panels disabled unless being moved for maintenance or being moved away from a dangerous situation.**

## ⚠ 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) as shown below. There are no messages when booting LINCS, starting engine, or releasing brakes. If this icon is illuminated, the operator should 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.


TA16126-PH-G3

**Figure 32. Drive System Abnormal Icon**

## Service Brakes

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.**

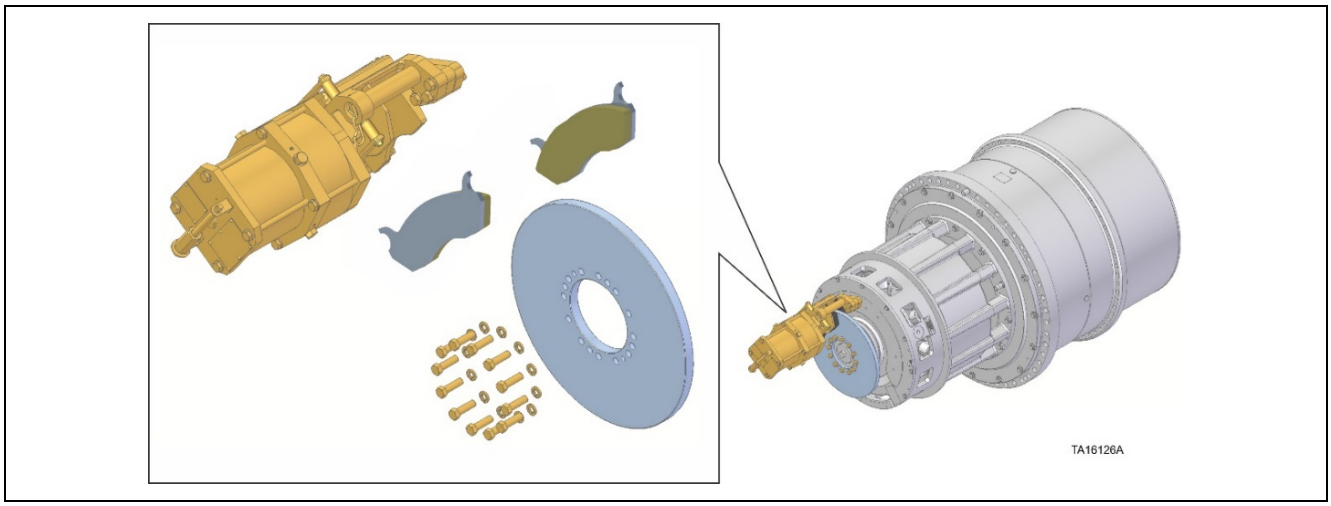



**Figure 33. Example 1: B-60 on 57” Driver**

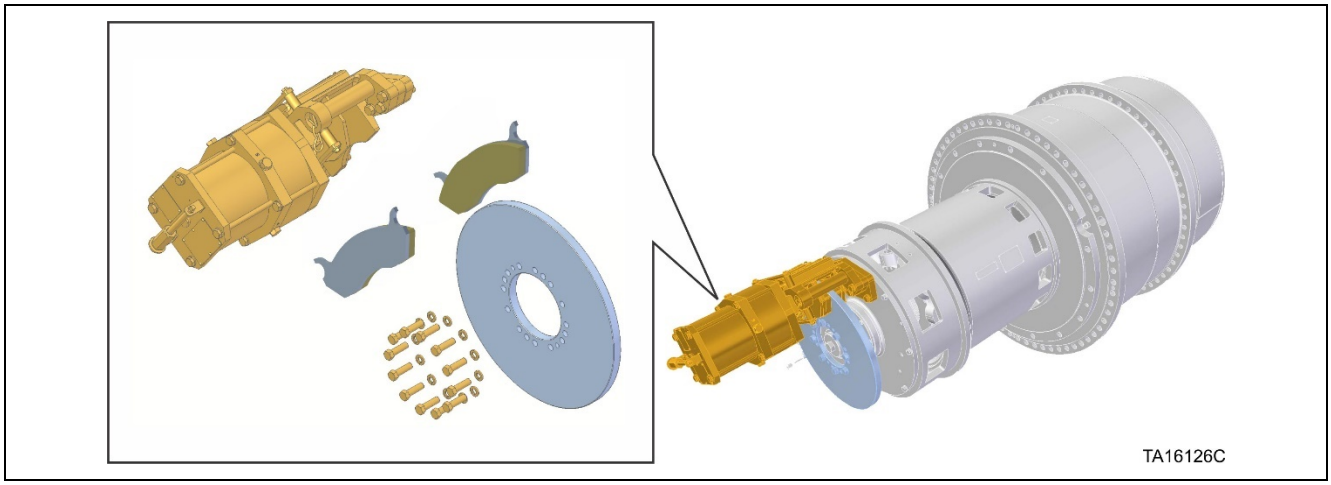



**Figure 34. Example 2: B-40A on 51” Driver**

## Overspeed Prevention Recommendations

**a.** 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.

**b.** 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").

**c.** Reduce speed PRIOR to descending a grade.

**d.** As a general rule, descend a grade no faster than the speed the machine will ascend the same grade with the same load.

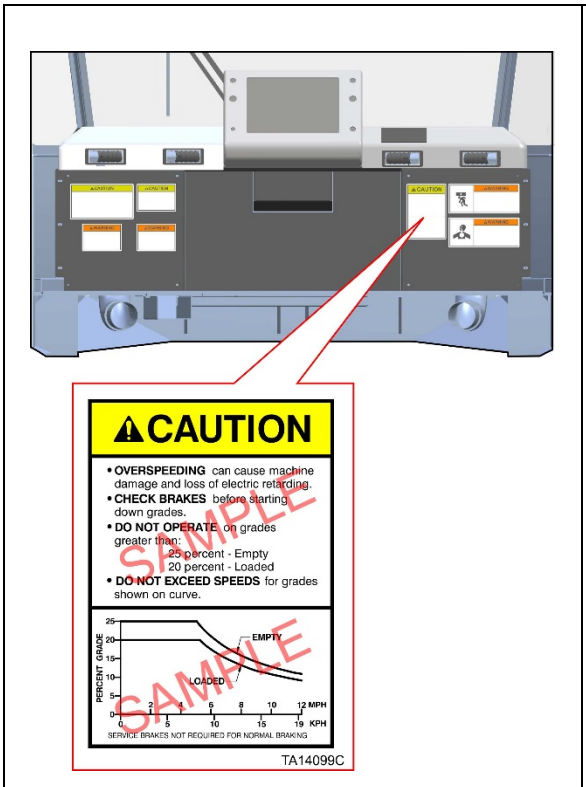
**e.** Promptly apply service brakes to slow the machine to a complete stop if an overspeed situation occurs.

**⚠ WARNING**

**The service brakes are not designed for continuous braking. The machine must be brought to a complete stop and the brakes allowed to cool before resuming grade descent.**

**⚠ 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.**




**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.**

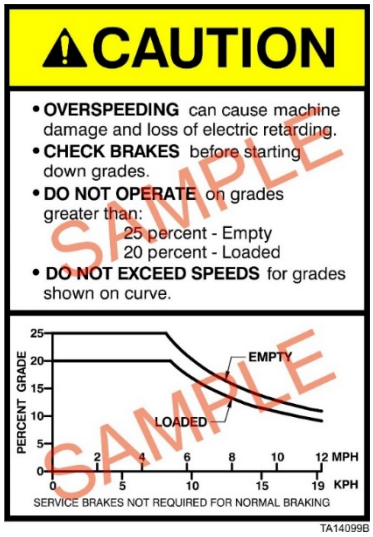



**Figure 35. Typical grade/speed chart**

# 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.**

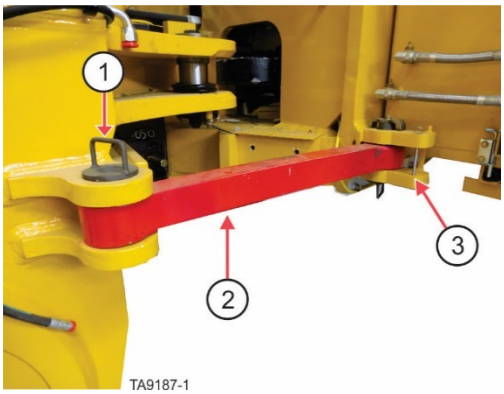
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 36. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

# 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 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.**

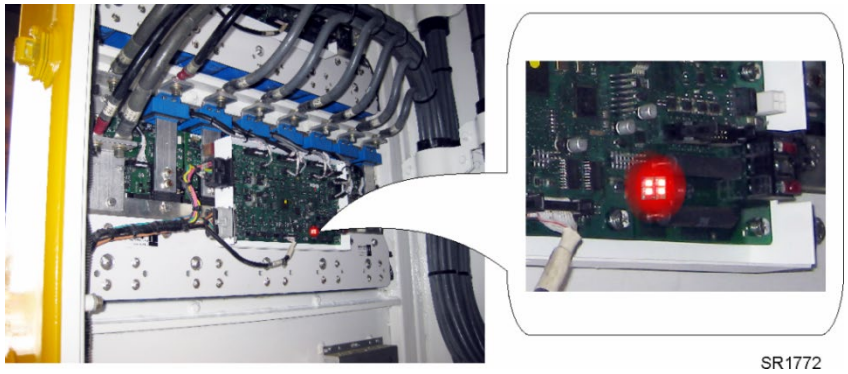



**Figure 37. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

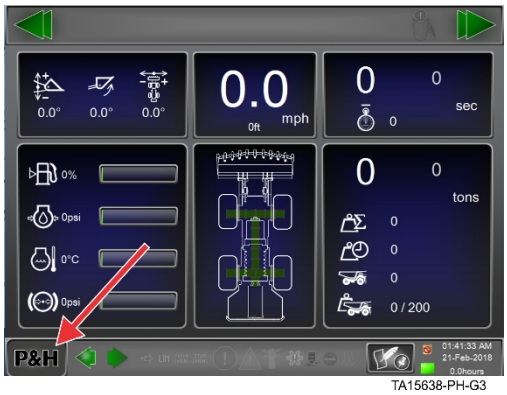
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

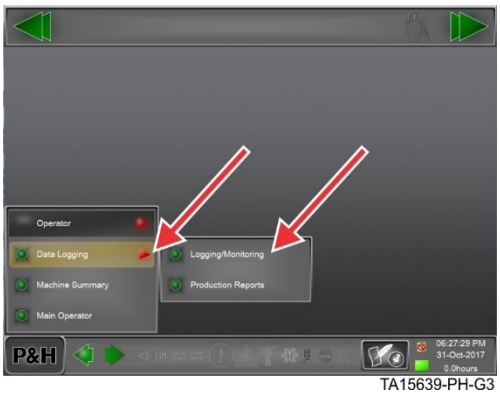
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.




**Main Menu Button**




**Data Logging & Logging/Monitoring**

**Figure 38. LINCS logging/monitoring menu access**

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

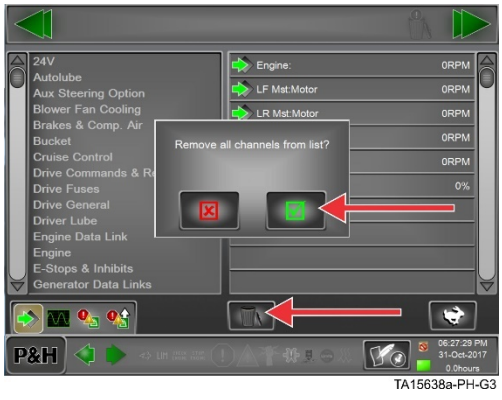



**Figure 39. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

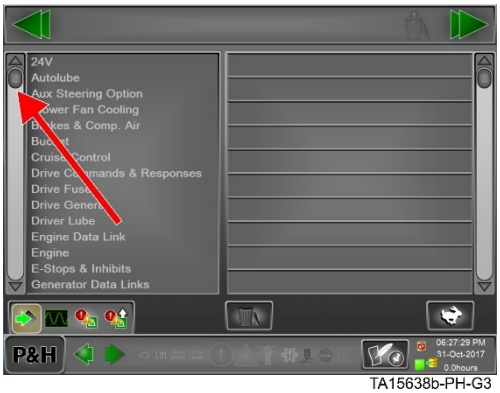



**Figure 40. Left hand scroll**

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

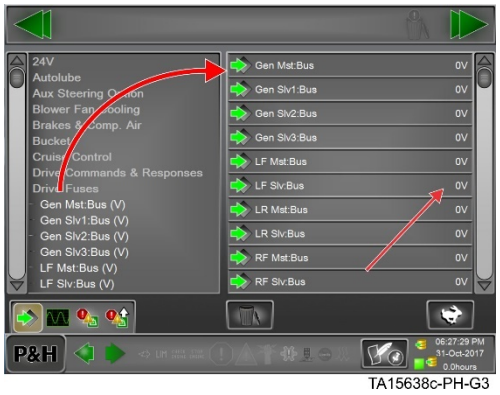



**Figure 41. Bus voltage indication**

6. 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.**

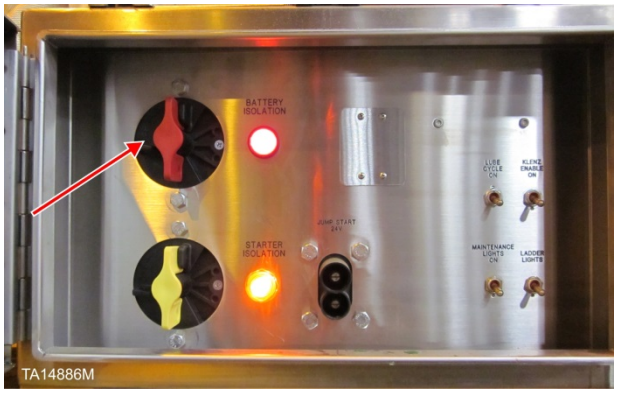
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 42. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

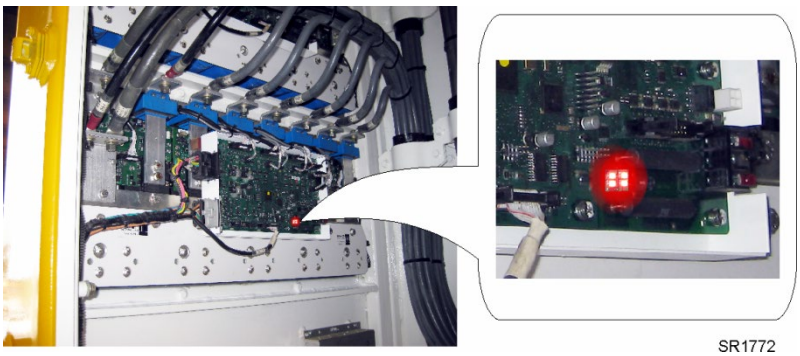



**Figure 43. Bus voltage LED array on SR control board**

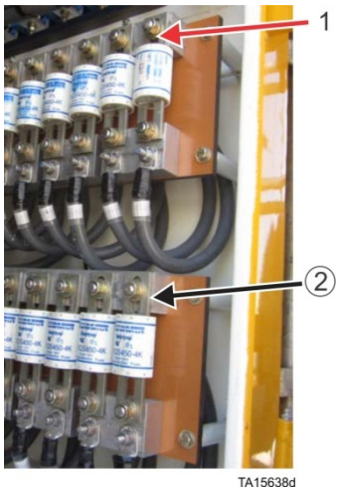
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 44. Main bus bars**

## 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.

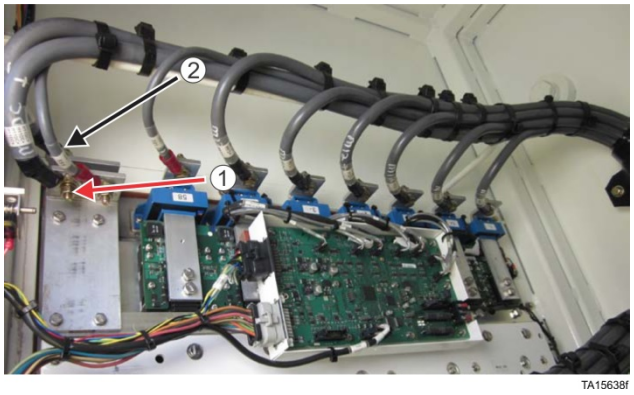
# NOTICE

**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.


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

**Figure 45. Converter assembly bus connections (rear of cabinet)**

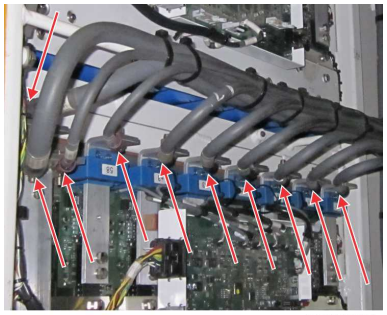



**1)** Positive bus bar, **2)** Negative bus bar

**Figure 46. Converter assembly bus connections (front of cabinet)**

# Isolating the Drive Assembly

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


TA15639g


TA15639h

**Figure 47. Converter assembly cable connections**

## CAUTION

**The use of two wrenchs 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.

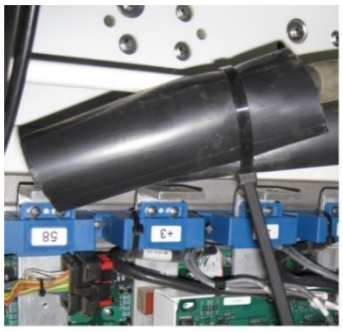

TA15639a

**Figure 48. Cable isolation and insulation**

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.


TA15639b

**Figure 49. Fuse assemblies (L-2350 shown)**

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

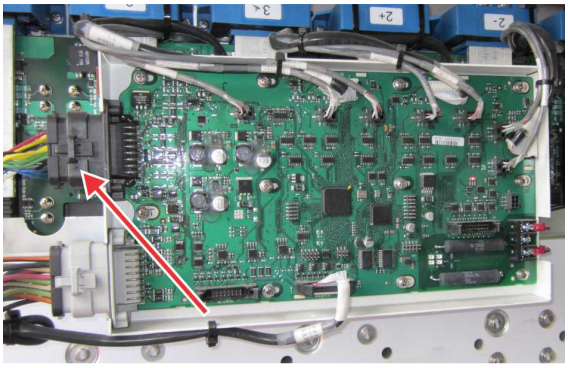



**Figure 50. Vehicle/power connector**

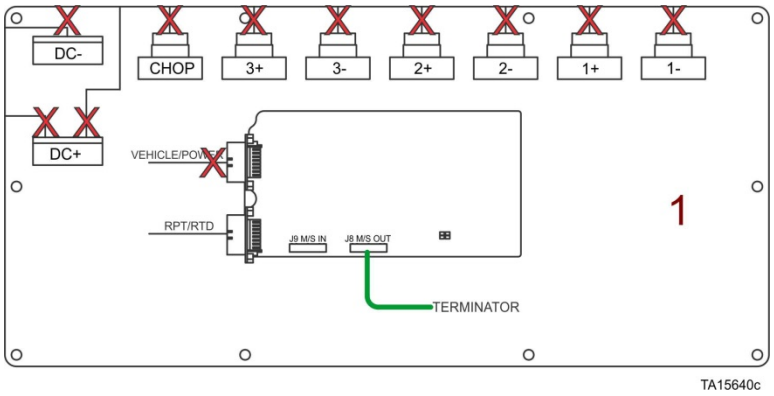
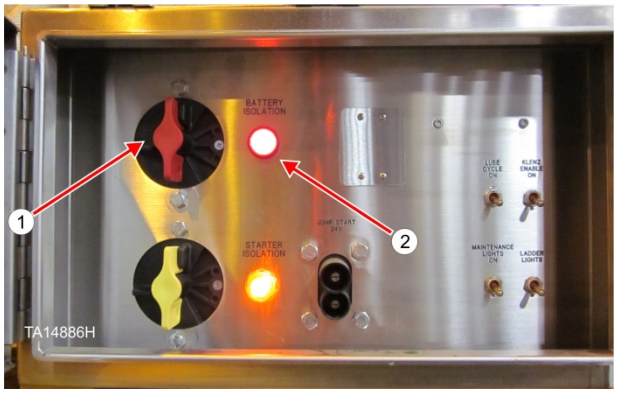



**Figure 51. Master converter assembly disconnected**

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).




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

**Figure 52. Isolation and control switch assembly**

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 53. 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.

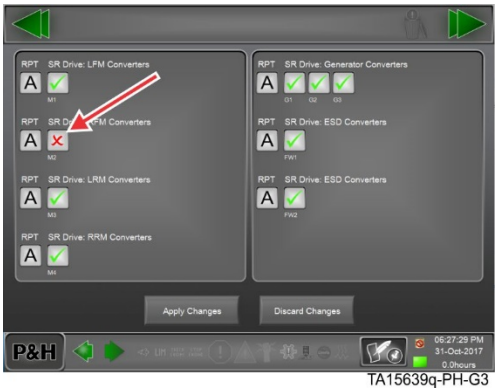



**Figure 54. LRM Converter isolation (example)**

9. Select Apply Changes.

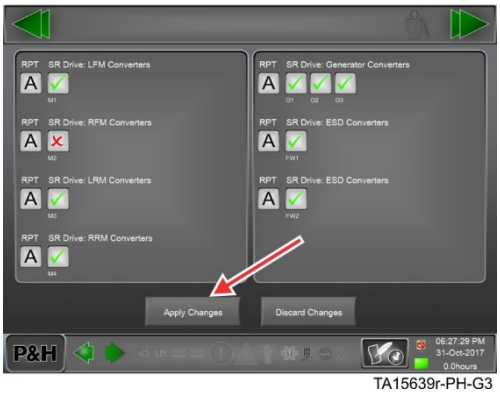



**Figure 55. LINCS drive configuration menu apply changes (example)**

10. Reboot LINCS.

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

# Isolating a Master Converter Assembly with a Single or Multiple Slave Drives (generator or 1850/2350 motor)

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 | KESS Converter Assemblies | Generator Converter Assemblies | Total Converter Assemblies |
|---|---|---|---|---|
| L-1350 | 4 (1 per motor) | 2 (1 per ESD) | 3 | 9 |
| L-1850, L-2350 | 8 (2 per motor) | NA | 4 | NA |

## 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) as shown below. There are no messages when booting LINCS, starting engine, or releasing brakes. If this icon is illuminated, the operator should 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.


TA16126-PH-G3

**Drive System Abnormal Icon**

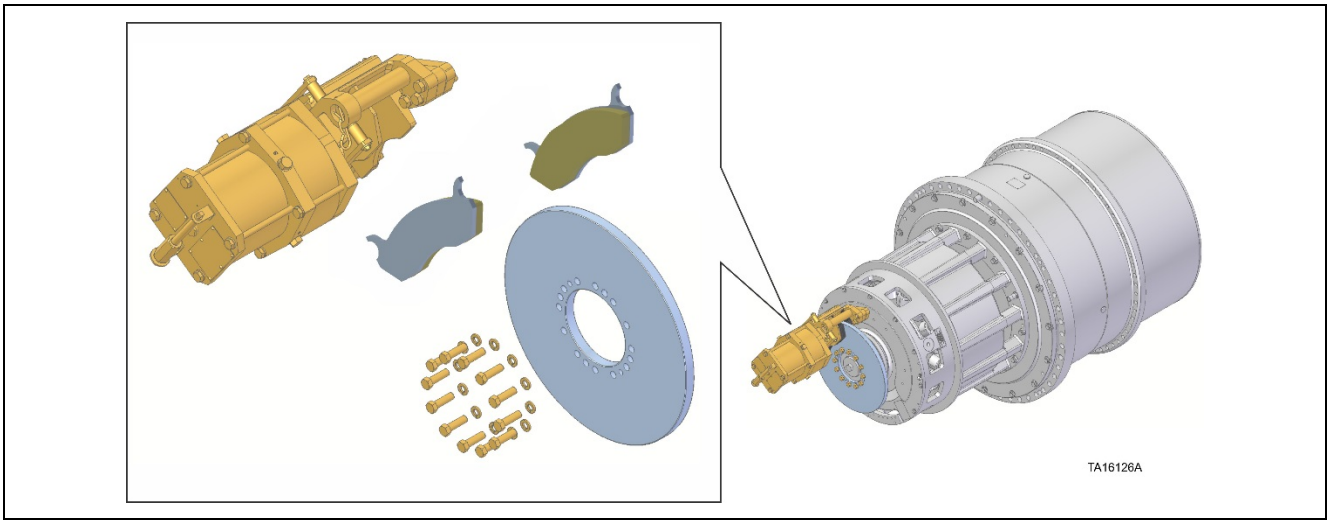
## Service Brakes

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:

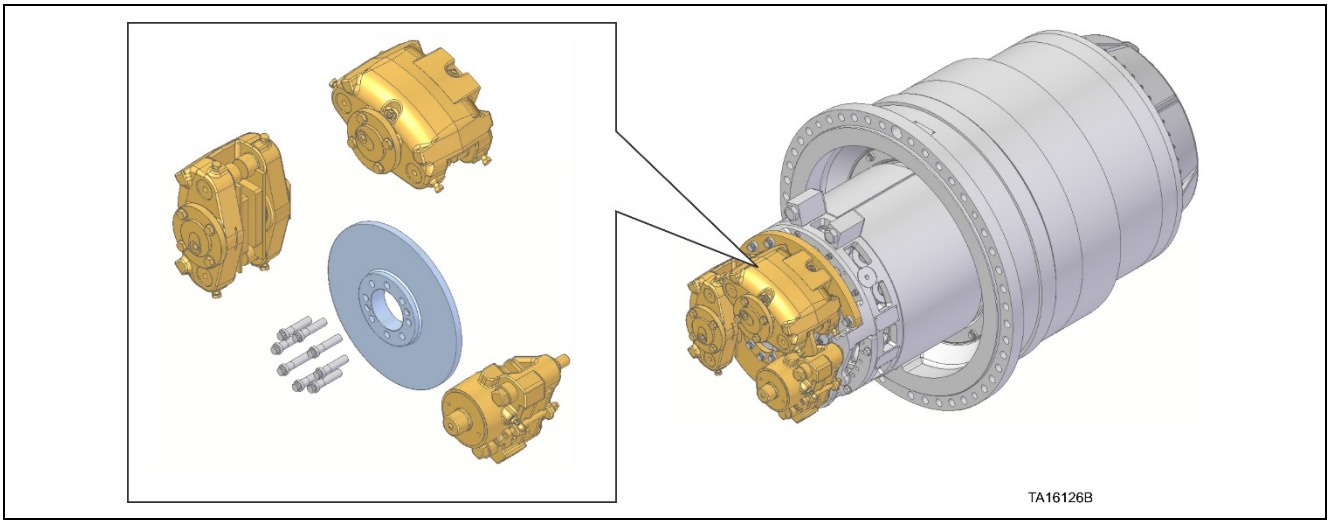
- The traction motor must be installed
- The traction motor or driver cannot be altered in any fashion
- Middle pinion on 57” driver cannot be removed

**⚠ 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.**




**Example 1: B-60 on 57” Driver**




**Example 2: B-9 on 29” Driver**

## Overspeed Prevention Recommendations

**a.** 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.

**b.** 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").

**c.** Reduce speed PRIOR to descending a grade.

**d.** As a general rule, descend a grade no faster than the speed the machine will ascend the same grade with the same load.

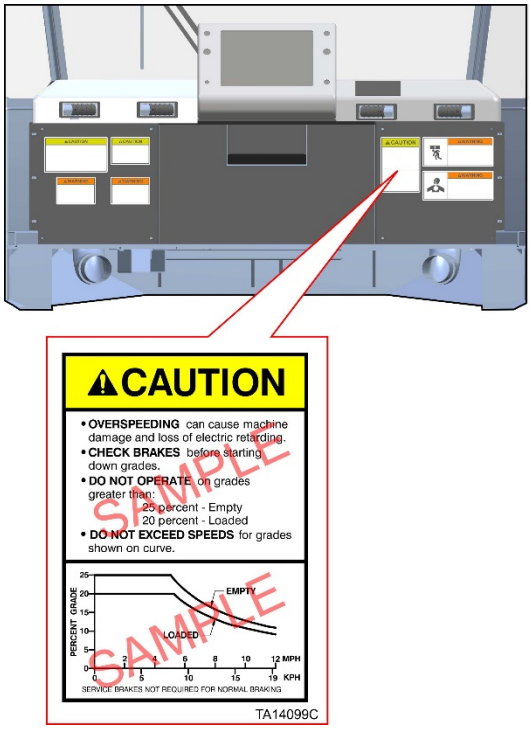
**e.** Promptly apply service brakes to slow the machine to a complete stop if an overspeed situation occurs.

**⚠ WARNING**

**The service brakes are not designed for continuous braking. The machine must be brought to a complete stop and the brakes allowed to cool before resuming grade descent.**

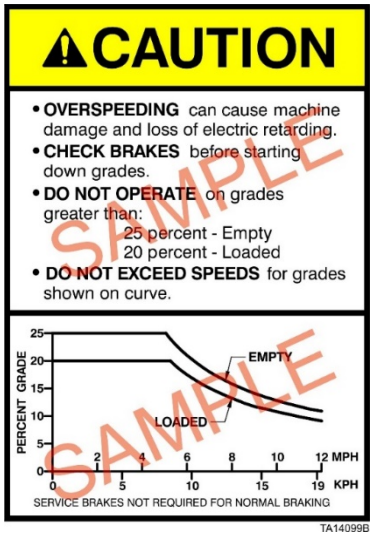
**⚠ WARNING**

**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.**




**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.**




**Typical grade/speed chart**

# 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.**

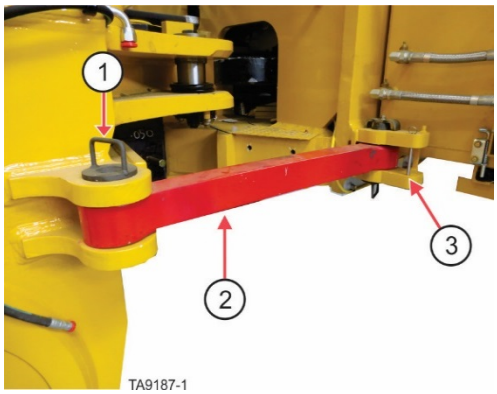
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 56. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

# 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 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.**

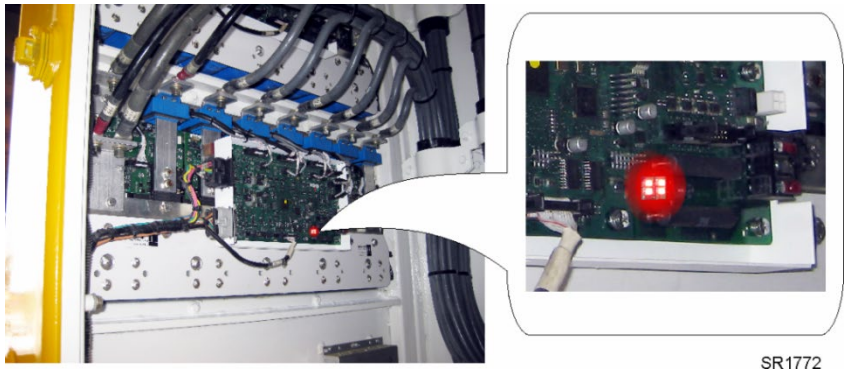



**Figure 57. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

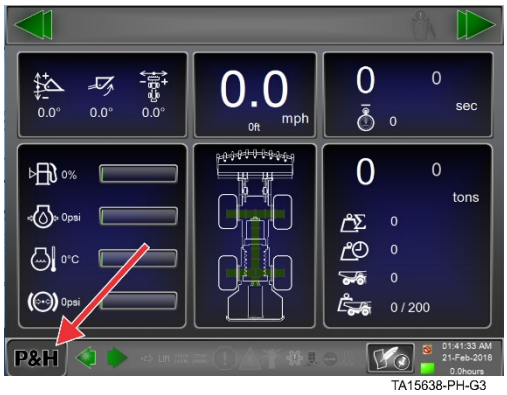
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

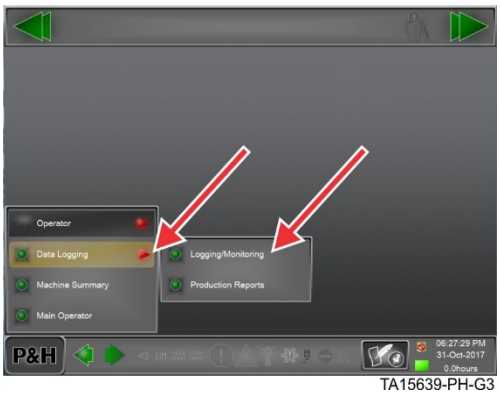
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.




**Main Menu Button**




**Data Logging & Logging/Monitoring**

**Figure 58. LINCS logging/monitoring menu access**

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

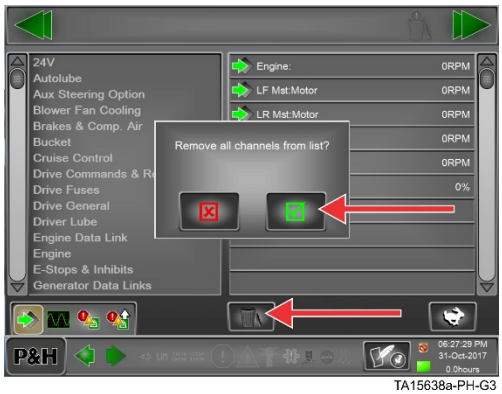



**Figure 59. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

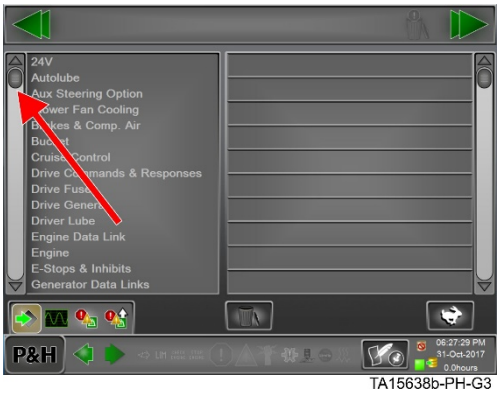



**Figure 60. Left hand scroll**

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

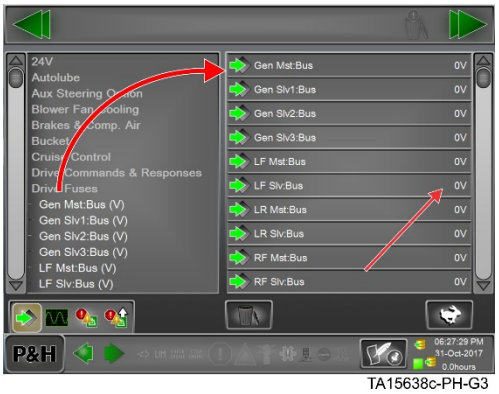



**Figure 61. Bus voltage indication**

6. 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.**

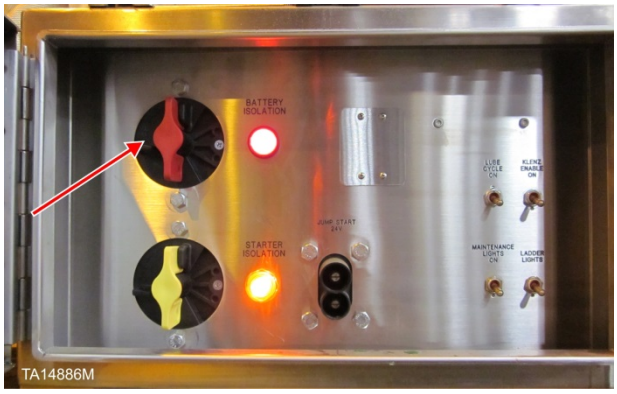
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 62. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

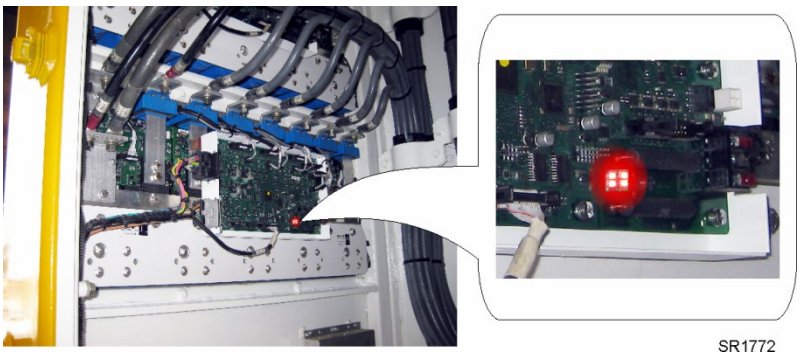



**Figure 63. Bus voltage LED array on SR control board**

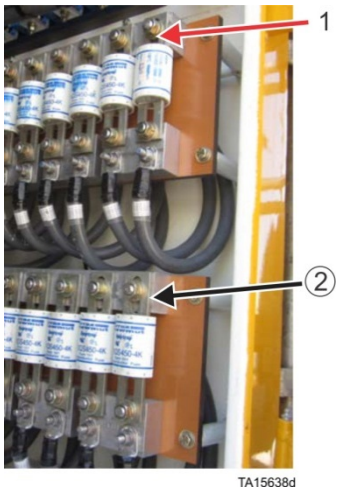
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 64. Main bus bars**

## 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.

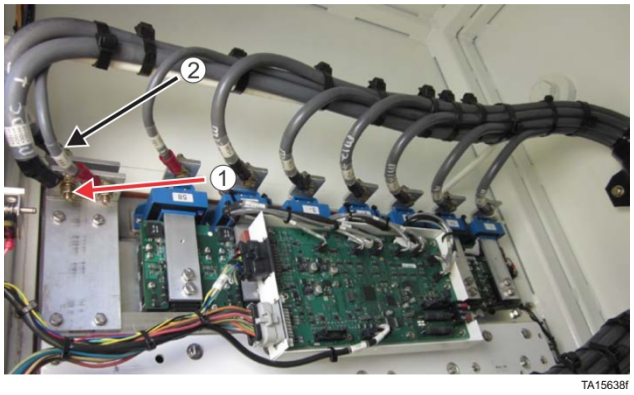
# NOTICE

**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.


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

**Figure 65. Converter assembly bus connections (rear of cabinet)**




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

**Figure 66. Converter assembly bus connections (front of cabinet)**

# Isolating the Drive Assembly

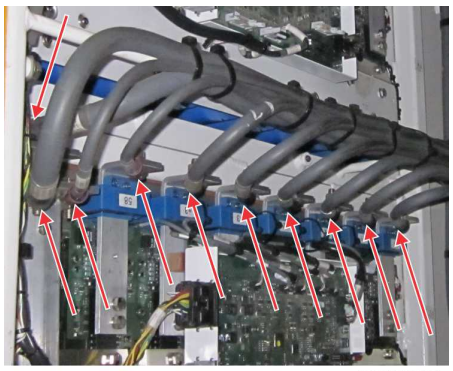
1. Disconnect all cable leads (+/- 1, 2, 3; Chopper (55 & 58, if connected), and +/- DC) from the converter assembly.

## 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.**

## NOTICE

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


TA15639g

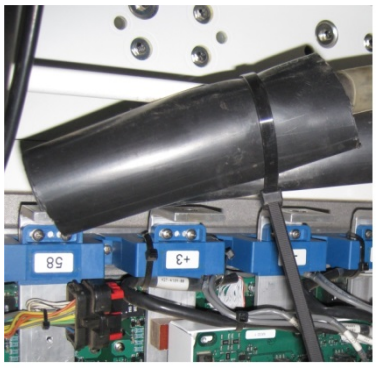
TA15639h

**Figure 67. Converter assembly cable connections**

## CAUTION

**The use of two wrenchs 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.



TA15639a

**Figure 68. Cable isolation and insulation**

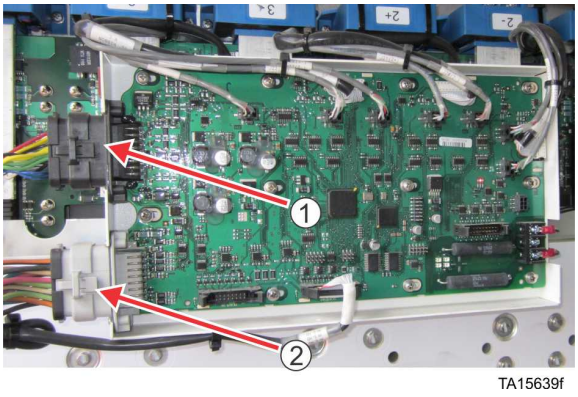
3. Remove the DC fuses (+ and -) associated with the converter assembly to be isolated. Fuses are located on the fuse assembly at the bottom of the high voltage cabinet.


