

SR Safety

Section 06-03-01 Gen2



Manual Number 0000

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Preface

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

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

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

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

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Safety

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



DANGER

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




WARNING

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



CAUTION

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

CAUTION

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

NOTICE

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

Safety Warnings and Cautions

ELECTRICAL SHOCK

- Risk of shock or injury by contact in the electrical cabinet, axles, or at the braking grids is possible. Converter Bus voltage of up to 750VDC can be present in the electrical cabinet and axle areas, and up to 375VDC at the braking grids when the engine is running or the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. Do not enter or touch any components in the electrical cabinet, do not remove the axle covers or enter the axle area, and do not open the door over the braking grids or touch anything on the grids if the engine is running or the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. Perform the Bus Discharge Verification Procedure before entering the electrical cabinet, axle housing, or the braking grid enclosure. Failure to do so may result in shock or other injury.
- Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation 2 SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

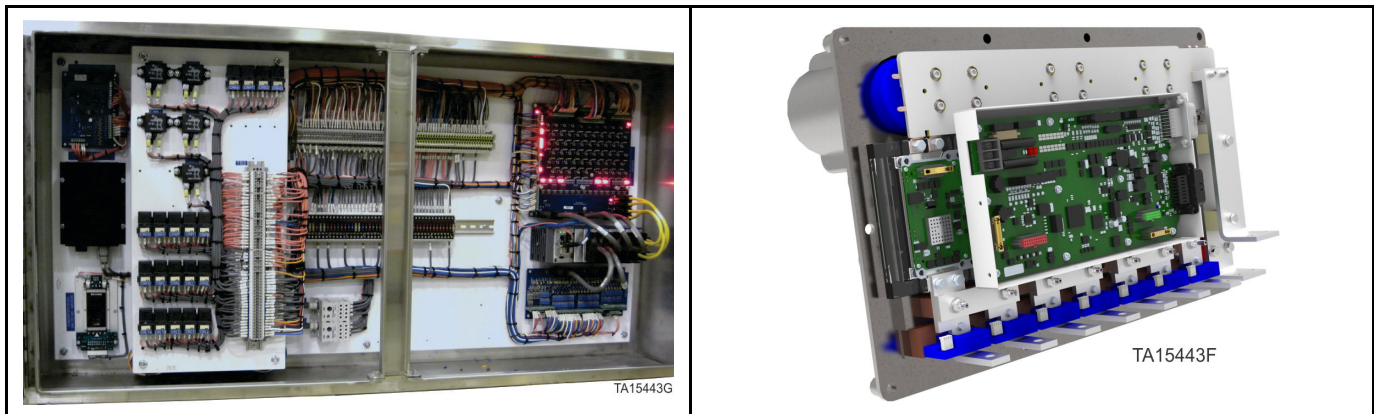
- Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.
- Risk of shock or injury by contact of the braking grids is possible. Do not 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. Failure to do so may result in shock or other injury.

Switched Reluctance (SR) Drive System Safety

NOTICE

Instructions and data contained herein are applicable to the GENERATION2 machines with switched reluctance motors and drive system.

Figure 1: SR drive electrical components



CAUTION

The diagnostic and repair procedures contained in this publication may require the removal and installation of cards or assemblies. Removal or installation of any card or assembly with the key switch ON may result in an arc or a short to the components resulting in damage ruining the electronics. Place the key switch in the OFF position and wait for the VCU (Vehicle Control Unit) to power down before attempting repair or replacement of any card or component. This caution must be adhered to without exception to avoid component damage.



WARNING



Risk of shock or injury by contact in the electrical cabinet, axles, or at the braking grids is possible. Converter Bus voltage of up to 750VDC can be present in the electrical cabinet and axle areas, and up to 375VDC at the braking grids when the engine is running or the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. Do not enter or touch any components in the electrical cabinet, do not remove the axle covers or enter the axle area, and do not open the door over the braking grids or touch anything on the grids if the engine is running or the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. Perform the Bus Discharge Verification Procedure before entering the electrical cabinet, axle housing, or the braking grid enclosure. Failure to do so may result in shock or other injury.

