

SR Drive System Components

Section 06-03-03 Gen2



Manual Number 0001

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Preface

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

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

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

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

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Scope of This Publication

SR Drive System Component Description contains general component and safety information for SR drive components. Listed on the Safety page are signal words, symbols and their meanings that may precede this information.

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Safety

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



DANGER

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




WARNING

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



CAUTION

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

CAUTION

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

NOTICE

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

Safety, Warnings and Cautions

It is important that all personnel read and understand all CAUTIONS and WARNINGS before operating or working on or near the machine.



WARNING

ELECTRICAL SHOCK

- 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.
- Risk of shock or injury by contact in the electrical cabinet is possible. The system was designed to provide very high bus resistance to frame, in order to limit current to a non-fatal level. Circumstances may still exist where serious injury or death may occur. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

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Motors/Generators

Figure 1: Motors & Generators



Motors

The SR Hybrid Drive motor is a dual bearing, bi directional 4 quadrant motor. This means the motor is capable of running in both directions and operating in power mode or generator mode for retarding. The motor does not use any brushes and the only wear parts are the bearings. Depending on the model, the motor can be rated up to 4500 rpm and runs at varying speeds depending on the command and limits of the machine.

Some advantages of the SR motor are:

- No commutator maintenance – there are no brushes or brush rigging.
- Unit can run forward or backward as either a motor or a generator.
- Rotor is simply a stack of laminated steel plates.
- All coils are stationary.

Generators

The SR Hybrid Drive generator is a single bearing generator. It does not use any brushes. The endbell and bearing components on the generator are the same or similar to those used on the 4B, 7B, 9B and 6R AC generators for parts commonality. There were some small changes to allow mounting of the RPT assembly.

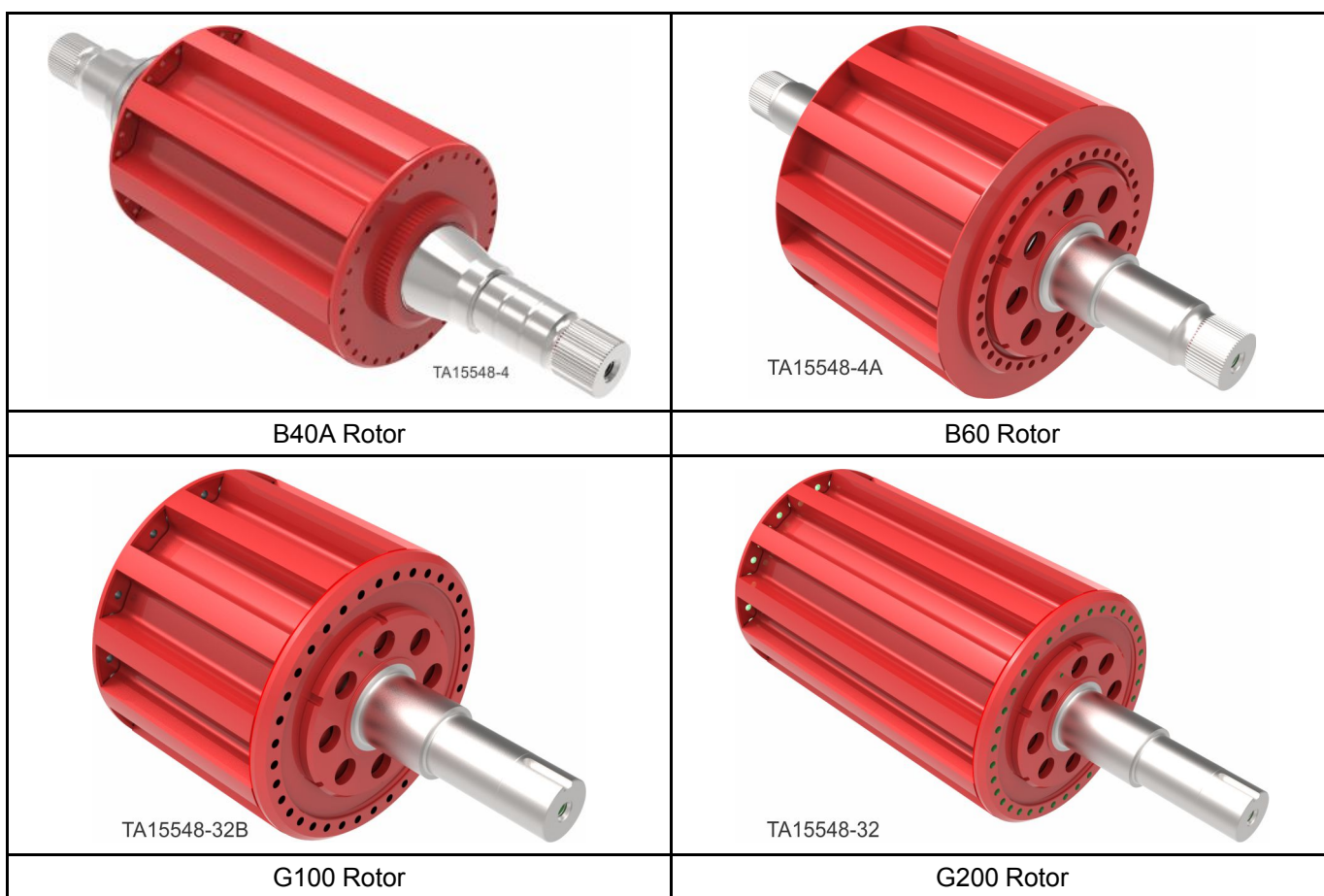
The generator turns at engine speeds and is capable of output power at all engine rpm.