**Figure 69. Fuse assemblies (L-2350 shown)**

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.**




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

**Figure 70. Vehicle/power and RPT/RTD connectors**

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.**

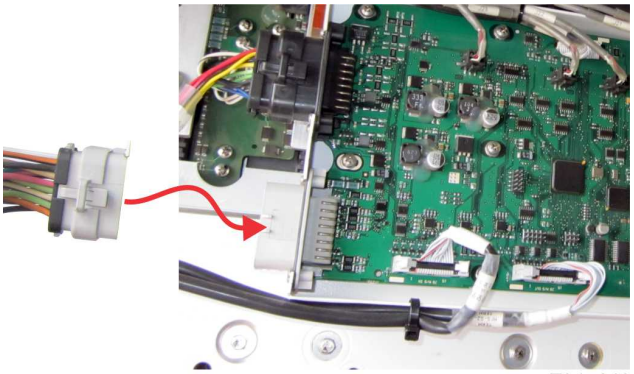
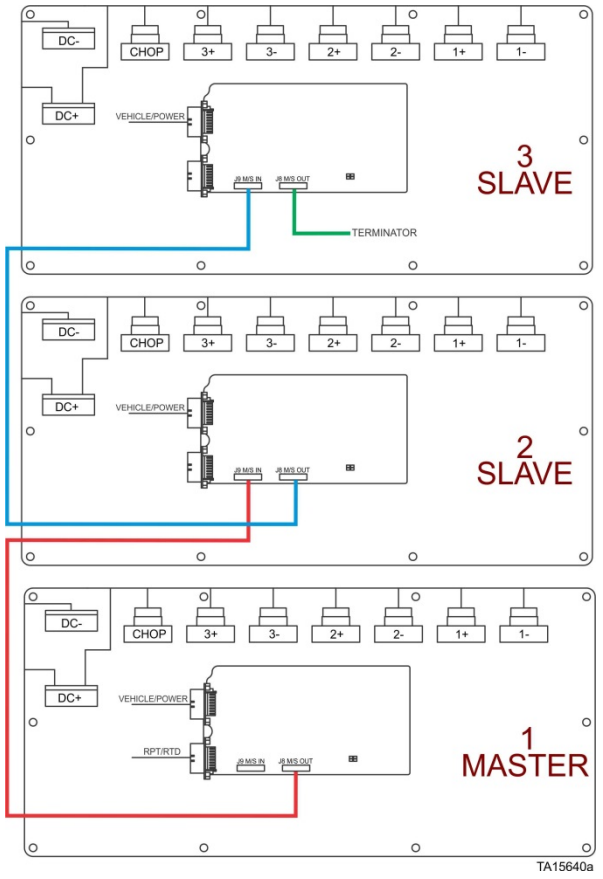
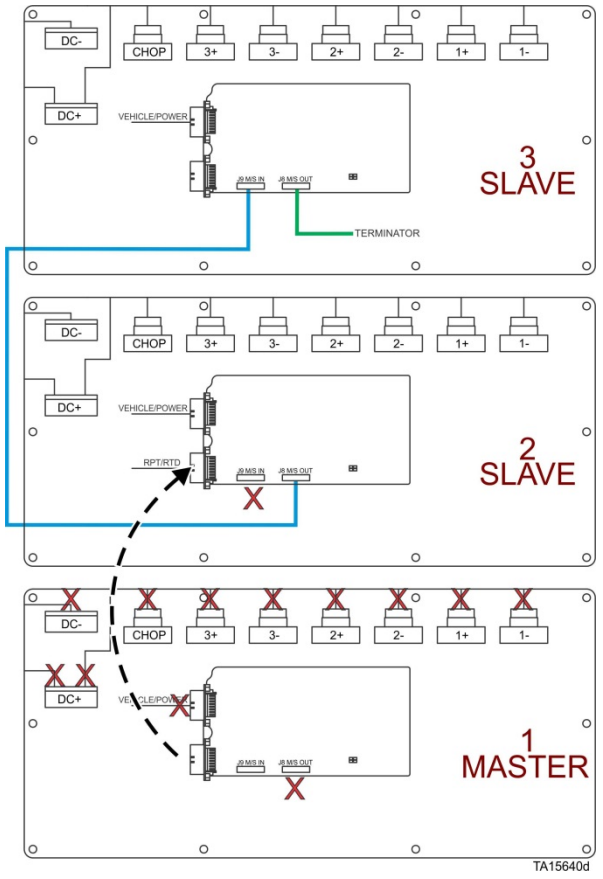



**Figure 71. RPT/RTD connection to slave converter assembly SR control board**

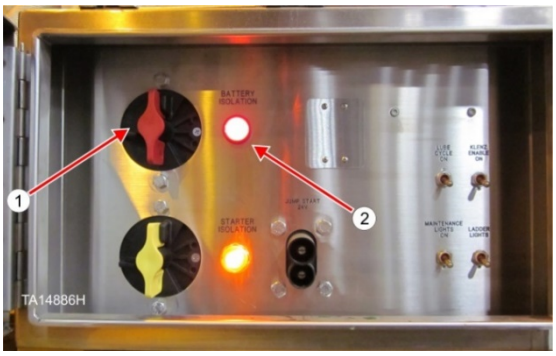



**Original connections** | **Isolated master connections**

**Figure 72. Isolated master connections**

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




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

**Figure 73. Isolation and control switch assembly**

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 74. 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.

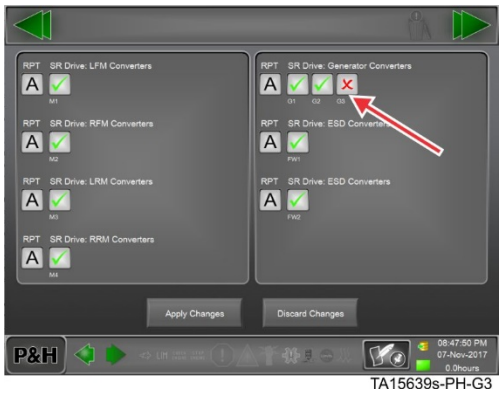



**Figure 75. LINCS drive configuration menu (example)**

11. Select Apply Changes.


**Figure 76. LINCS drive configuration menu apply changes (example)**

12. Reboot LINCS.

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

# Isolating a Slave Converter Assembly in a Single Slave Drive (1850/2350 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 | KESS Converter Assemblies | Generator Converter Assemblies | Total Converter Assemblies |
|---|---|---|---|---|
| L-1350 | 4 (1 per motor) | 2 (1 per ESD) | 3 | 9 |
| L-1850, L-2350 | 8 (2 per motor) | NA | 4 | NA |

## 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) as shown below. There are no messages when booting LINCS, starting engine, or releasing brakes. If this icon is illuminated, the operator should 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.


TA16126-PH-G3

**Drive System Abnormal Icon**

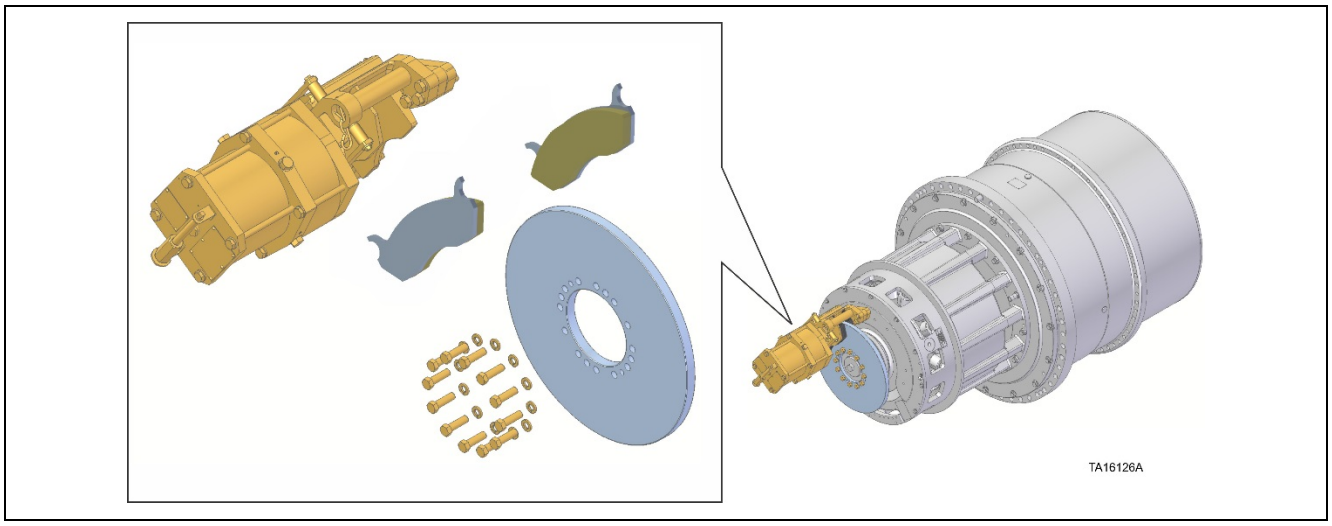
## Service Brakes

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:

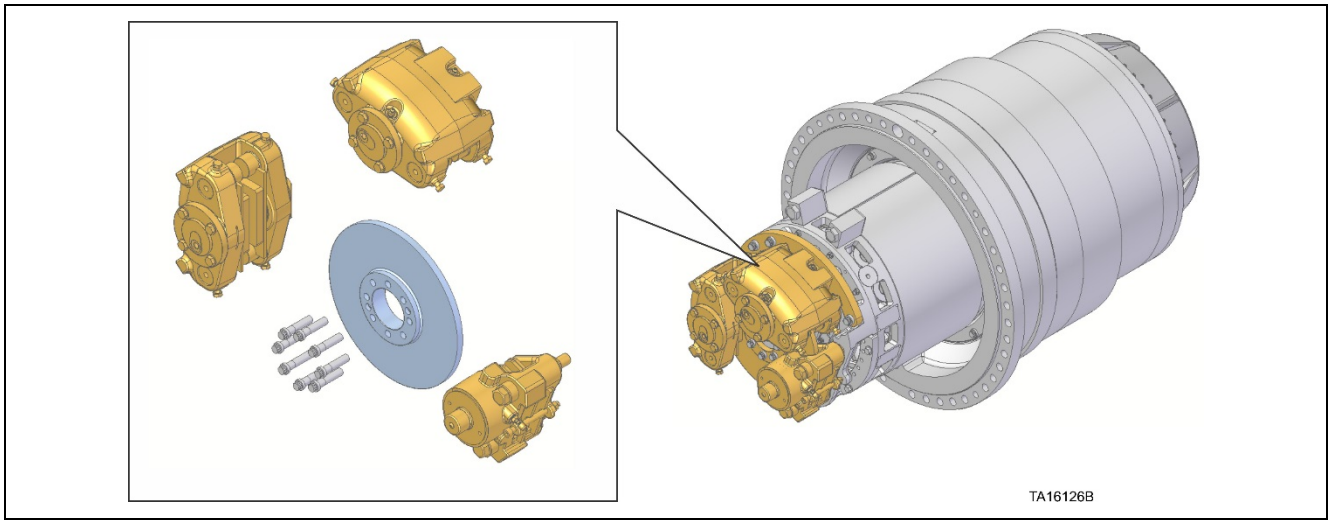
- The traction motor must be installed
- The traction motor or driver cannot be altered in any fashion
- Middle pinion on 57” driver cannot be removed

**⚠ 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.**




**Example 1: B-60 on 57” Driver**




**Example 2: B-9 on 29” Driver**

## Overspeed Prevention Recommendations

**a.** 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.

**b.** 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").

**c.** Reduce speed PRIOR to descending a grade.

**d.** As a general rule, descend a grade no faster than the speed the machine will ascend the same grade with the same load.

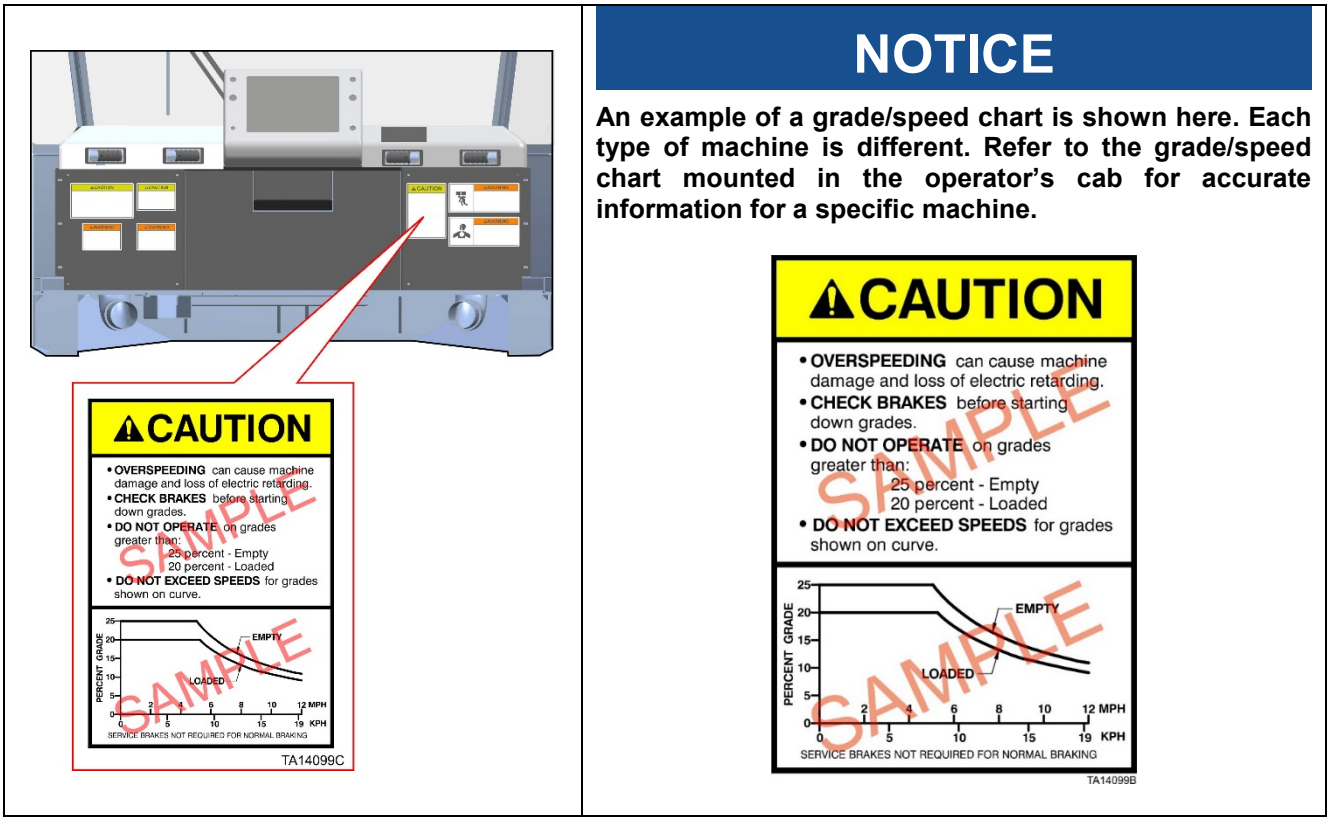
**e.** Promptly apply service brakes to slow the machine if an overspeed situation occurs.

**⚠ WARNING**

**The service brakes are not designed for continuous braking. The machine must be brought to a complete stop and the brakes allowed to cool before resuming grade descent.**

**⚠ 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.**




**Typical grade/speed chart**

# 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.**

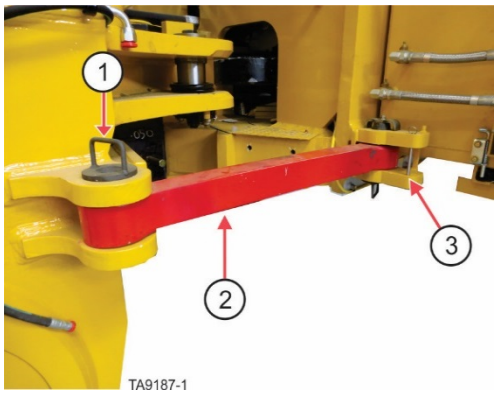
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 77. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

# 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 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.**

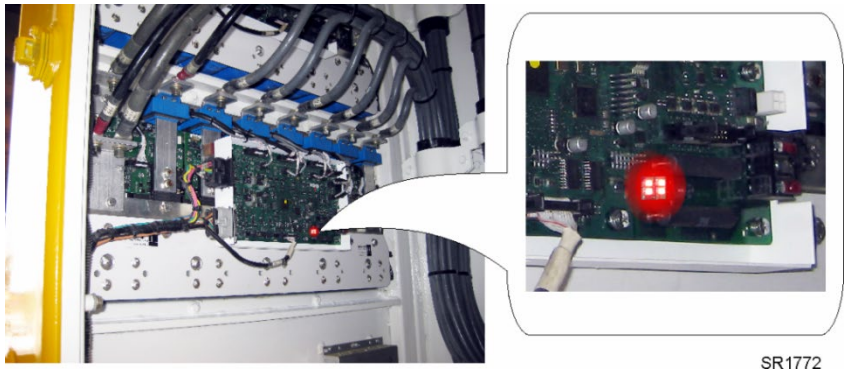



**Figure 78. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

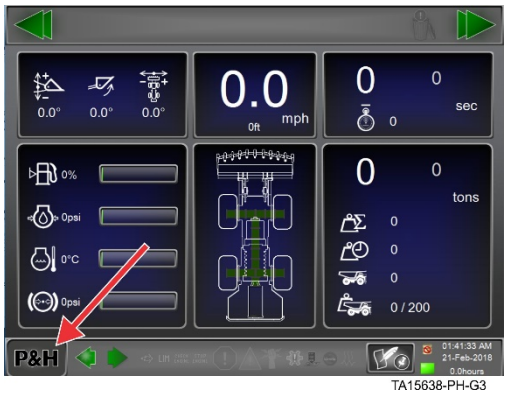
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

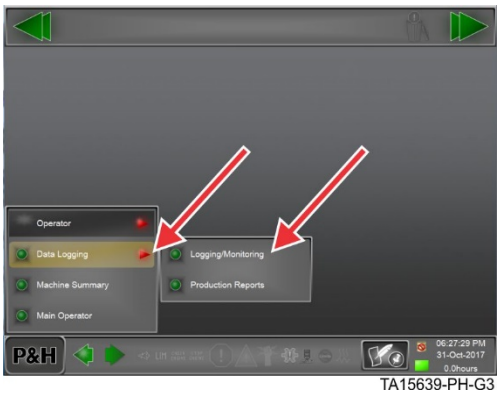
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.




**Main Menu Button**




**Data Logging & Logging/Monitoring**

**Figure 79. LINCS logging/monitoring menu access**

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

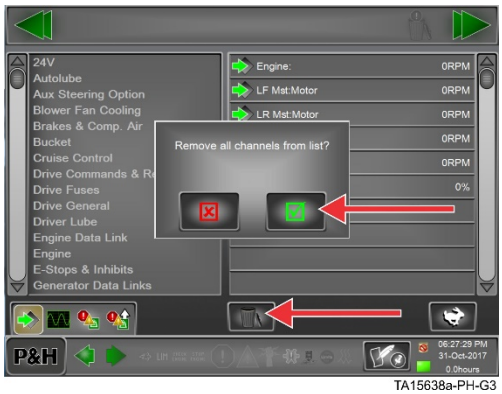



**Figure 80. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

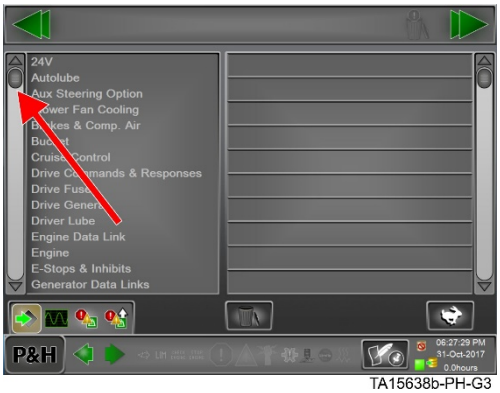



**Figure 81. Left hand scroll**

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

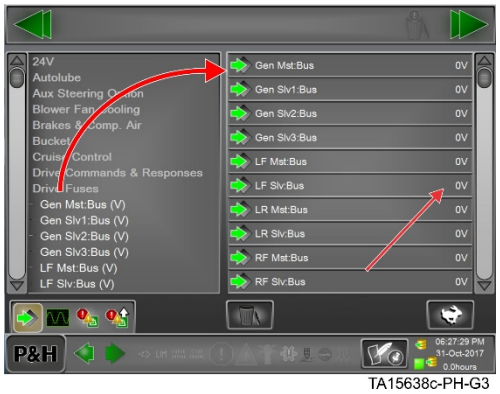



**Figure 82. Bus voltage indication**

6. 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.**

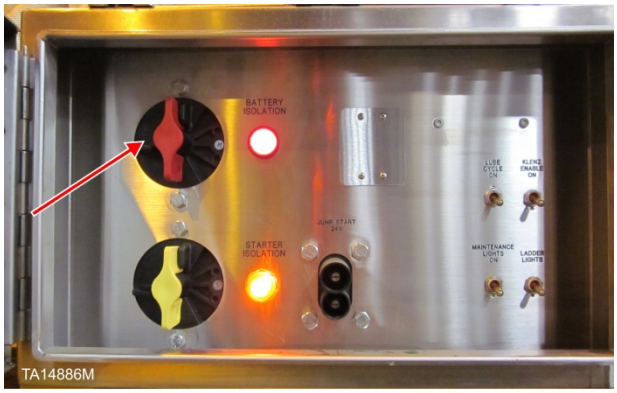
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 83. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

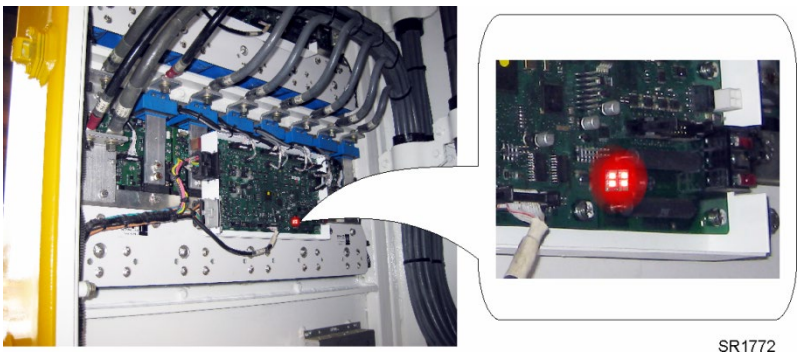



**Figure 84. Bus voltage LED array on SR control board**

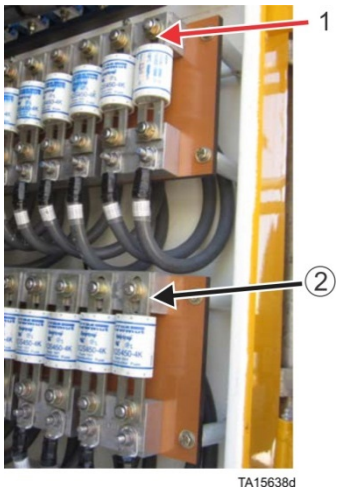
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 85. Main bus bars**

## 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.

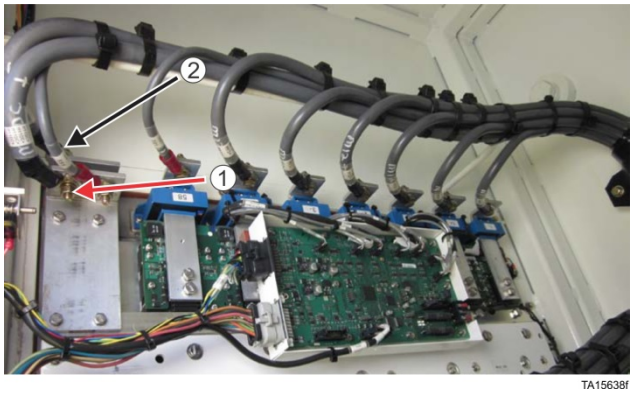
# NOTICE

**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.


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

**Figure 86. Converter assembly bus connections (rear of cabinet)**




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

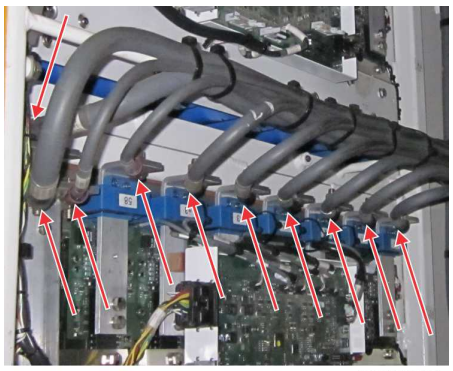
**Figure 87. Converter assembly bus connections (front of cabinet)**

# 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.**



TA15639g

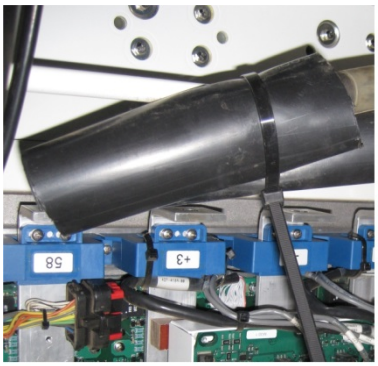

TA15639h

**Figure 88. Converter assembly cable connections**

## CAUTION

**The use of two wrenchs 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.




TA15639a

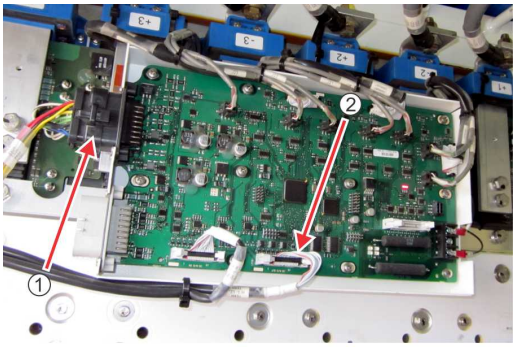
**Figure 89. Cable isolation and insulation**

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.

TA15639b

**Figure 90. Fuse assemblies (L-2350 shown)**

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.

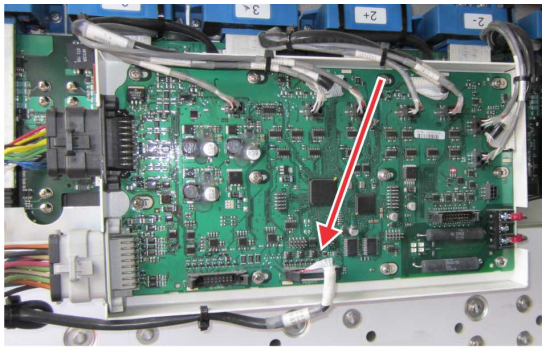



TA15640g

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

**Figure 91. SR control board**

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.

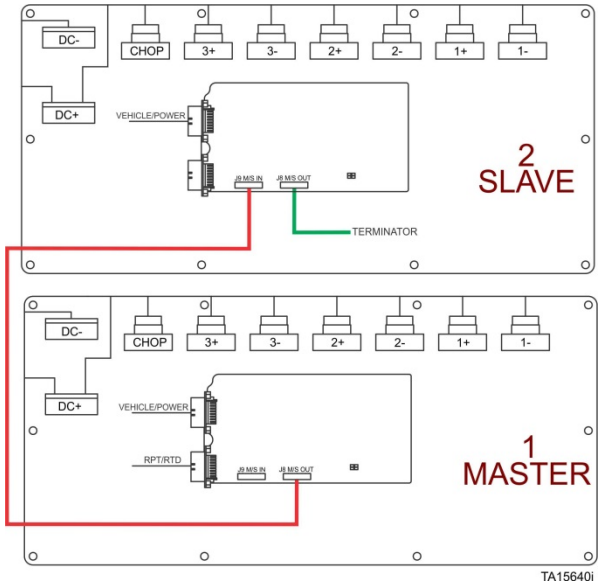


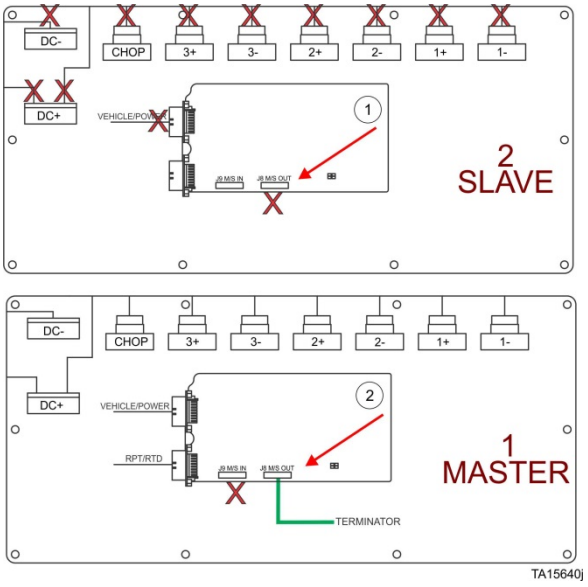
TA15640h

**Figure 92. SR control board – terminator cable**

# 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.**

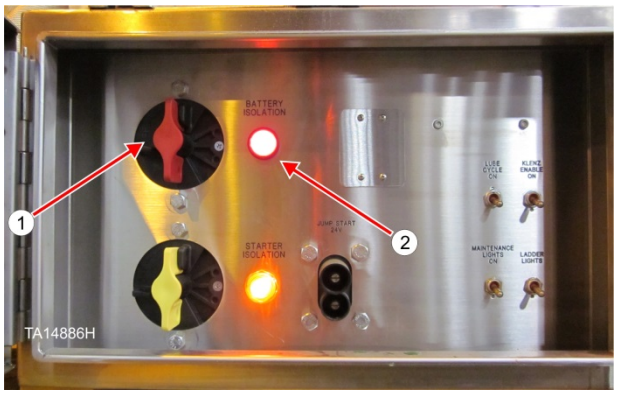



| | |
|---|---|
| | **1.** Remove Terminator<br>**2.** Attach Terminator |
| **Original Connections** | **Isolated Slave Connections** |

**Figure 93. Isolated single slave connections**

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




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

**Figure 94. Isolation and control switch assembly**

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 95. 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.

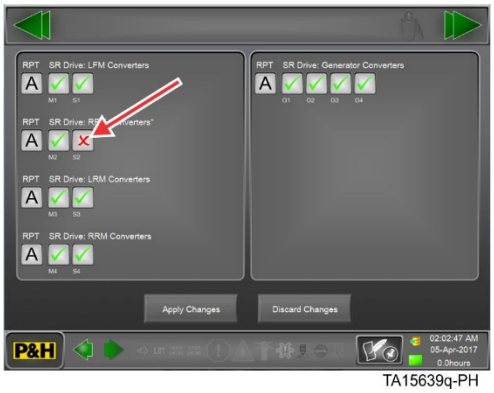



**Figure 96. LINCS drive configuration menu (example)**

10. Select Apply Changes.

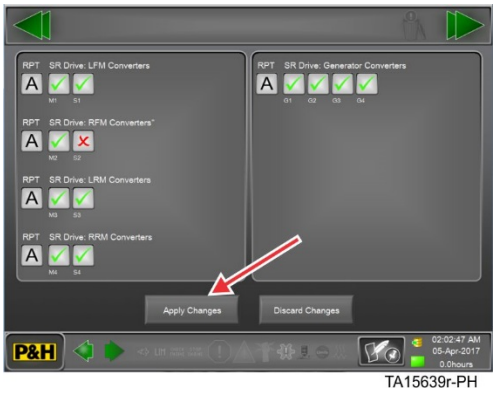



**Figure 97. LINCS drive configuration menu apply changes (example)**

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 | KESS Converter Assemblies | Generator Converter Assemblies | Total Converter Assemblies |
|---|---|---|---|---|
| L-1350 | 4 (1 per motor) | 2 (1 per ESD) | 3 | 9 |
| L-1850, L-2350 | 8 (2 per motor) | NA | 4 | NA |

## 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) as shown below. There are no messages when booting LINCS, starting engine, or releasing brakes. If this icon is illuminated, the operator should 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.


TA16126-PH-G3

**Drive System Abnormal Icon**

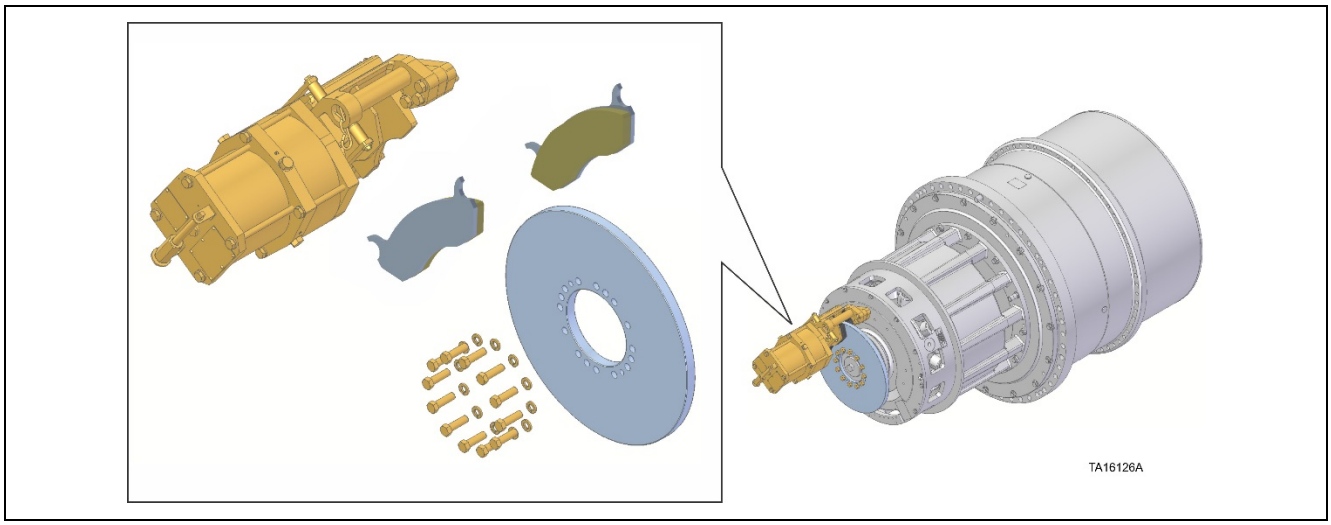
## Service Brakes

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:

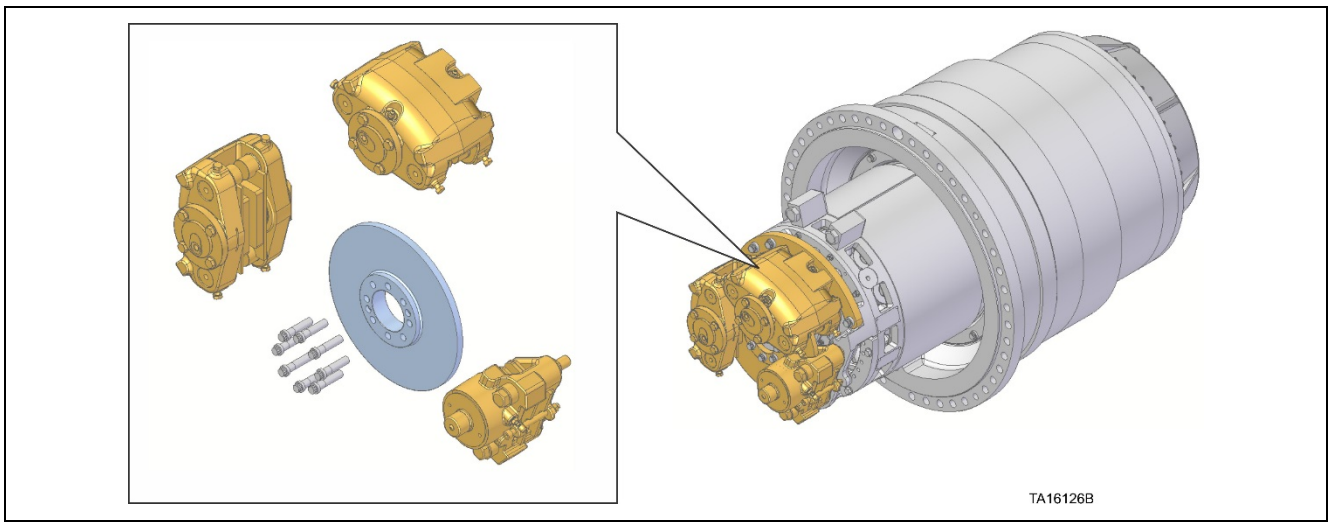
- The traction motor must be installed
- The traction motor or driver cannot be altered in any fashion
- Middle pinion on 57” driver cannot be removed

**⚠ 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.**




**Example 1: B-60 on 57” Driver**




**Example 2: B-9 on 29” Driver**

## Overspeed Prevention Recommendations

**a.** 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.

**b.** 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").

**c.** Reduce speed PRIOR to descending a grade.

**d.** As a general rule, descend a grade no faster than the speed the machine will ascend the same grade with the same load.

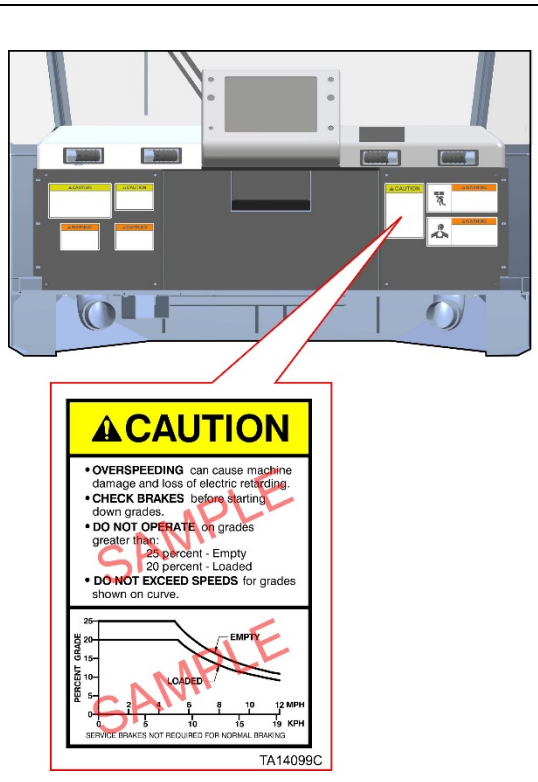
**e.** Promptly apply service brakes to slow the machine if an overspeed situation occurs.

**⚠ WARNING**

**The service brakes are not designed for continuous braking. The machine must be brought to a complete stop and the brakes allowed to cool before resuming grade descent.**

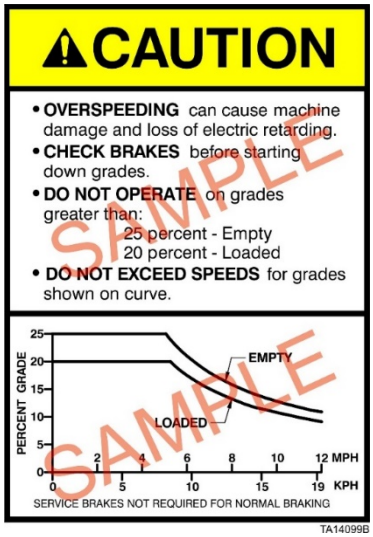
**⚠ WARNING**

**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.**




**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.**




**Typical grade/speed chart**

# 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.**

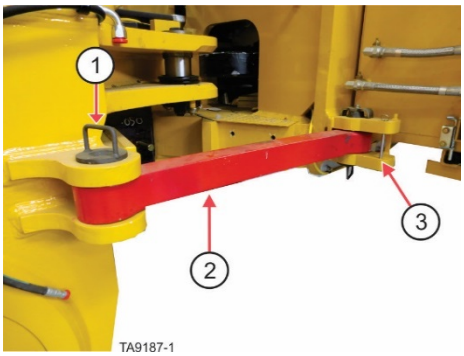
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 98. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

# 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 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.**

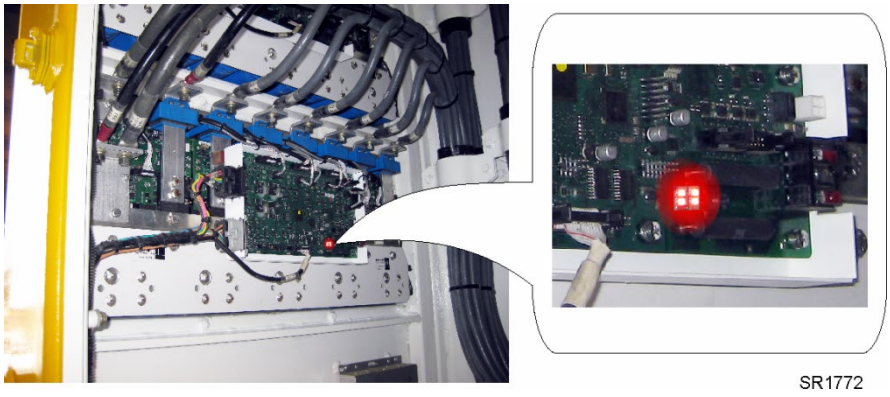



**Figure 99. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

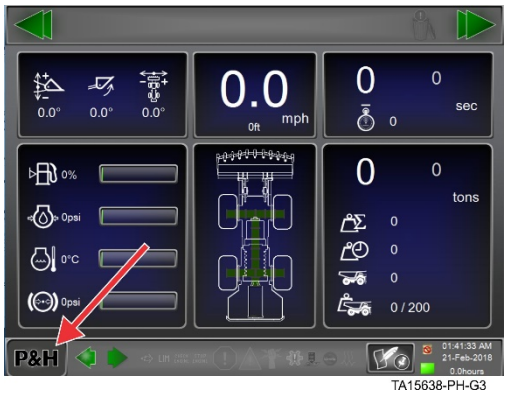
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

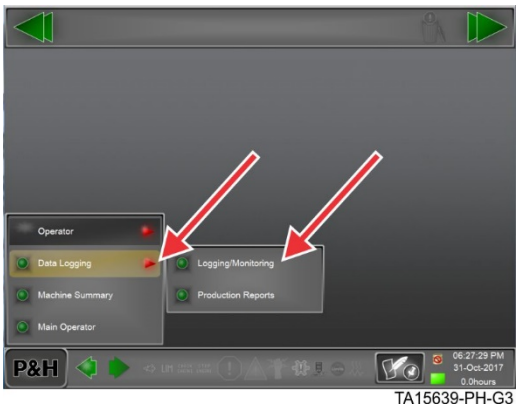
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.