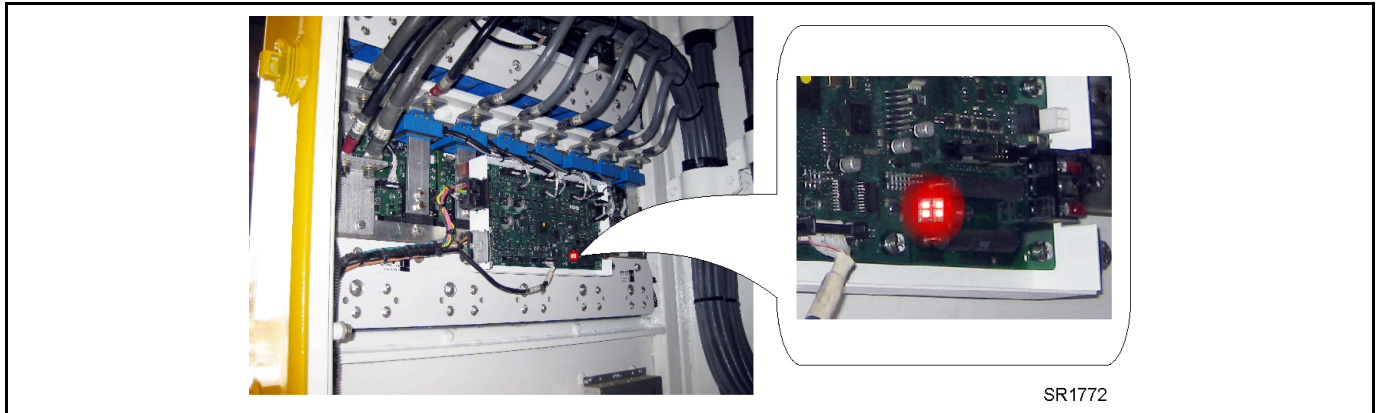
NOTICE

The converter panel has several circuits with red LED's that will either be constantly illuminated, flashing, or off. The bus voltage LED's are distinct by the high intensity.

NOTICE

Under normal operating conditions the bus will almost instantly discharge once the machine has been shut down. However, under some fault conditions, the bus discharge circuit may become damaged. Under these conditions, bus discharge may require a longer period of time.