As with all SR motors or generators the number of poles on the rotor is different from the number of poles on the stator.

Motor and Generator Rotors

The rotor does not have any copper – it consists of laminations with poles mounted on a shaft and pressed and held together with plates at each end.

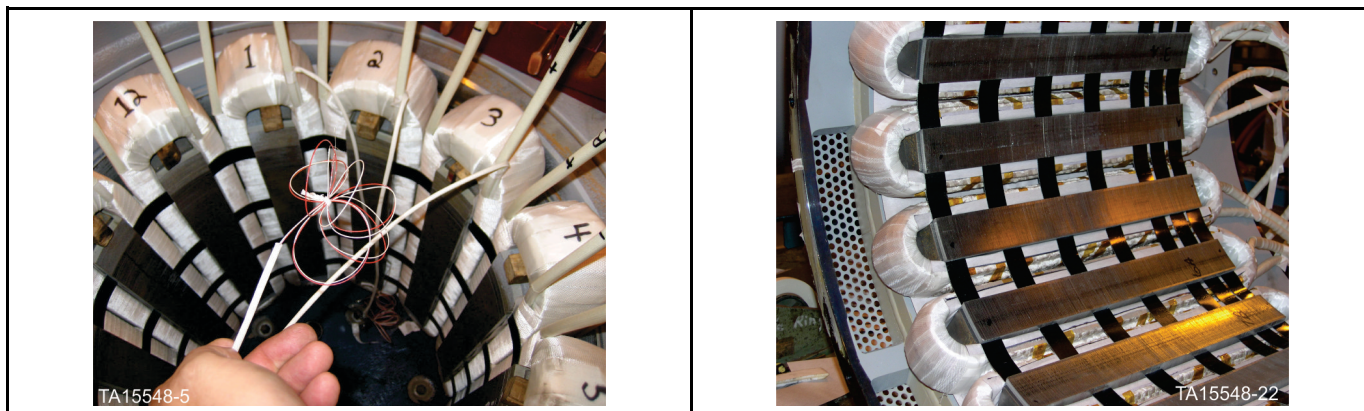
Figure 2: Motor and generator rotors



Stator Coils

Each pole of the stator has a single multi-turn coil of copper wire. These coils are installed in a “green” state (no epoxy or varnish in the coil) and then the stator is processed in a VPI (Vacuum Pressure Impregnated) system to fully impregnate the coil and adhere the coil to the stator pole.