Main Menu Button




Data Logging & Logging/Monitoring

**Figure 100. LINCS logging/monitoring menu access**

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

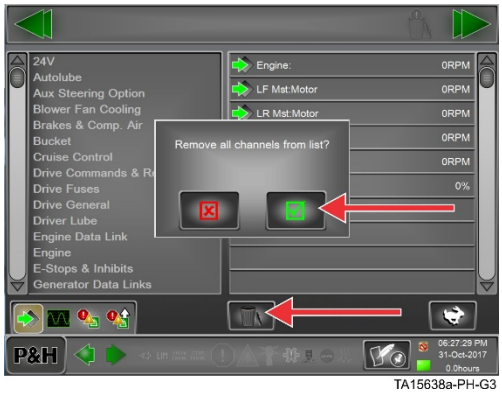



**Figure 101. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

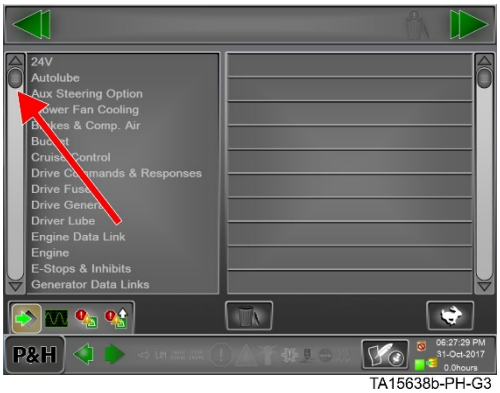



**Figure 102. Left hand scroll**

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

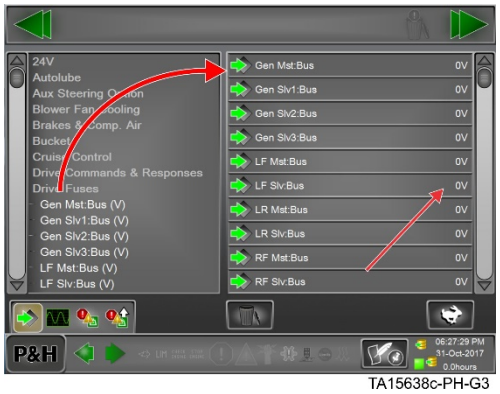



**Figure 103. Bus voltage indication**

6. 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.**

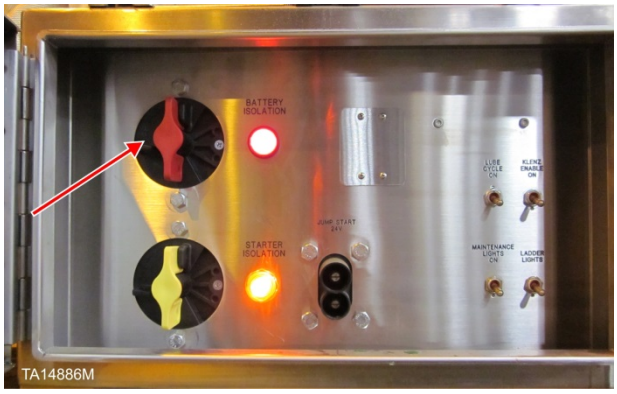
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 104. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

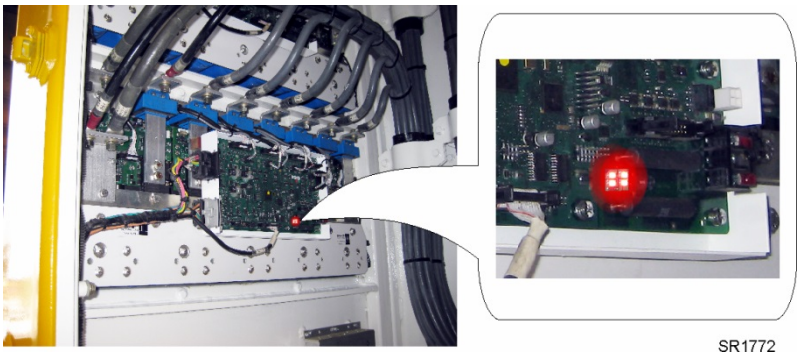



**Figure 105. Bus voltage LED array on SR control board**

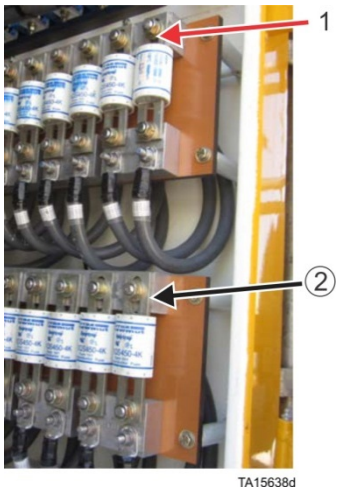
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 106. Main bus bars**

## 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.

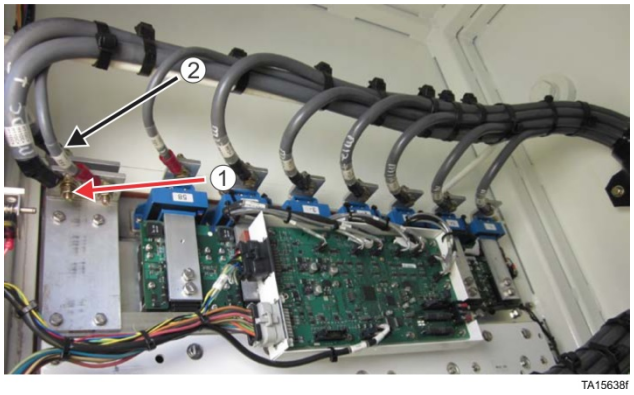
# NOTICE

**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.


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

**Figure 107. Converter assembly bus connections (rear of cabinet)**

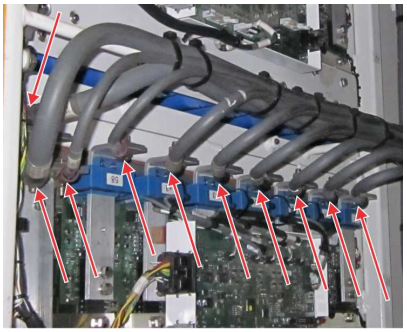



**1)** Positive bus bar, **2)** Negative bus bar

**Figure 108. Converter assembly bus connections (front of cabinet)**

# Isolating the Drive Assembly

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


TA15639g


TA15639h

**Figure 109. Converter assembly cable connections**

## CAUTION

**The use of two wrenchs 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.

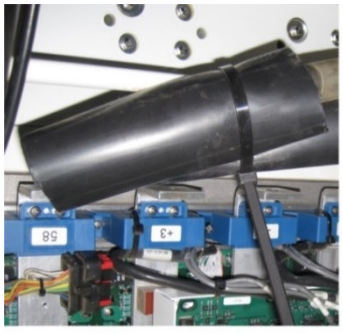

TA15639a

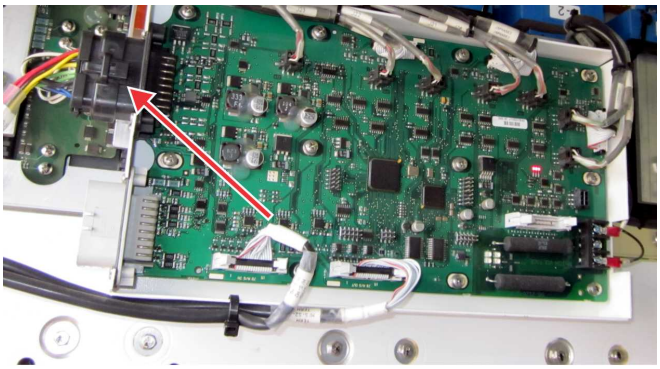
**Figure 110. Cable isolation and insulation**

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.

TA15639b

**Figure 111. Fuse assembly (L-2350 shown)**

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

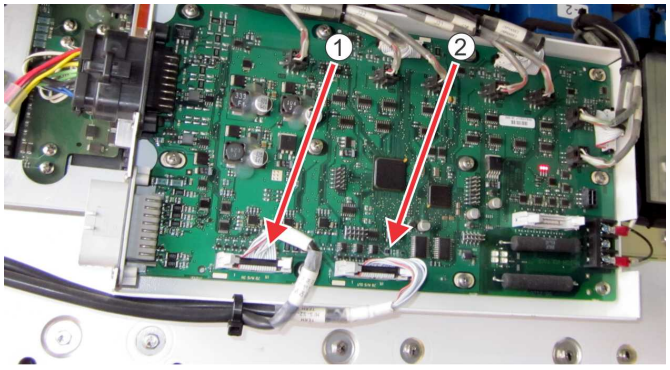


TA15640k

**Figure 112. SR control board slave converter assembly**

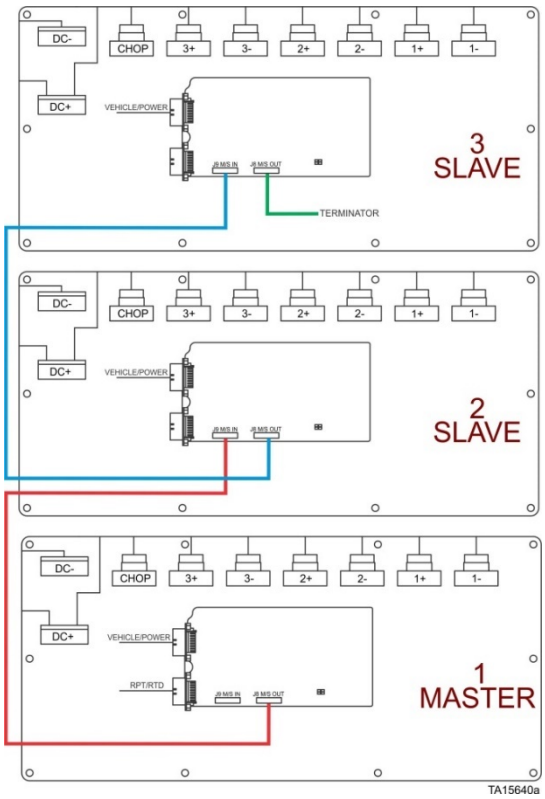
5. Isolating slave converter assembly:

   a. **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').

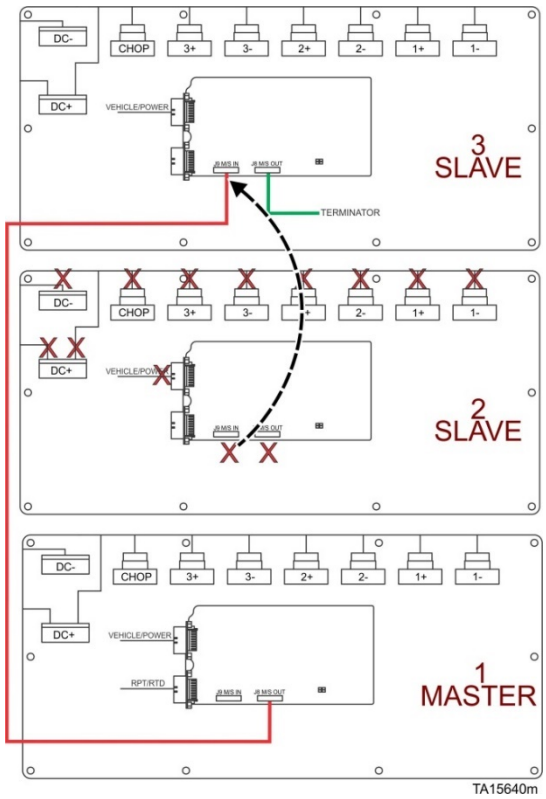



**1)** Master/Slave IN J9, **2)** Master/Slave OUT J8

**Figure 113. Master/slave connectors**



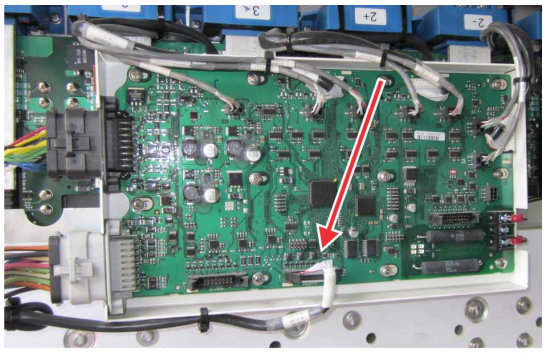

**Original Connections**




**Isolated Slave Connections - Slave converter assembly is not the last converter assembly in the drive**

**Figure 114. Isolating non-terminating slave assembly**

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').

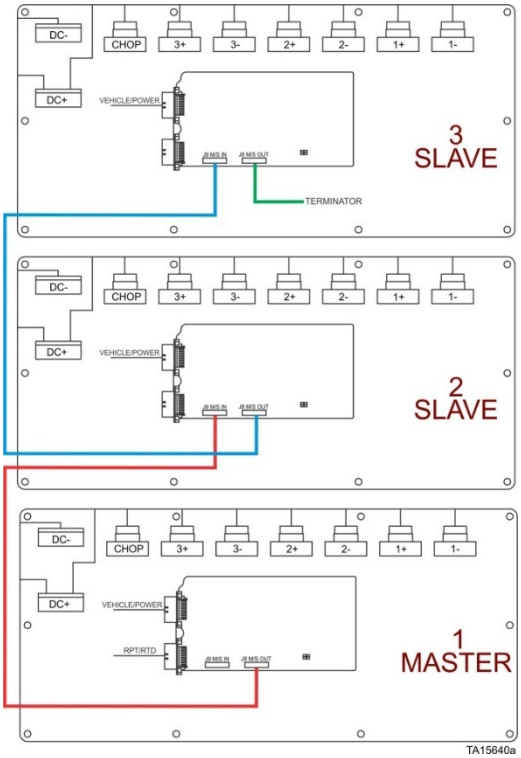


TA15640h

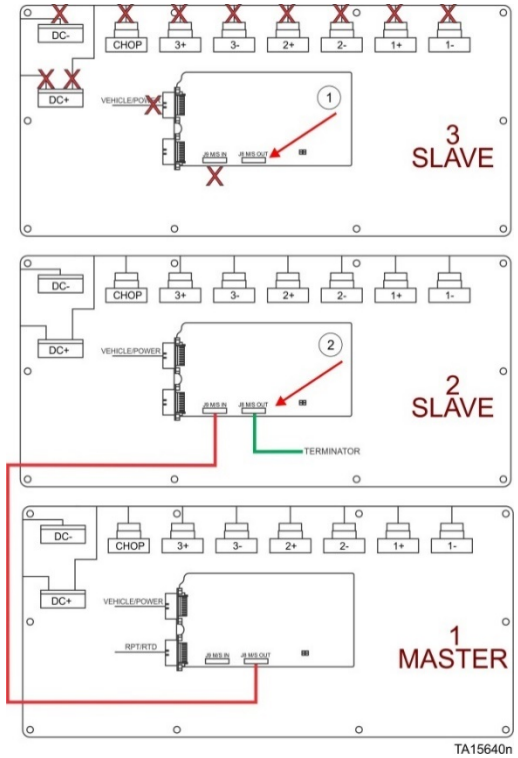
**Figure 115. SR control board – terminator cable**

# 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.**




TA15640a




TA15640n

| | |
|---|---|
| | **1)** Remove Terminator<br>**2)** Attach Terminator |
| **Original Connections** | **Isolated Slave Connections – Slave converter assembly is last converter assembly in drive** |

**Figure 116. Isolating terminating slave assembly**

# 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.**

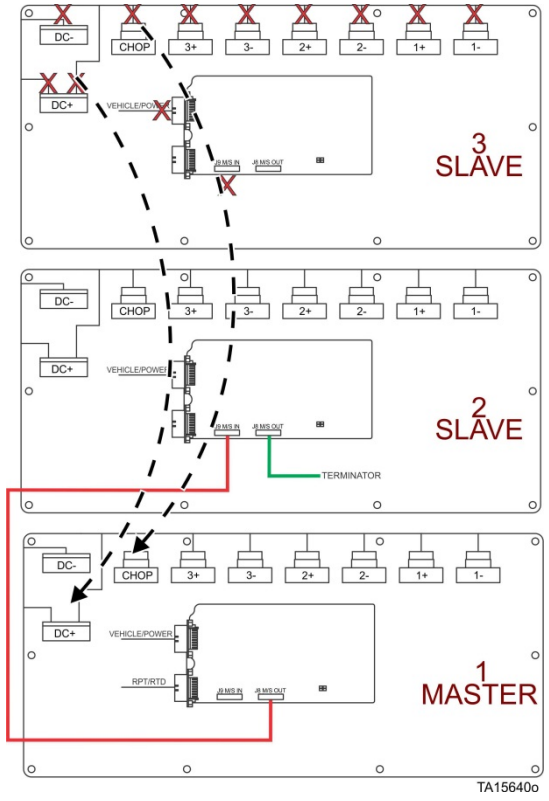
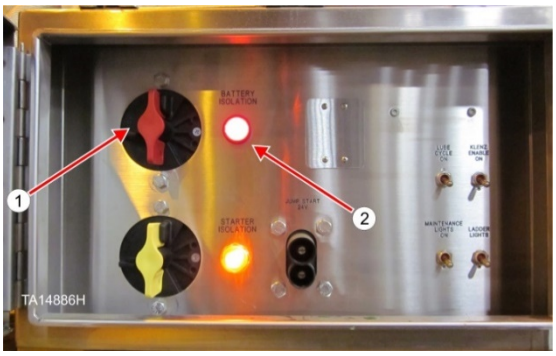



**Figure 117. L-1350 grid cable relocation**

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




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

**Figure 118. Isolation and control switch assembly**

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 119. 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.

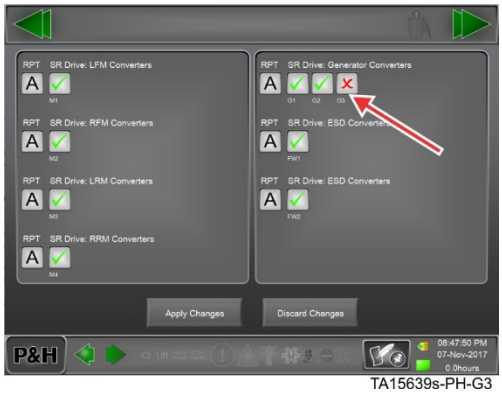



**Figure 120. LINCS drive configuration generator converter isolation (example)**

10. Select Apply Changes

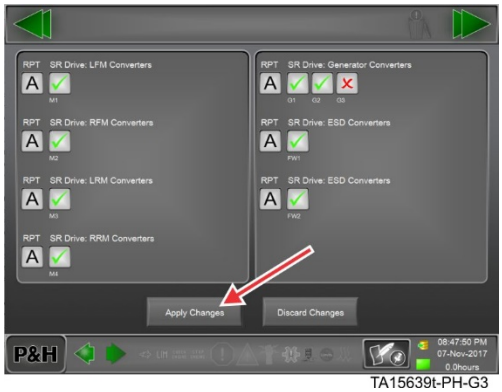



**Figure 121. LINCS drive configuration generator converter apply changes (example)**

11. Reboot LINCS.

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

# 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 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.

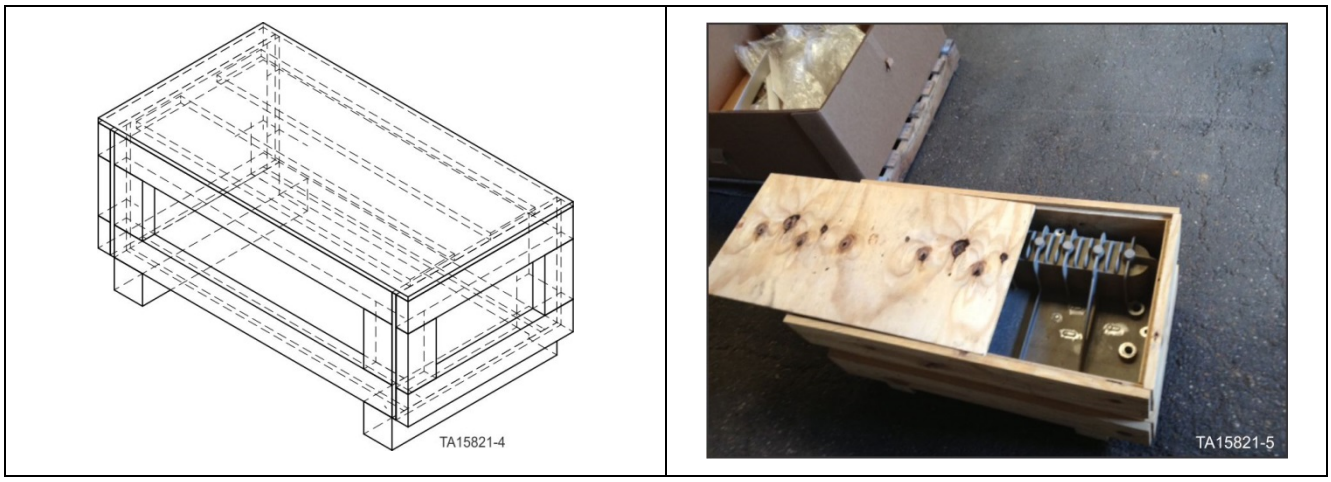



**Figure 122. Converter assembly transportation container**

## 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.**

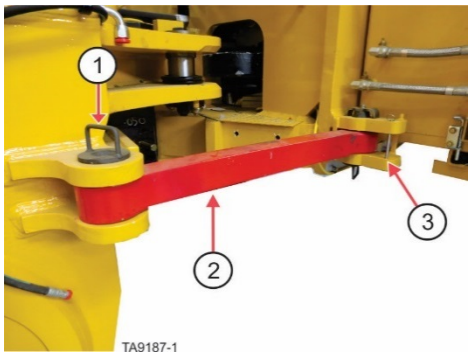
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 123. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

# 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 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.**

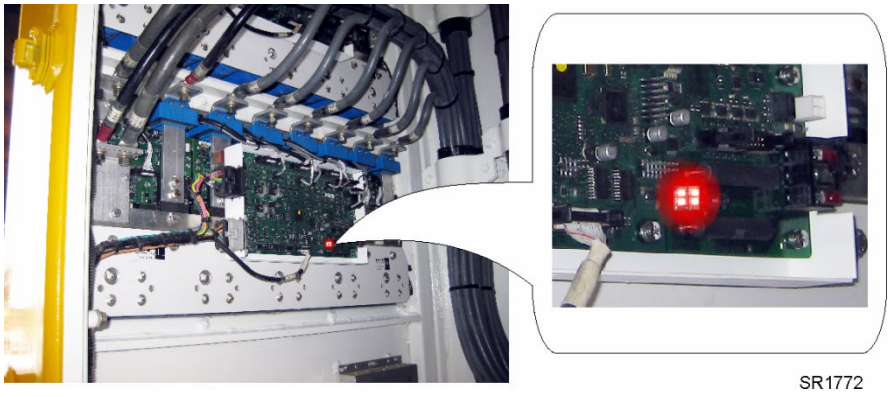



**Figure 124. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

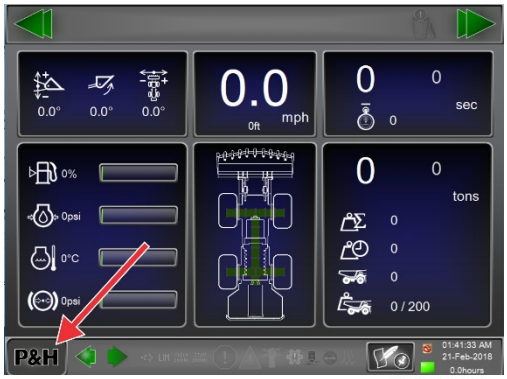
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

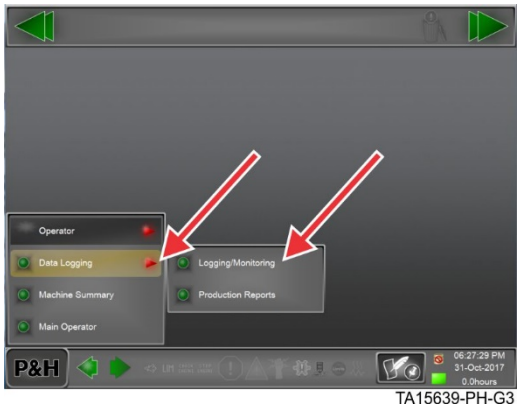
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.




**Main Menu Button**




**Data Logging & Logging/Monitoring**

**Figure 125. LINCS logging/monitoring menu access**

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

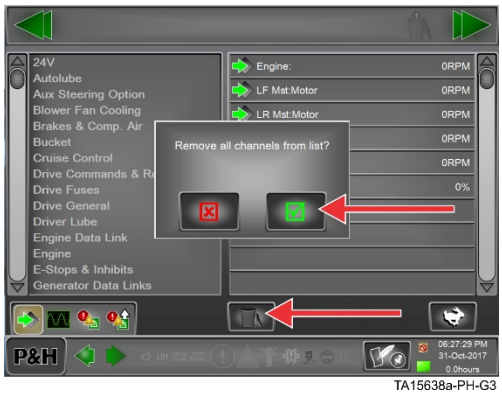



**Figure 126. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

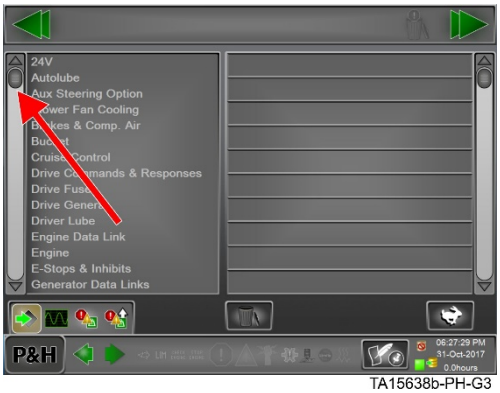



**Figure 127. Left hand scroll**

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

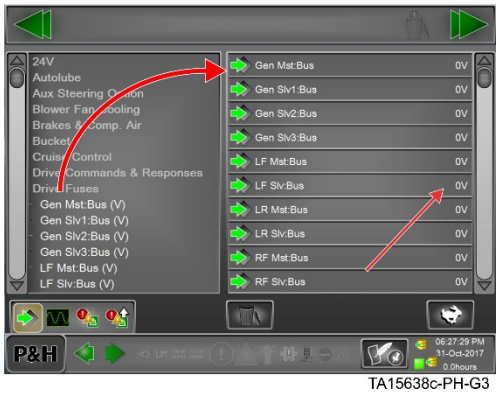



**Figure 128. Bus voltage indication**

6. 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.**

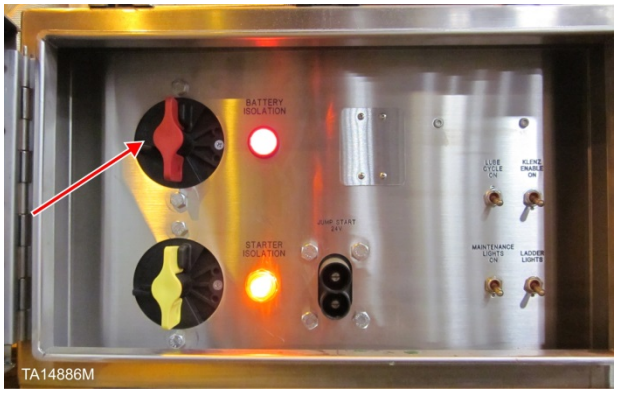
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 129. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

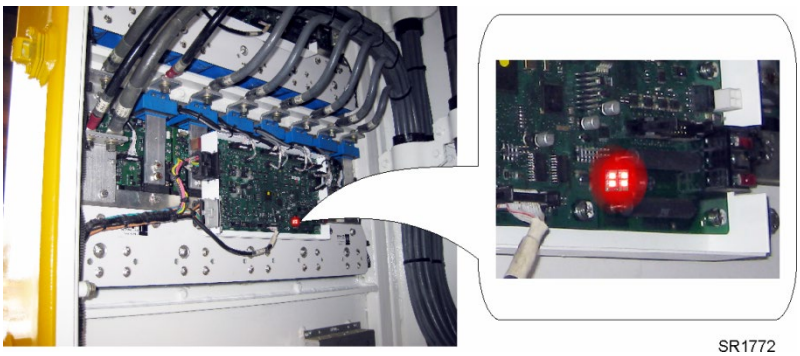



**Figure 130. Bus voltage LED array on SR control board**

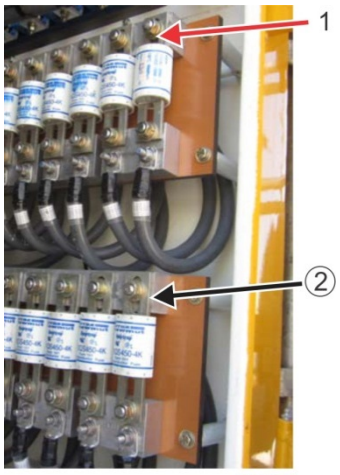
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 131. Main bus bars**

## 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.

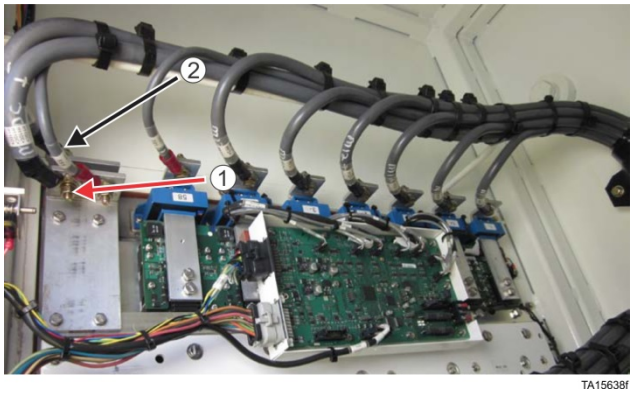
# NOTICE

**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.


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

**Figure 132. Converter assembly bus connections (rear of cabinet)**




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

**Figure 133. Converter assembly bus connections (front of cabinet)**

# 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 wrenchs is required to prevent improper directional torque on nuts/bolts. Not doing so could cause damage to converter components.**

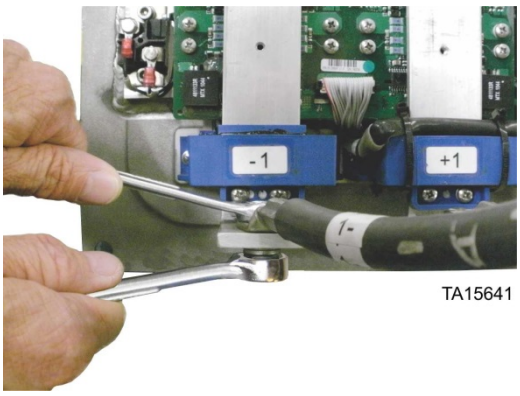



**Figure 134. Cable removal**

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

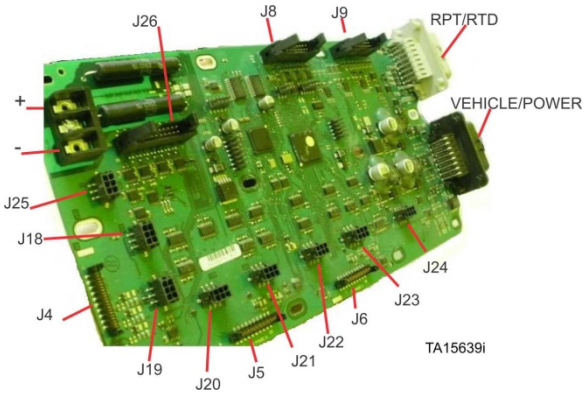



**Figure 135. SR control board connections**

## 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.


TA15641a

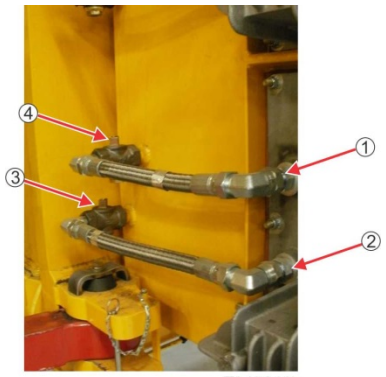
**Figure 136. Coolant supply valve**

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.



TA15641b

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

**Figure 137. Coolant lines**

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

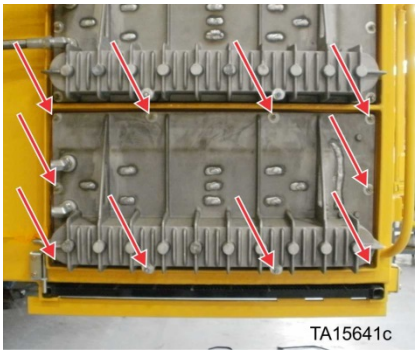



**Figure 138. Converter assembly outside bolts**

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 139. 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.

# 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

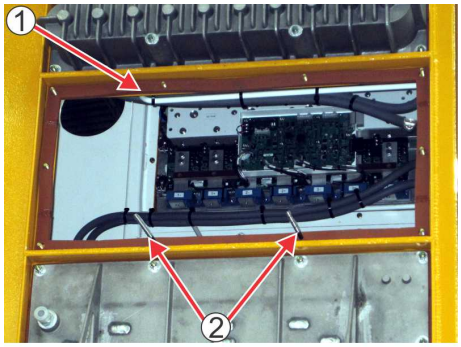
**A converter assembly weighs approximately 125 pounds (57kg). A crane or come-along can be used to assist in the removal or installation of the converter assembly. All safety precautions for using the tool must be observed.**

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.




TA15641e

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

**Figure 140. Gasket seal & guide rods**

3. Install nuts on outside of converter assembly.

4. Torque nuts to 8 ft-lbs (11 N-M) using proper sequence.

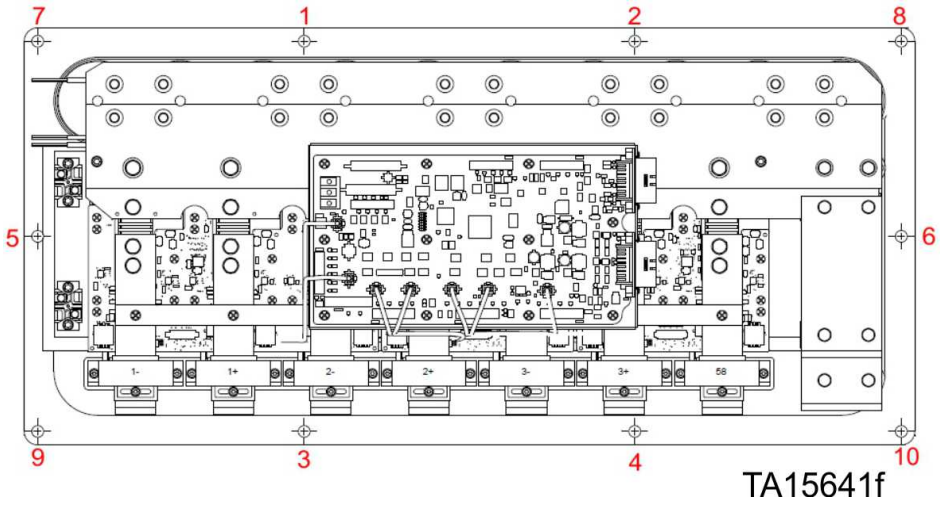


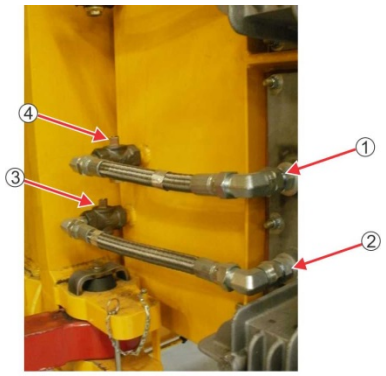

**Figure 141. Torque sequence**

# 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.




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

**Figure 142. Coolant lines (shown with valve on supply and return)**

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.

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

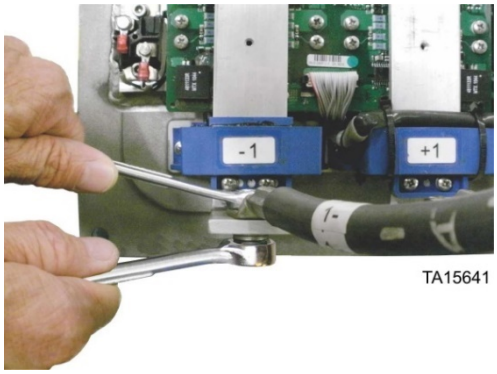
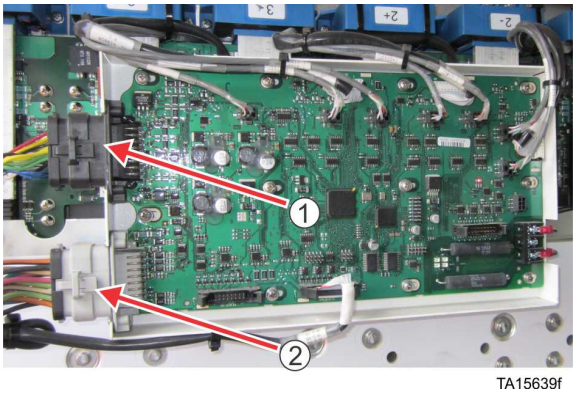



**Figure 143. Cable installation**

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




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

**Figure 144. Vehicle/power and RPT/RTP connectors**

14. Install cable to connector J-8.
15. Install cable connector/terminator into J-9 (if applicable).

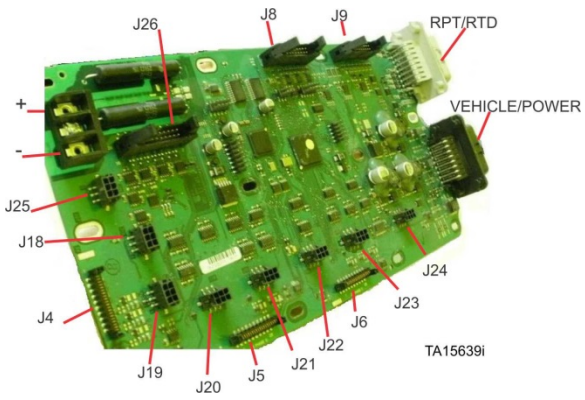



**Figure 145. SR control board connections**

# 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.

# 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.**

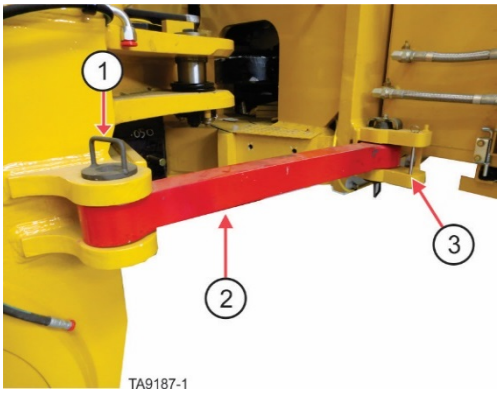
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 146. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

## 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 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.**

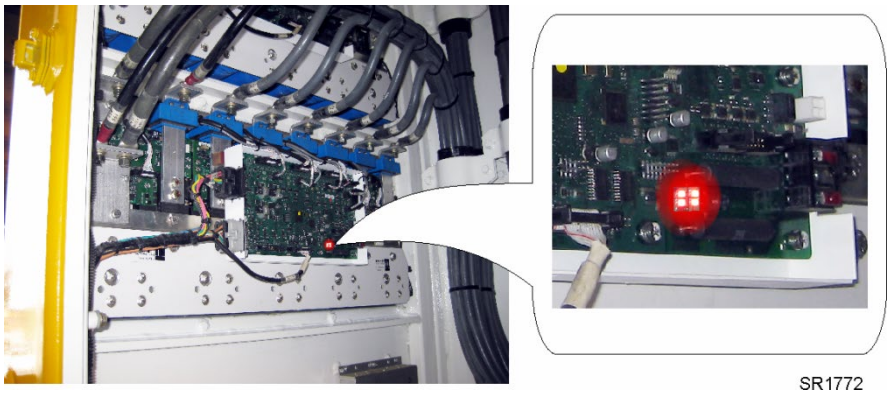



**Figure 147. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

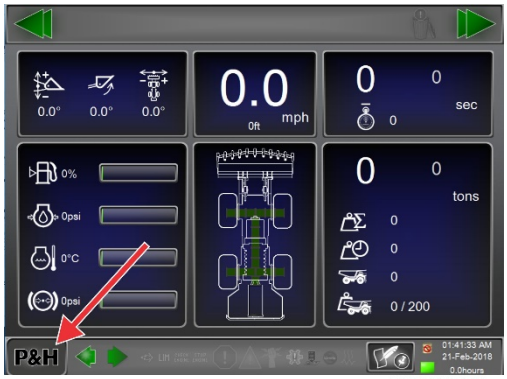
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

# In Cab Verification Using LINCS II Display

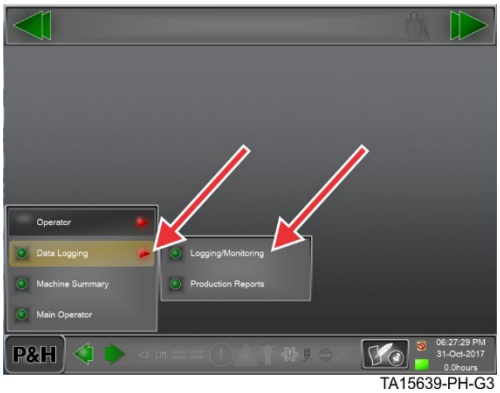
1. Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.