Figure 2: Converter bus LED lights



Bus Discharge Verification Procedure

Converter Bus Voltage

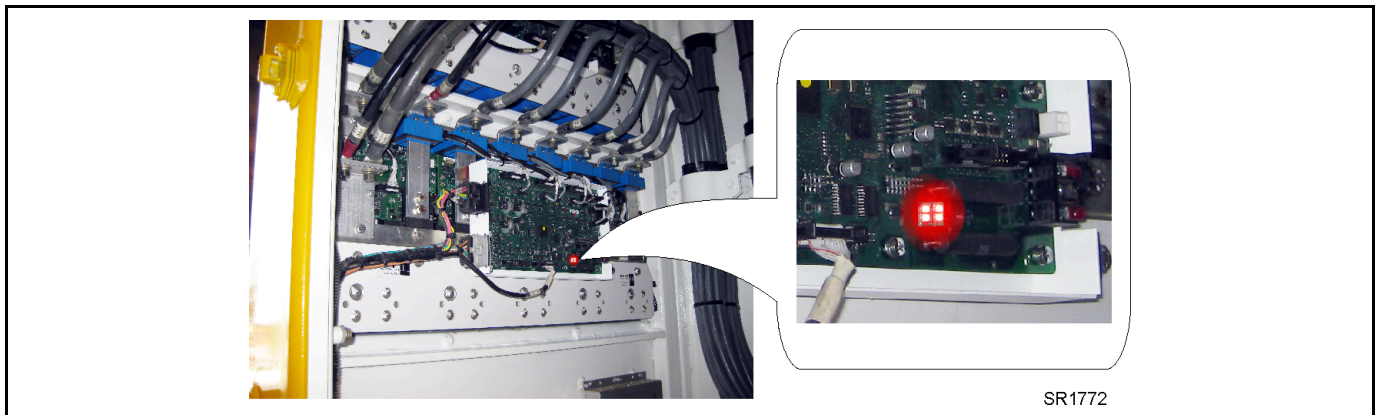


WARNING



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

Figure 3: Converter assembly bus LED's



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

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

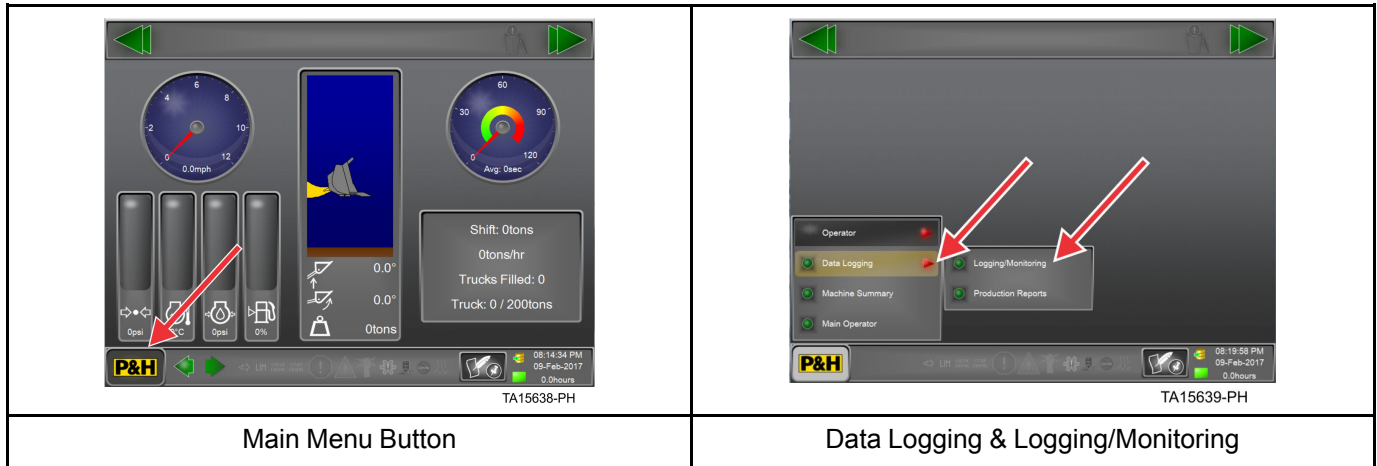
In Cab Verification Using LINCS II Display

Before You Begin

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

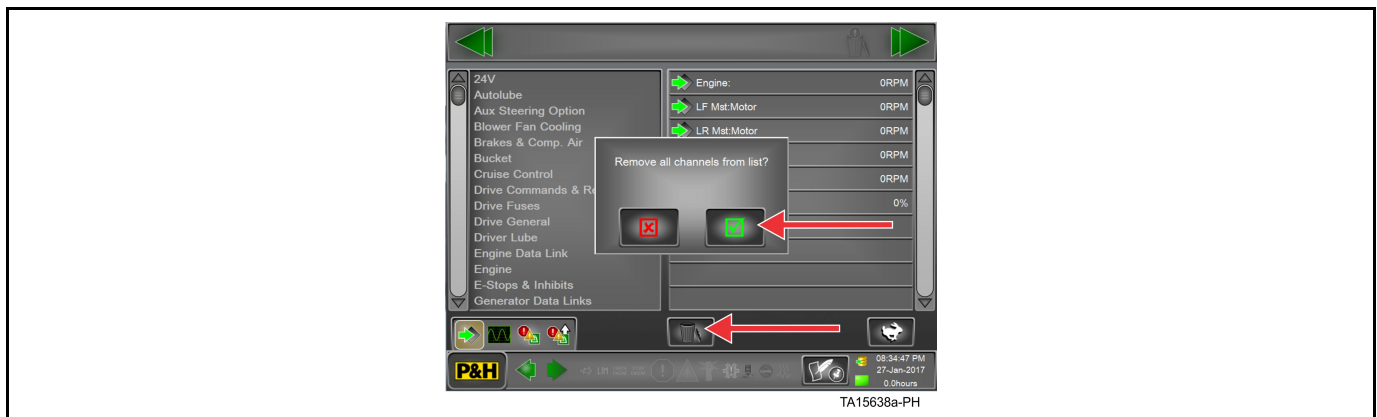
Step 1: As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging and Logging/Monitoring.