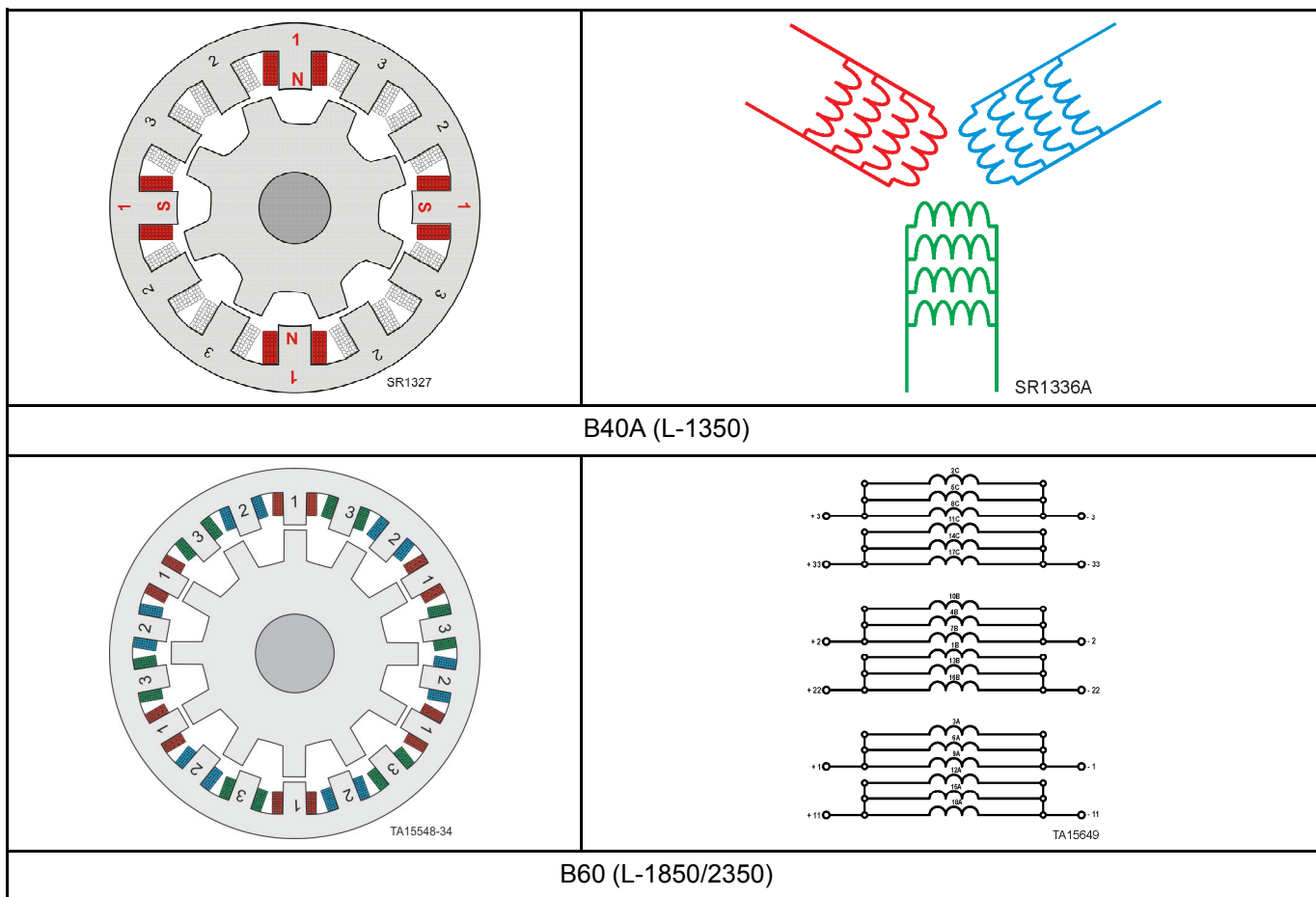
Figure 3: Stator coils



Motor Stator Coils/Connections

The coils are joined in parallel in 3 groups. All of the coils in a group are energized at the same time.

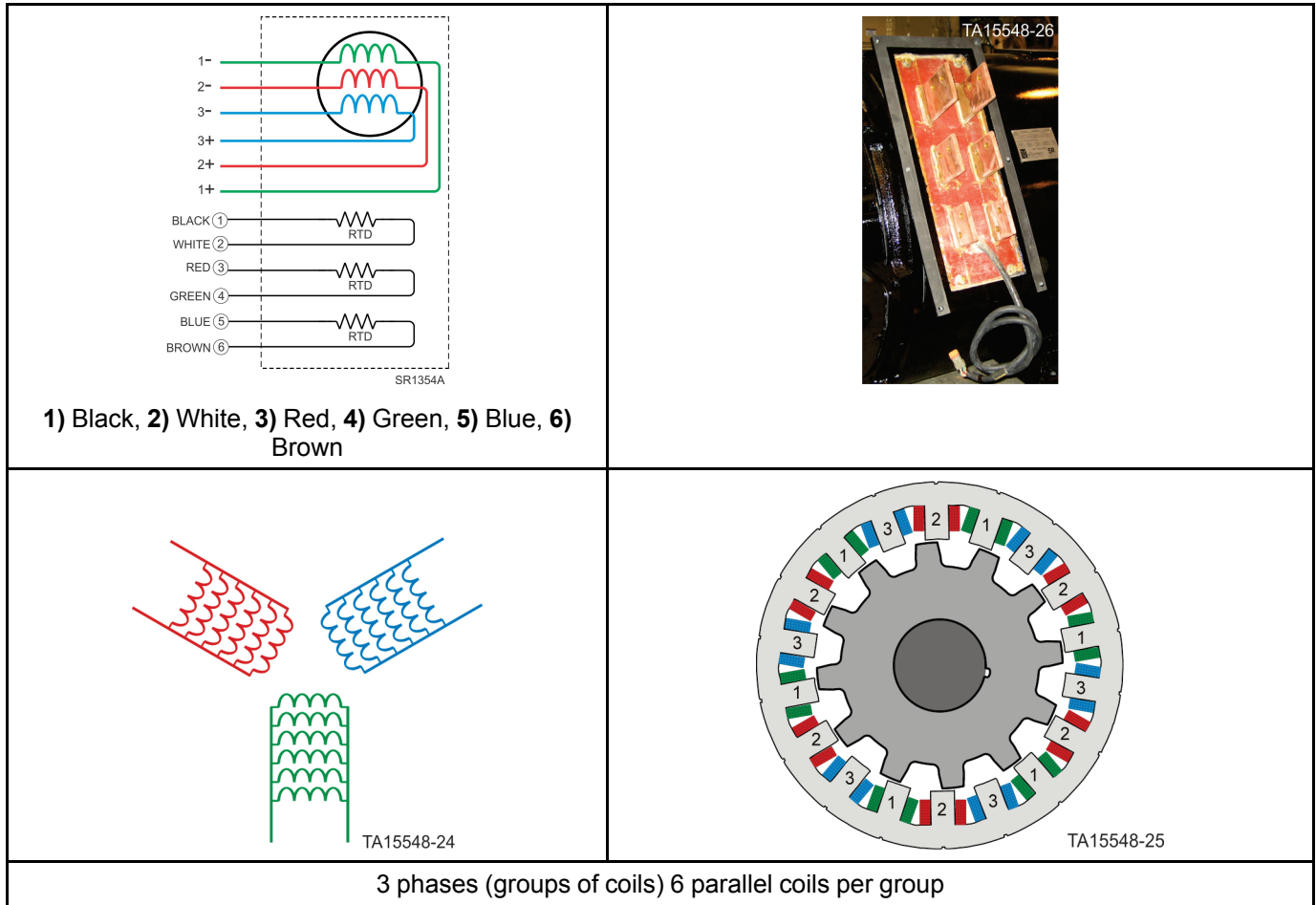
Figure 4: Motor coil groups/connections (typical)