TA15638-PH-G3

**Main Menu Button**

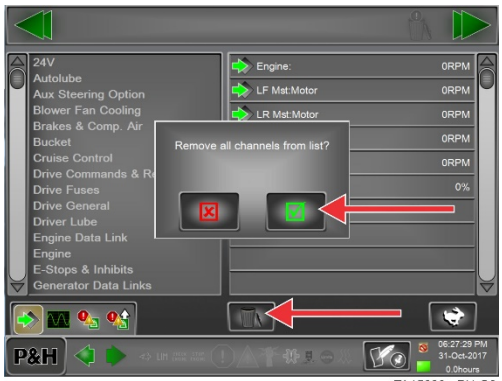


TA15639-PH-G3

**Data Logging & Logging/Monitoring**

**Figure 148. LINCS logging/monitoring menu access**

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



TA15638a-PH-G3

**Figure 149. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

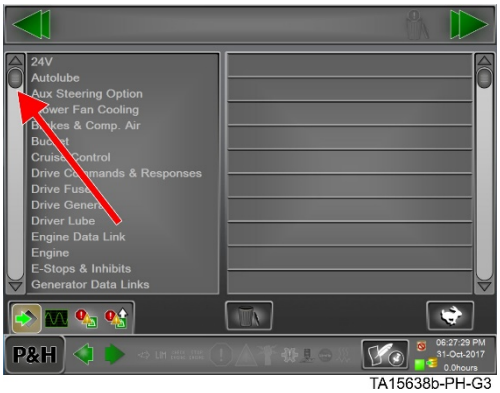



**Figure 150. Left hand scroll**

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

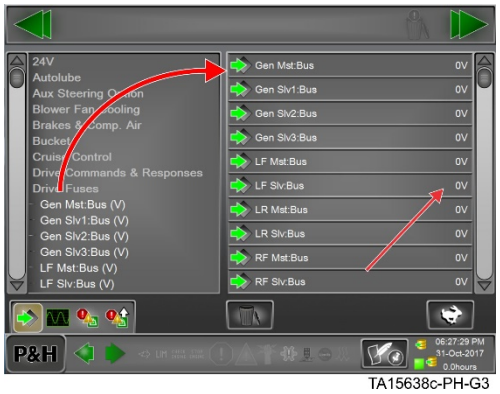



**Figure 151. Bus voltage indication**

6. 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.**

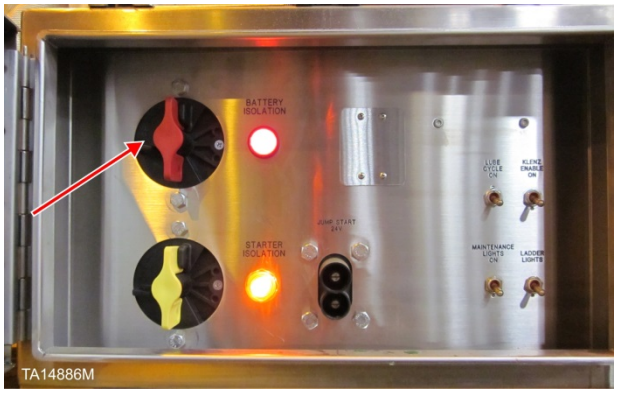
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 152. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

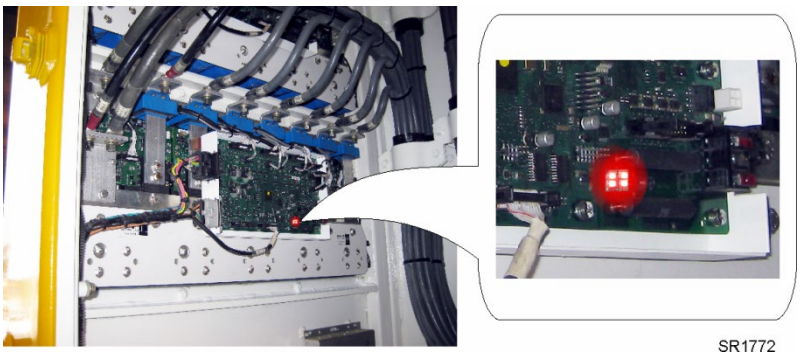



**Figure 153. Bus voltage LED array on SR control board**

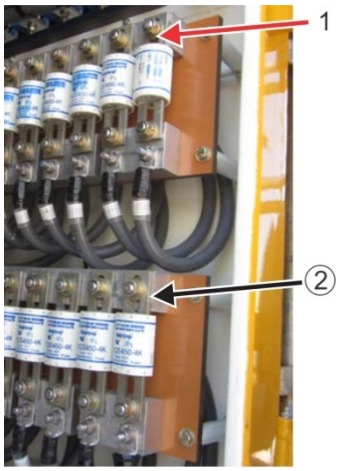
# Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 154. Main bus bars**

## 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.

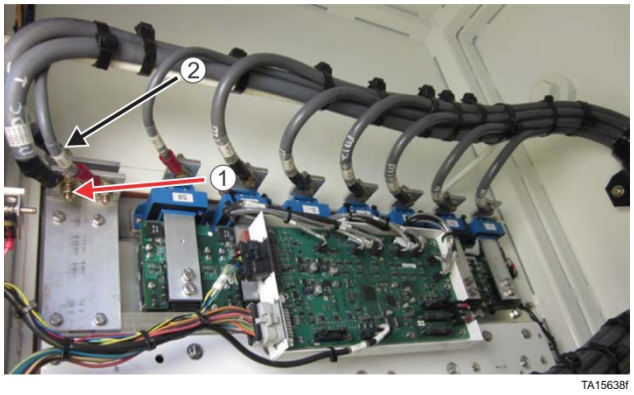
# NOTICE

**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.


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

**Figure 155. Converter assembly bus connections (rear of cabinet)**




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

**Figure 156. Converter assembly bus connections (front of cabinet)**

# Removing an SR Control Board

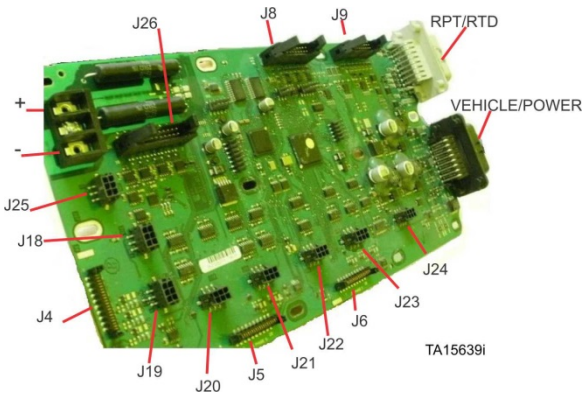



**Figure 157. SR control board connections**

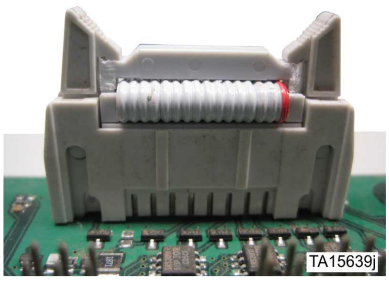
## NOTICE

**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.**



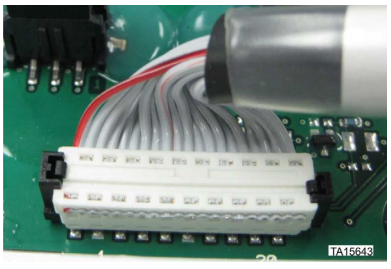
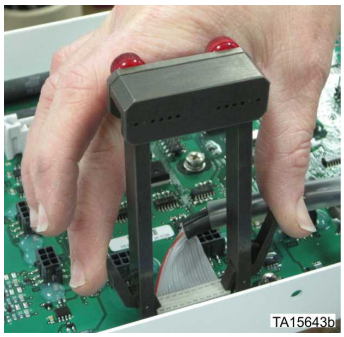
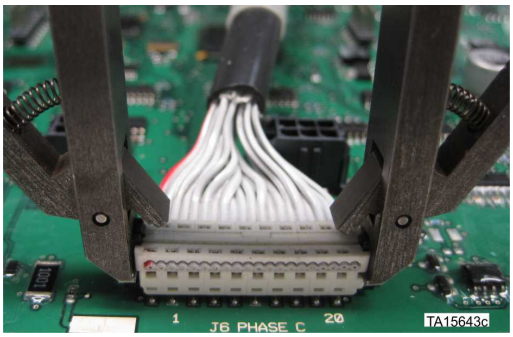




**Figure 158. Phase connectors**

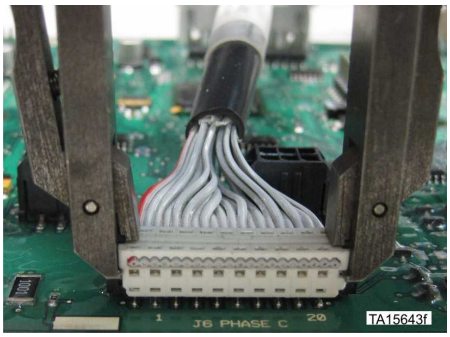
# CAUTION

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



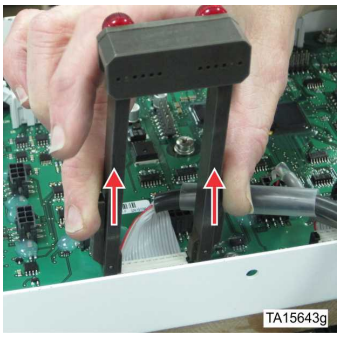
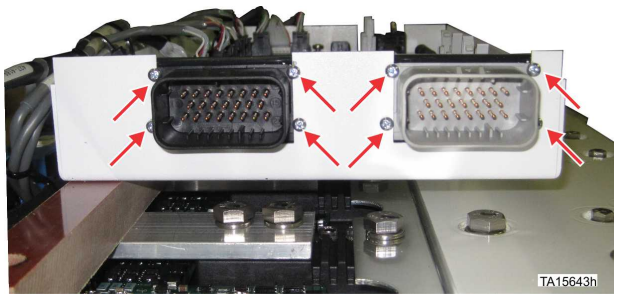




**Figure 159. Extractor tool use**

8. Remove mounting screws for RPT/RTD and Vehicle Power connectors.

9. Disconnect + and – terminals.



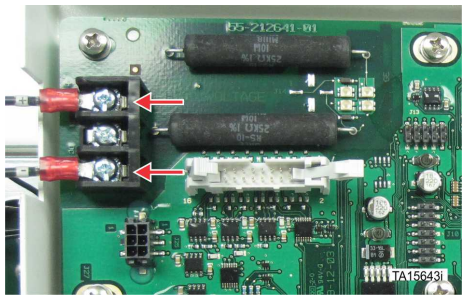




**Figure 160. Connector mounting and + / – terminal screws**

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

# 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.

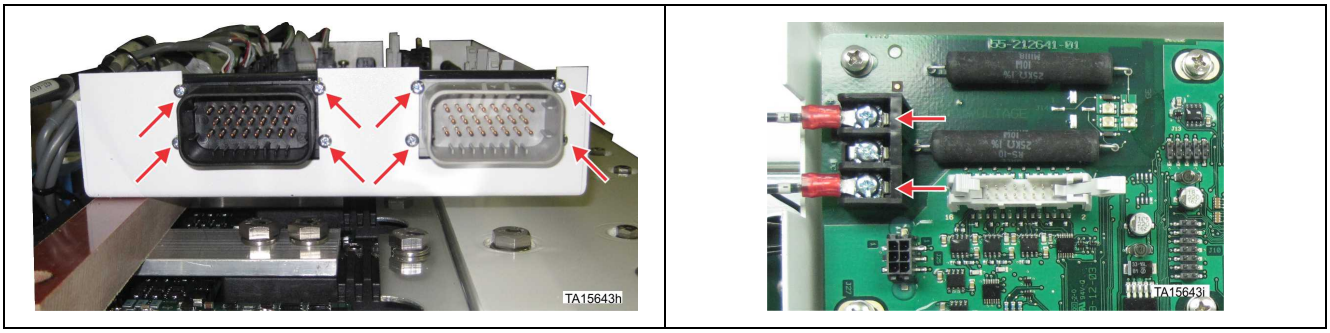



**Figure 161. Connector mounting and + / – terminal screws**

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

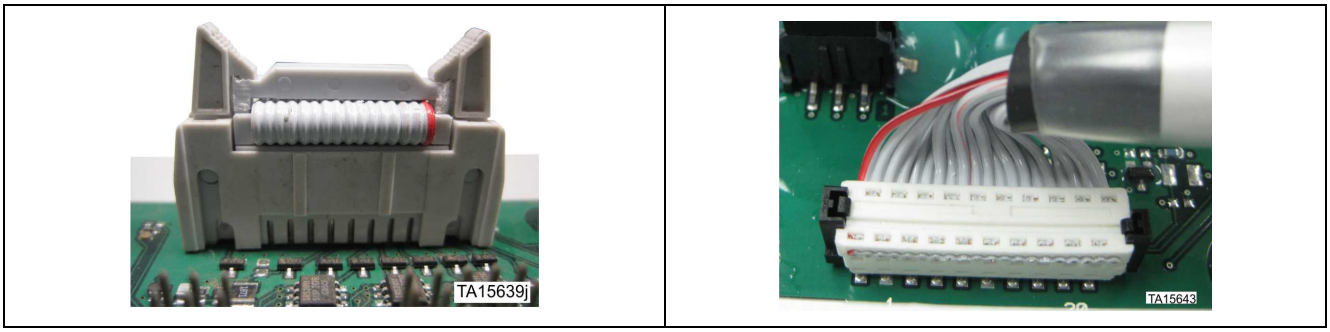



**Figure 162. Phase connectors**

5. Install connectors J18 through J24.

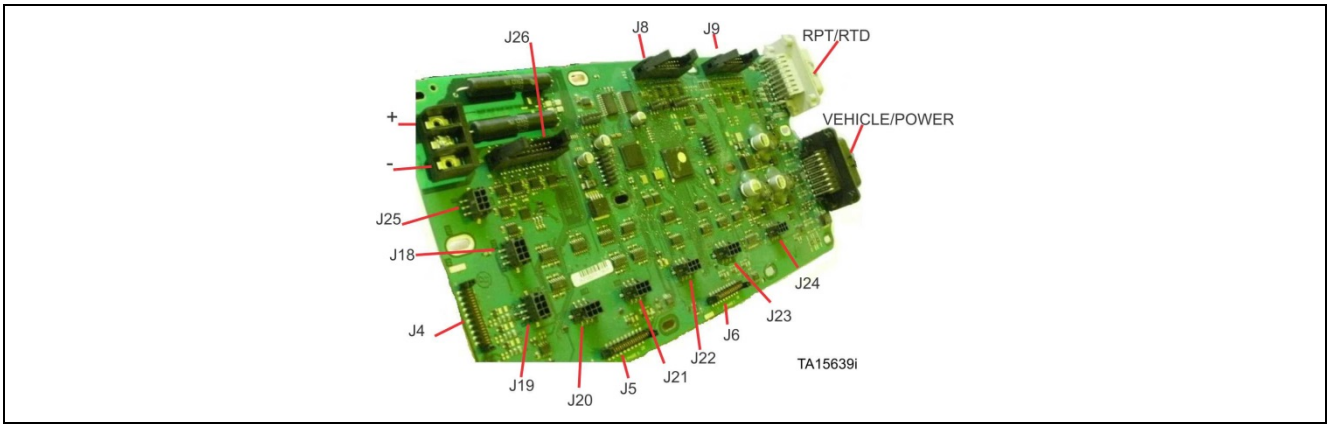



**Figure 163. SR Control board connections**

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.

# 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.

SR 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).

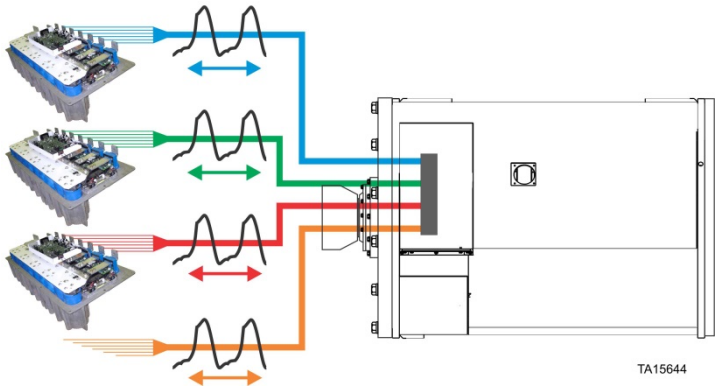



**Figure 164. Parallel panels for generators (qty varies depending on model)**

# 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 |
| Master/Slave Harness 71-1/4” | 425-9332 | 3 | 4 |
| Four Channel Oscilloscope<br>Specs: 4 Channel<br>Bandwidth 200 Mhz<br>Real Time Sample 2.5GS/s<br>1000V<br>Fluke 190-240 Series II or equivalent<br>  <br> | 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<br>Test Kit Contents:<br>2 ea. P/N 426-2070 Data Acquisition Boards<br>2 ea. P/N 425-9332 Master/Slave harnesses 71-1/4”<br>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.**

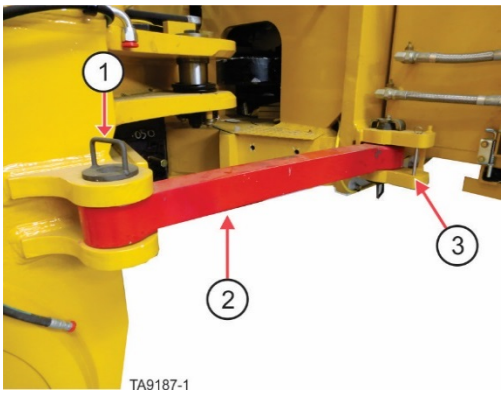
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 165. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

# 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 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.**

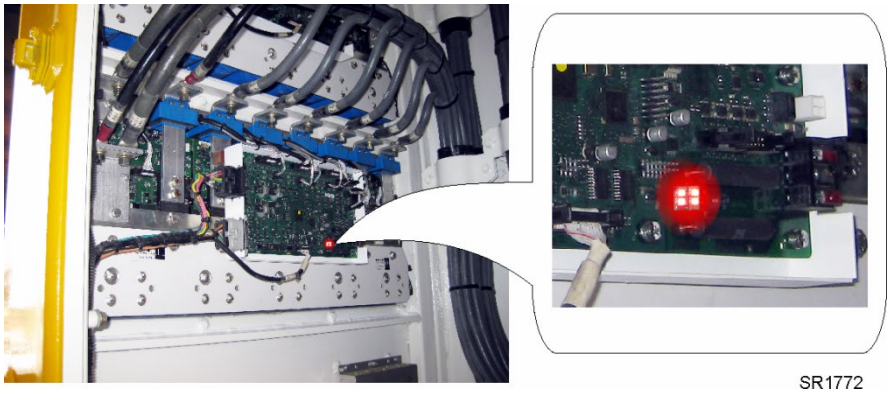



**Figure 166. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

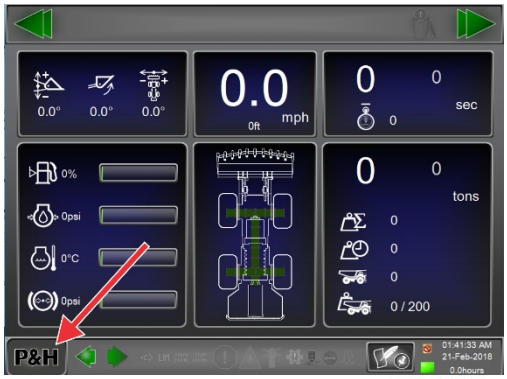
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

# In Cab Verification Using LINCS II Display

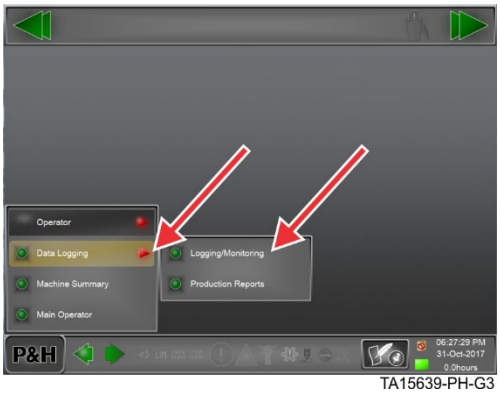
1. Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.



TA15638-PH-G3

**Main Menu Button**

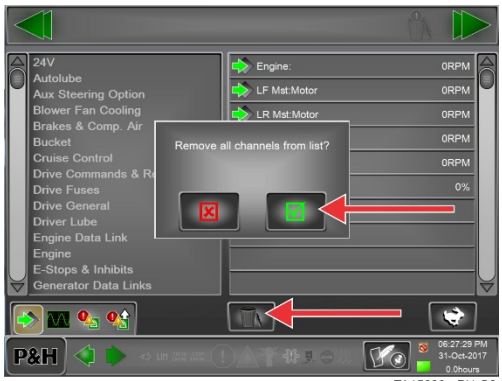


TA15639-PH-G3

**Data Logging & Logging/Monitoring**

**Figure 167. LINCS logging/monitoring menu access**

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



TA15638a-PH-G3

**Figure 168. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

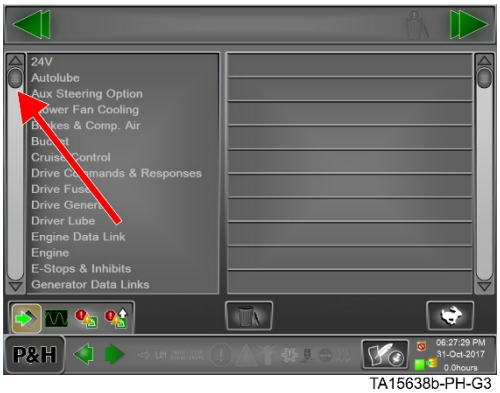



**Figure 169. Left hand scroll**

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

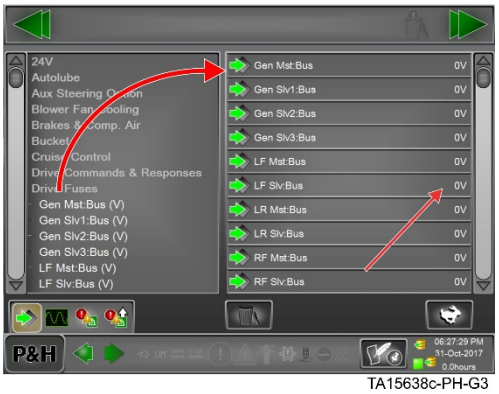



**Figure 170. Bus voltage indication**

6. 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.**

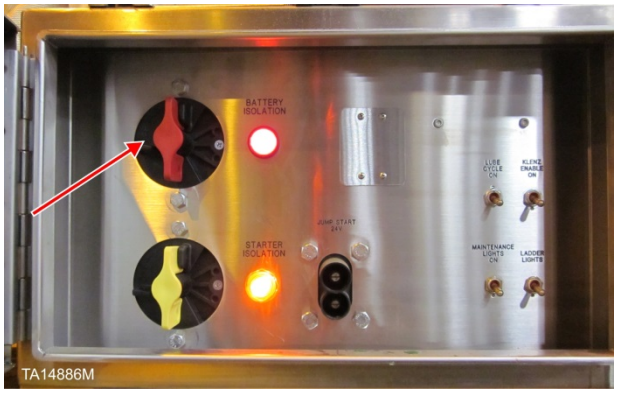
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 171. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

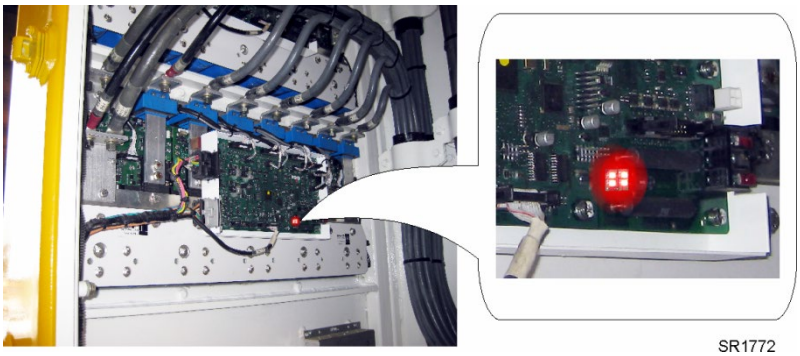



**Figure 172. Bus voltage LED array on SR control board**

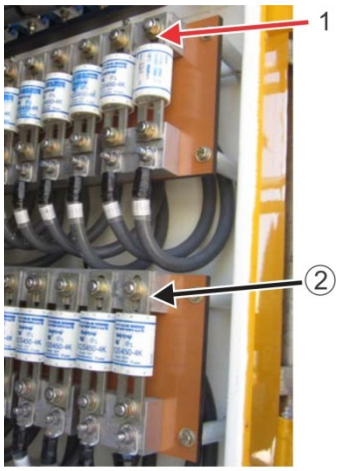
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 173. Main bus bars**

## 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.

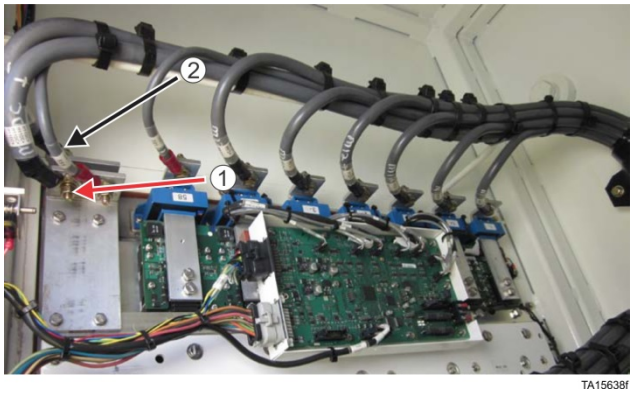
# NOTICE

**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.


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

**Figure 174. Converter assembly bus connections (rear of cabinet)**




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

**Figure 175. Converter assembly bus connections (front of cabinet)**

# Hardware Configuration

## NOTICE

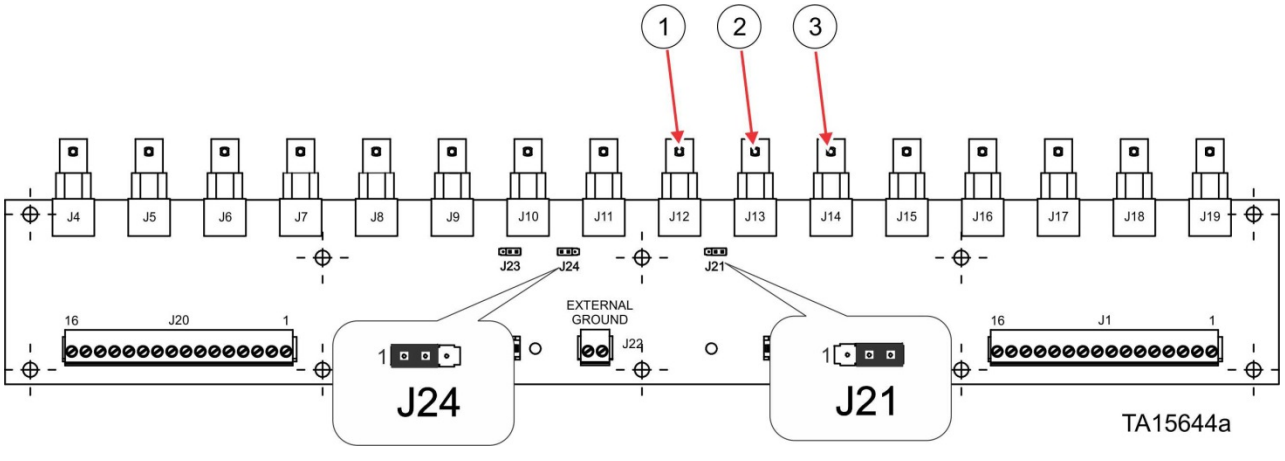
**The Master Converter Assembly is used as the primary trace and is compared to all the Slave Converter Assemblies with which it shares loads.**

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).**




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

**Figure 176. Data acquisition board jumpers and Phase connections**

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.**

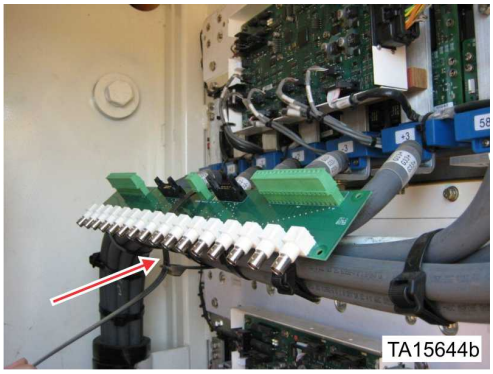



**Figure 177. Data acquisition board**

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

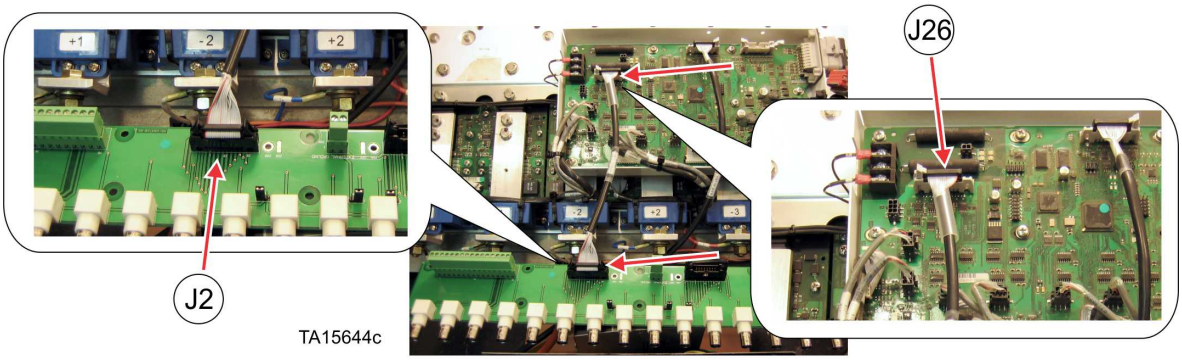



**Figure 178. Ribbon cable connection**

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.

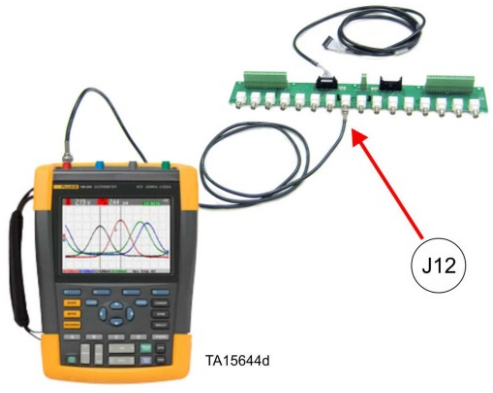



**Figure 179. Oscilloscope BNC connection (reference only)**

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.**

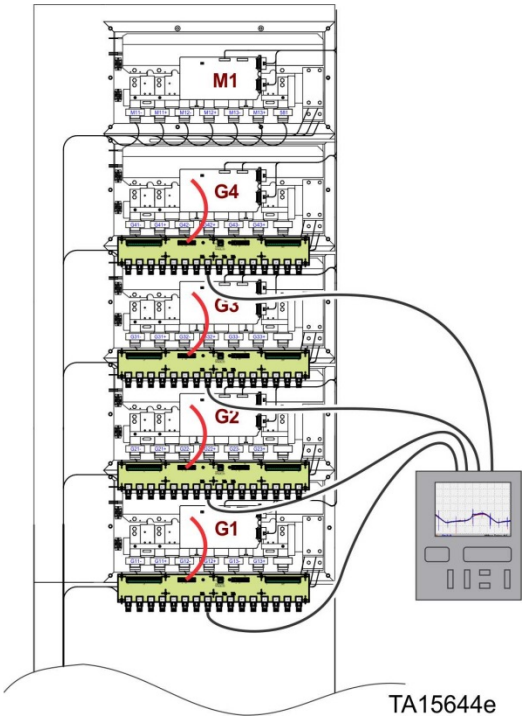



**Figure 180. Oscilloscope connection (L-1850/L-2350 depicted)**

# Oscilloscope Configuration

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


**Figure 181. Oscilloscope setup**

# Test Procedure

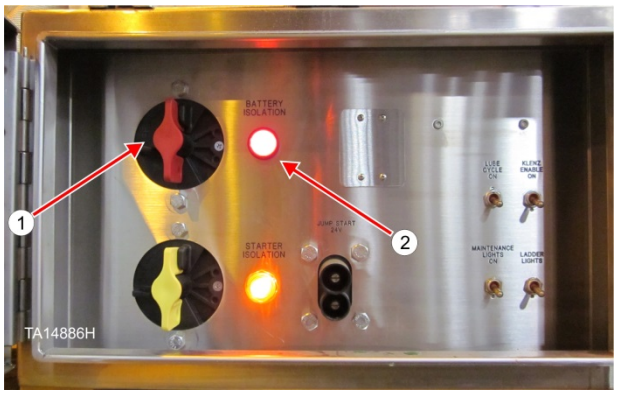
## CAUTION

**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 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).




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

**Figure 182. Isolation and control switch assembly**

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).


**Figure 183. Drive switch power button LED's illuminated**

5. Place the machine in Load Bank Mode.

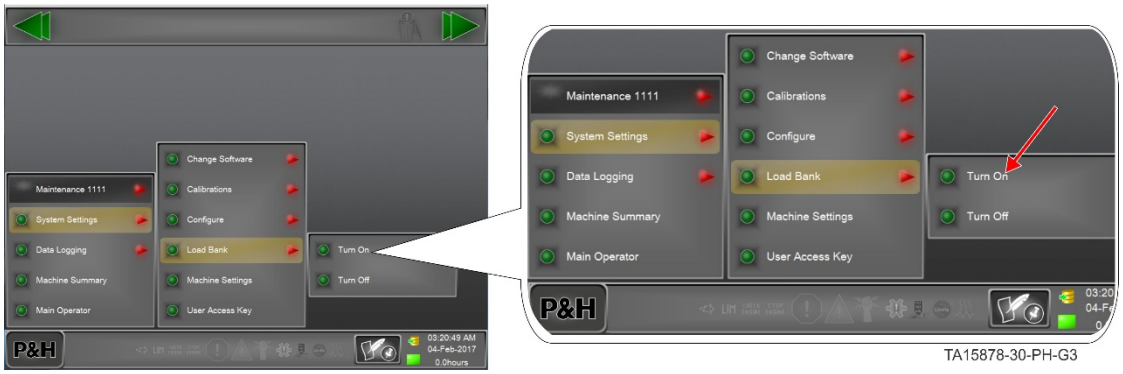



**Figure 184. Load bank mode select**

# 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.**

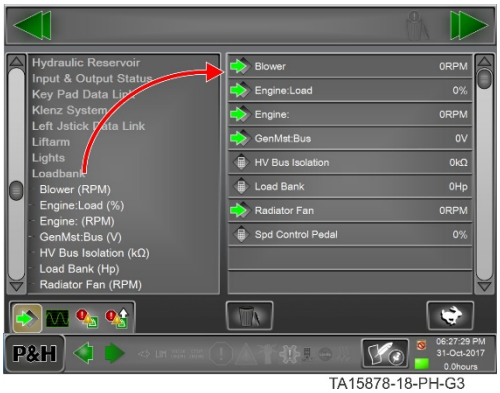



**Figure 185. Data logging – logging/monitoring menu**

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 186. Drive switch power button LED's off**

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.

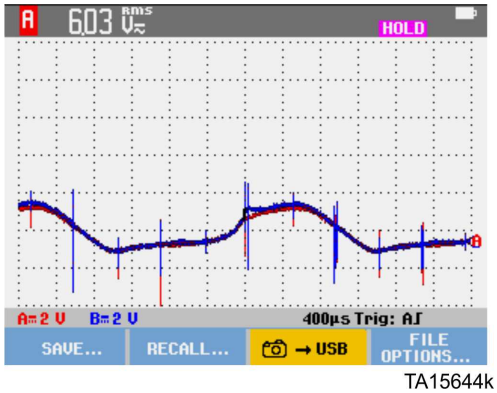



**Figure 187. Good waveforms**

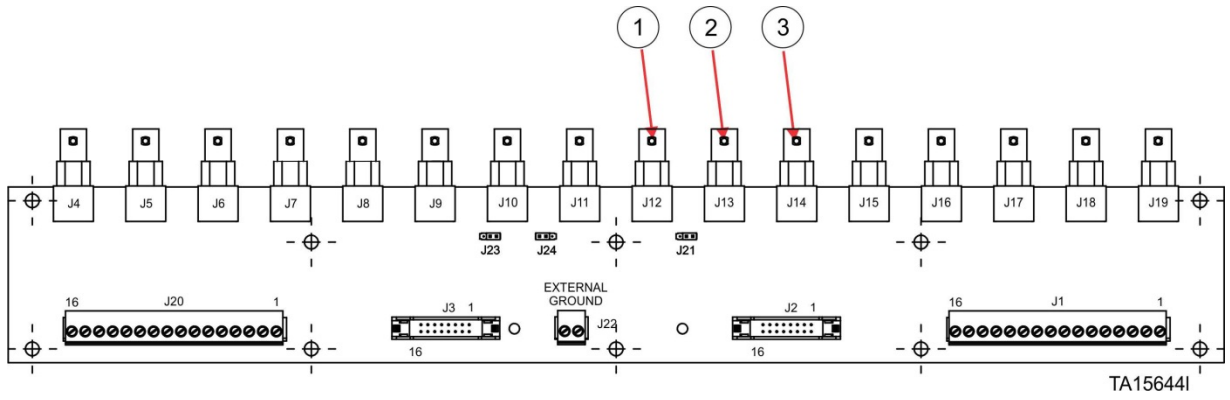
# NOTICE

**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 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).




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

**Figure 188. Phase connections on data acquisition board**

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 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 (1850/2350)

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.

All SR 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).

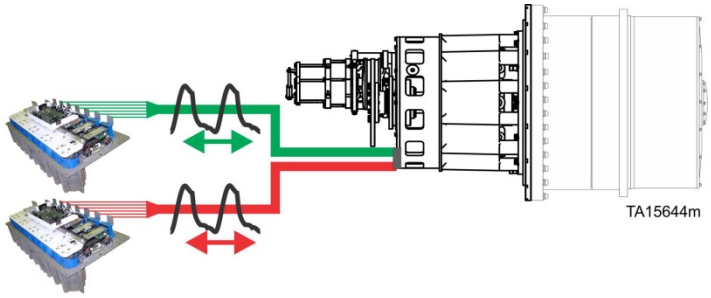



**Figure 189. Parallel panels for B60 motor**

## ⚠ 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 | |
|---|---|---|---|
| | | 1850 | 2350 |
| Data Acquisition Board | 426-2070 | 2 | 2 |
| BNC to BNC Cable 20ft | 427-4379 | 2 | 2 |
| Four Channel Oscilloscope<br>Specs: 4 Channel<br>Bandwidth 200 Mhz<br>Real Time Sample 2.5GS/s<br>1000V<br>Fluke 190-240 Series II or equivalent<br>  <br> | 427-4378 | 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 |
|---|---|---|
| | | 1850/2350 |
| Current Sharing Test Kit<br>Test Kit Contents:<br>2 ea. P/N 426-2070 Data Acquisition Boards<br>2 ea. P/N 425-9332 Master/Slave harnesses 71-1/4”<br>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.**

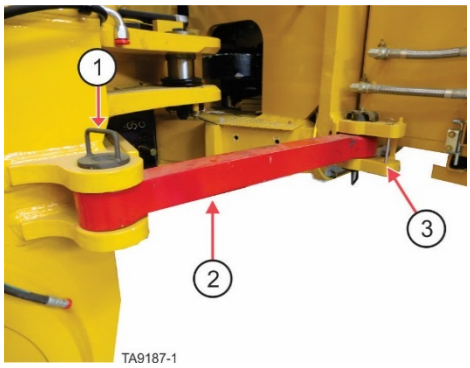
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 190. Frame Lock**

b. Set bucket flat and level on the ground.

c. Set the parking brakes.

# 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 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.**

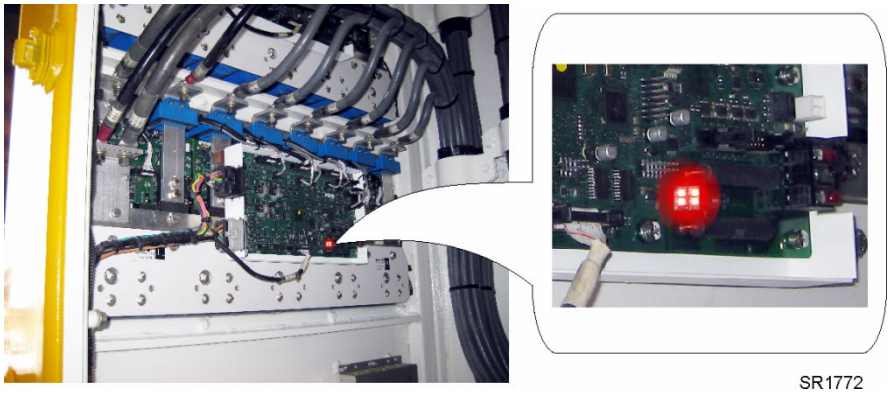



**Figure 191. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

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

All of these steps are required in order to assure that the system is properly discharged.

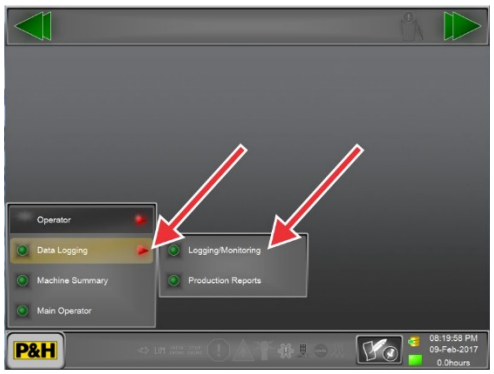
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.


TA15638-PH-G3

**Main Menu Button**

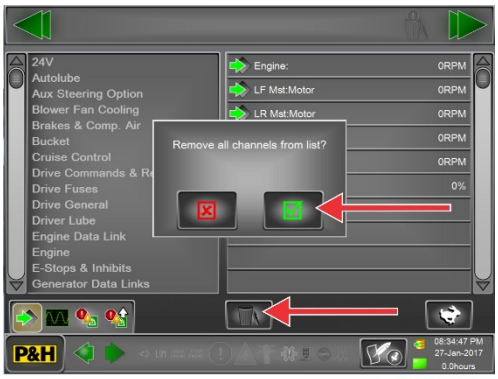



TA15639-PH

**Data Logging & Logging/Monitoring**

**Figure 192. LINCS logging/monitoring menu access**

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




TA15638a-PH

**Figure 193. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.


**Figure 194. Left hand scroll**

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

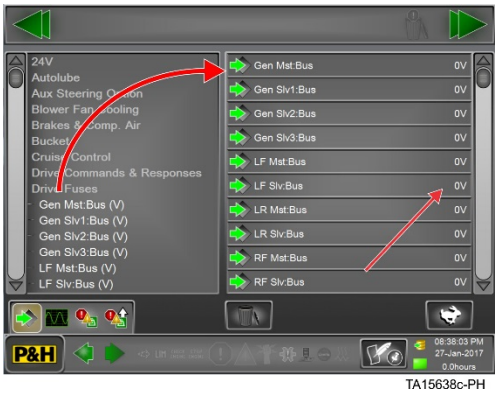



**Figure 195. Bus voltage indication**

6. 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.**

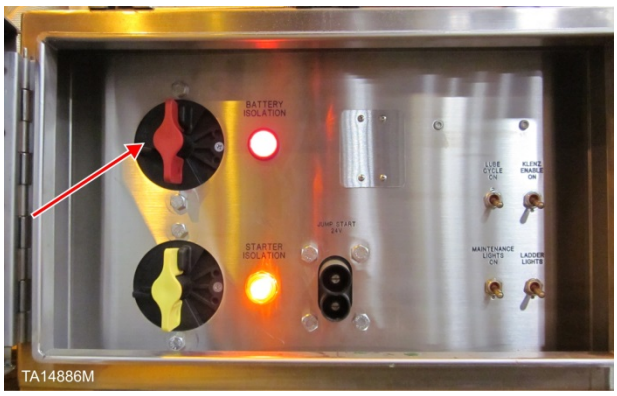
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 196. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

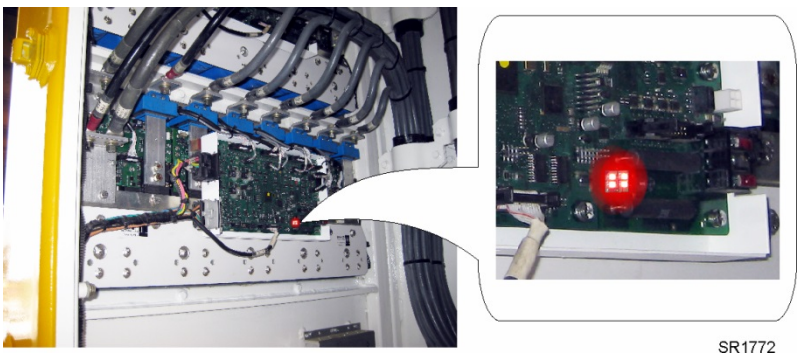



**Figure 197. Bus voltage LED array on SR control board**

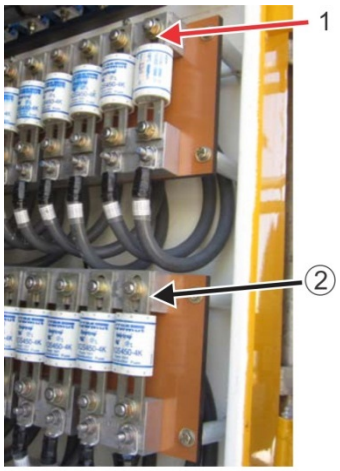
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 198. Main bus bars**

## 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.

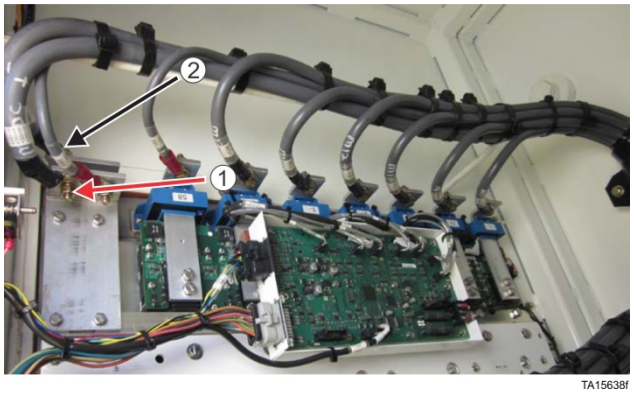
# NOTICE

**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.**

Conect 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.