Figure 4: LINCS logging/monitoring menu access



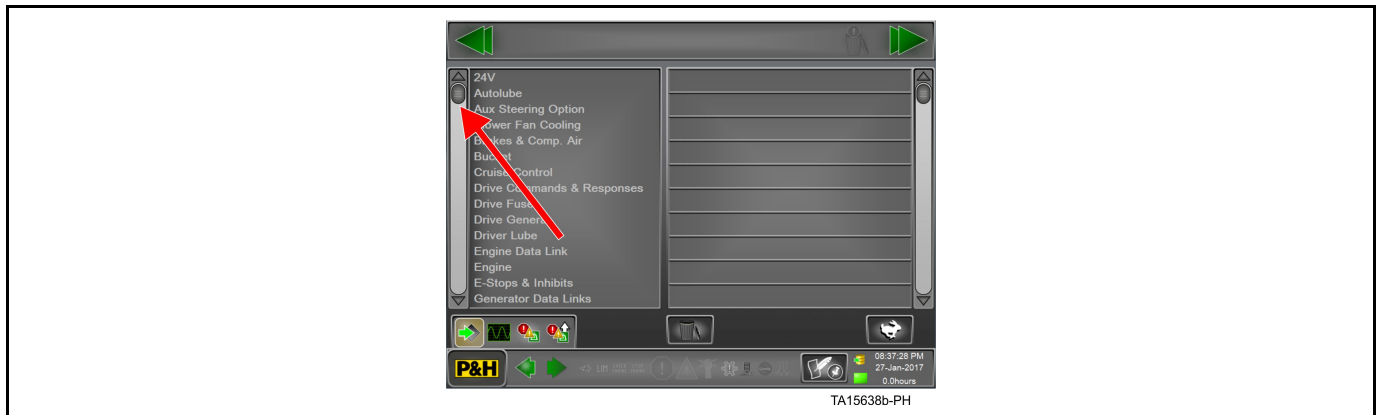
Step 2: Select the Trash Can icon and select the Check Mark to clear any selection on the right hand side of the screen (if applicable).

Figure 5: Remove channels



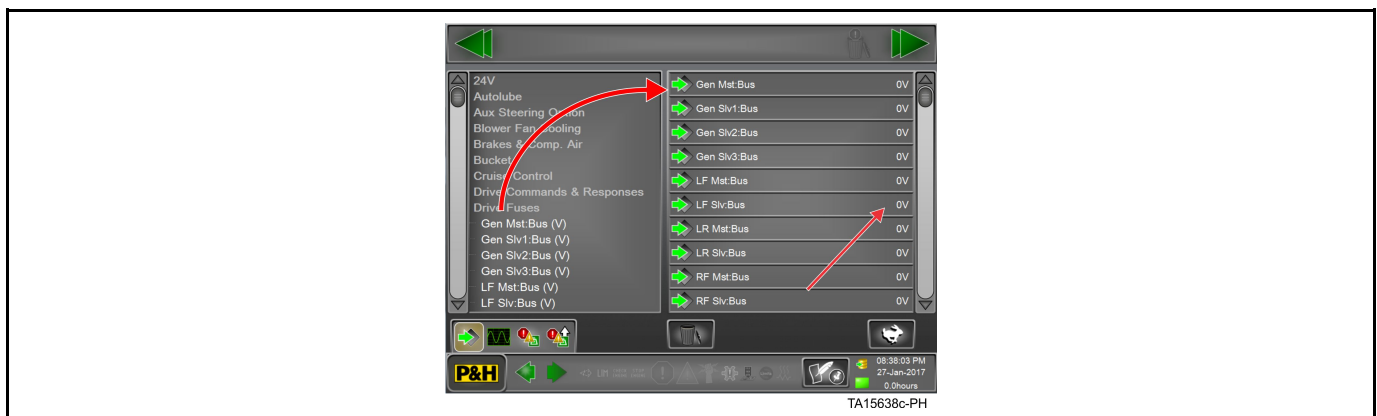
Step 3: Scroll down the left hand list until Drive Fuses is displayed.