Generator Stator Coils/Connections

The coils are joined in parallel in 3 groups. All of the coils in a group are energized at the same time.

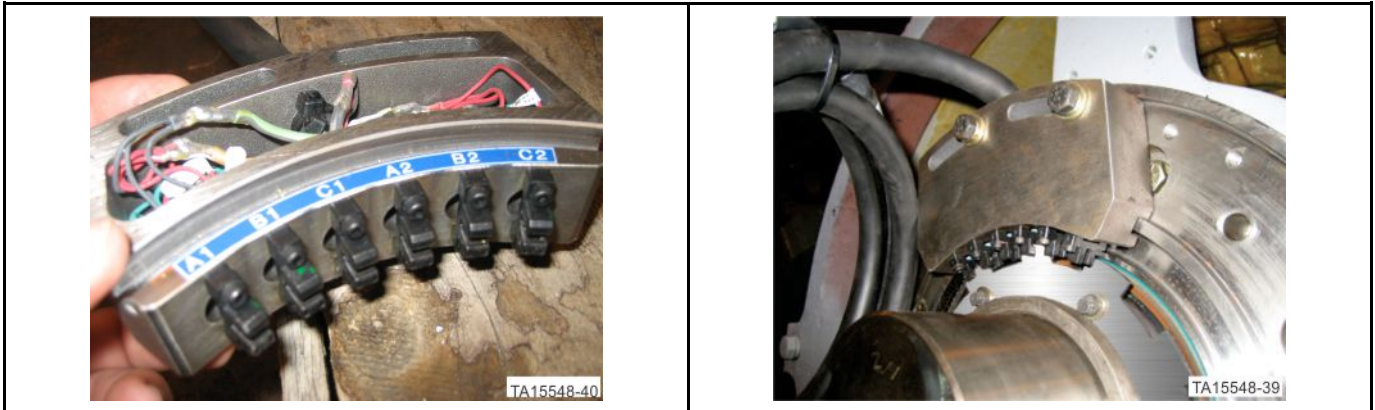
Figure 5: Generator coil groups/connections (typical)



RPT (Rotor Position Transducer)

The position and speed of the motors and generator are determined by use of RPT (Rotor Position Transducer). The RPT's are mounted near the drive shaft on the generator and near the brake disk on the motors. The RPT looks at the position of the shutter tabs as they pass through the sensor. Only three of the 6 RPT's are used at any one time. The other 3 are spares.

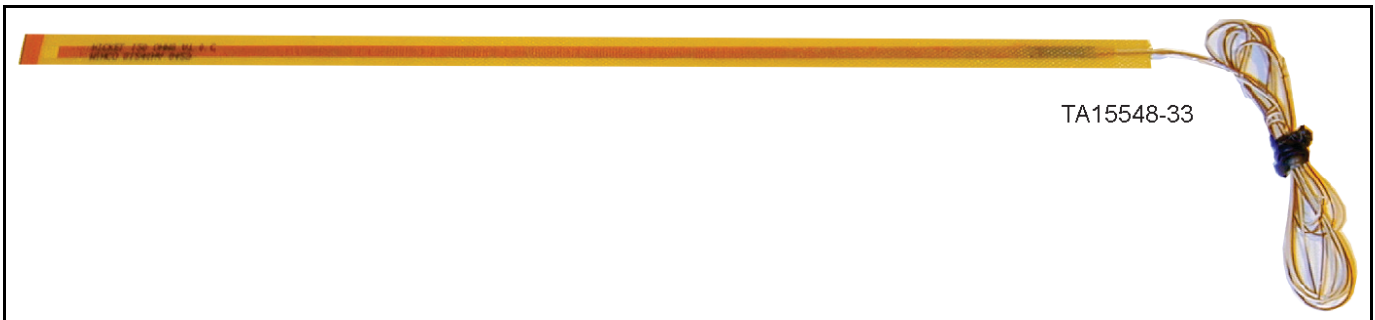
Figure 6: RPT assembly



RTD'S (Resistance Temperature Detectors)

The temperature of the motor and generator are monitored by RTD devices. These are installed along with the coils during fabrication of the stator. The stator is then VPI'd (Vacuum Pressure Impregnated). These devices cannot be changed without changing the coil.

