



Operating Manual for: XINV-4000-NRE

**MC40002
Issue 2, June 2012**

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LIMITED WARRANTY

TSi Power Corporation warrants this product to be free from defects in materials and workmanship for two (2) years from the date of purchase from TSi or its authorized representatives. TSi will repair (or at its option, replace) any defective component(s) during this warranty period.

To make a request or claim for service under this limited warranty, the original purchaser must return the product, in the original shipping container or equivalent, to TSi or its authorized agent, accompanied by a written receipt showing the date of purchase and both the model name and serial number of the product.

Warranty does not cover transportation costs. Damage by misuse, accident or unauthorized tampering of the product is not covered by the warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED. TSI IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

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REVISIONS

<u>ISSUE</u>	<u>DATE</u>	<u>REASON FOR REVISION</u>
1	November, 2011	Initial Issue
2	June, 2012	Revised to Add par. 3.33, new P/Ns, photos and tabular specs.

1. GENERAL

1.1 PRODUCT APPLICATION

The XINV-4000-NRE Inverter is designed specifically for powering air conditioners or other AC type equipment in locomotive type applications. The unit can supply 4000 W continuously on two (2) 2000 W military-type pin connector outlets and features a modular design that is vibration mount isolated with separate, replaceable power inverter units. Each power inverter unit produces 120 V AC with a nominal 16.7 A current output from a 74 V DC nominal input voltage at a 30 A nominal current. The internal electronic circuit boards are protected by a layer of conformal coating.



Figure 1: The XINV-4000-NRE Inverter

1.2 SAFETY ALERTS

SAFETY SIGNAL WORD DEFINITIONS

This document contains safety alert pictorial Symbols and Words that point out areas and procedures that require special attention with regards to safety. These Symbols and Words are defined in ANSI Z535.4-1998, Product Safety Signs and Labels.



DANGER:

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.




WARNING:

WARNING indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.



CAUTION:

CAUTION indicates an imminently hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

The safety alert pictorial symbol  appears in this document to make users aware of important operating and safety concerns.

1.3 FEATURES

- Mounting pattern same as Transtronic,
- Forced air cooling using two (2) thermostatically controlled dc fans,
- Same Input/Output connectors as current unit,
- Modular design w/two (2) easily replaceable power inverter modules and backend for transformers and interface connectors,
- Part Number for complete assembly,
- Separate serial numbers for base unit and for each power inverter module to facilitate tracking, inventory and warranty management,
- Conformal coated circuit boards,
- Surge protection of DC bus,
- LED fault indicators,
- Two (2) DC input circuit breakers,

1.4 OVERALL DIMENSIONS

The XINV-4000-NRE enclosure w/mounting bracket dimensions are 12.575" (31.9 cm) H x 23.375" (59.5 cm) W x 16.715" (42.5 cm) D and weighs 153 lbs. (69.4 kg) – see Fig. 2.

1.5 CONSTRUCTION

The XINV-4000-NRE is constructed of 14 gauge steel and finished with a black polyester/epoxy powder coat that is designed to meet Industry specifications for protection against corrosion, UV radiation and impact resistance. The main enclosure and electrical/electronic components are isolated against vibration and shock by means of four rubber Vibration-Damping Mounts. These vibration mounts are located between the main housing and standoff mounting plate. Stainless Steel Locking and mounting hardware is used throughout.