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

**Figure 199. Converter assembly bus connections (rear of cabinet)**




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

**Figure 200. Converter assembly bus connections (front of cabinet)**

# Hardware Configuration

## NOTICE

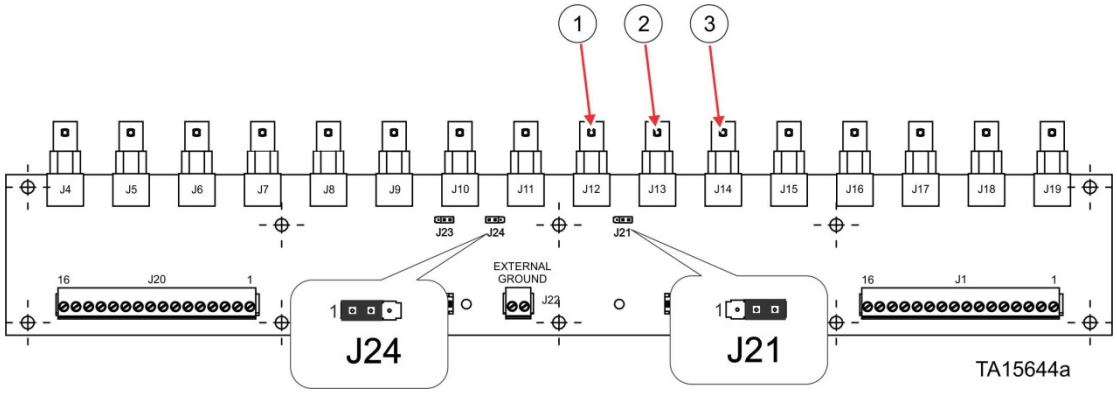
**The Master Converter Assembly is used as the primary trace and is compared to all the Slave Converter Assemblies with which it shares loads.**

6. 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.**




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

**Figure 201. Data acquisition board jumpers and Phase connections**

7. 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.**

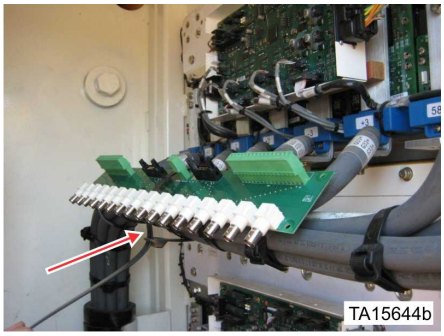



**Figure 202. Data acquisition board**

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

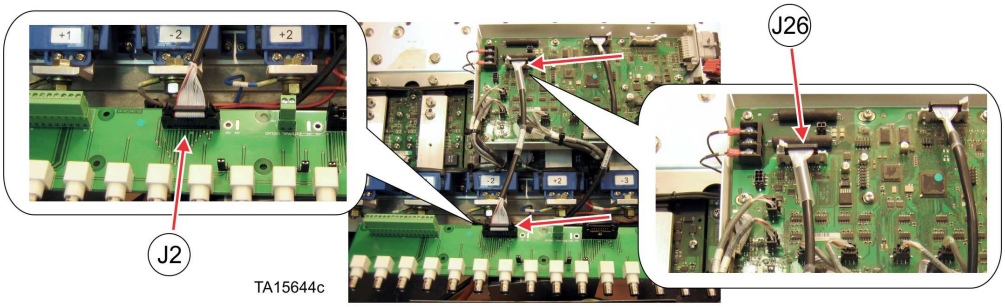



**Figure 203. Ribbon cable connection**

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

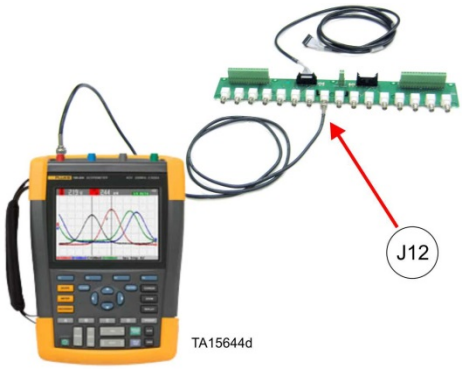



**Figure 204. Oscilloscope BNC connection (reference only)**

10. 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.**

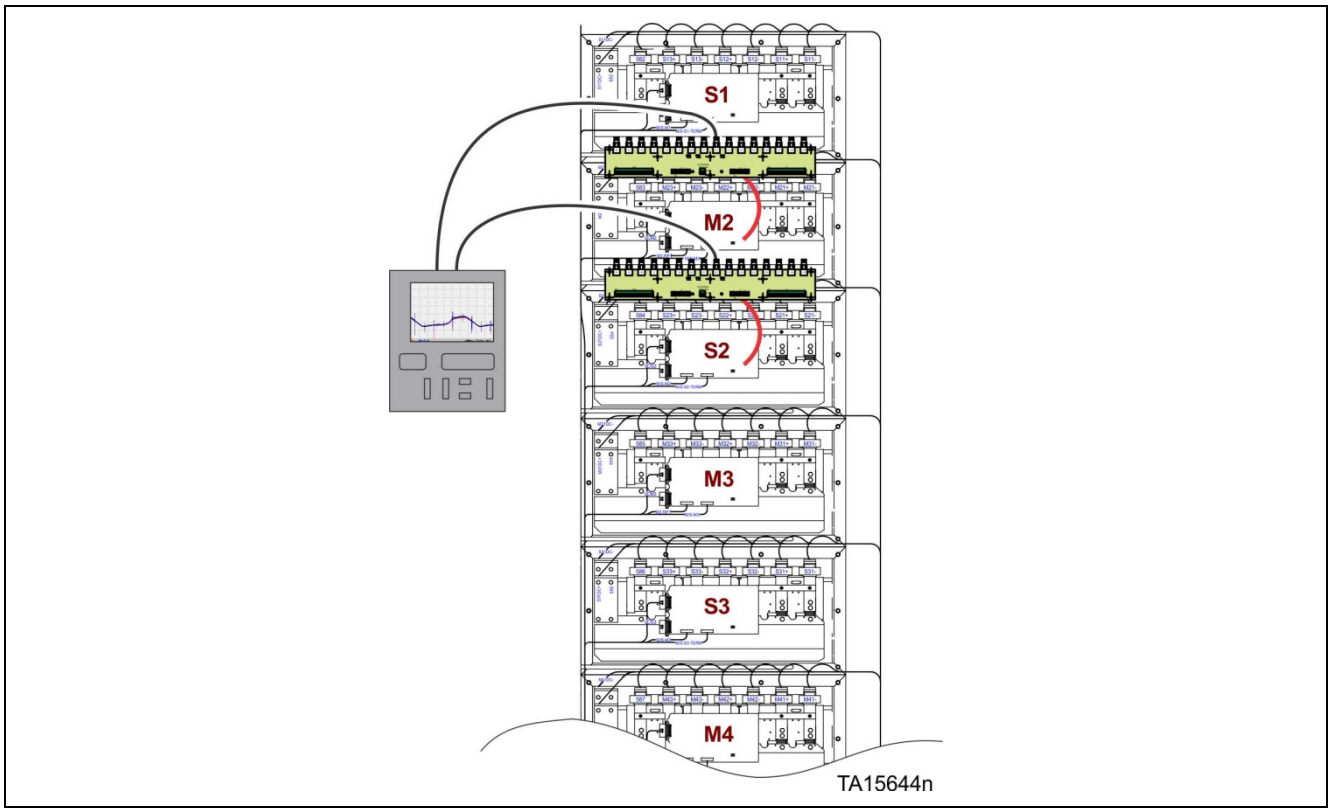



**Figure 205. Oscilloscope connection**

# Oscilloscope Configuration

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

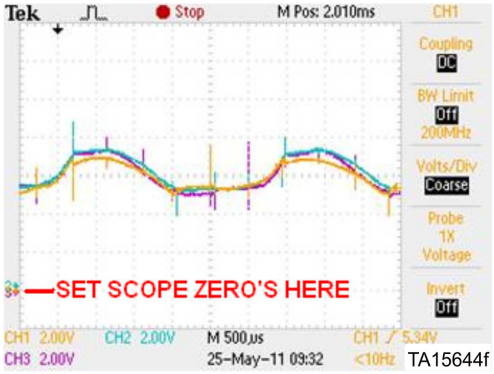



**Figure 206. Oscilloscope setup**

# 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 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.**

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).


**Figure 207. Drive switch power button LED's illuminated**

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.

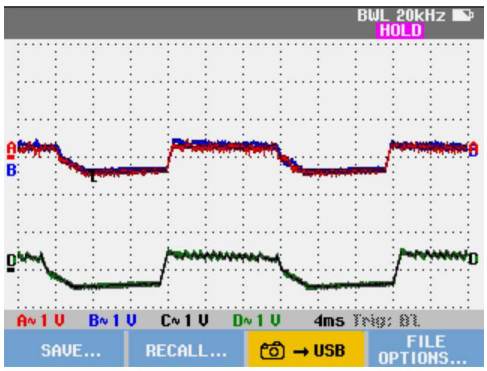



**Figure 208. Good waveforms**

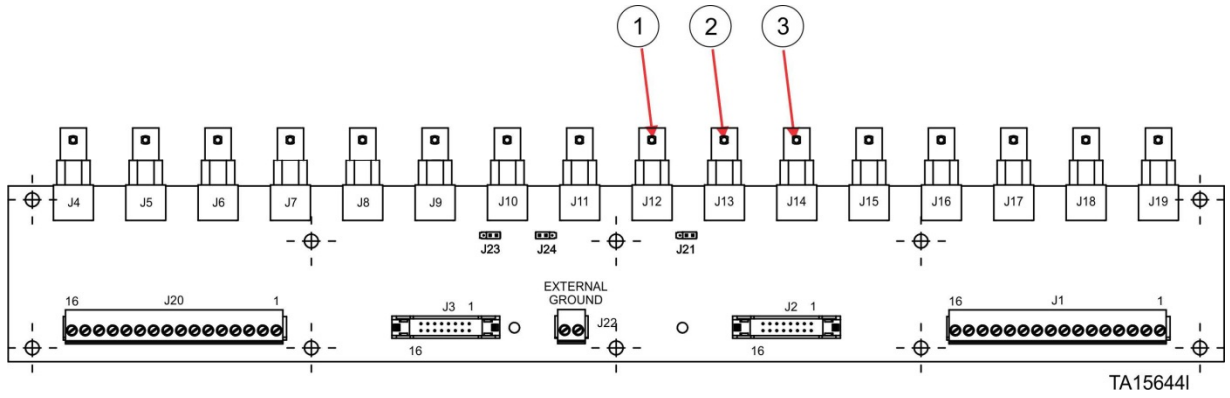
# NOTICE

**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.**

## ⚠ 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 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).




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

**Figure 209. Phase connections on data acquisition board**

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 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.**

# 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.

## CAUTION

**Operation of the machine on less than four wheel motors or with any of the converter panels disabled will result in:**

- **the electric (dynamic) braking being reduced**
- **reduced tractive power when digging**
- **longer stopping distance when using dynamic braking**
- **higher risk for overspeed on grades.**

If the wheel motor or converter panel has been isolated using the proper procedure, the operators panel will display a small illuminated gray gear cog (Drive System Abnormal icon) as shown. 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.


TA16126-PH-G3

**Drive System Abnormal Icon**

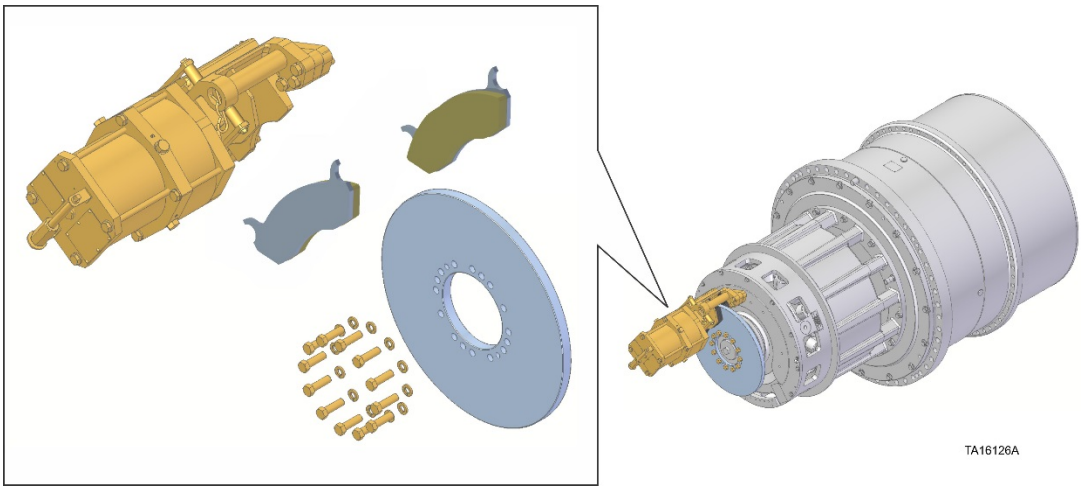
## Service Brakes

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:

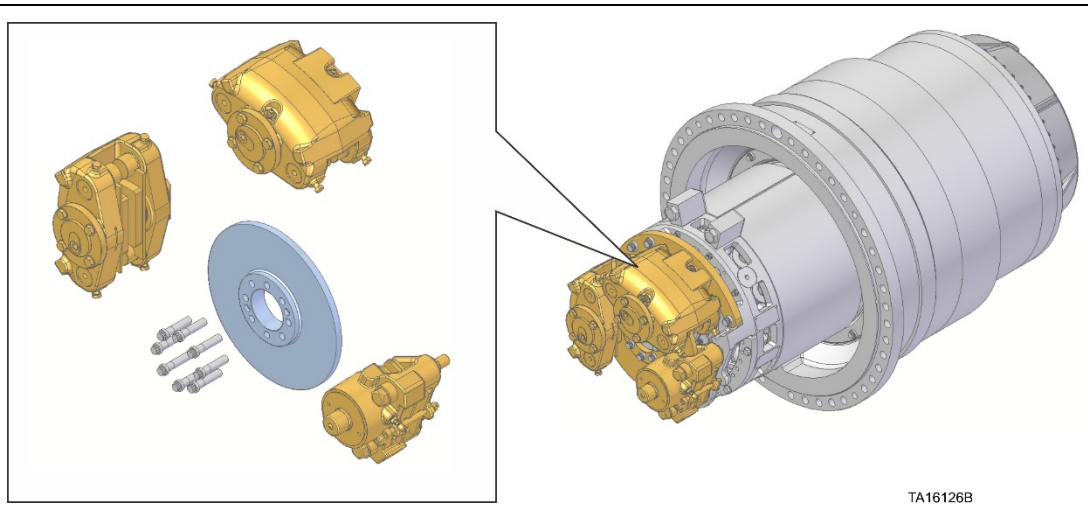
- The traction motor must be installed
- The traction motor or driver cannot be altered in any fashion
- Middle pinion on 57” driver cannot be removed

# CAUTION

**Operation of the machine on less than 4 service brakes should only be done 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 4 service brakes. The service brakes must be maintained and working properly – disk in spec, pads in spec, gap in spec, pressures in spec, no leaks, etc.**




**Example 1: B-60 on 57” Driver**




**Example 2: B-9 on 29” Driver**

# Overspeed Prevention Recommendations

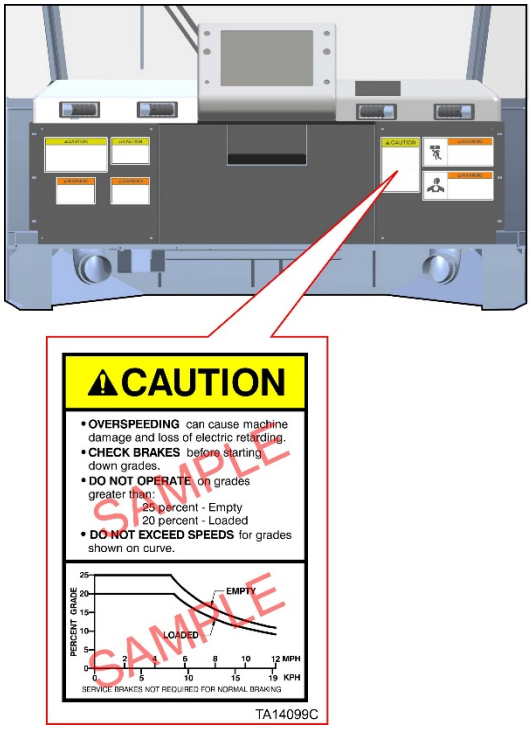
**a.** Each machine has a grade/speed chart that indicates the dynamic retarding limits of that machine when going down a grade. When either converter panels or motors have been disabled - the speed going down a grade should be reduced to prevent a runaway situation.

**b.** 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”).

**c.** Reduce speed PRIOR to descending a grade.

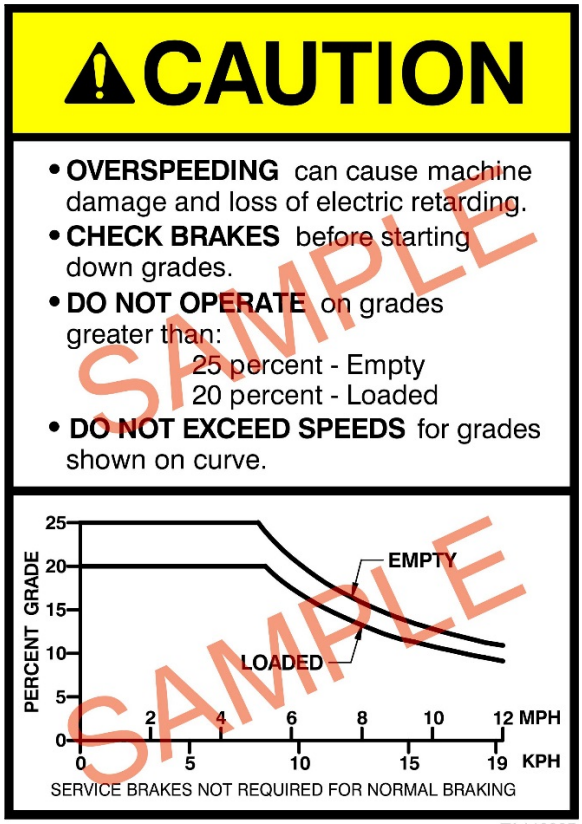
**d.** As a general rule, descend a grade no faster than what the machine will ascend the same grade with the same load.

**e.** Promptly apply service brakes to slow the machine if an overspeed situation occurs.




**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.**




**Typical grade/speed chart**

# Safety Preparations Frame

## ⚠ 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.**

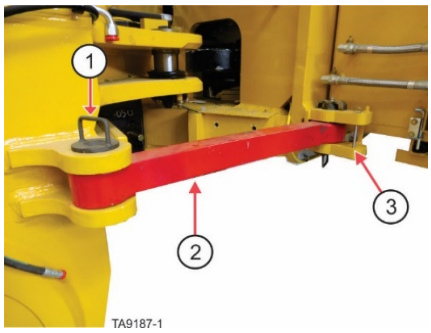
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 210. Frame lock in locked position**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

# Isolating the Wheel Motor (software)

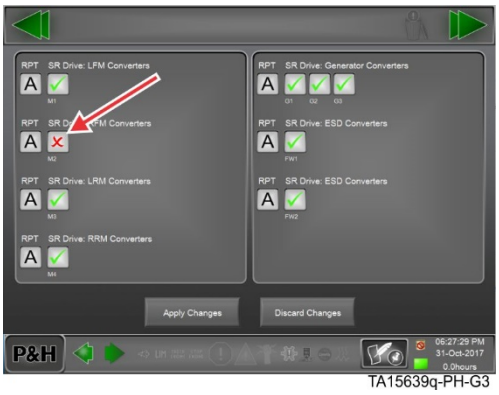
1. In LINCS, log on with a Maintenance key (or higher).

2. Navigate to the System Settings >Configure >Drives screen.


**Figure 211. 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



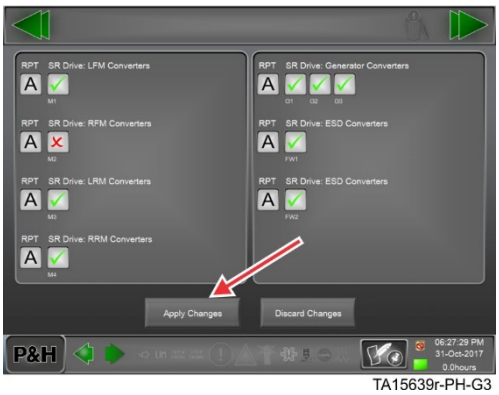




**Figure 212. Drive select**

# Safety Preparations Electrical

## 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 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.**

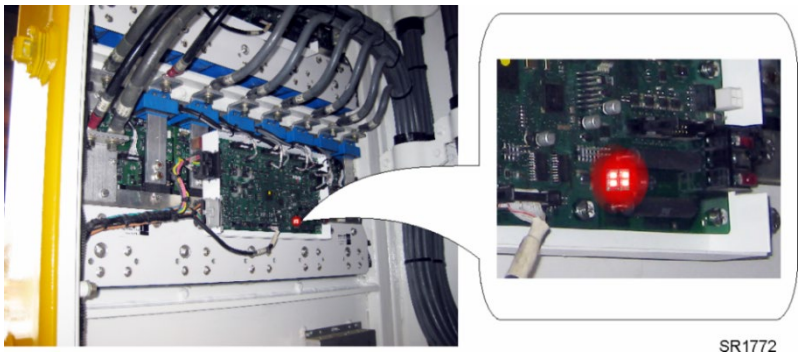



**Figure 213. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

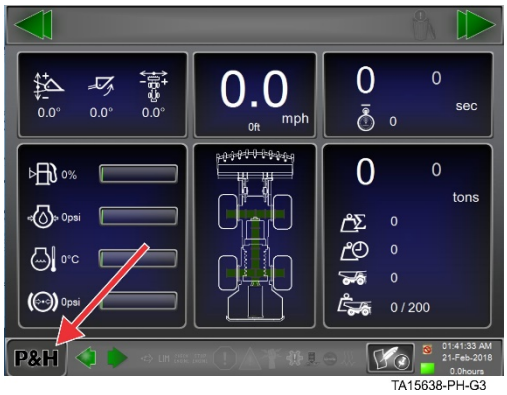
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

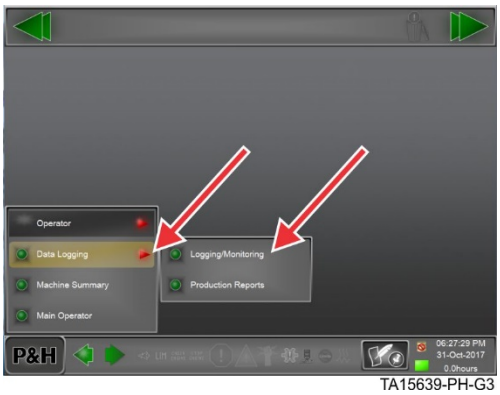
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.




**Main Menu Button**




**Data Logging & Logging/Monitoring**

**Figure 214. LINCS logging/monitoring menu access**

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

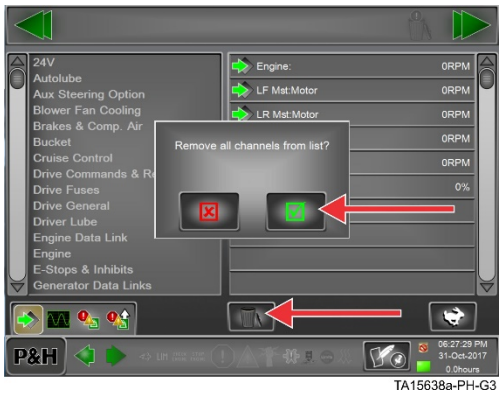



**Figure 215. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

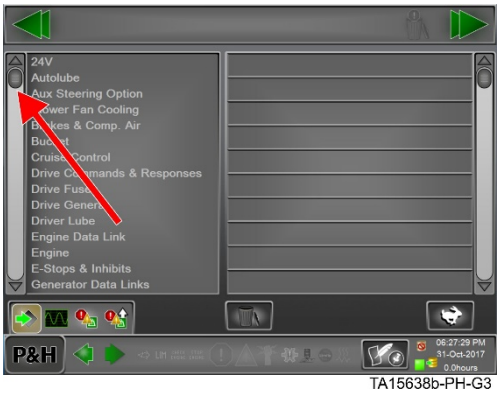



**Figure 216. Left hand scroll**

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

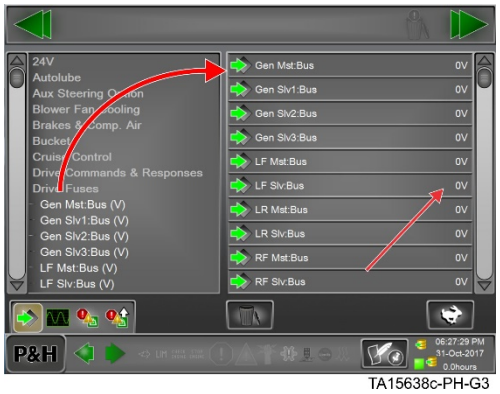



**Figure 217. Bus voltage indication**

6. 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.**

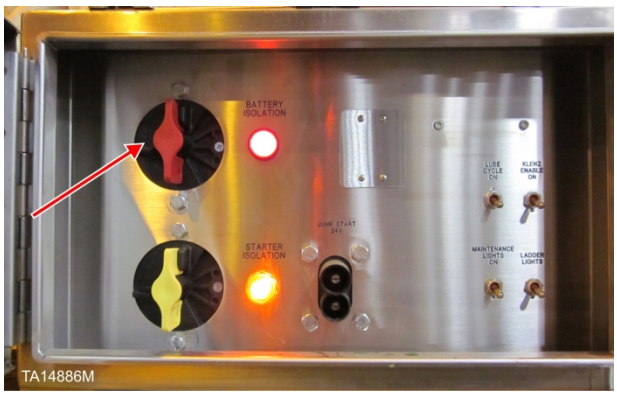
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 218. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

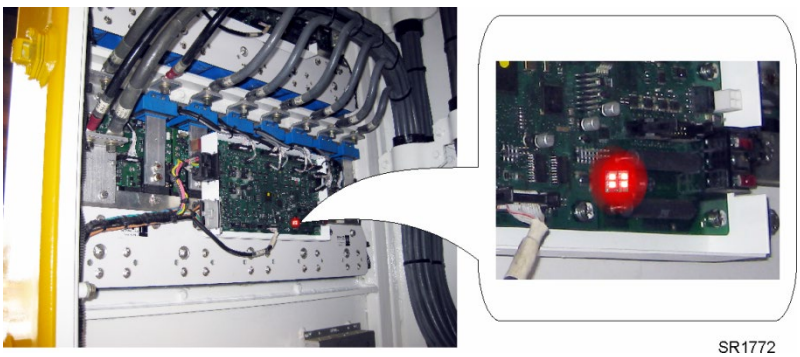



**Figure 219. Bus voltage LED array on SR control board**

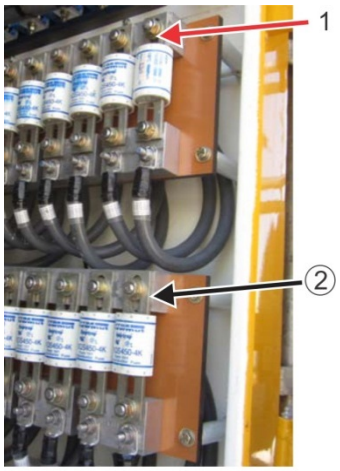
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 220. Main bus bars**

## 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.

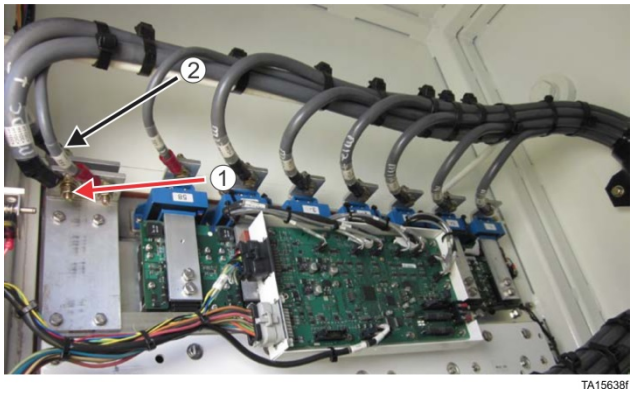
# NOTICE

**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.


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

**Figure 221. Converter assembly bus connections (rear of cabinet)**



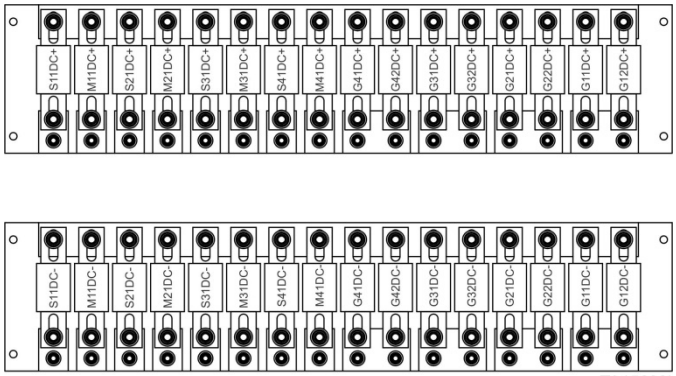

**1)** Positive bus bar, **2)** Negative bus bar

**Figure 222. Converter assembly bus connections (front of cabinet)**

# Isolating the Wheel Motor (Hardware)

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

TA15639b



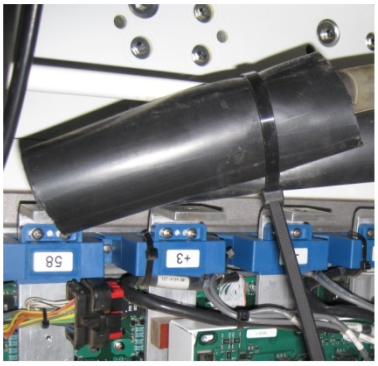

TA15639l

**Figure 223. Fuse assemblies (L-2350 shown)**

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

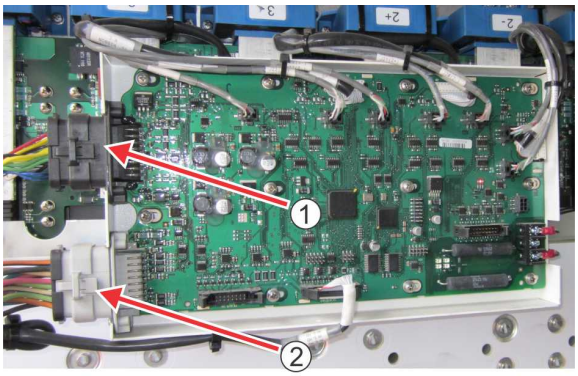
**Motor leads will be disconnected in the appropriate axle. Do not remove from converter assemblies.**




TA15639a

**Figure 224. Grid cable (58) isolation**

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




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

**Figure 225. Vehicle/power and RPT/RTP connectors**

4. Remove the appropriate axle cover.

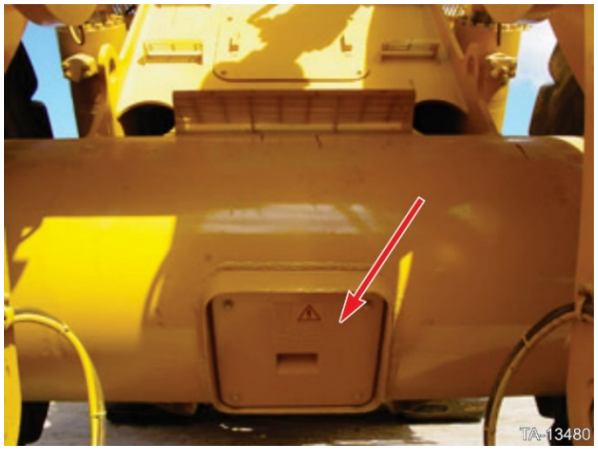



**Figure 226. Axle cover (front axle shown)**

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


**Figure 227. 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.**

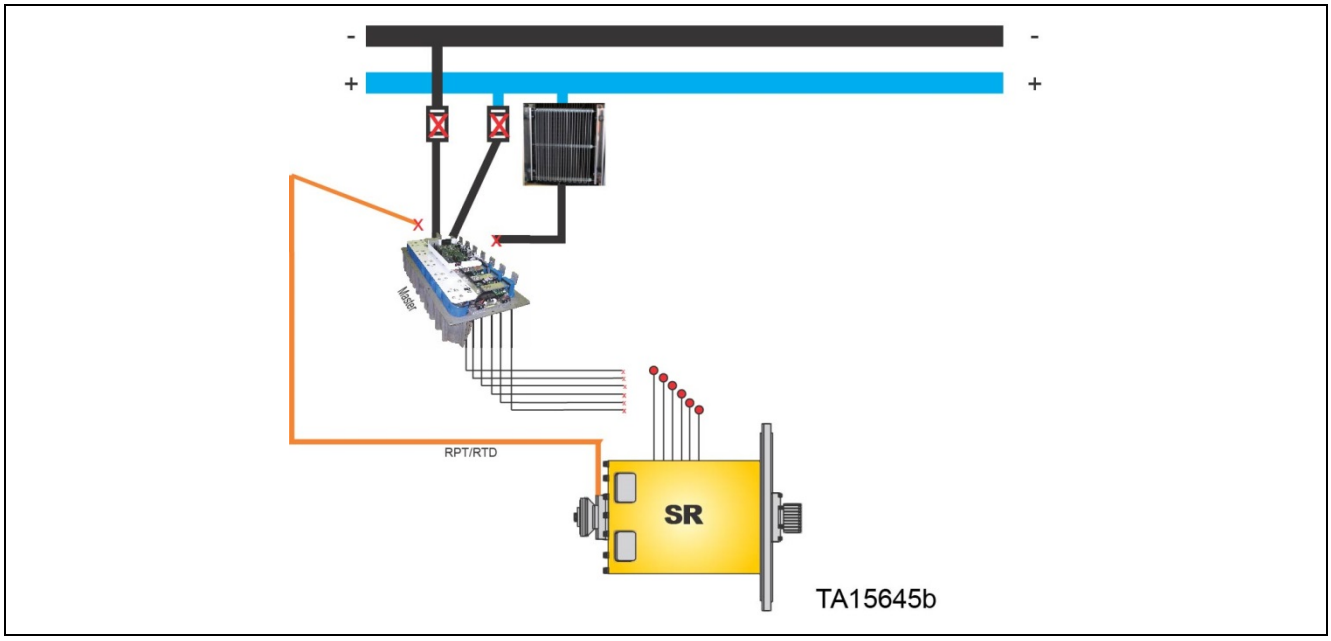



**Figure 228. Motor isolation**

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.

# Fuse Replacement Procedure

This procedure should be used when removing/replacing the DC bus fuses on a SR 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.**

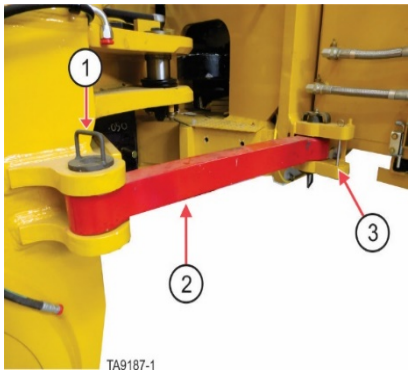
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 229. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

## 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 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.**

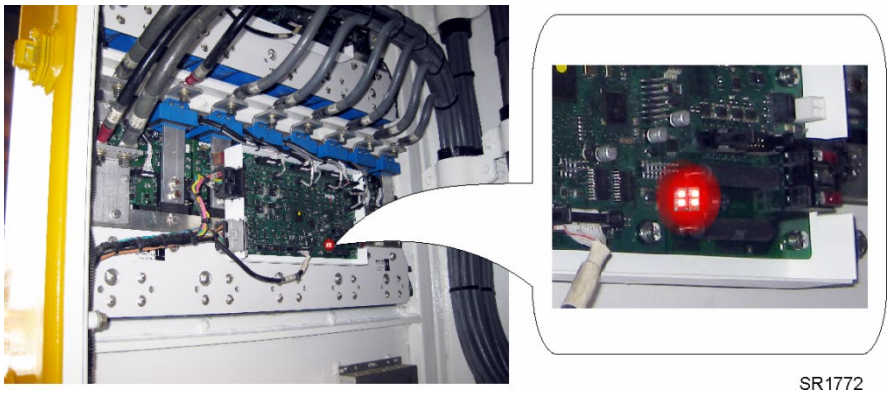



**Figure 230. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

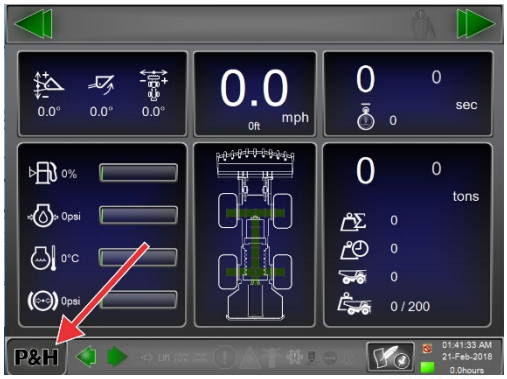
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

# In Cab Verification Using LINCS II Display

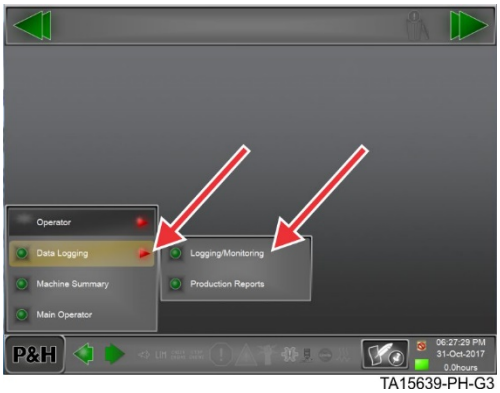
1. Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.