Figure 7: RTD (Resistance Temperature Detector)



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Braking Grids

Braking grids, located at the rear of the machine, are designed to dissipate energy and provide electrical braking capability. These grids are connected to one side of the electrical bus. Whenever bus voltage is present, the grids always have voltage 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.

L-1350: Each motor chopper has one grid (total 4), with each grid measuring 2.2 ohms.

L-1350: Two grids on two generator converter panels (total 2), with each grid measuring 2.2 ohms.

L-1850/2350: Each motor chopper has two grids (total 8), with each grid measuring 2.2 ohms.

NOTICE

All converters have built in chopper circuits; however, based on the loader model, not all converters have grids connected to them. In some cases, a generator converter will have a grid connected to it to assist in dissipating energy. Keep in mind the system uses a common bus to which all converters are connected. When bus energy needs to be dissipated across the grids, all choppers receive the command regardless if they are connected to a grid or not.

Machine Type	Total Converter Panels	Number of Grids
L1350	7	6
L1850, L2350	12	8

Figure 8: Converter panel bus LED's

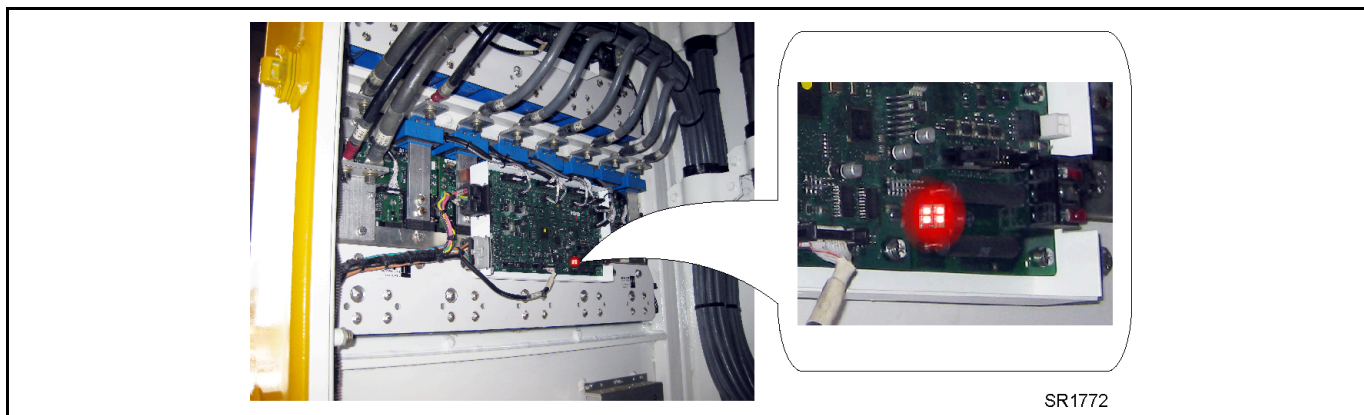


Figure 9: Grid connection schematic

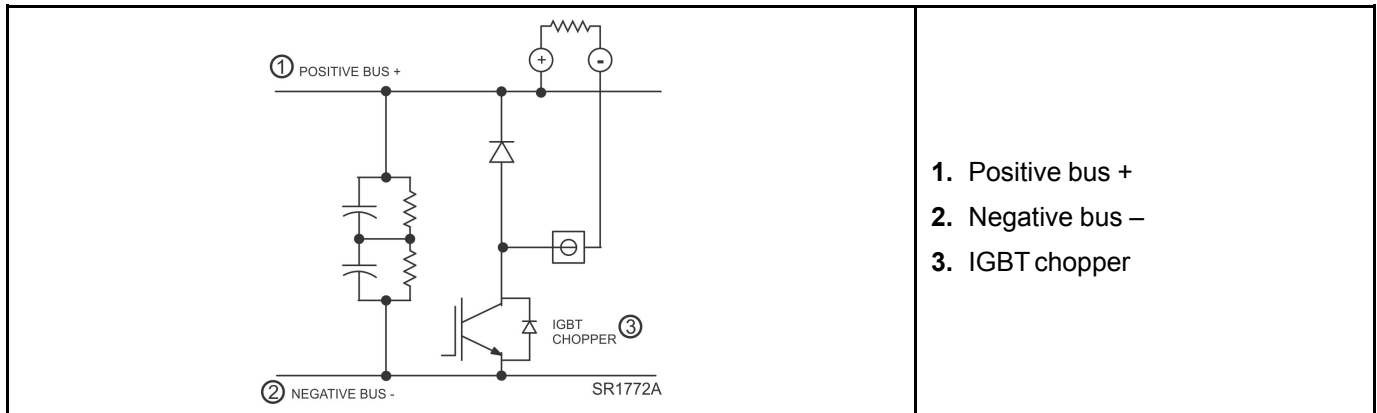
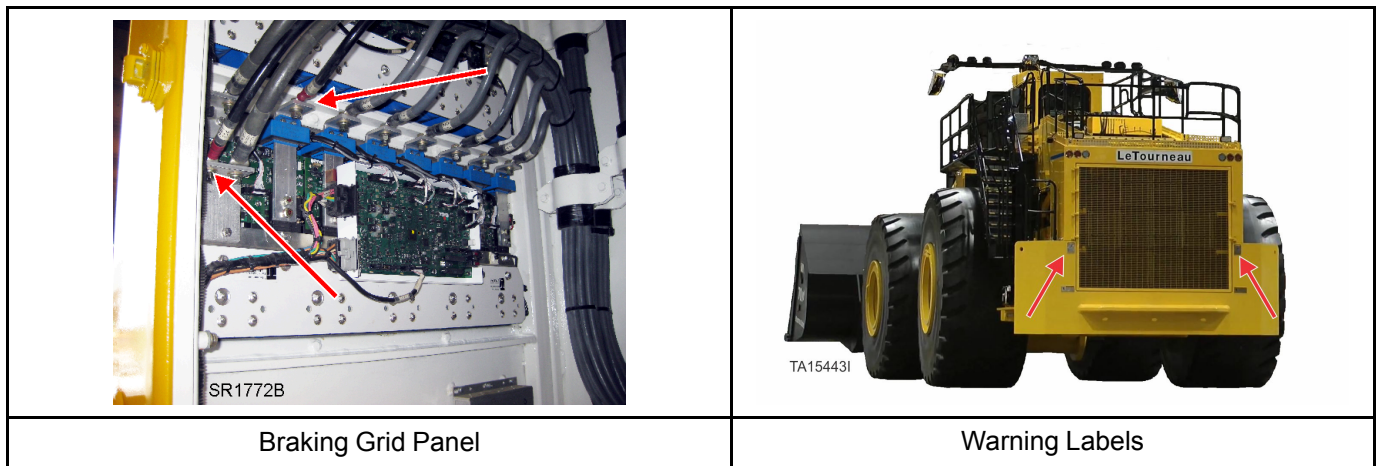


Figure 10: Braking grid panel connections & warning labels



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.

Prior to any work being performed in this area, perform the following Bus Discharge Verification Procedure.

Isolation Monitor

NOTICE

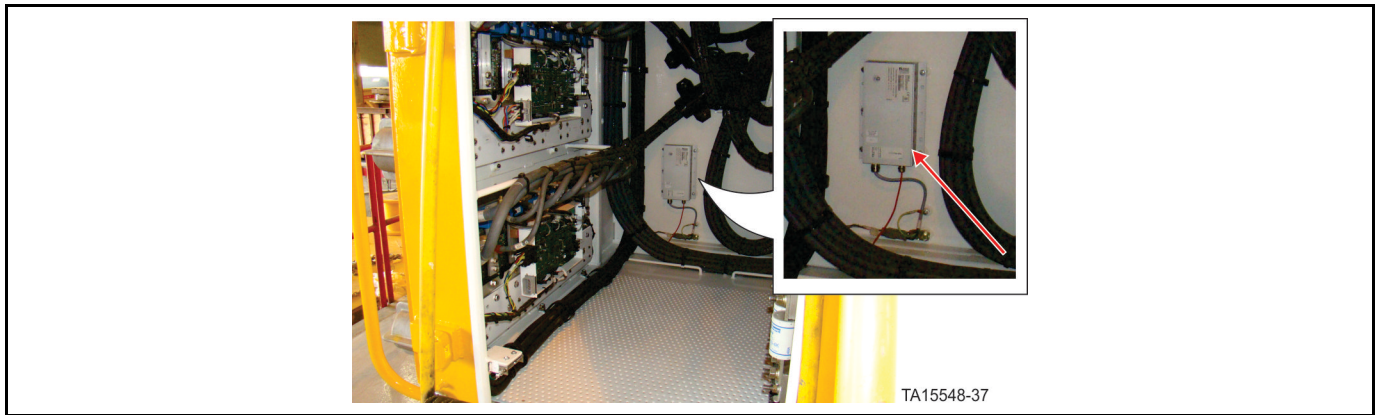
The system was designed to provide very high bus resistance to frame, in order to limit current to a non-fatal level.