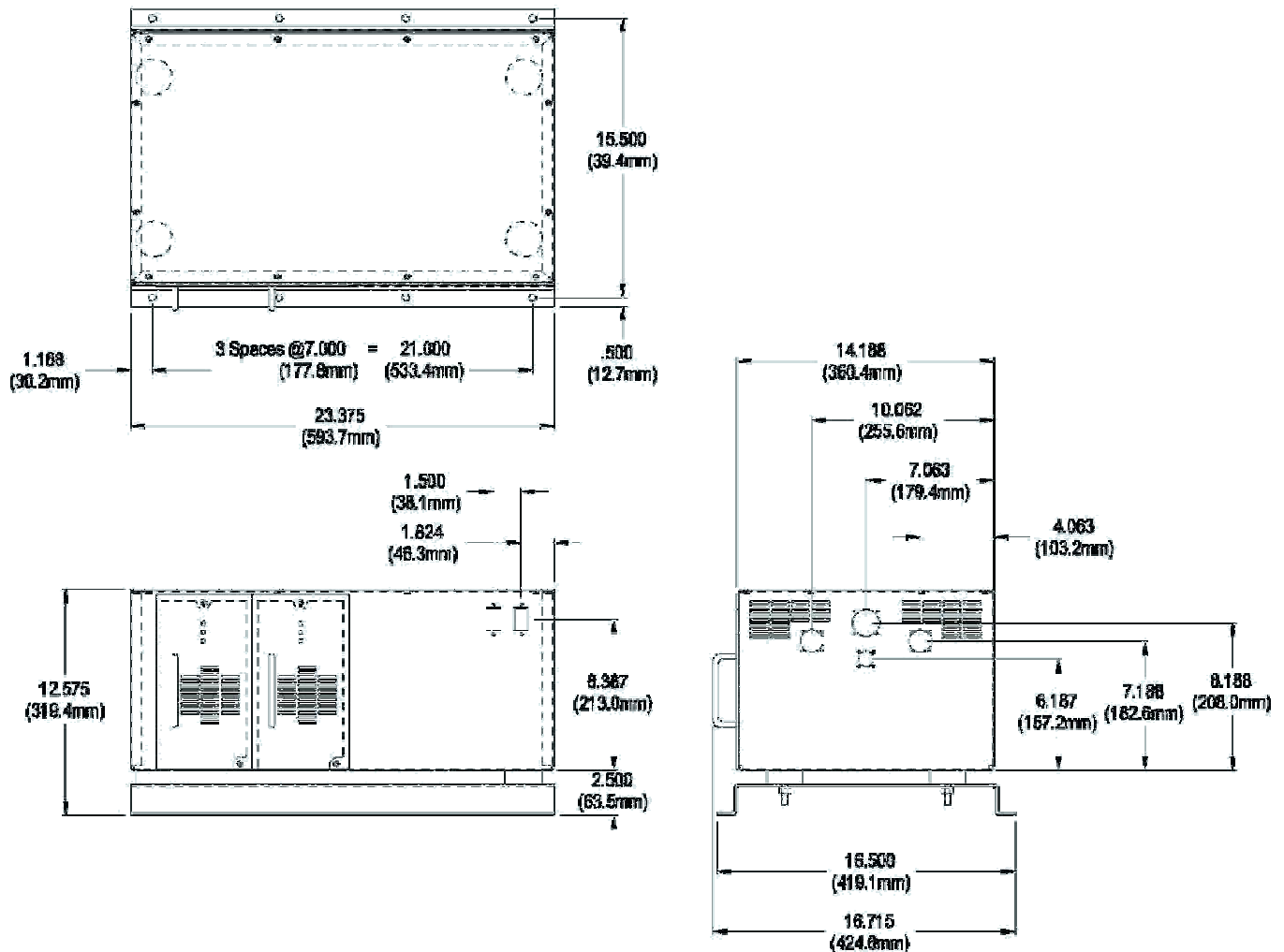


Figure 2: XINV-4000-NRE Dimensions

1.6 COMPONENT LOCATIONS

1.6.1 WITH TOP COVER REMOVED - See Figure 3

Removing the top cover, exposes the main wiring and major components of the XINV.

▲ DANGER: If the unit has already been installed and prior to the removal of the top cover, make sure that the DC INPUT CONNECTOR AND CONTROL CONNECTOR (see Figure 5) have been disconnected and that the dc CIRCUIT BREAKERS (see Figure 10) have been shut off.