Figure 6: Left hand scroll



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

Figure 7: Bus voltage indication



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

NOTICE

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

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

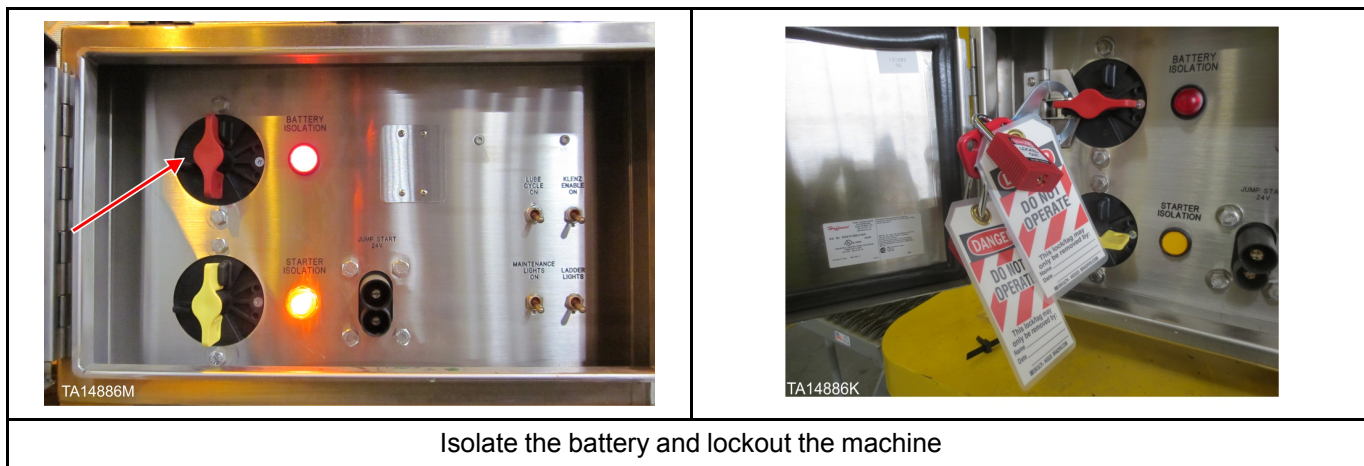
Verification by Visual Indication

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

To conduct this test, ensure that:

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

Figure 8: Isolation and control switch assembly

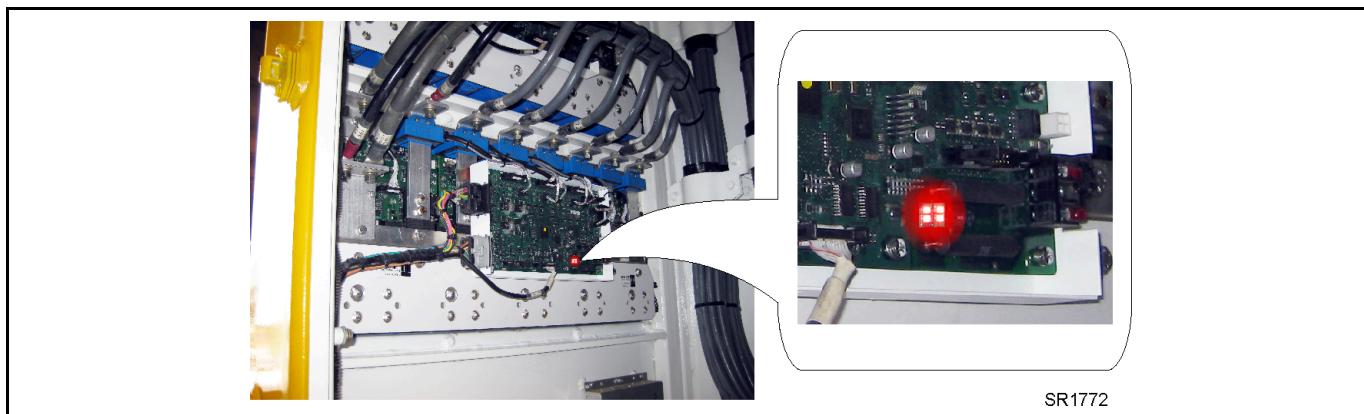


Isolate the battery and lockout the machine

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

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

Figure 9: Bus voltage LED array on SR control board



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

Verification by Physical Measurement Main Bus Bars

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

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

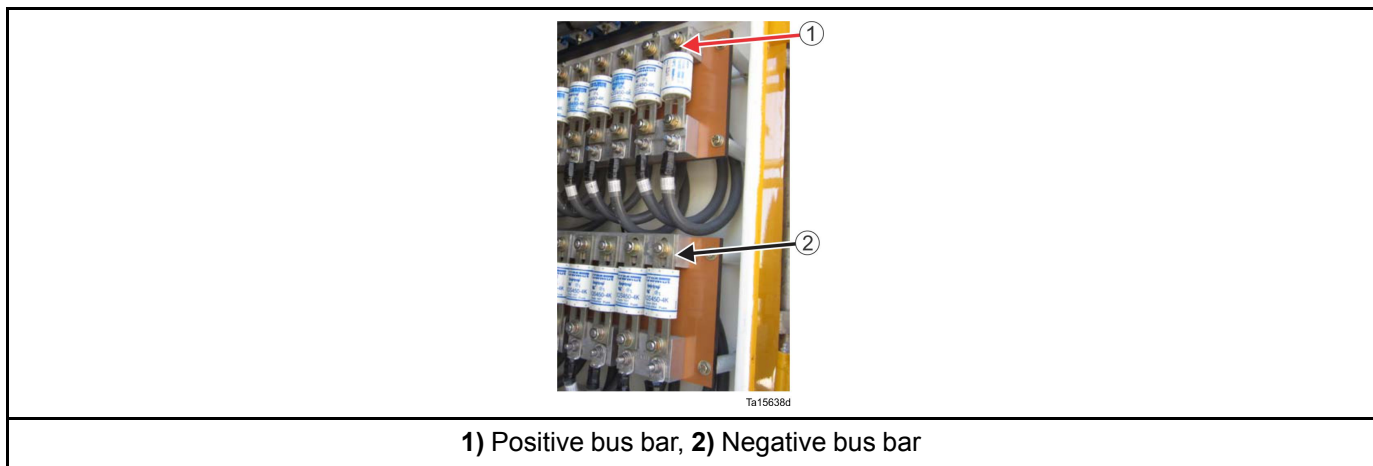


WARNING



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

Figure 10: 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.

Figure 11: Converter assembly bus connections (rear of cabinet)