WARNING

Risk of shock or injury by contact in the electrical cabinet is possible. The system was designed to provide very high bus resistance to frame, in order to limit current to a non-fatal level. Circumstances may still exist where serious injury or death may occur. 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 11: Isolation monitor



The drive system design is such that the DC bus is fully isolated from the machine frame. The resistance between the DC bus and the machine frame is derived from very high impedance measurement circuits on drive control cards and other leakage of components (motors, generator, grids, etc.). The Isolation Monitor measures resistance between the bus and frame. If the High Voltage Isolation circuit measures less than an assigned threshold value, a High Voltage Bus Isolation Resistance Low warning message is triggered.

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Converter Assemblies

Figure 12: Converter panel

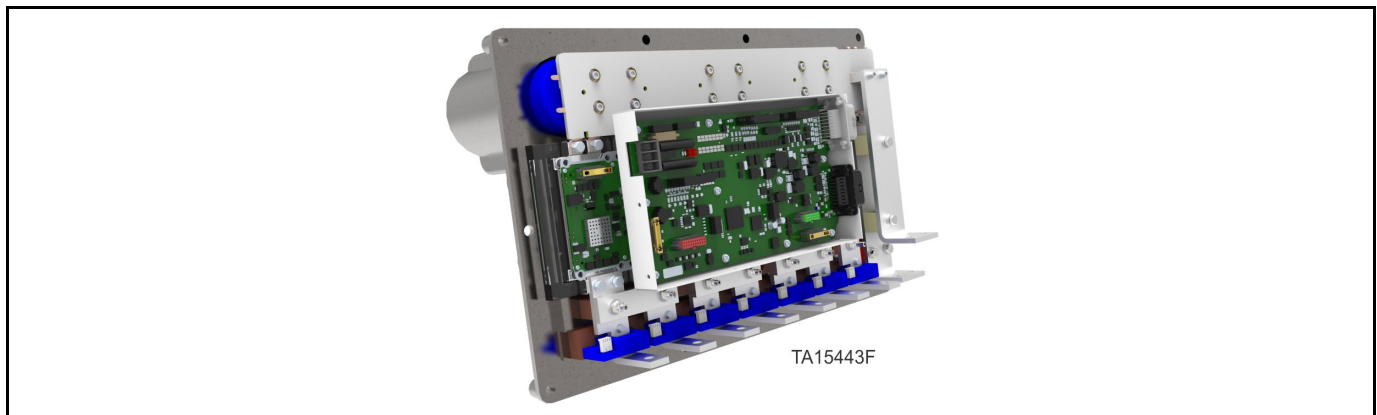
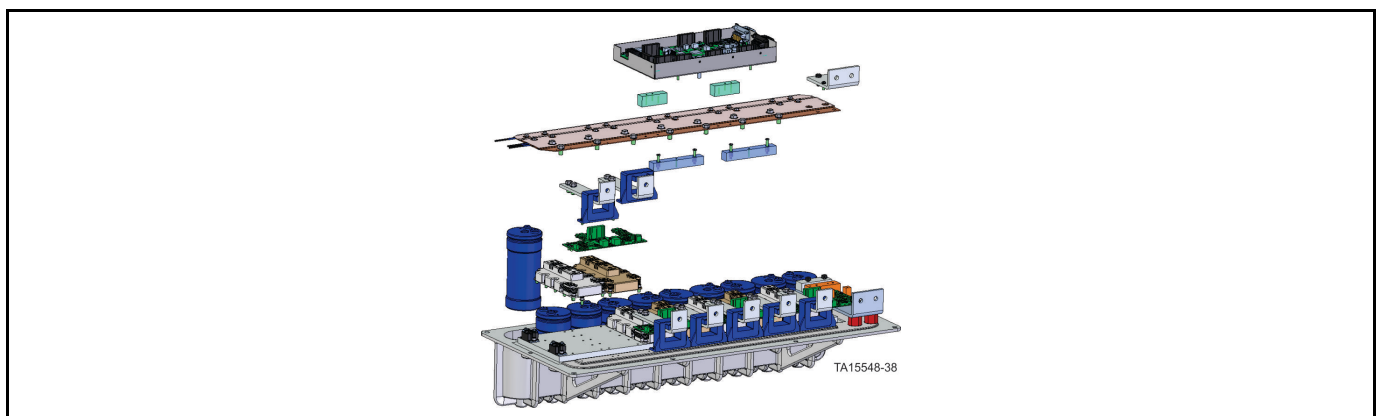