TA15638-PH-G3

**Main Menu Button**

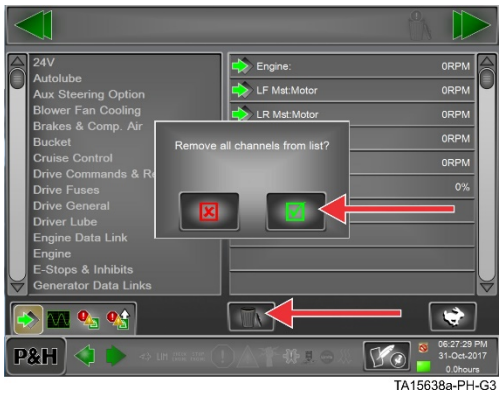


TA15639-PH-G3

**Data Logging & Logging/Monitoring**

**Figure 231. LINCS logging/monitoring menu access**

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



TA15638a-PH-G3

**Figure 232. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

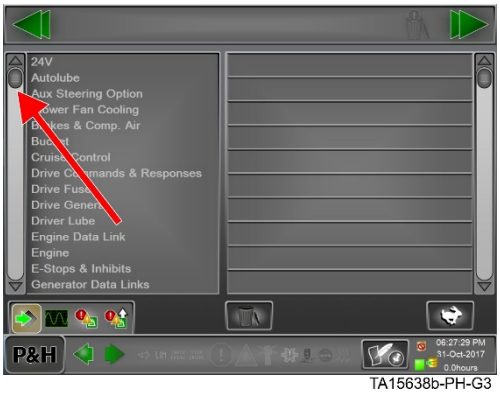



**Figure 233. Left hand scroll**

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

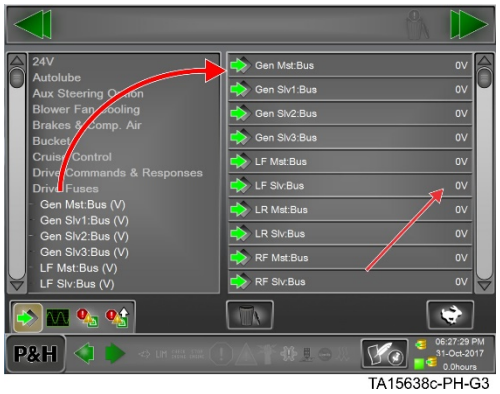



**Figure 234. Bus voltage indication**

6. 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.**

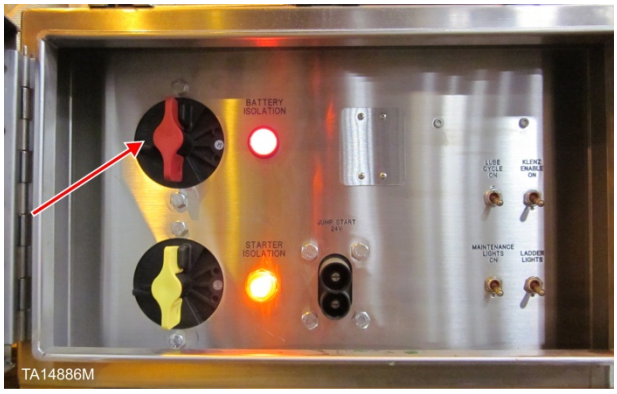
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 235. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

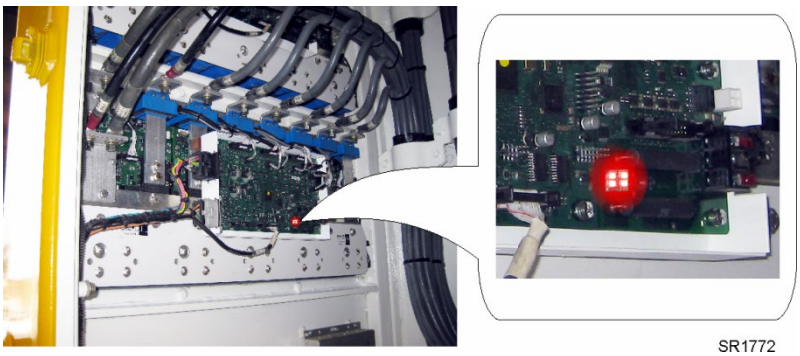



**Figure 236. Bus voltage LED array on SR control board**

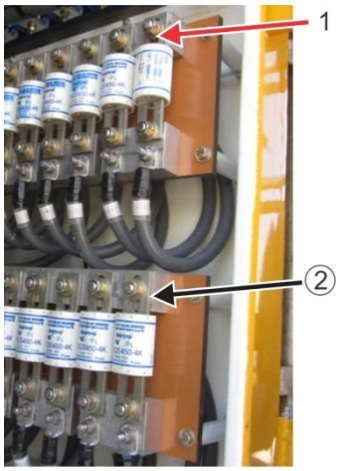
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 237. Main bus bars**

## 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.

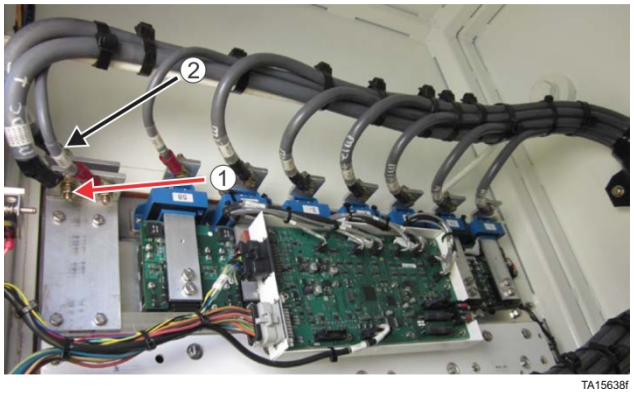
# NOTICE

**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.


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

**Figure 238. Converter assembly bus connections (rear of cabinet)**



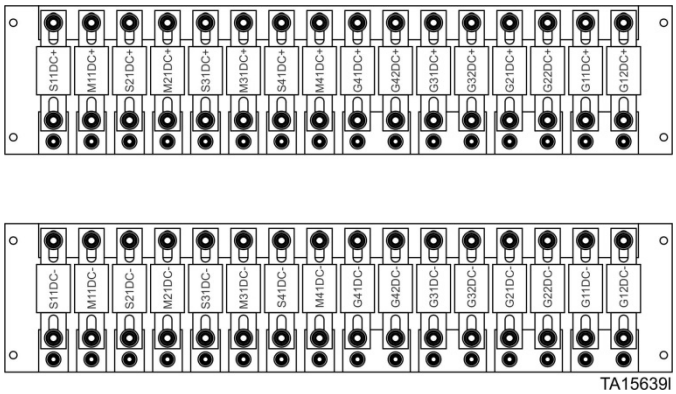

**1)** Positive bus bar, **2)** Negative bus bar

**Figure 239. Converter assembly bus connections (front of cabinet)**

# Replacing a Fuse

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

TA15639b

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| L-2350 Fuse Panels | L-2350 Fuse Assembly |
|---|---|

**Figure 240. Fuse assemblies**

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.

# 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.**

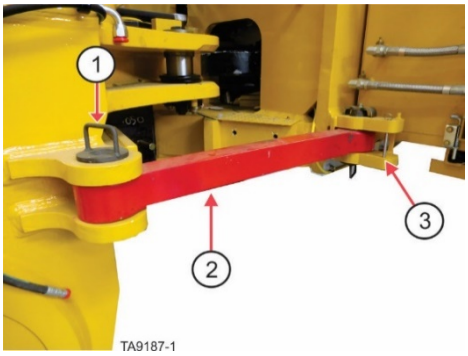
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**Frame lock in locked position**

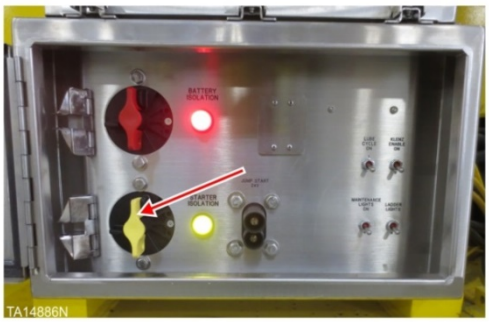
**1)** Retaining pin for locked position, **2)** Frame lock - shown in locked position,
**3)** Retaining pin bracket for un-locked position

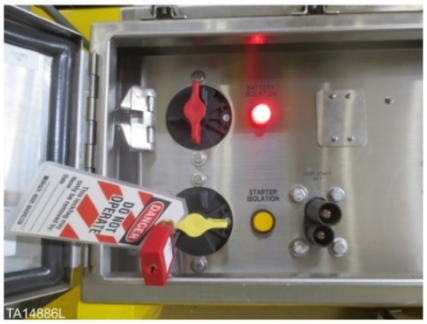
**Figure 241. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

f. At the battery box, isolate the starter, making the machine unable to start.



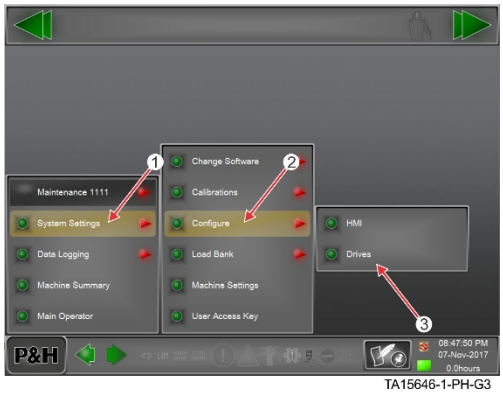




**Isolate and lockout the starter**

**Figure 242. Isolation and control switch assembly**

# Switching the RPT Set

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




**1)** System settings, **2)** Configure, **3)** Drives

**Figure 243. LINCS screen**

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).

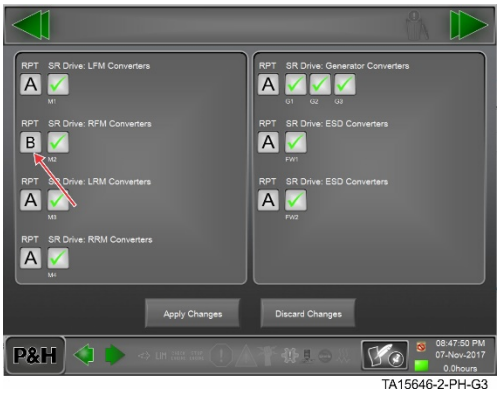



**Figure 244. Selecting RPT B set on appropriate Converter**

4. Touch '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.**

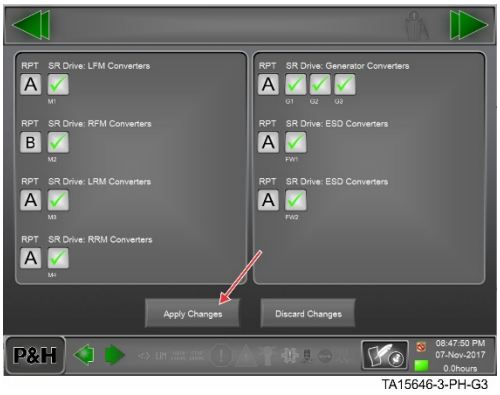



**Figure 245. Apply changes to set RPT set**

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.

# 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.**

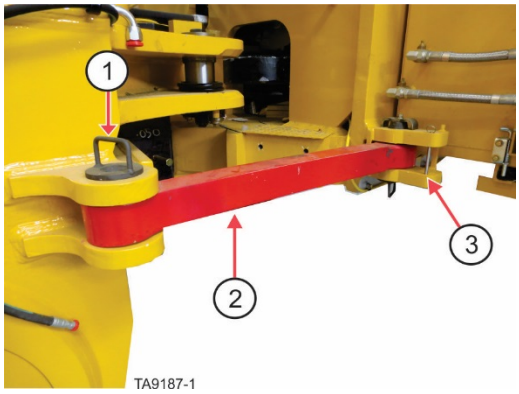
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 246. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

# 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 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.**

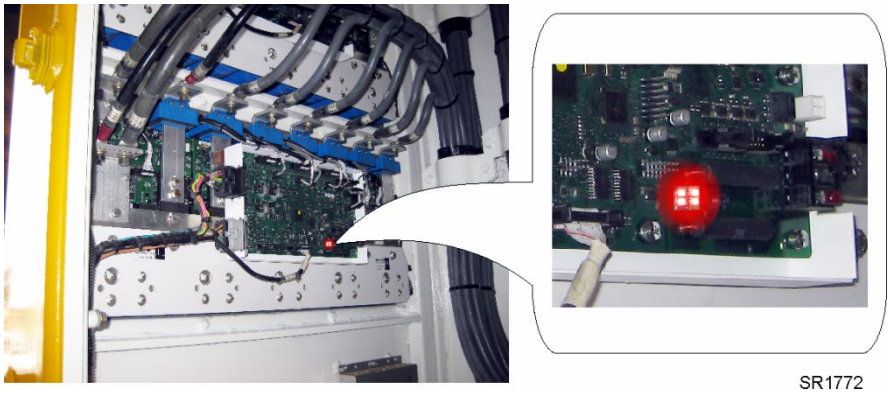



**Figure 247. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

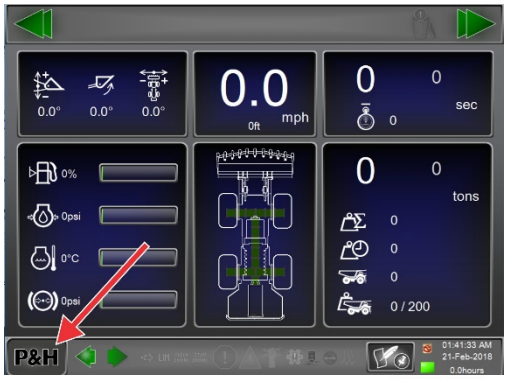
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

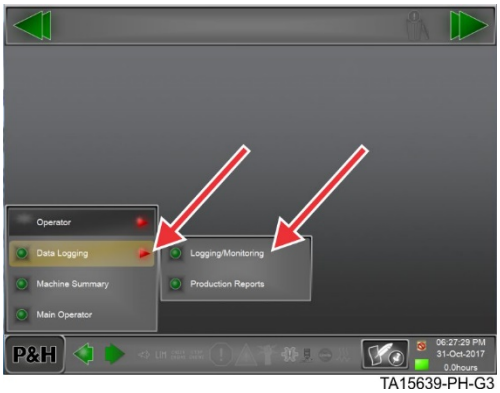
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.




**Main Menu Button**




**Data Logging & Logging/Monitoring**

**Figure 248. LINCS logging/monitoring menu access**

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

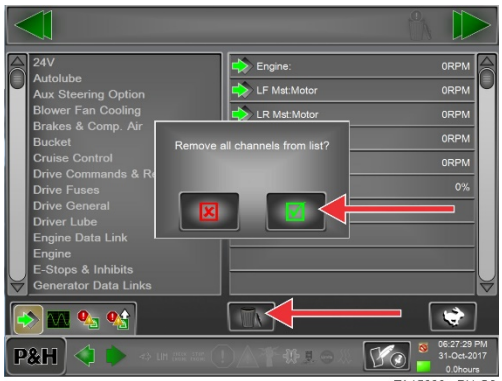



**Figure 249. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

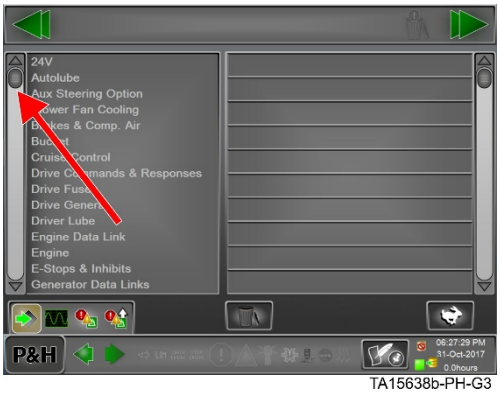



**Figure 250. Left hand scroll**

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

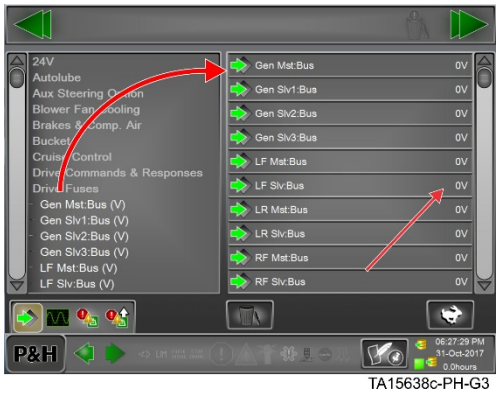



**Figure 251. Bus voltage indication**

6. 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.**

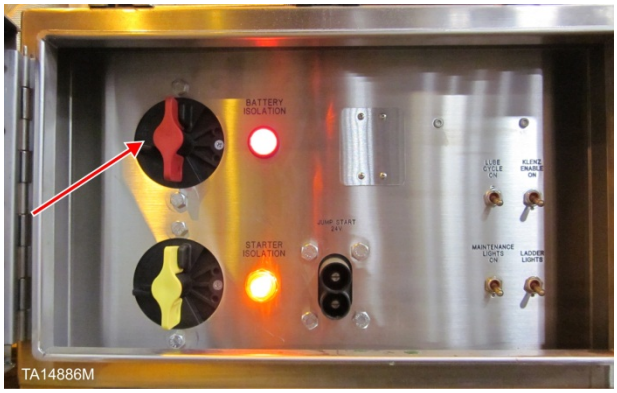
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 252. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

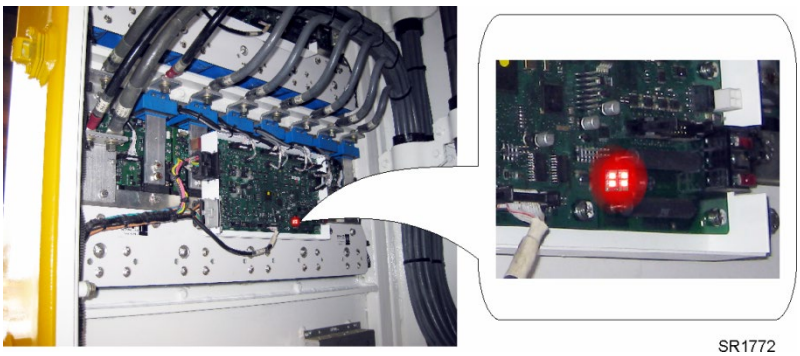



**Figure 253. Bus voltage LED array on SR control board**

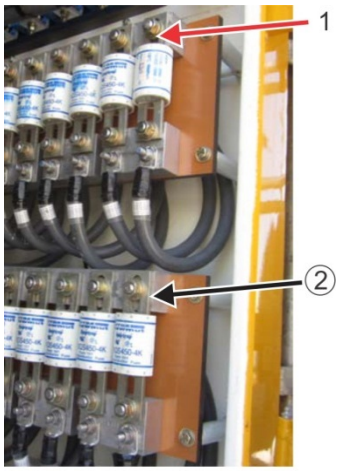
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 254. Main bus bars**

## 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.

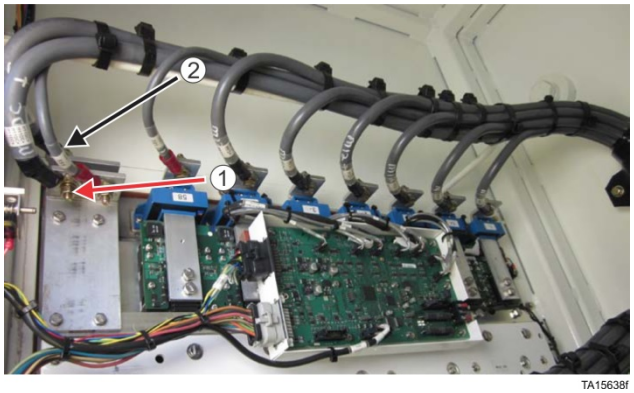
# NOTICE

**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.


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

**Figure 255. Converter assembly bus connections (rear of cabinet)**




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

**Figure 256. Converter assembly bus connections (front of cabinet)**

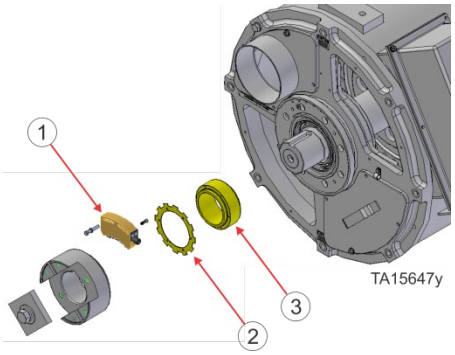
# Adjusting the RPT:

## NOTICE

**This procedure requires turning the rotor in order to test the LED's. This is accomplished by rotating the engine crankshaft.**

## Items Required

| Item | Part Number |
|---|---|
| RPT/RTD Tester | 427-0151 |
| Test Cable RPT/RTD | 427-2153 |
| Power Cable RPT/RTD Tester | 427-2154 |
| DC Power Source (+5 to +24VDC) | |
| Portable DC Welder Capable of 600 AMPS | |




**1)** RPT assembly, **2)** Shutter, **3)** Outer race

**Figure 257. RPT, shutter and 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

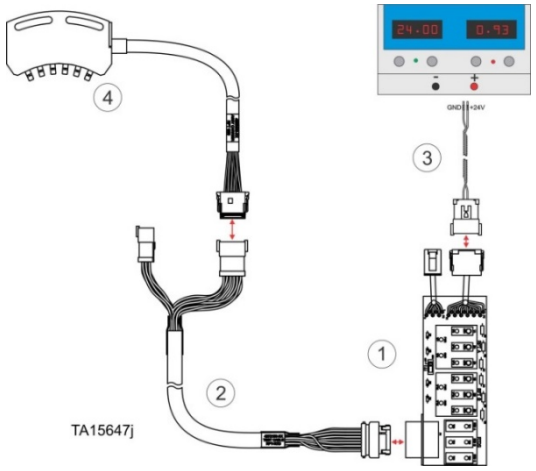
**Previous to connecting the RPT/RTD test card, the LED's can be tested by applying 12VDC to the card. At this time all LED's will be OFF, if any are ON, there is a potential problem with the test card. If all LED's are OFF, move SW1 on the tester card to position 1 and LED set 1 will come ON. Move SW1 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.
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.




1. RPT/RTD tester card
2. Test cable RPT/RTD
3. Power cable RPT/RTD tester
4. RPT carrier assembly

**Figure 258. RPT tester card and cables**

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.

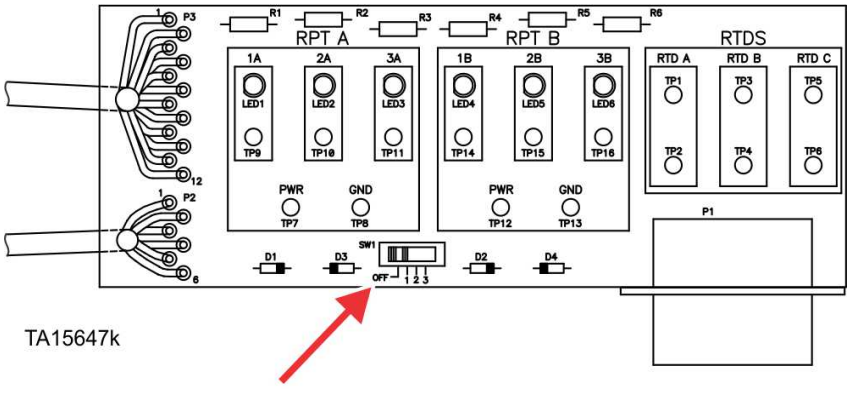


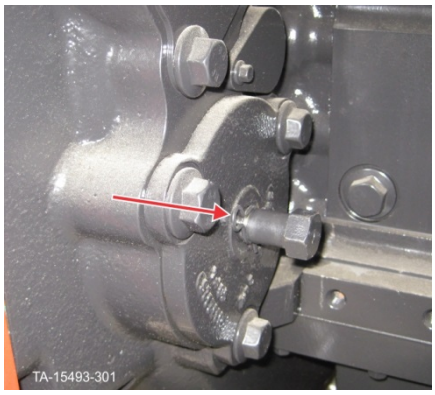

**Figure 259. Tester card (SW1 OFF)**

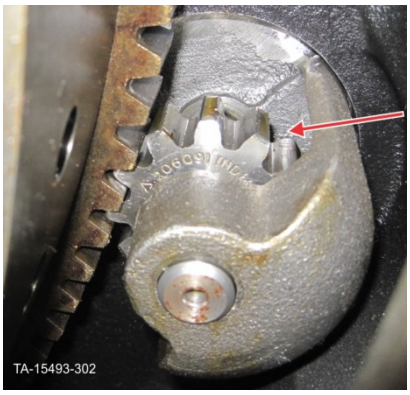
8. Turn on the DC power supply and check to see that at least one of the RPT LED's illuminates.

# 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




**Cummins Engine engine rotation tool, retainer ring, and internal gear**

**Figure 260. Cummins engine rotation tool**

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.

# 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.

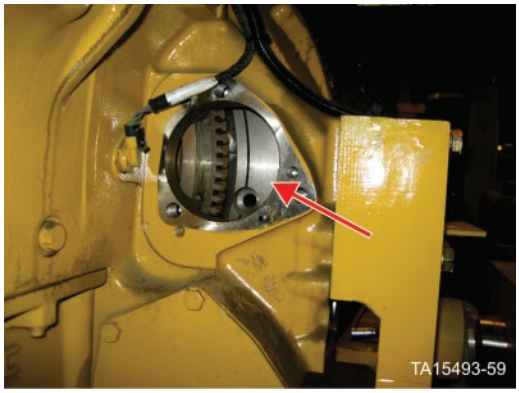




**Figure 261. Remove starter**

**NOTICE**

**Commercial tool is available from Detroit dealers. Contact your Detroit dealer for more information.**

2. Install the engine rotation tool.



**Figure 262. Detroit engine rotation tool**

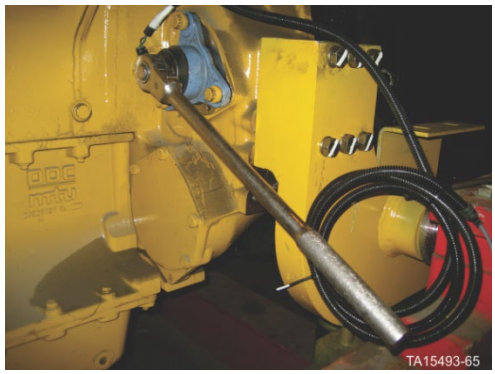



**Figure 263. Rotating engine crankshaft with manual drive gear**

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 portable DC welder capable of outputting at least 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 welding unit is OFF prior to attaching the welding leads to the terminal posts and before continuing with this test procedure. Shock and equipment arcing is possible if trying to connect the welder while unit is powered on.**

## Setting Phase 3

1. Attach the welding leads to phase 3 + and – terminal posts.
2. Set the welder to 600 Amps and energize phase 3.

# NOTICE

**Depending on the size of the welding leads, it may be necessary to attach a bolt to the terminal post in order to provide a good clamp location.**

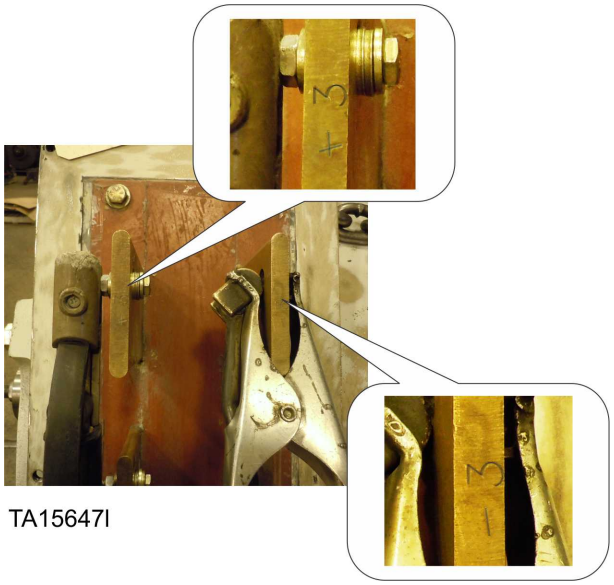
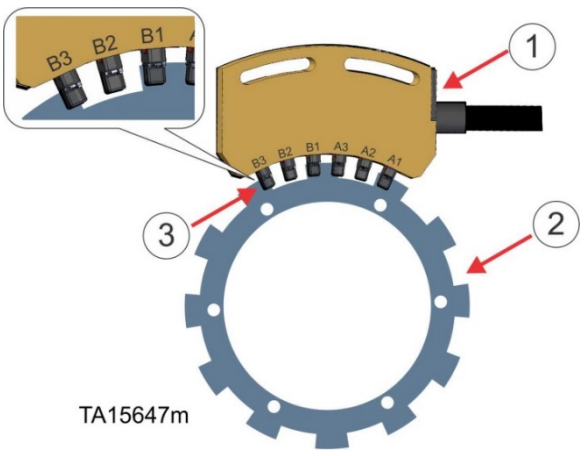



**Figure 264. Phase terminal posts**

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.




1. RPT carrier
2. RPT shutter
3. Shutter aligned to RPT B3

**Figure 265. Shutter aligned to RPT**

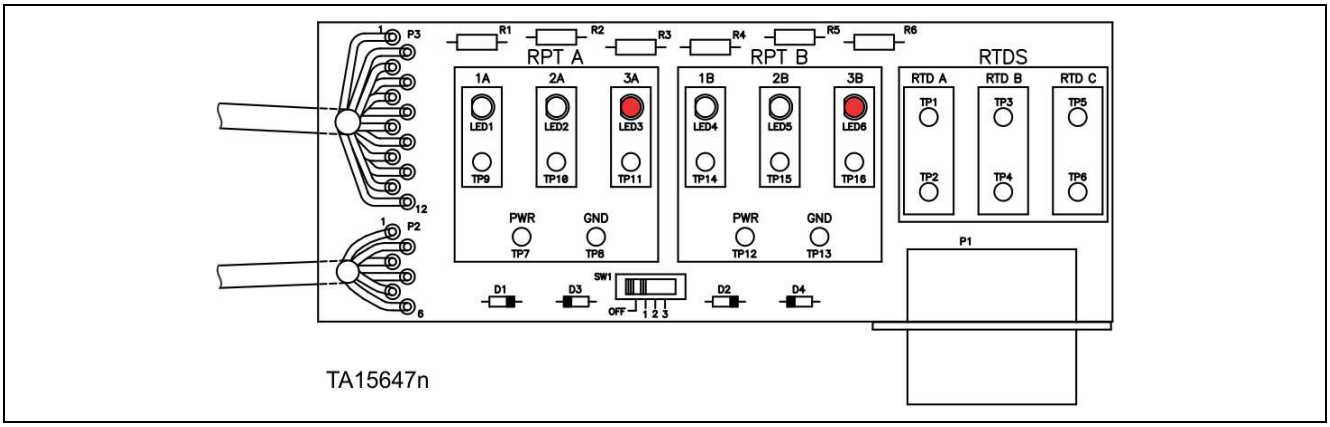



**Figure 266. Tester card Phase 3 LED's**

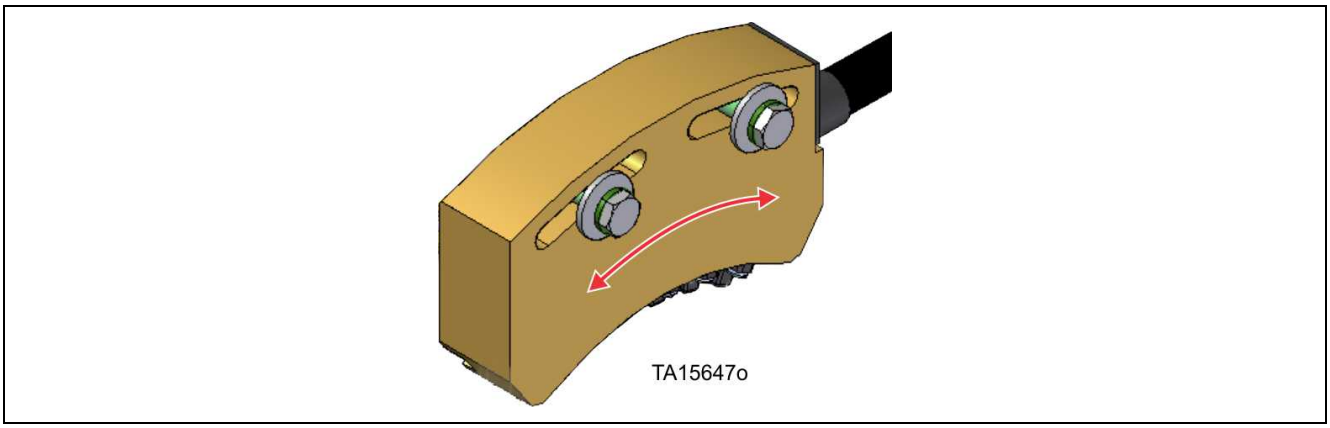



**Figure 267. RPT adjustment**

# 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 welder off in order to rotate the rotor. Rotate the rotor slightly and then turn the welder 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.**

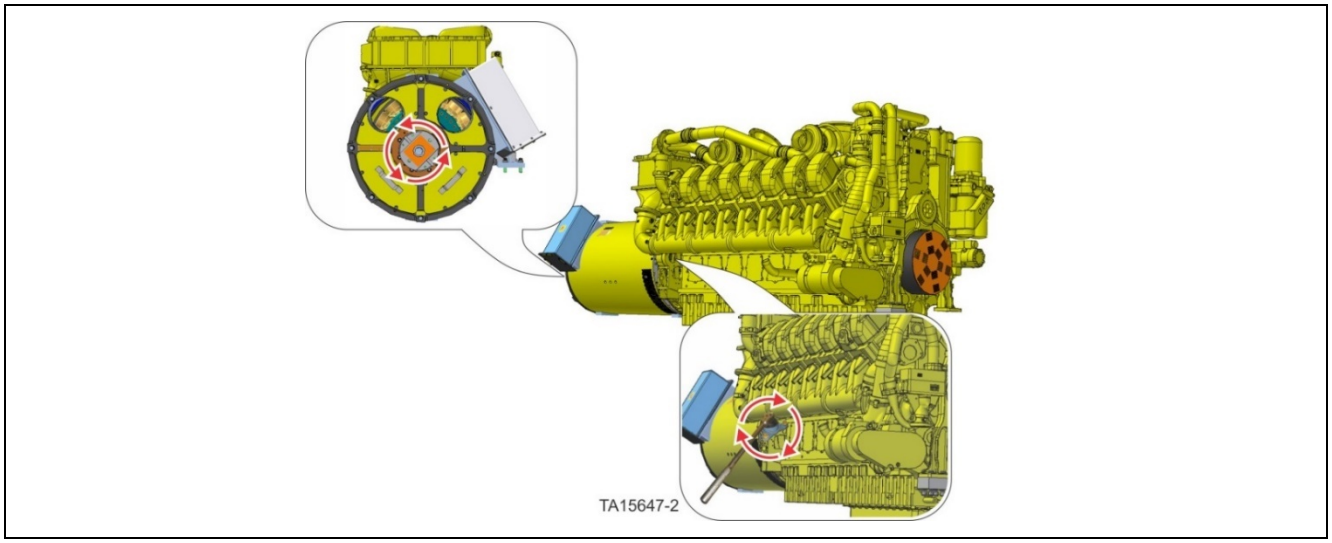



**Figure 268. Counter clockwise alignment**

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.

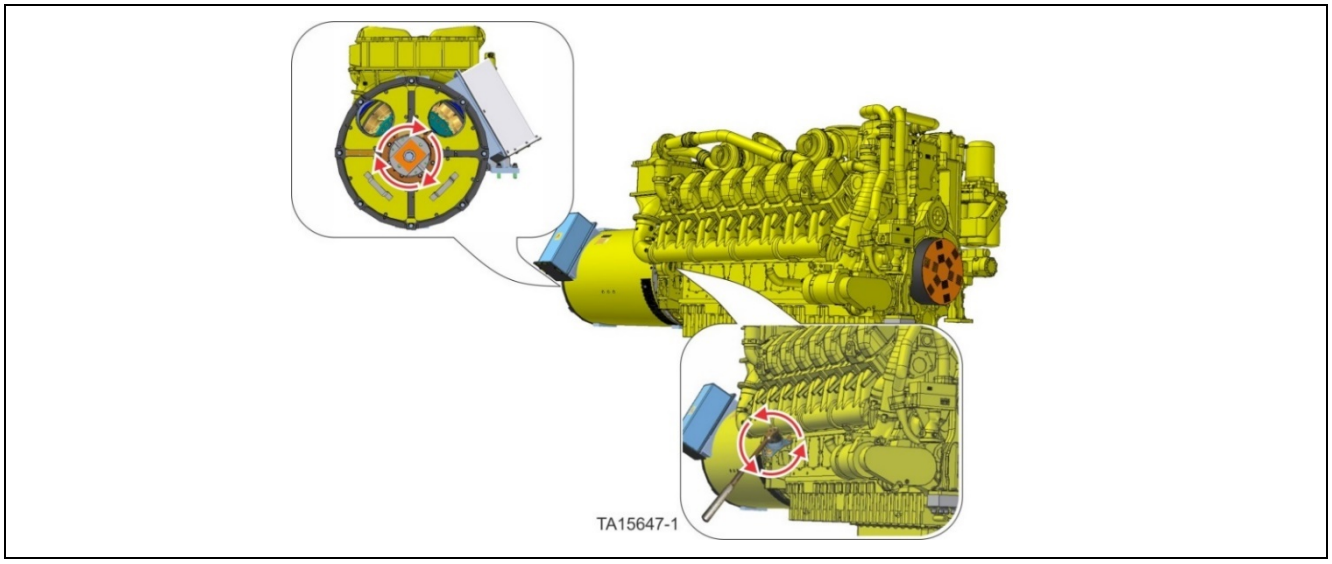



**Figure 269. Clockwise alignment**

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.
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 welding unit and move welding leads to phase 2 + and – terminal posts.

**⚠ WARNING**

**Risk of shock exists while performing the RPT settings. Make sure the welding unit is OFF prior to removing or attaching the welding leads to the terminal posts and before continuing with this test procedure. Shock and equipment arcing is possible if trying to connect the welder while unit is powered on.**

2. Make sure the welder is set to 600 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 positon.

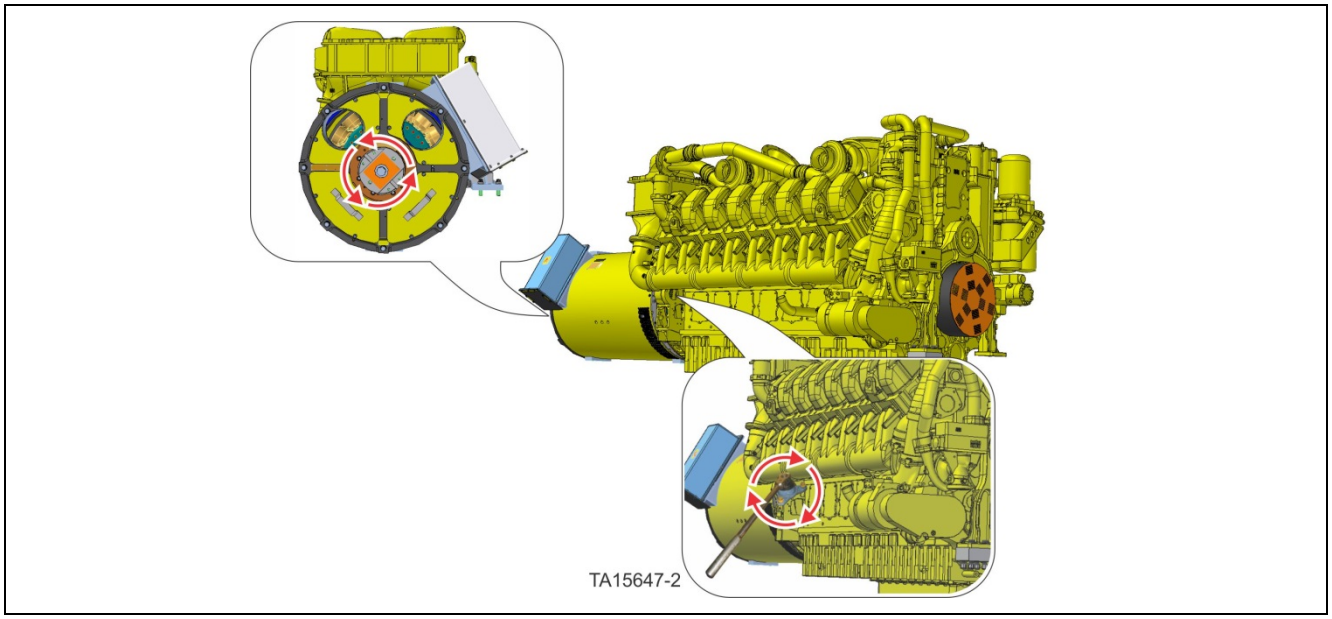



**Figure 270. Counter clockwise alignment**

5. Verify that both 2B and 2A LED's are now ON.

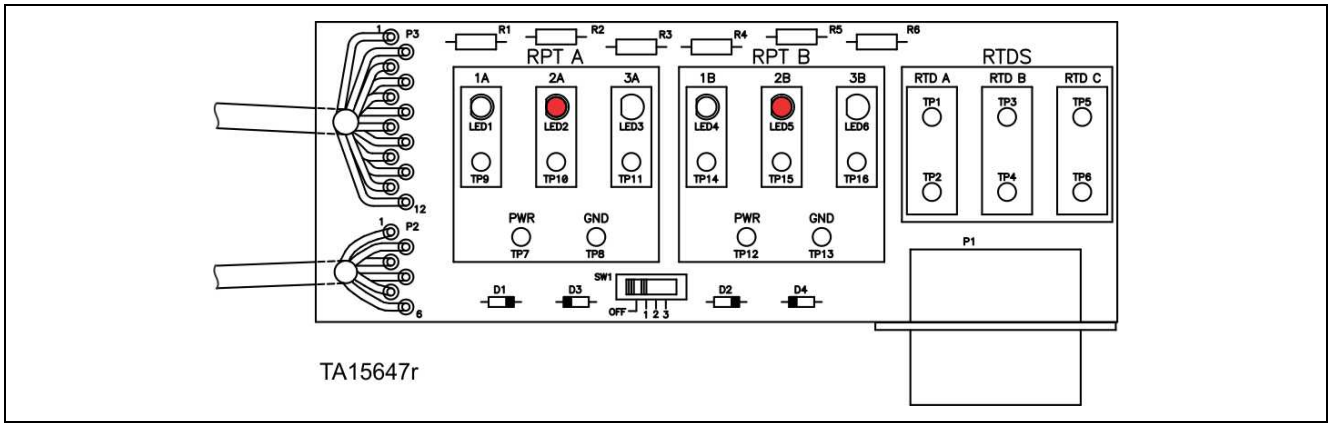



**Figure 271. Tester card Phase 2 LED's**

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.

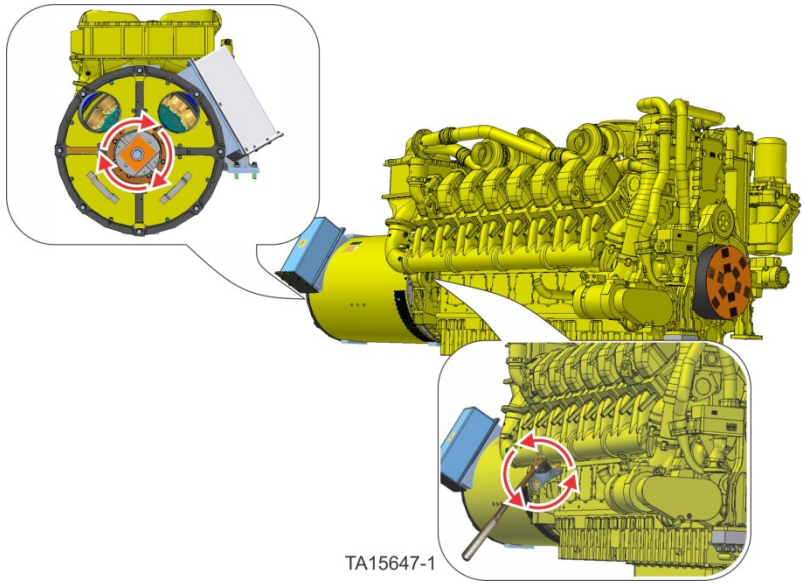



**Figure 272. Clockwise alignment**

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.