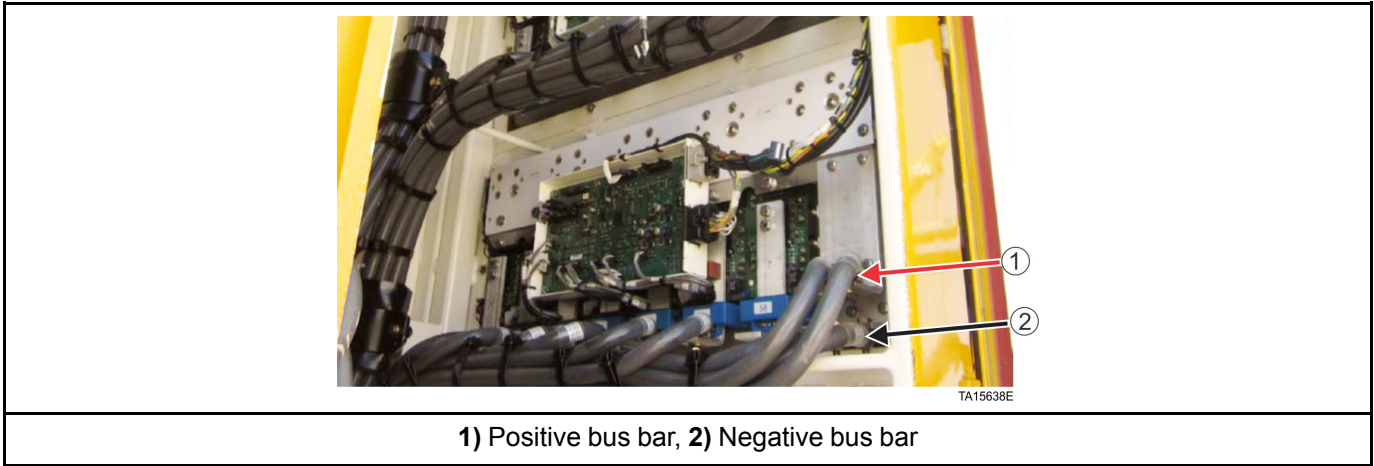
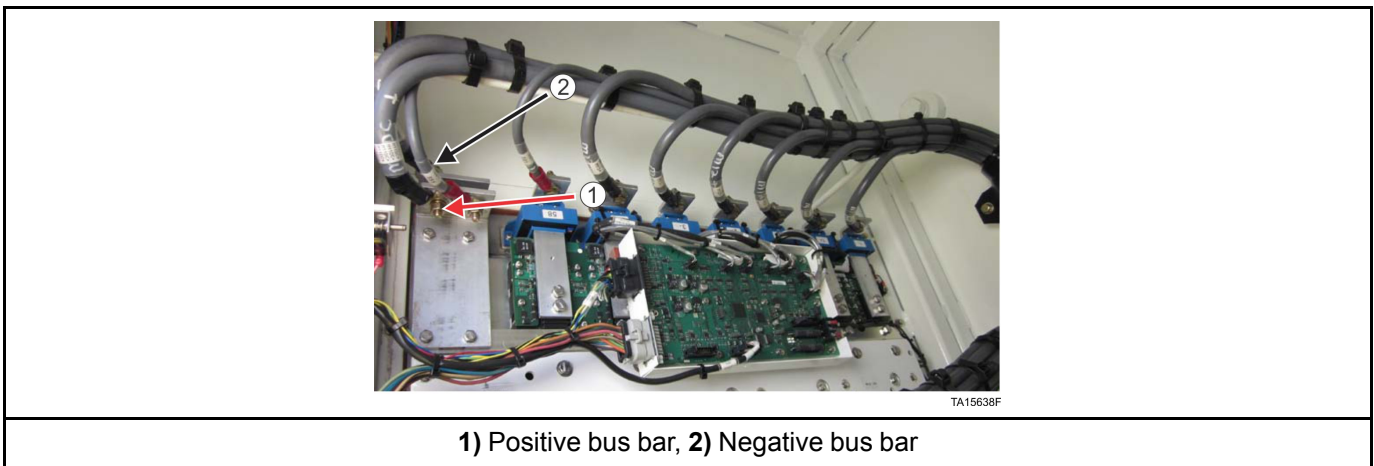


Figure 12: Converter assembly bus connections (front of cabinet)



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

Braking Grids

Braking grids are located at the rear of the machine to dissipate energy and provide electrical braking capability. These grids are connected to one side of the electrical bus. They have high voltage present at all times that bus voltage is present.

⚠ WARNING



Risk of shock or injury 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. Failure to do so may result in shock or other injury.