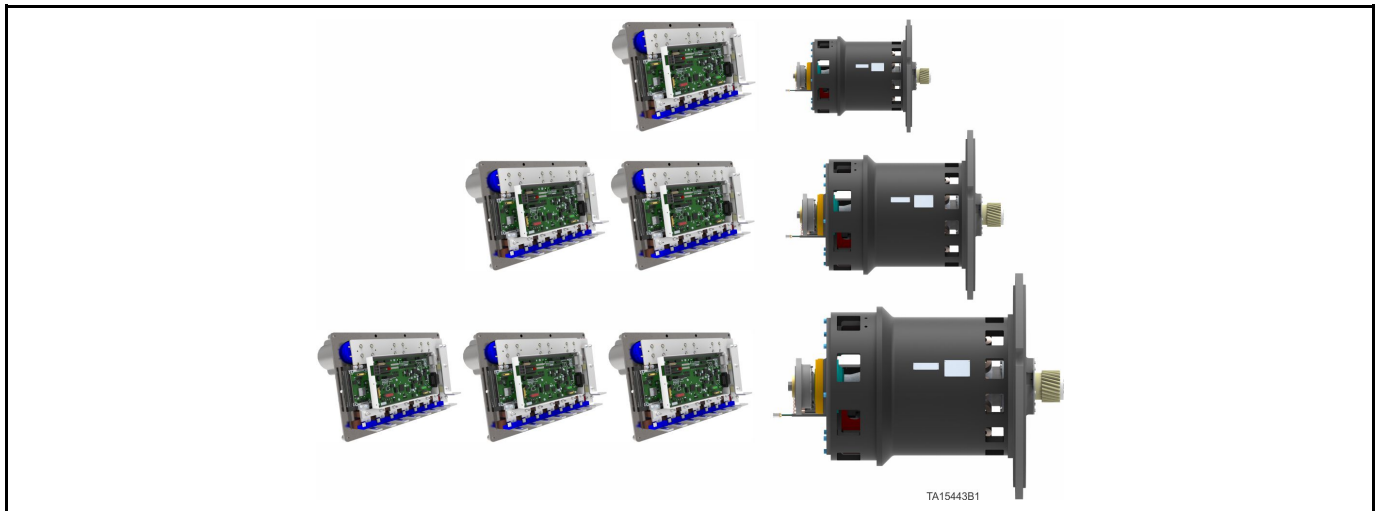
Figure 13: Converter panel exploded view



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 has two converter assemblies per motor. The Electrical Converter Cabinet will have up to 12 converter assemblies depending on the machine type. The generator converter assemblies will have 3 or 4 assemblies, depending on machine type. Refer to table below.

Machine Type	Wheel Motor Converter Panels	Generator Panels	Total Panels
L-1350	4	3	7
L-1850, L-2350	8	4	12

Figure 14: Converter scalability

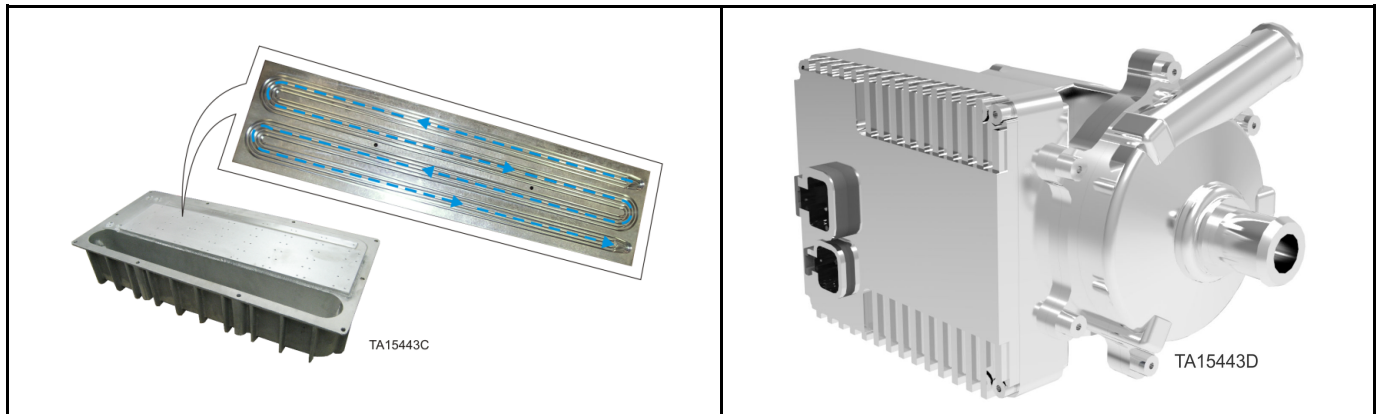


The converter assemblies are comprised of a SR Control Board, Gate Driver Boards (phase and chopper), IGBT's, and DC bus capacitors with equalizing resistors. There are no field serviceable parts on these assemblies.

Cooling Pumps

The IGBT modules are mounted to the panel and cooled by a dedicated liquid cooling system. CAN controlled pumps supply liquid flow based on the greatest converter temperature, and will run at full speed if the CAN data link is missing.

Figure 15: IGBT cooling structure and pump



The capacitors are convection cooled while the rest of the electrical converter cabinet components are air cooled by way of a 4" duct at the top of the cabinet and an exit screen at the bottom.

Model	Component	Capacity		Fluid
L1350	Drive Module(s) Coolant Reservoir	31 gallons	117 liters	Use engine manufacturer specifications.
L1850	Drive Module(s) Coolant Reservoir	40 gallons	151 liters	
L2350	Drive Module(s) Coolant Reservoir	41 gallons	155 liters	

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