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 18 ft-lbs (24 Nm).

16. Remove the other mounting bolt and perform the same process.

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.**

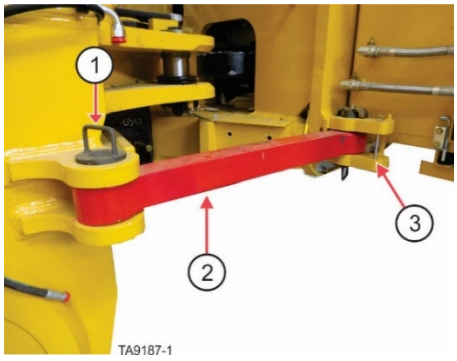
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 273. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

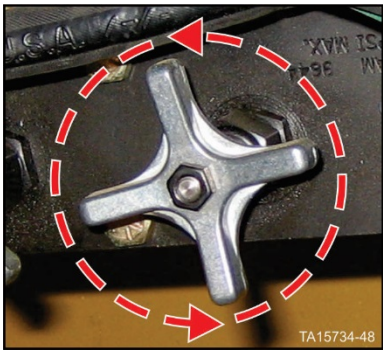
## ⚠ WARNING

**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.**

f. 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.

g. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.

- Open the valve completely and leave it open during this procedure.



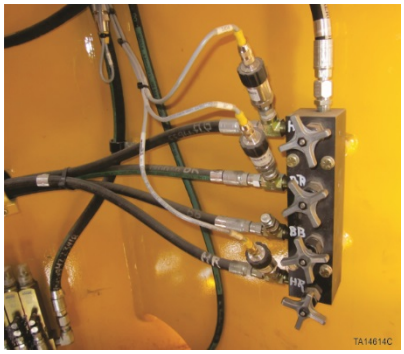




**Figure 274. Pressure bleed down valves**

# 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 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.**

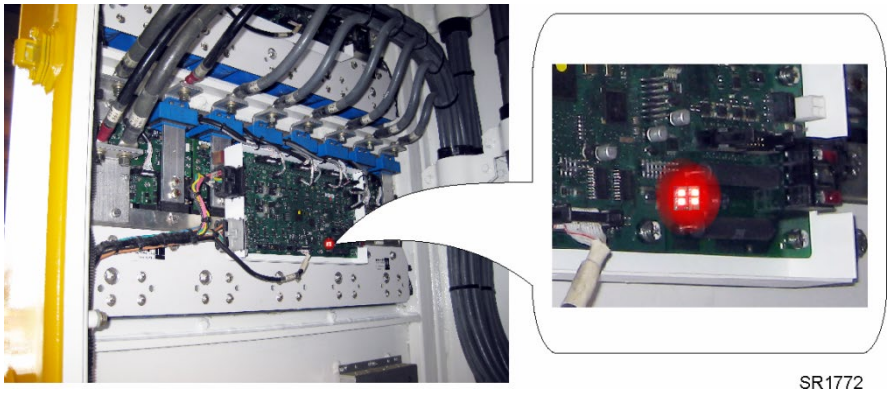



**Figure 275. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

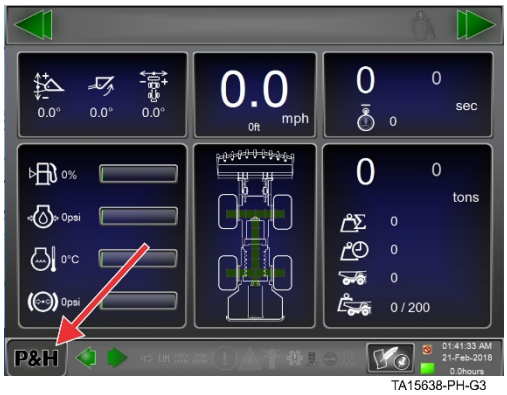
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

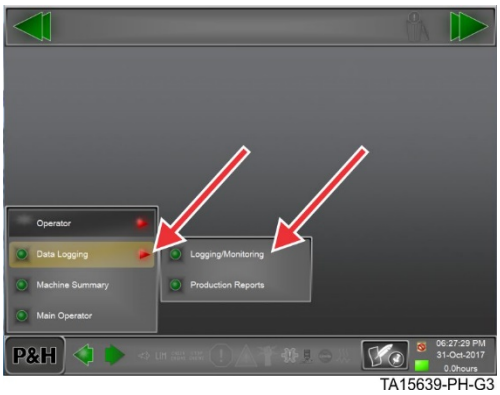
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.




**Main Menu Button**




**Data Logging & Logging/Monitoring**

**Figure 276. LINCS logging/monitoring menu access**

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

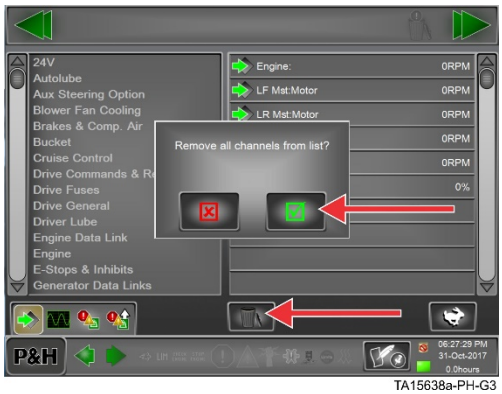



**Figure 277. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

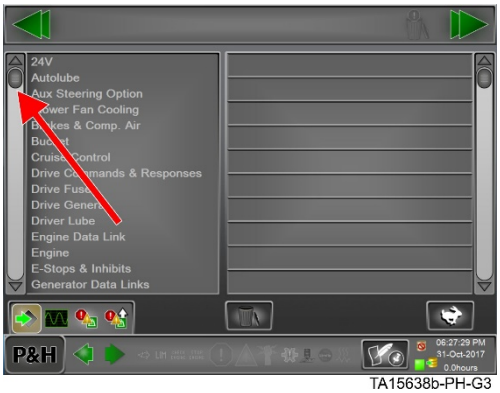



**Figure 278. Left hand scroll**

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

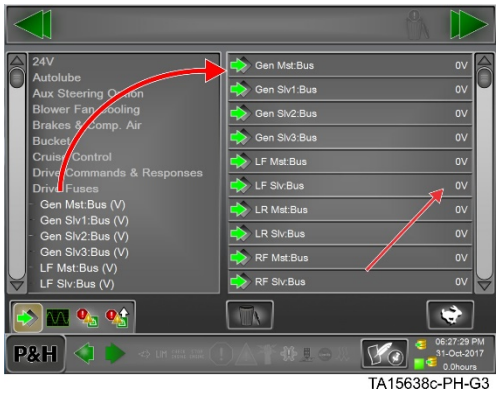



**Figure 279. Bus voltage indication**

6. 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.**

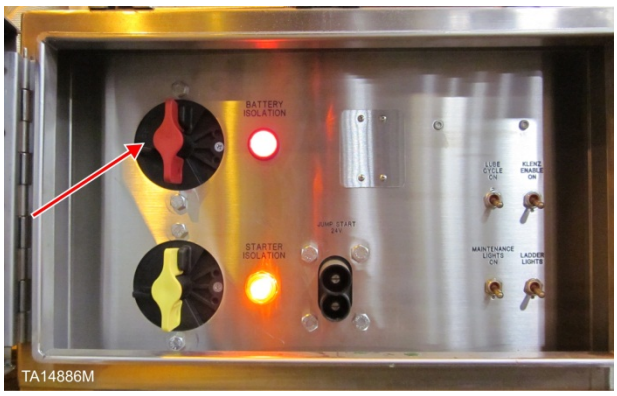
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 280. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

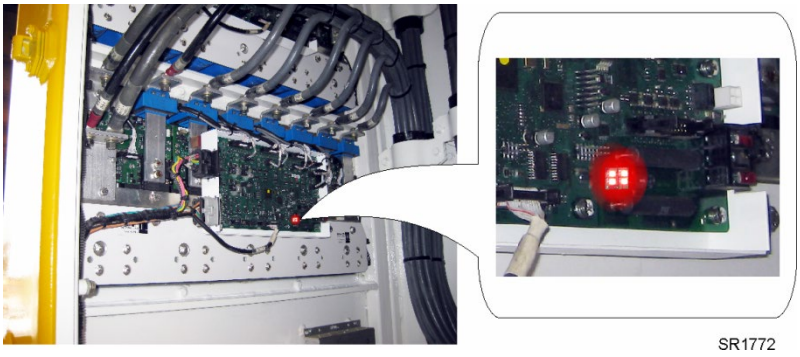



**Figure 281. Bus voltage LED array on SR control board**

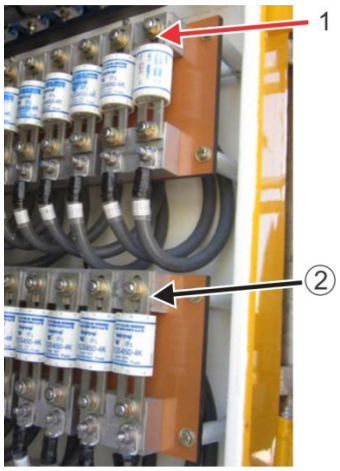
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 282. Main bus bars**

## 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.

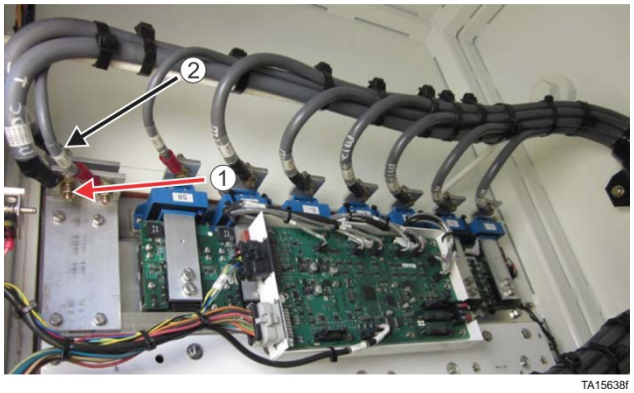
# NOTICE

**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.


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

**Figure 283. Converter assembly bus connections (rear of cabinet)**

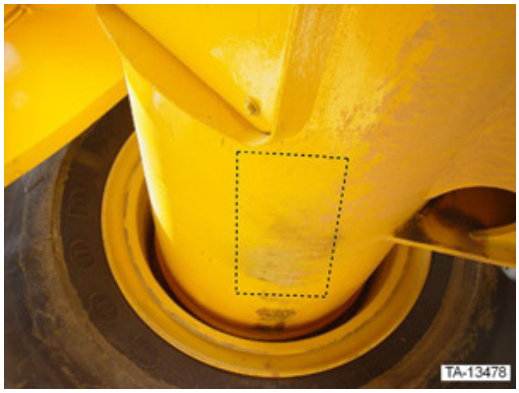



**1)** Positive bus bar, **2)** Negative bus bar

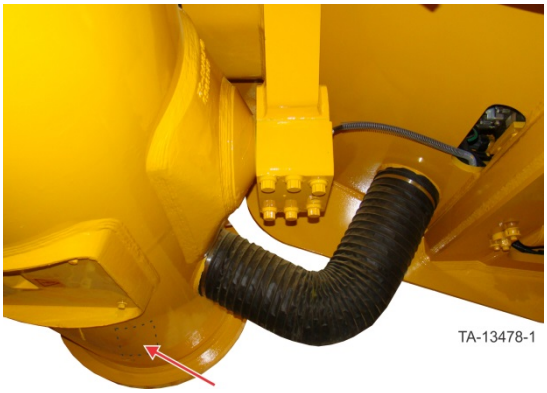
**Figure 284. Converter assembly bus connections (front of cabinet)**

## Jacking the Machine

1. Jack the appropriate wheel motor to a height where the wheel motor can be rotated.

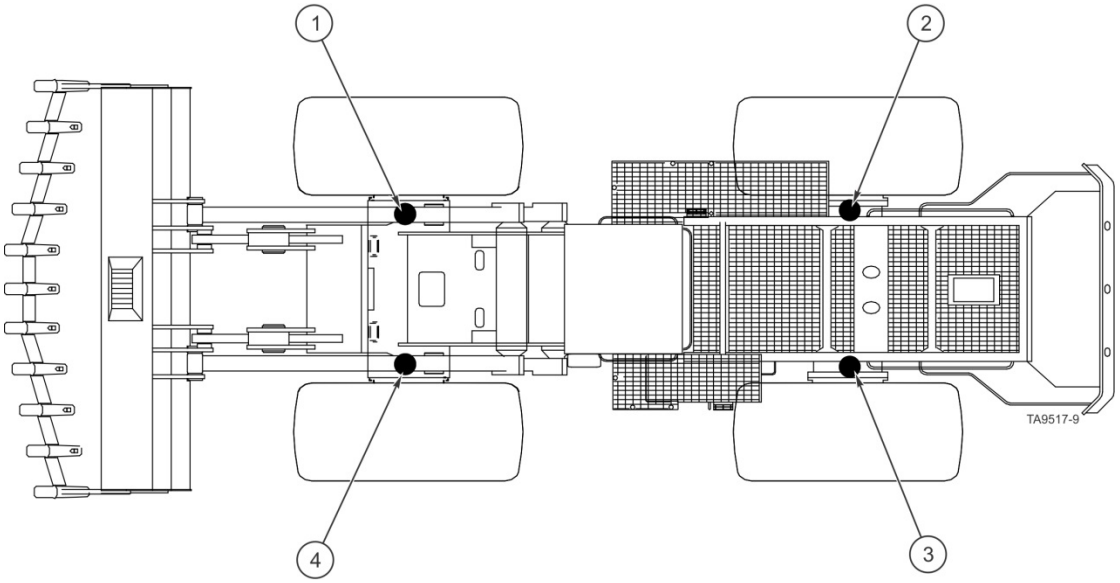



Front axle (typical)




Rear axle (typical)

**Figure 285. Front and rear axle jacking and jack stand placement location (typical)**




| | 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) |

**1)** Right front jacking point **2)** Right rear jacking point **3)** Left front jacking point **4)** Left rear jacking point

**Figure 286. Recommended jack stand placement locations (typical all models)**

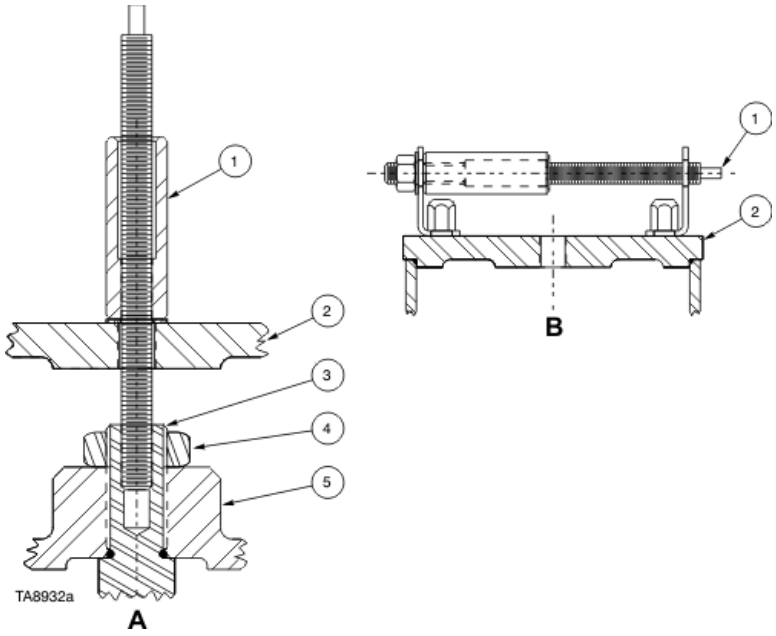
# NOTICE

**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.**




**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.**

**Figure 287. Rod installation for releasing brake**


**Figure 288. View of jack rod installed in brake cylinder**

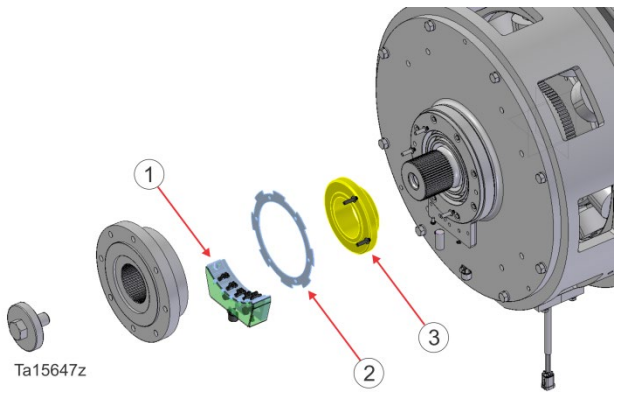
# Adjusting the RPT

## 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 | 427-0151 |
| Test Cable RPT/RTD | 427-2153 |
| Power Cable RPT/RTD Tester | 427-2154 |
| DC Power Source (+5 to +24VDC) | |
| Portable DC Welder Capable of 600 AMPS | |




**1)** RPT assembly, **2)** Shutter, **3)** Outer race seal

**Figure 289. RPT, Shutter and outer race**

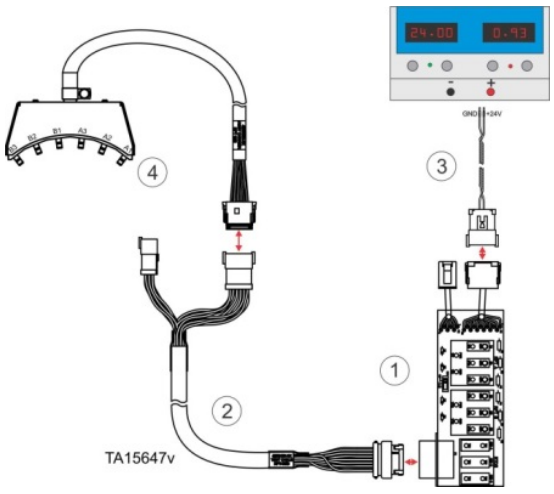
# NOTICE

**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.
4. Connect the Ground and 24V leads on the Power Cable RPT/RTD Tester to a +24VDC power supply.




1. RPT/RTD Tester card
2. Test cable RPT/RTD
3. Power cable RPT/RTD tester
4. RPT carrier assembly

**Figure 290. RPT Tester card and cables**

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.

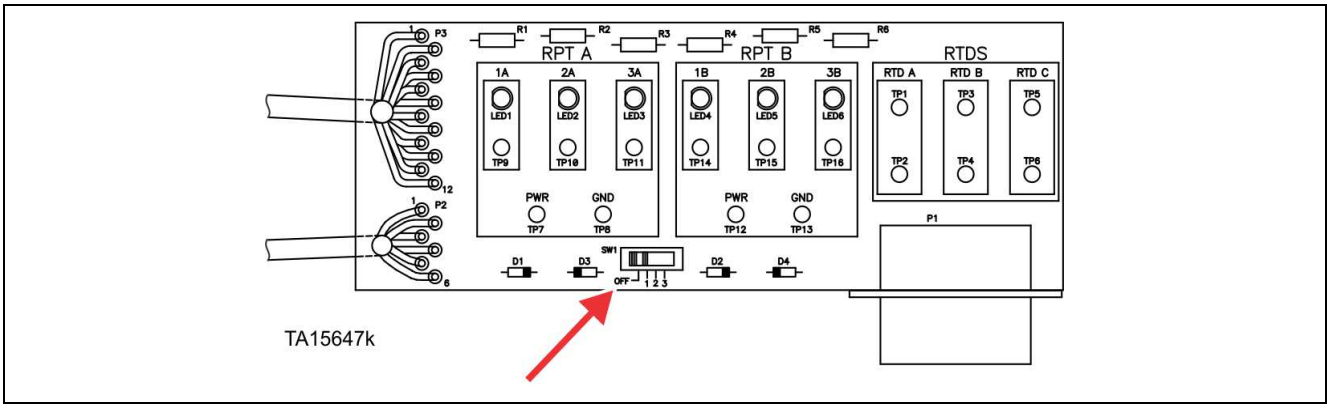



**Figure 291. Tester card (SW1 OFF)**

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 portable welder capable of outputting at least 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 welding unit is OFF prior to attaching the welding leads to the terminal posts and before continuing with this test procedure. Shock and equipment arcing is possible if trying to connect the welder while unit is powered on.**

## Setting Phase 3

1. Attach the welding leads to phase 3 + and – terminal posts.
2. Set the welder to 600 Amps and energize phase 3.

# NOTICE

**Depending on the size of the welding leads, it may be necessary to attach a bolt to the terminal post in order to provide a good clamp location.**

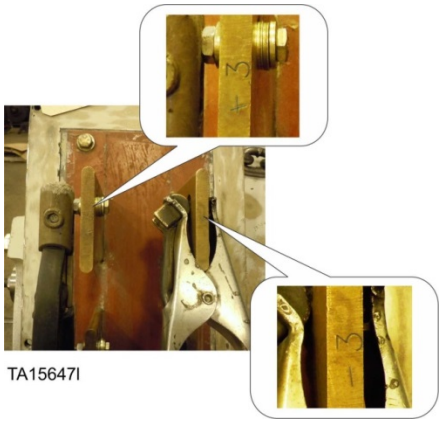
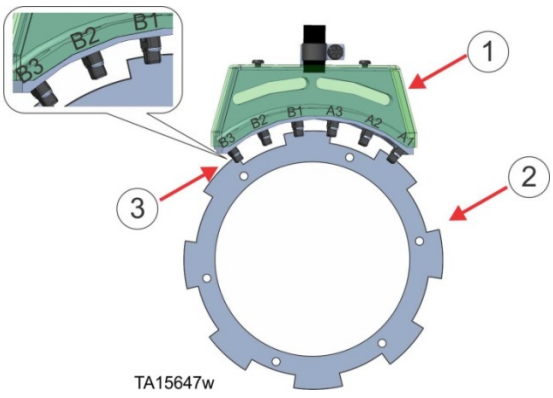



**Figure 292. Phase terminal posts**

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.




1. RPT carrier
2. RPT shutter
3. Shutter aligned to RPT B3

**Figure 293. Shutter alignment to RPT**

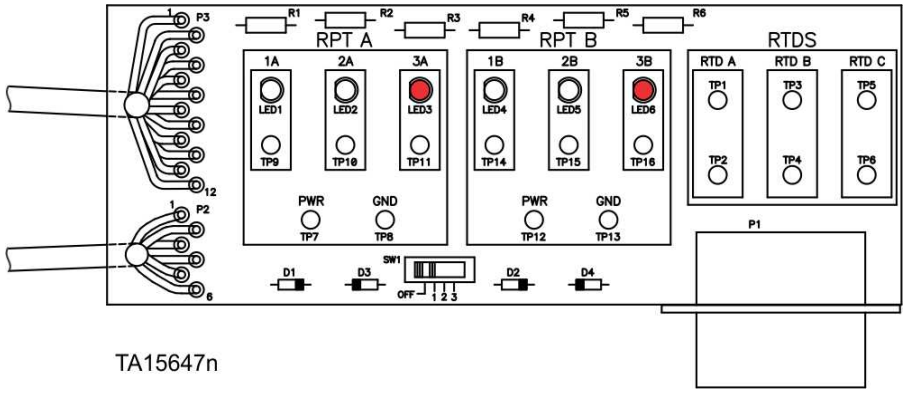



**Figure 294. Tester card Phase 3 LED's**

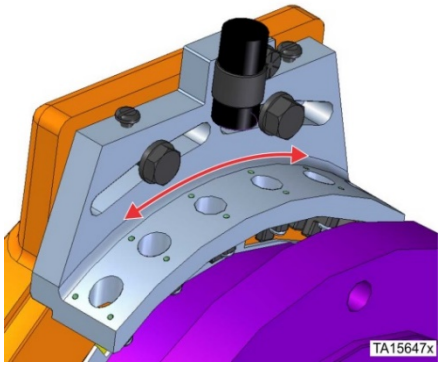



**Figure 295. RPT adjustment**

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 welder off in order to rotate the rotor. Rotate the rotor slightly by turning the brake disk, then turn the welder back on and ensure the rotor returns to its aligned position.**

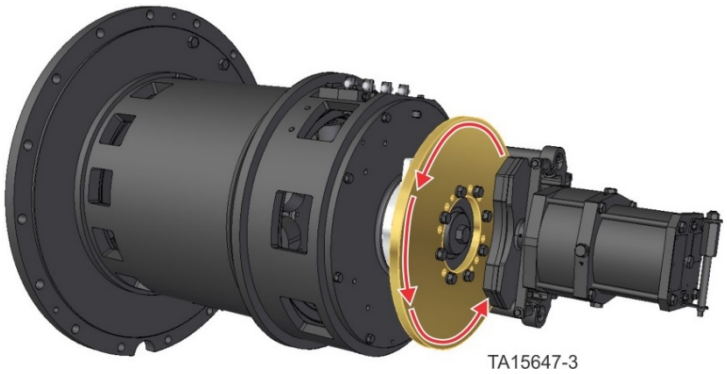



**Figure 296. Counter clockwise alignment**

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 welder off in order to rotate the rotor. Rotate the rotor slightly by turning the brake disk, then turn the welder back on and ensure the rotor returns to it aligned position.**

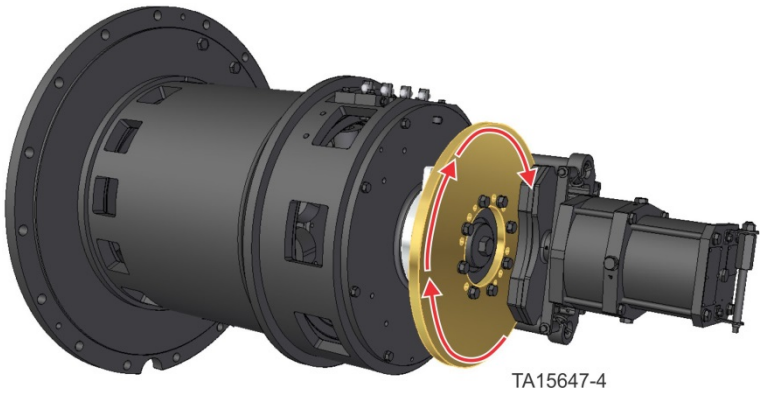



**Figure 297. Clockwise alignment**

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.

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 welding unit and move welding leads to phase 2 + and – terminal posts.

**⚠ WARNING**

**Risk of shock exists while performing the RPT settings. Make sure the welding unit is OFF prior to removing or attaching the welding leads to the terminal posts and before continuing with this test procedure. Shock and equipment arcing is possible if trying to connect the welder while unit is powered on.**

2. Make sure the welder is set to 600 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 positon.

**NOTICE**

**It will be necessary to turn the welder off in order to rotate the rotor. Rotate the rotor slightly by turning the brake disk, then turn the welder back on and ensure the rotor returns to its aligned position.**

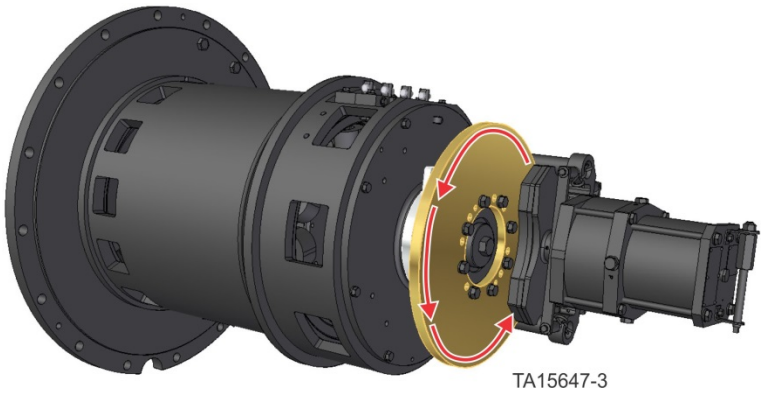



**Figure 298. Counter clockwise alignment**

5. Verify that both 2B and 2A LED's are now ON.

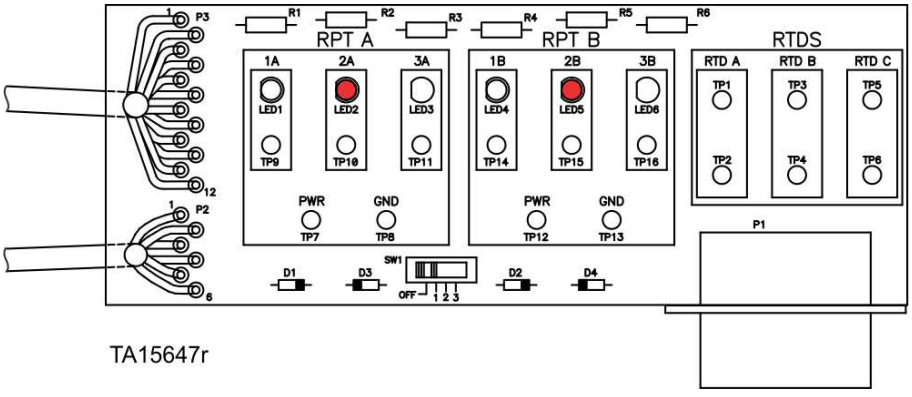



**Figure 299. Tester card Phase 2 LED's**

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 welder off in order to rotate the rotor. Rotate the rotor slightly by turning the brake disk, then turn the welder back on and ensure the rotor returns to its aligned position.**

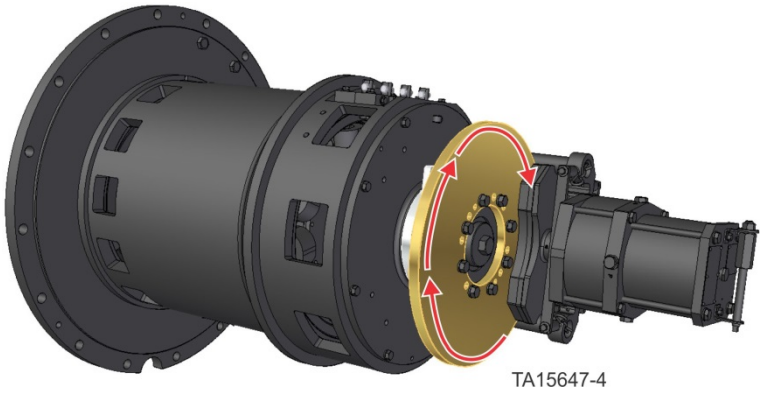



**Figure 300. Clockwise alignment**

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.
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.

# 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.**

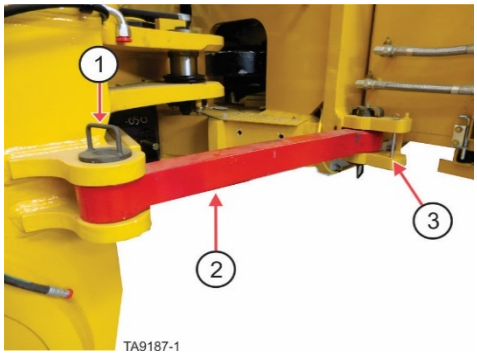
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 301. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

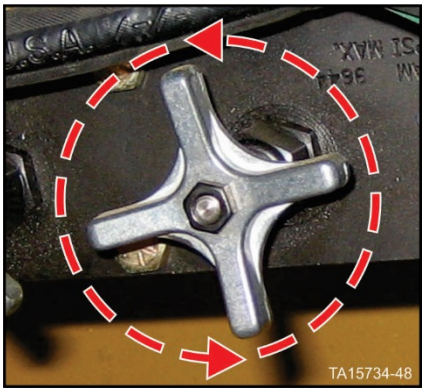
## ⚠ WARNING

**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.**

f. 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.

g. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.

- Open the valve completely and leave it open during this procedure.



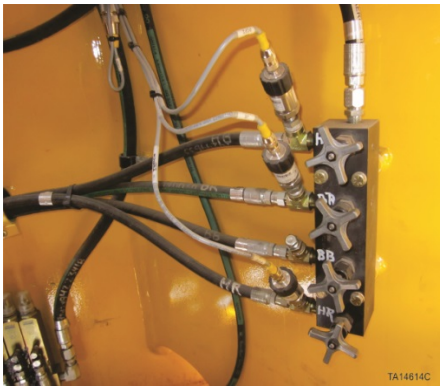




**Figure 302. Pressure bleed down valves**

# 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 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.**

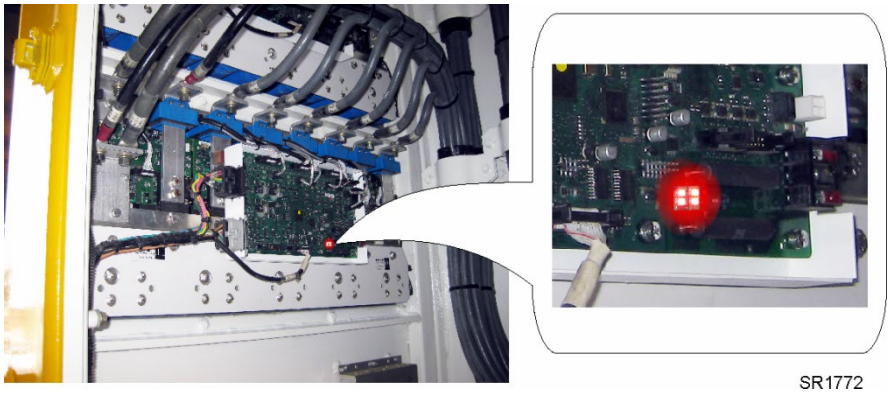



**Figure 303. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

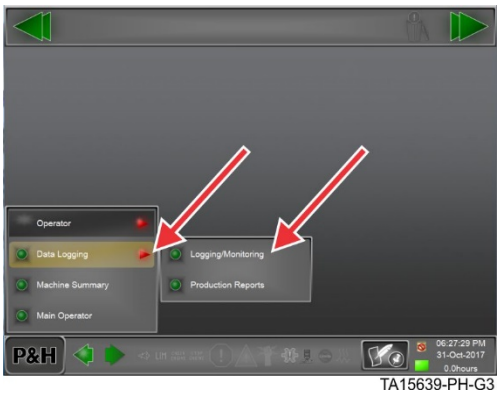
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.


| Main Menu Button | Data Logging & Logging/Monitoring |
|---|---|

**Figure 304. LINCS logging/monitoring menu access**

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

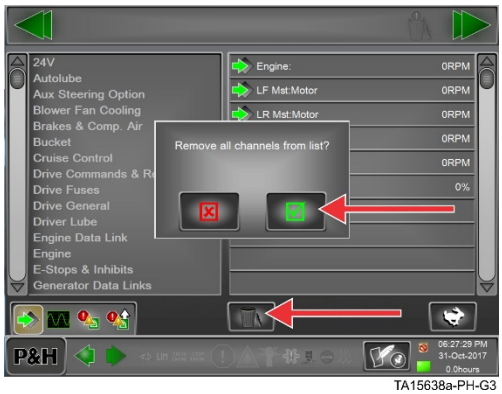



**Figure 305. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

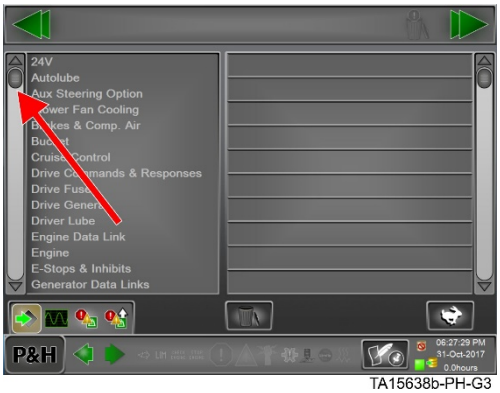



**Figure 306. Left hand scroll**

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

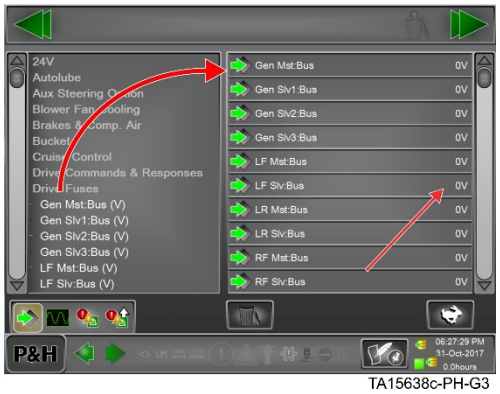



**Figure 307. Bus voltage indication**

6. 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.**

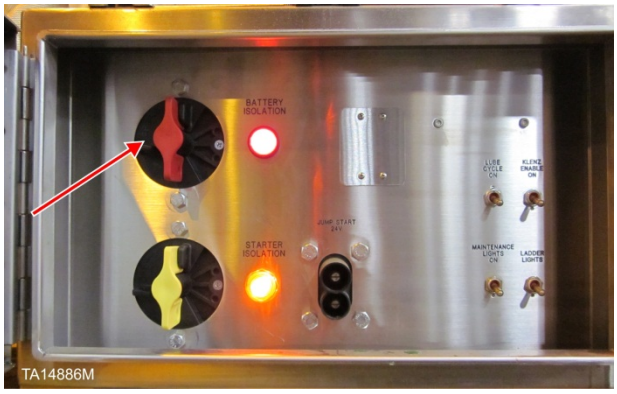
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 308. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

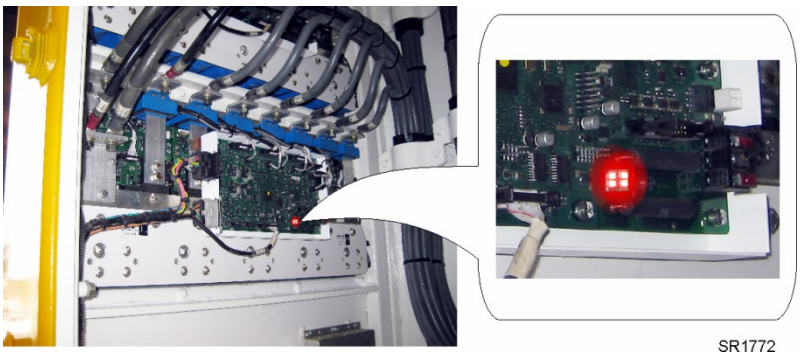



**Figure 309. Bus voltage LED array on SR control board**

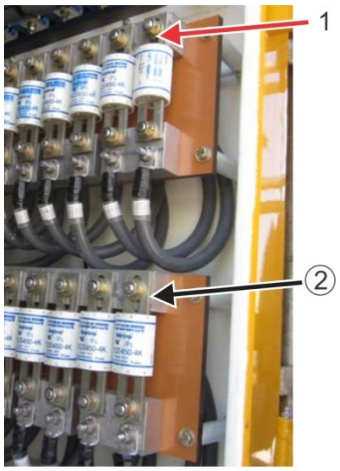
## Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 310. Main bus bars**

## 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.

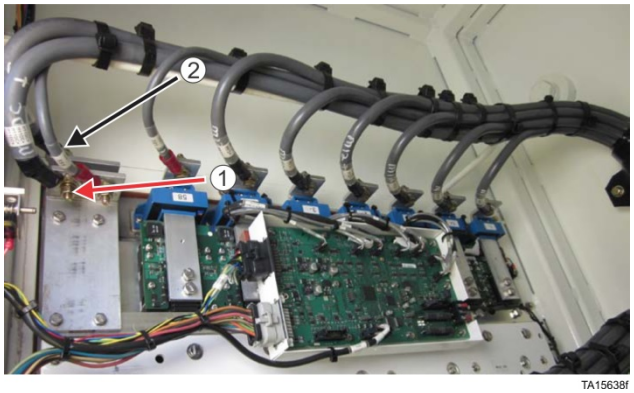
# NOTICE

**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.


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

**Figure 311. Converter assembly bus connections (rear of cabinet)**




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

**Figure 312. Converter assembly bus connections (front of cabinet)**

# 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.

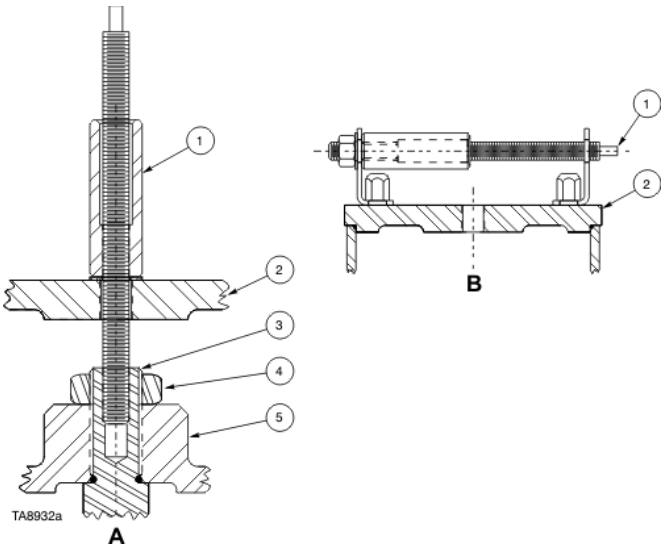
To remove the middle pinion, perform the following procedure:

a. Remove axle access covers.

b. 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.**




**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.**

**Figure 313. Rod installation for releasing brake**

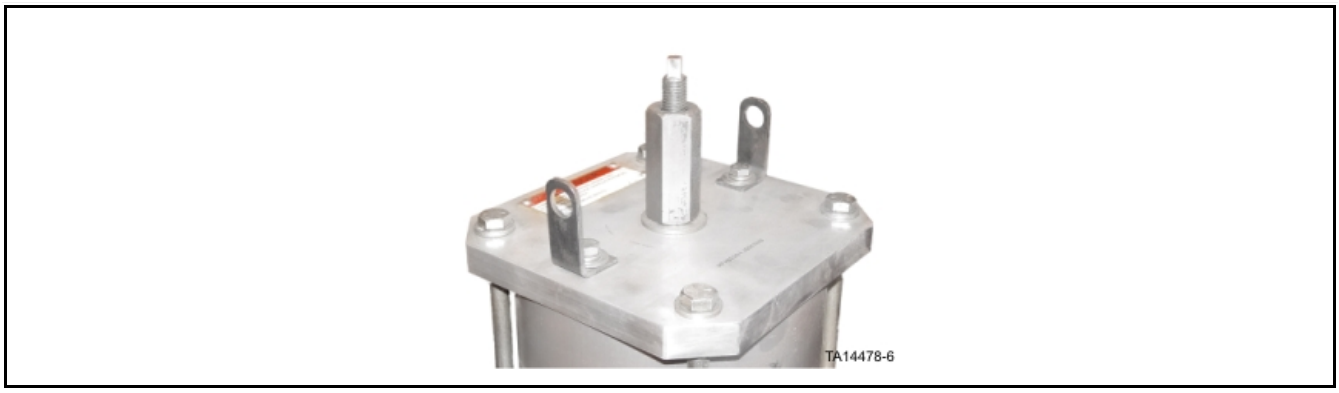



**Figure 314. View of jack rod installed in brake cylinder**

c. Drain planetary drive.