NOTICE

Under some fault conditions, the bus discharge circuit may become damaged. Under these conditions, bus discharge may require a longer period of time.

Figure 13: LINCS II grid connections

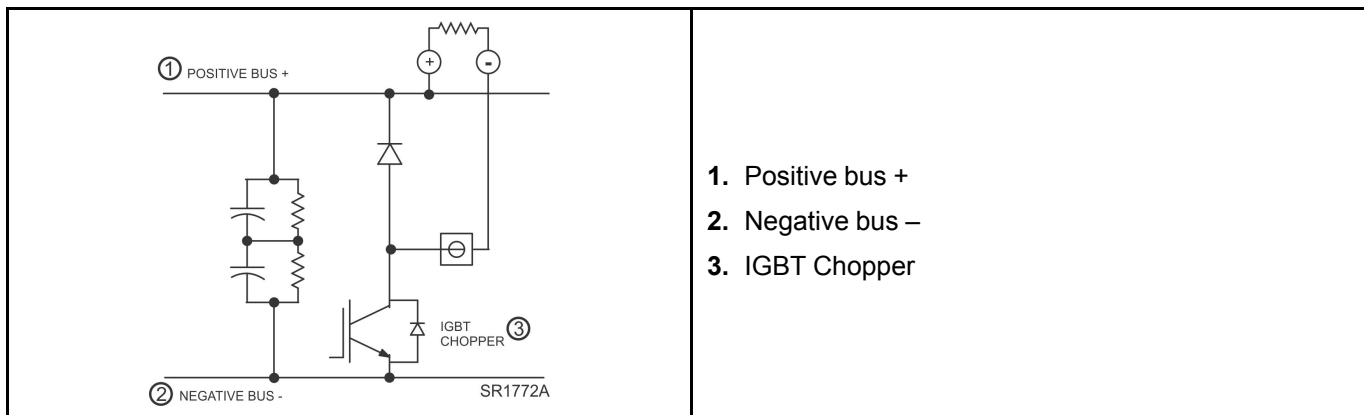
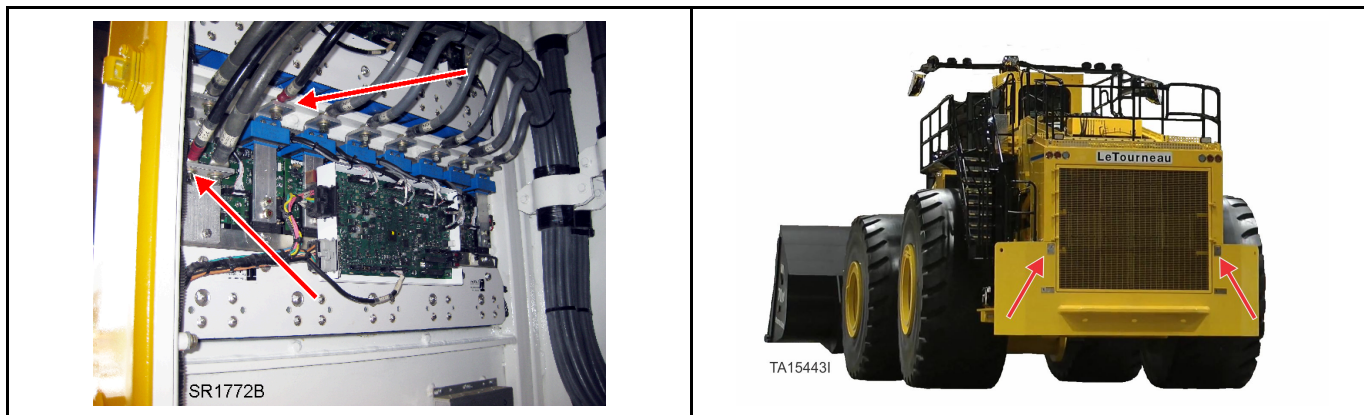


Figure 14: LINCS II braking grids – connections – warning labels



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