- Follow all local rules and regulations to catch the oil drained from the drive.

d. Remove the inspection plate located in the center of the planetary drive's cover structure.

e. 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").

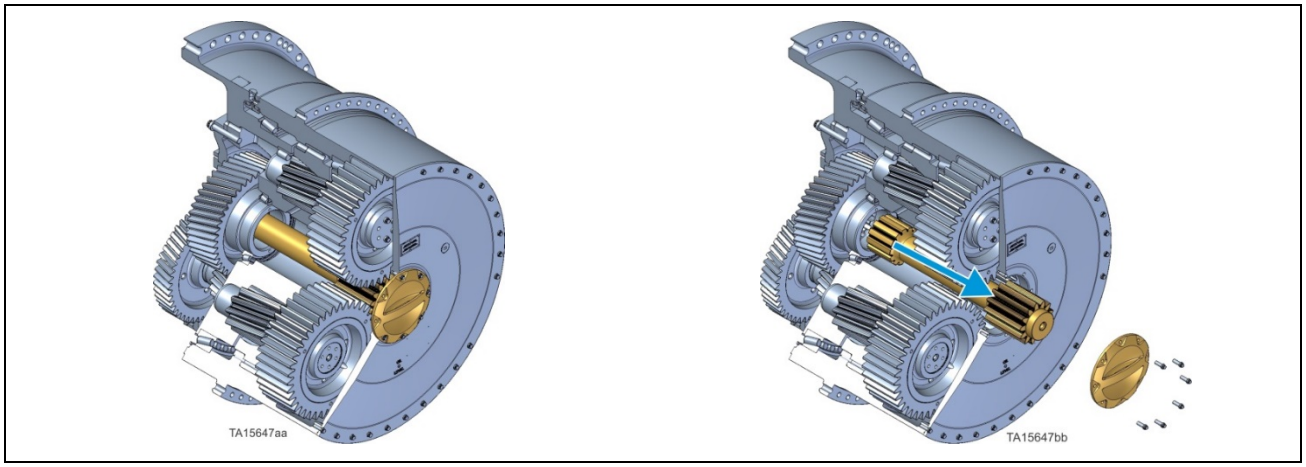



**Figure 315. Middle pinion removal/replacement model 57**

f. Attach middle pinion removal arm P/N 423-4753 to the removal hub with eight 1" - 8 x 3.5" UNC bolts.

g. 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.**

h. Cover and store the pinion in a dust free environment until reinstallation in the driver.

# Remove Brake Cylinder and Brake Disk

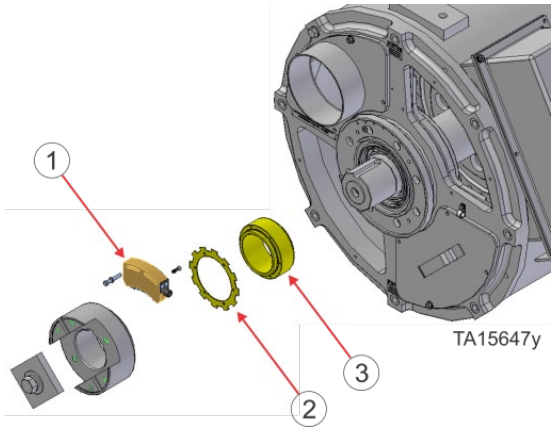
**NOTICE**

**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.**

# Adjusting the RPT

## Items Required

| 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 Current Supply | |




**1)** RPT assembly, **2)** Shutter, **3)** Outer race

**Figure 316. RPT, shutter and outer race**

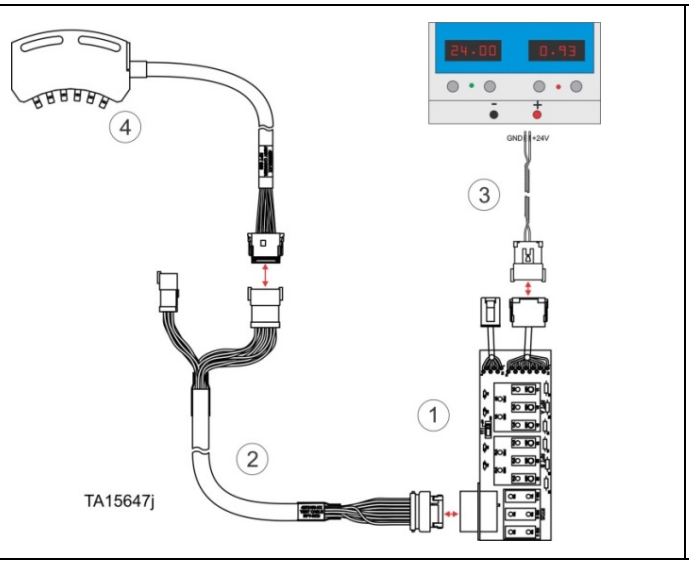
**NOTICE**

**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.
4. Connect the Ground and 24V leads on the Power Cable RPT/RTD Tester to a +24VDC power supply.




1. RPT/RTD tester card
2. Test cable RPT/RTD
3. Power cable RPT/RTD tester
4. RPT carrier assembly

**Figure 317. RPT tester card and cables**

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.

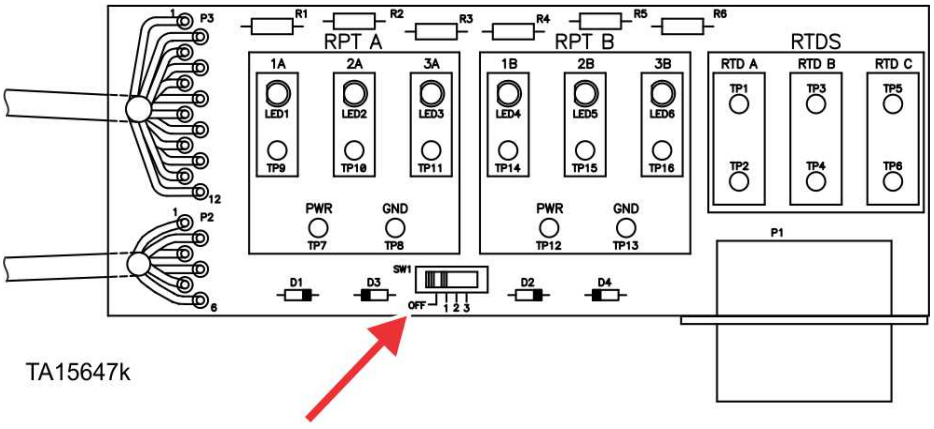



**Figure 318. Tester card (SW1 OFF)**

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 portable 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 welding unit is OFF prior to attaching the welding leads to the terminal posts and before continuing with this test procedure. Fatal shock and equipment arcing is possible if trying to connect the welder 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.

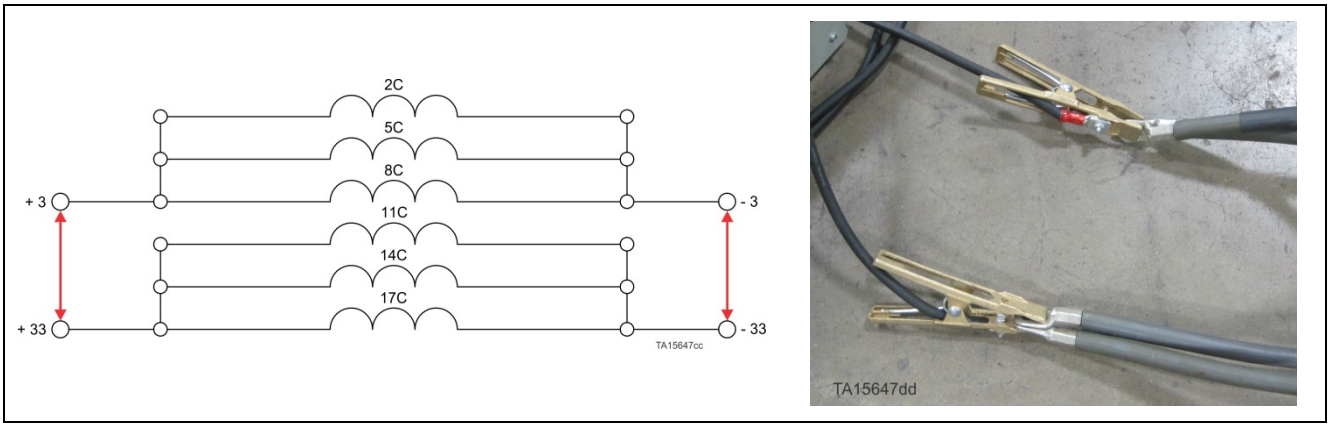



**Figure 319. Phase cable connections**

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.**

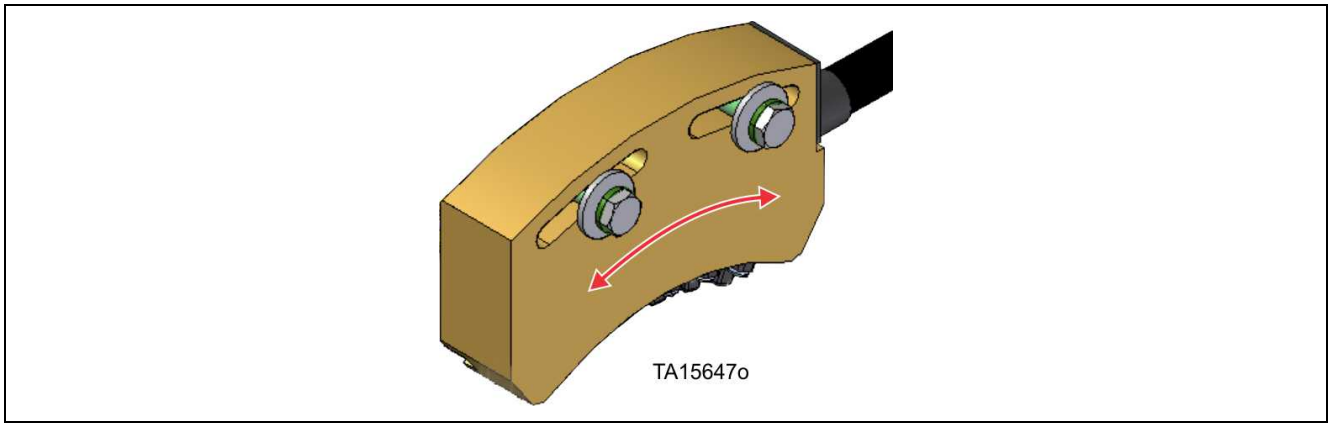



**Figure 320. RPT adjustment**

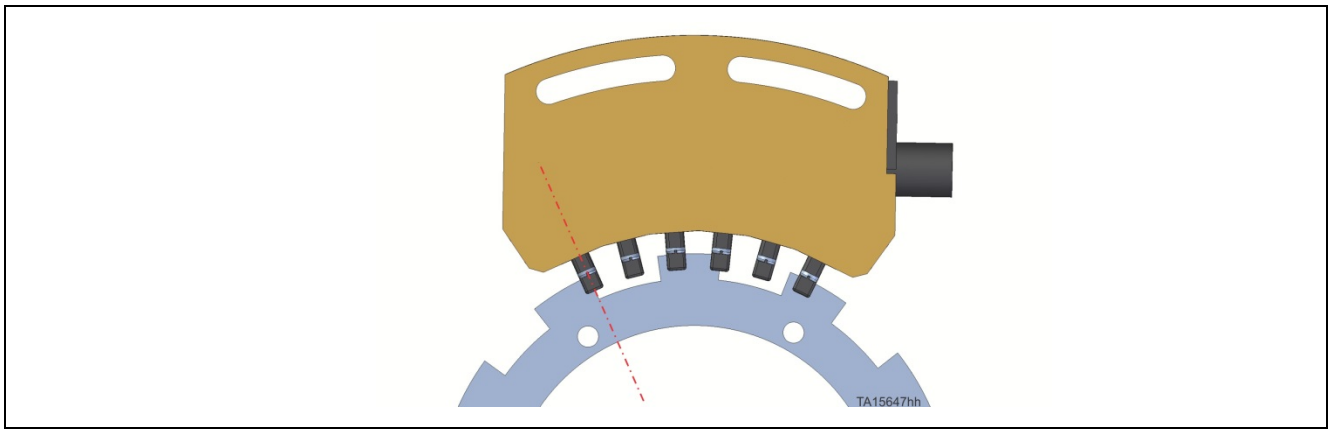



**Figure 321. Shutter aligned to RPT**

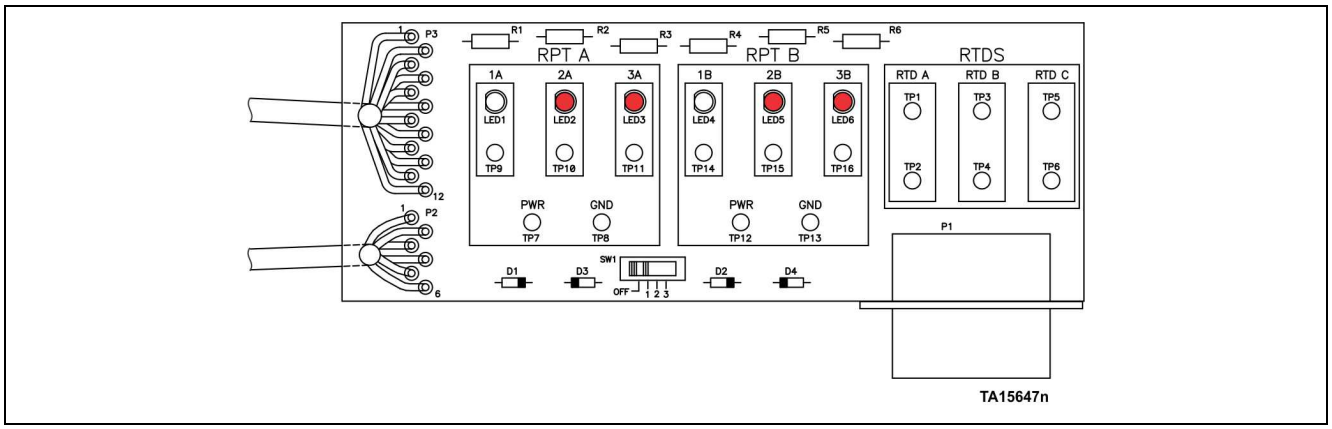



**Figure 322. Tester card Phase 3 LED's RPT aligned**

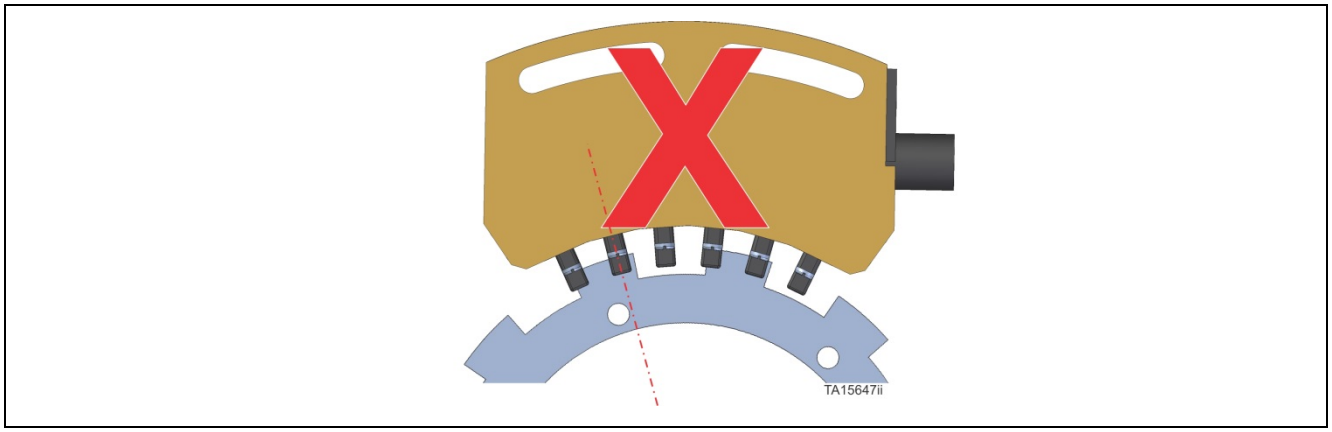



**Figure 323. Shutter incorrectly aligned to RPT**

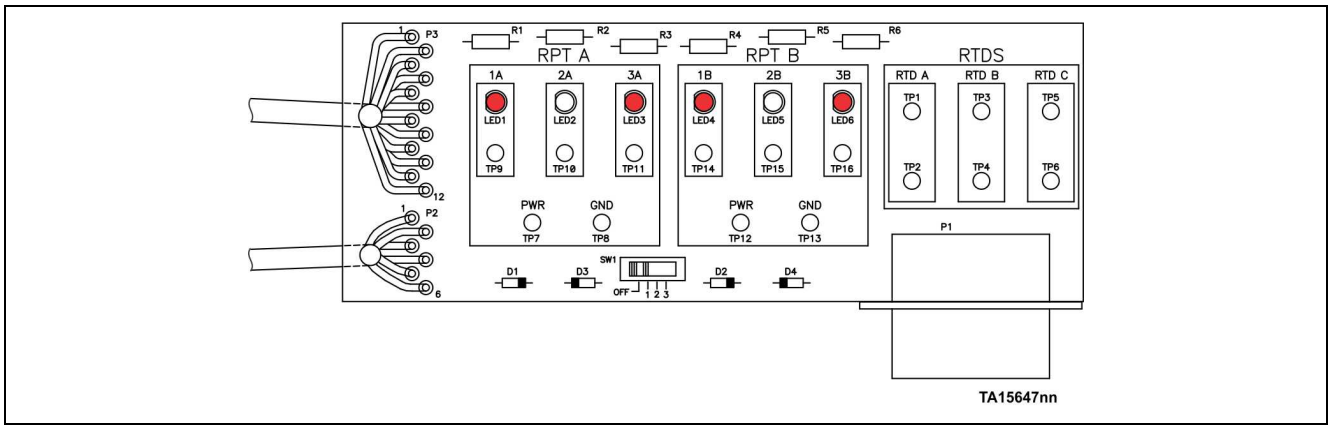



**Figure 324. Tester card Phase 3 LED's RPT incorrectly aligned**

6. Turn the rotor slightly in the counter clockwise direction and allow the rotor to return to its aligned position.

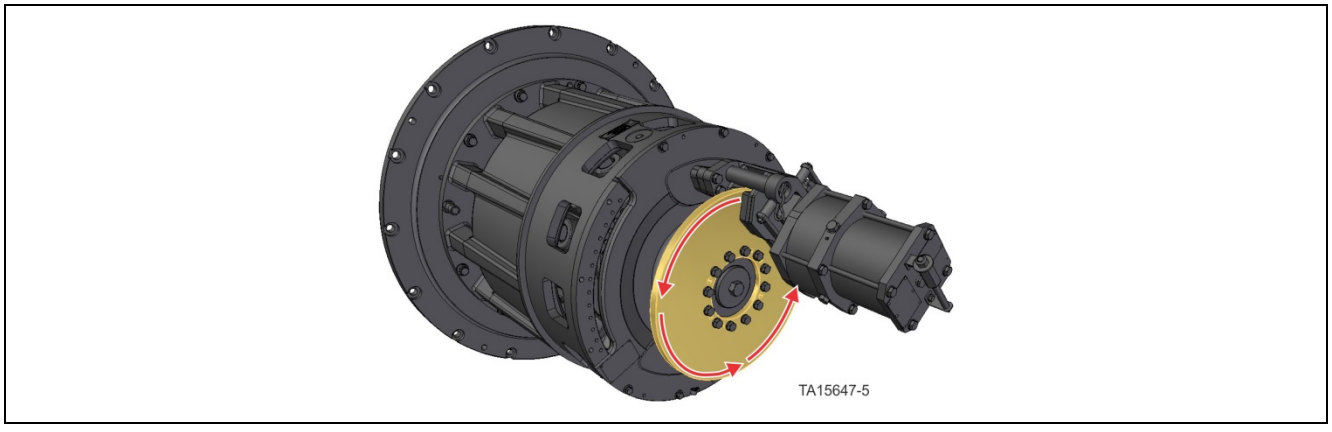



**Figure 325. Counter clockwise alignment**

# 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.**

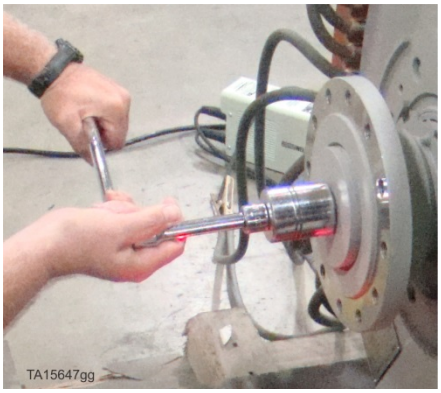



**Figure 326. Turning rotor with socket and flex handle**

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 327. 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.

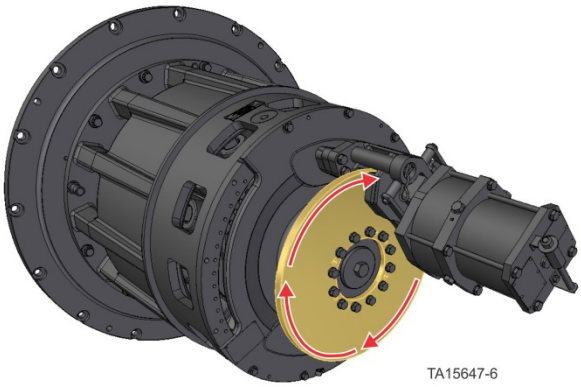



**Figure 328. Clockwise alignment**

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.

## Checking Phase 2

**⚠ WARNING**

**Risk of shock exists while performing the RPT settings. Make sure the welding unit is OFF prior to removing or attaching the welding leads to the terminal posts and before continuing with this test procedure. Fatal shock and equipment arcing is possible if trying to connect the welder 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 welder to 70 Amps and energize phase 2.

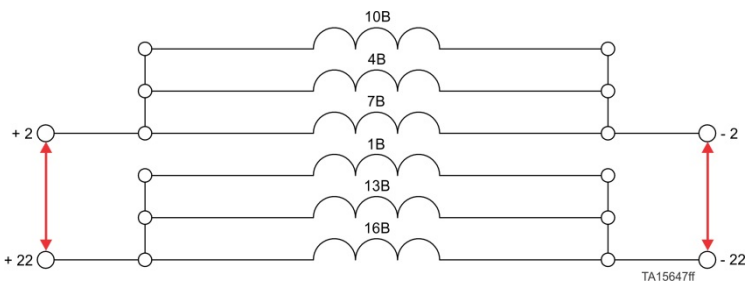




**Figure 329. Phase cable connections**

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 positon.

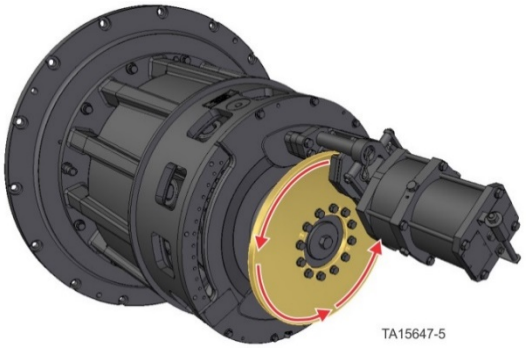



**Figure 330. Counter clockwise alignment**

6. Verify that both 2B and 2A LED's are ON.

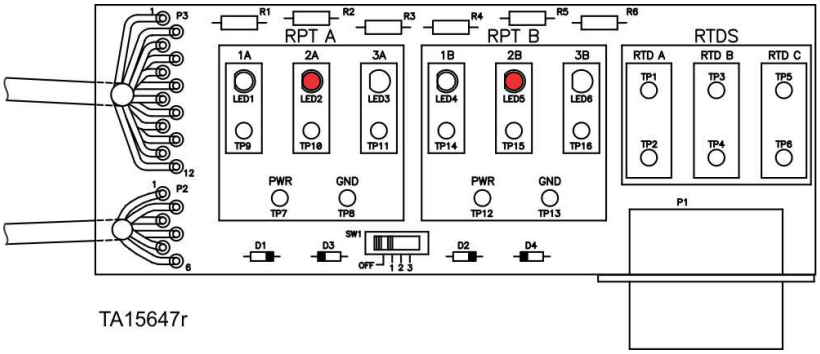



**Figure 331. Tester card Phase 2 LED's**

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.

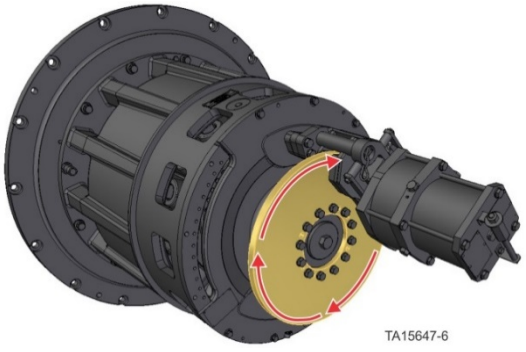



**Figure 332. Clockwise alignment**

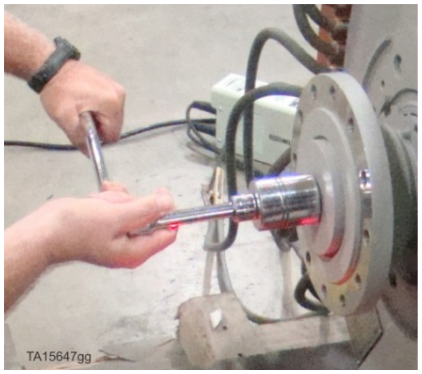



**Figure 333. Turning rotor with socket and flex handle**

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.

a. Be sure the pinion is clean and free of rust prior to installation.

b. Attach removal hub and removal arm.

c. Lubricate the splines and gear teeth with NLGI #2 lithium based grease.

d. 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.

e. Remove hub and arm and replace inspection plate.

f. Refill planetary drive with oil.

g. Reset brake on electric traction motor.

h. Move frame lock to unlocked position.

i. 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.**

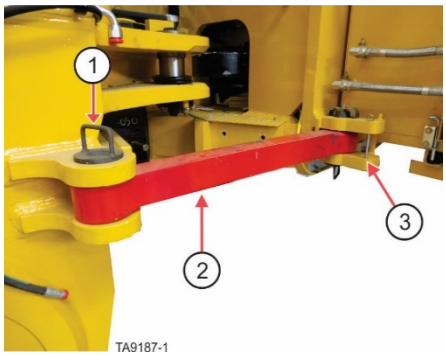
a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.

c. 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.**




**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

**Figure 334. Frame Lock**

d. Set bucket flat and level on the ground.

e. Set the parking brakes.

# 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 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.**

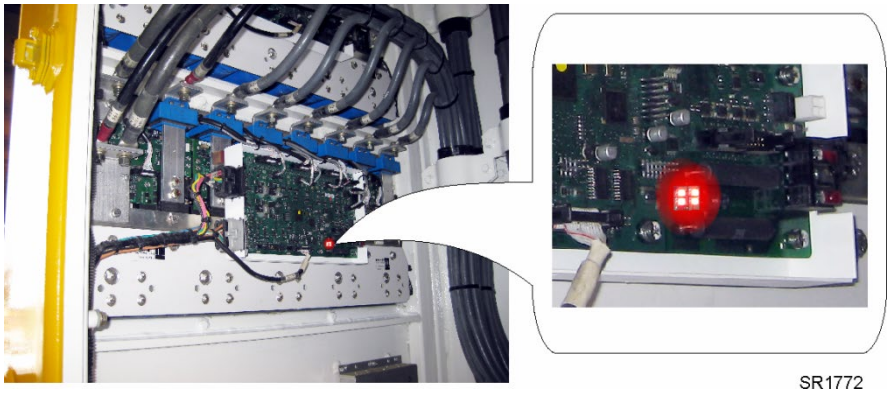



**Figure 335. Converter assembly bus LED's**

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

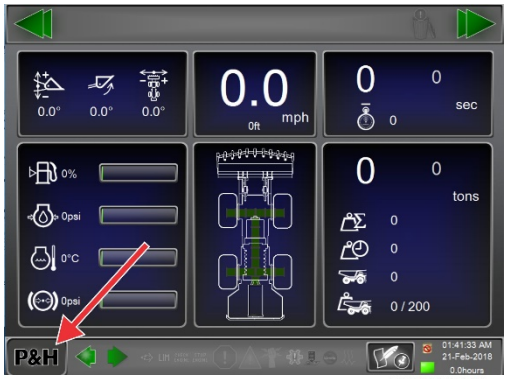
1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

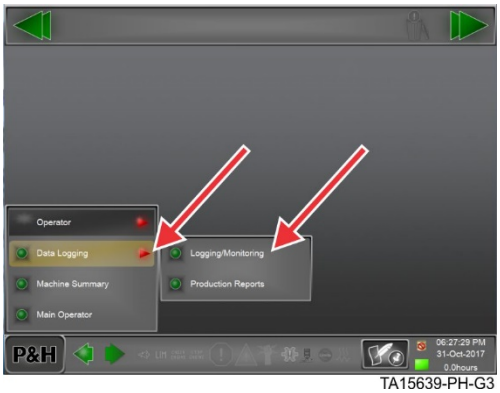
# In Cab Verification Using LINCS II Display

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

2. As shown in the figure below, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.




**Main Menu Button**




**Data Logging & Logging/Monitoring**

**Figure 336. LINCS logging/monitoring menu access**

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

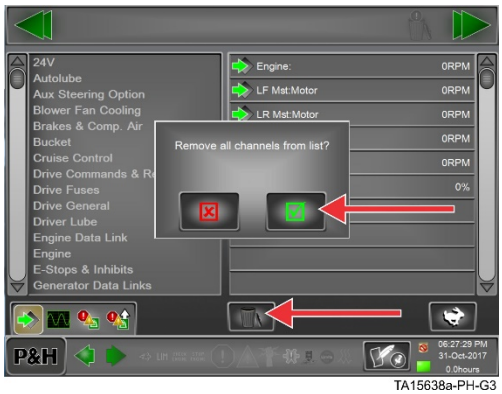



**Figure 337. Remove channels**

4. Scroll down the left hand list until Drive Fuses is displayed.

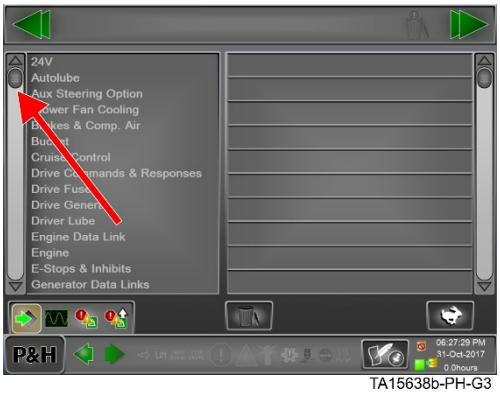



**Figure 338. Left hand scroll**

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

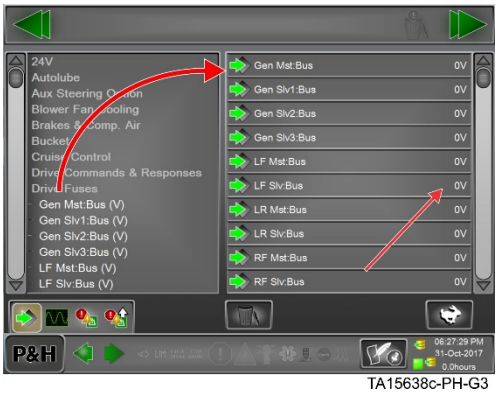



**Figure 339. Bus voltage indication**

6. 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.**

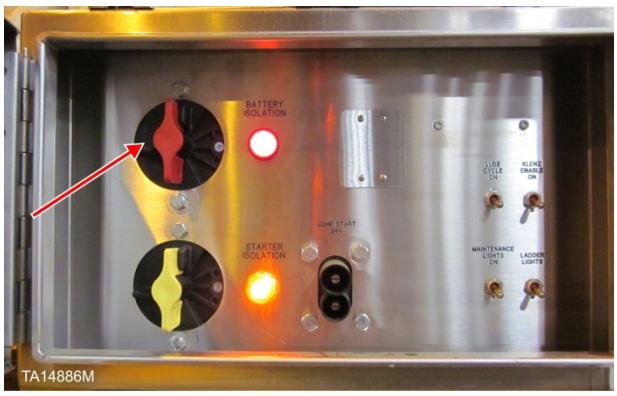
7. Turn the key switch to the OFF position and proceed to the next step in the verification process.

# 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 24VDC power is isolated at the battery disconnect (turned off and locked out) per site requirements.





**Isolate the battery and lockout the machine**

**Figure 340. Isolation and control switch assembly**

- The SR electrical converter cabinet door should 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.

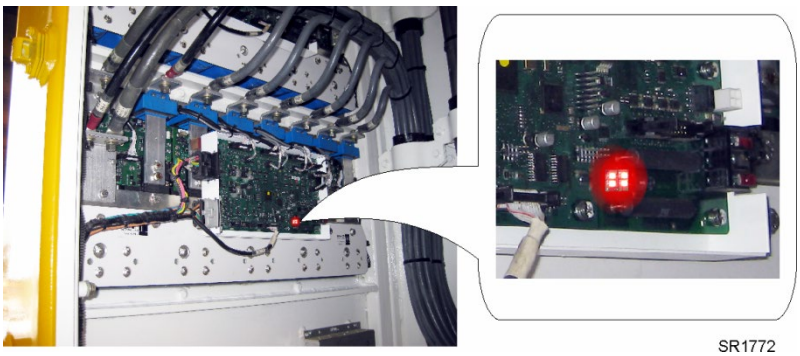



**Figure 341. Bus voltage LED array on SR control board**

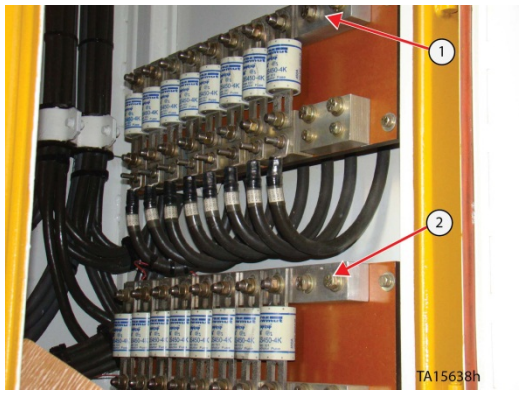
# Verification by Physical Measurement Main Bus Bars

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.

a. 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.**




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

**Figure 342. Main bus bars**

## 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.

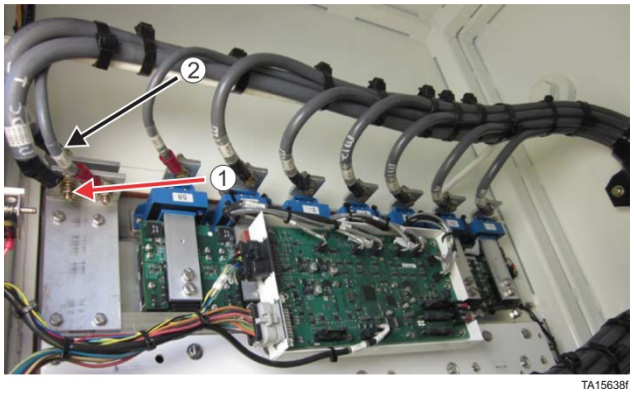
# NOTICE

**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.


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

**Figure 343. Converter assembly bus connections (rear of cabinet)**




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

**Figure 344. Converter assembly bus connections (front of cabinet)**

# 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.

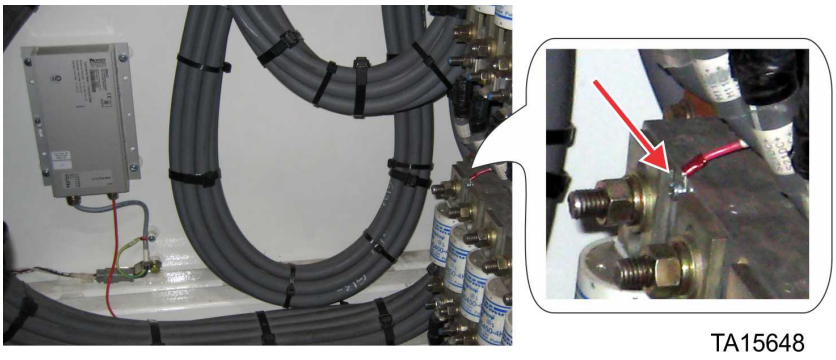
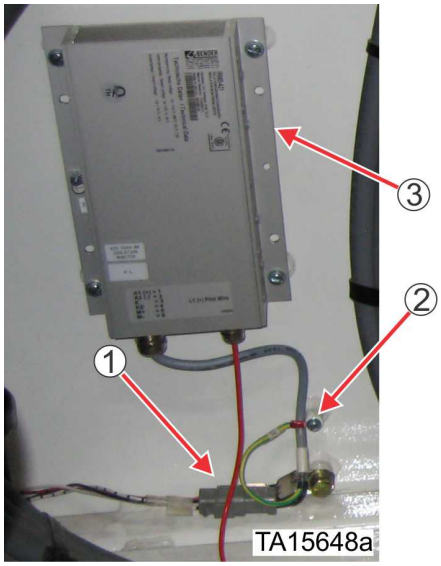



**Figure 345. Sense wire connection negative bus bar**

3. Unplug the 6-pin Deutch connector.
4. Remove the ground connector.
5. Remove and replace the fault isolation monitor.




**1)** 6-pin Deutch connector, **2)** Ground connector, **3)** Isolation monitor

**Figure 346. Isolation monitor connections**

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.

# Low Impedance Test

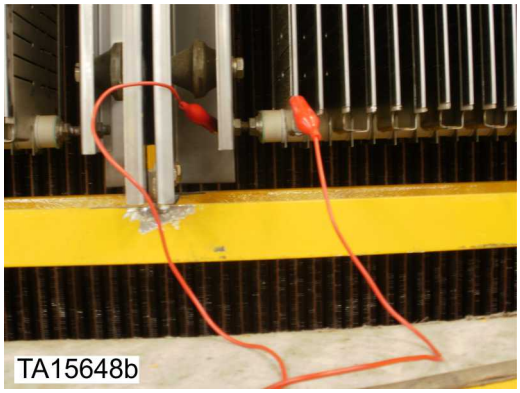
**⚠ WARNING**

**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.**

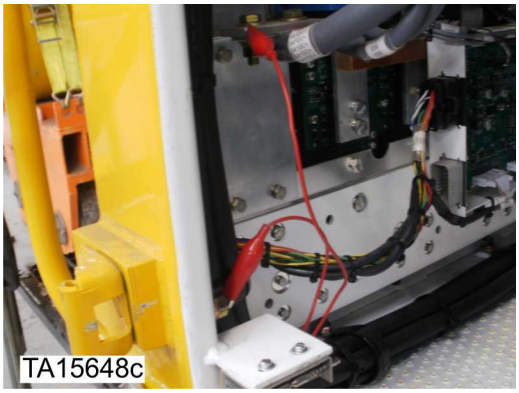
**⚠ WARNING**

**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).




**Frame to Grid**




**Frame to Bus**

**Figure 347. Isolation monitor ground test**

2. Close the battery disconnect.
3. Boot LINCS.
4. After approximately 10 seconds, LINCS should display a condition of "Bus Isolation Resistance Low".


**Figure 348. Bus isolation resistance low fault**

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 in non compliance of this warning.**

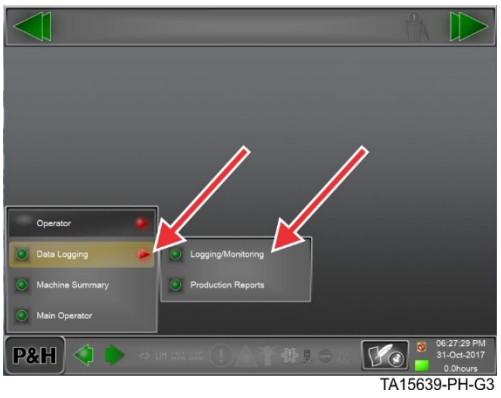




**Figure 349. HV bus isolation resistance reading**

6. Once test has been completed, shut down LINCS and follow Bus Discharge Procedure.

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 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.

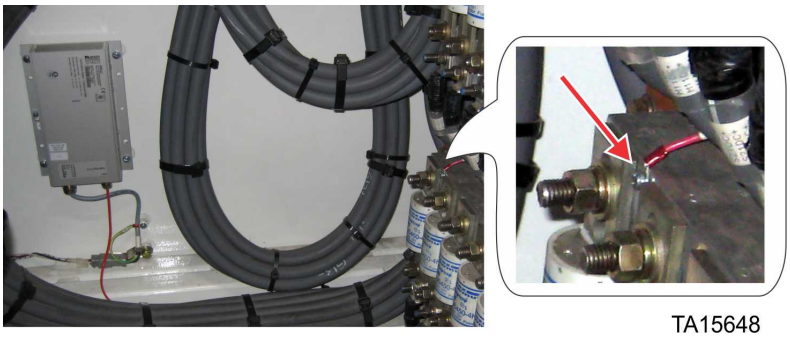



**Figure 350. Sense wire connection negative bus bar**

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.

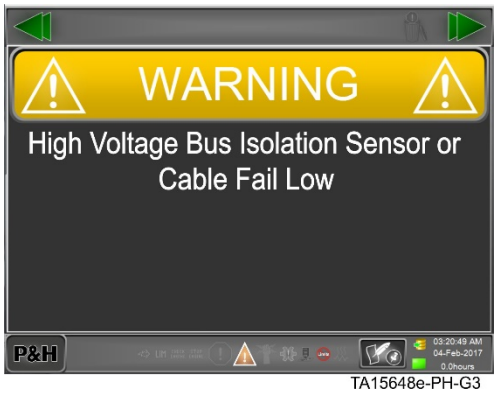



**Figure 351. HV bus isolation sensor or cable fail**

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 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.