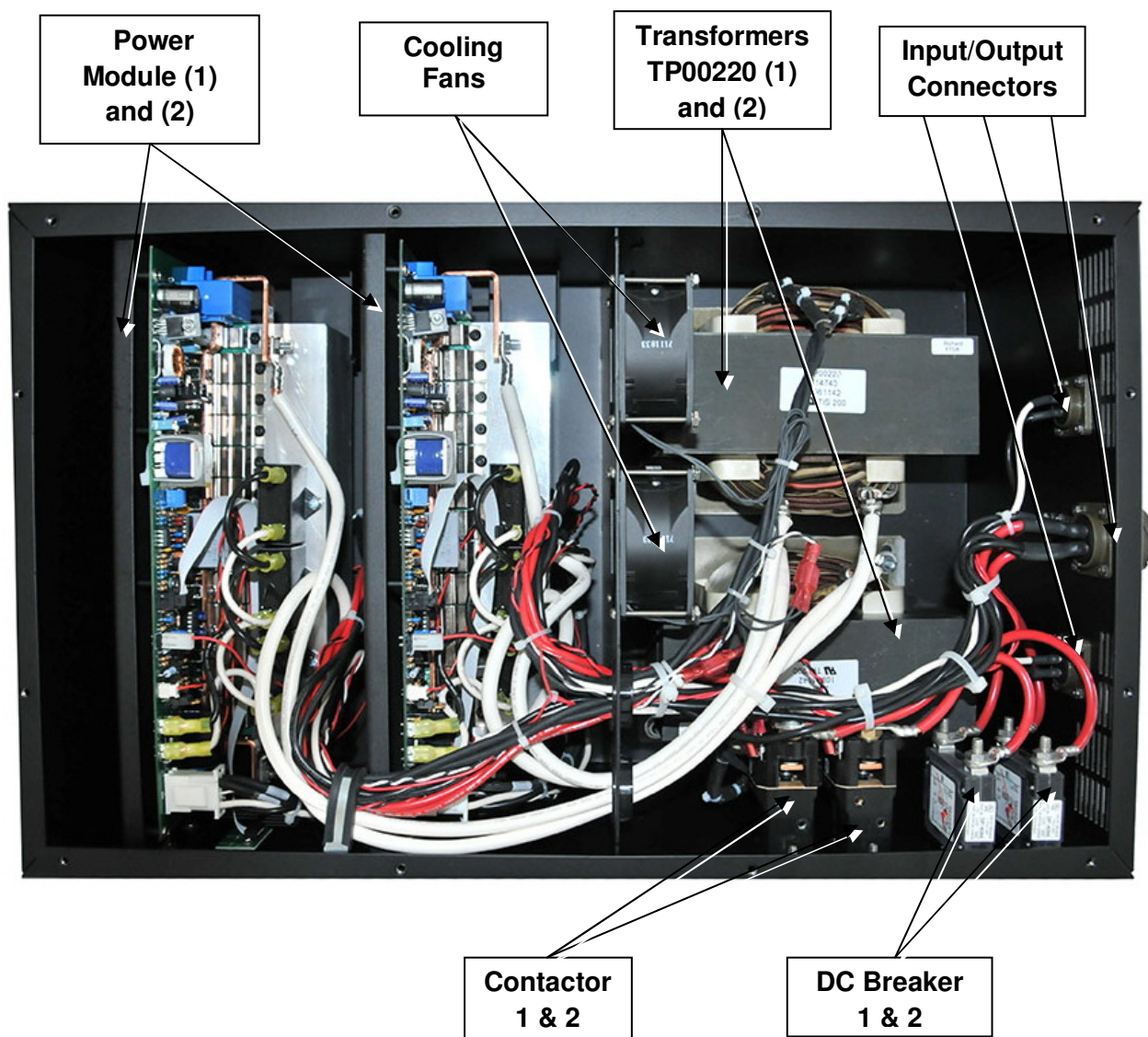


Figure 3: Inverter with Top Cover Removed

1.62 FRONT VIEW – See Figure 4

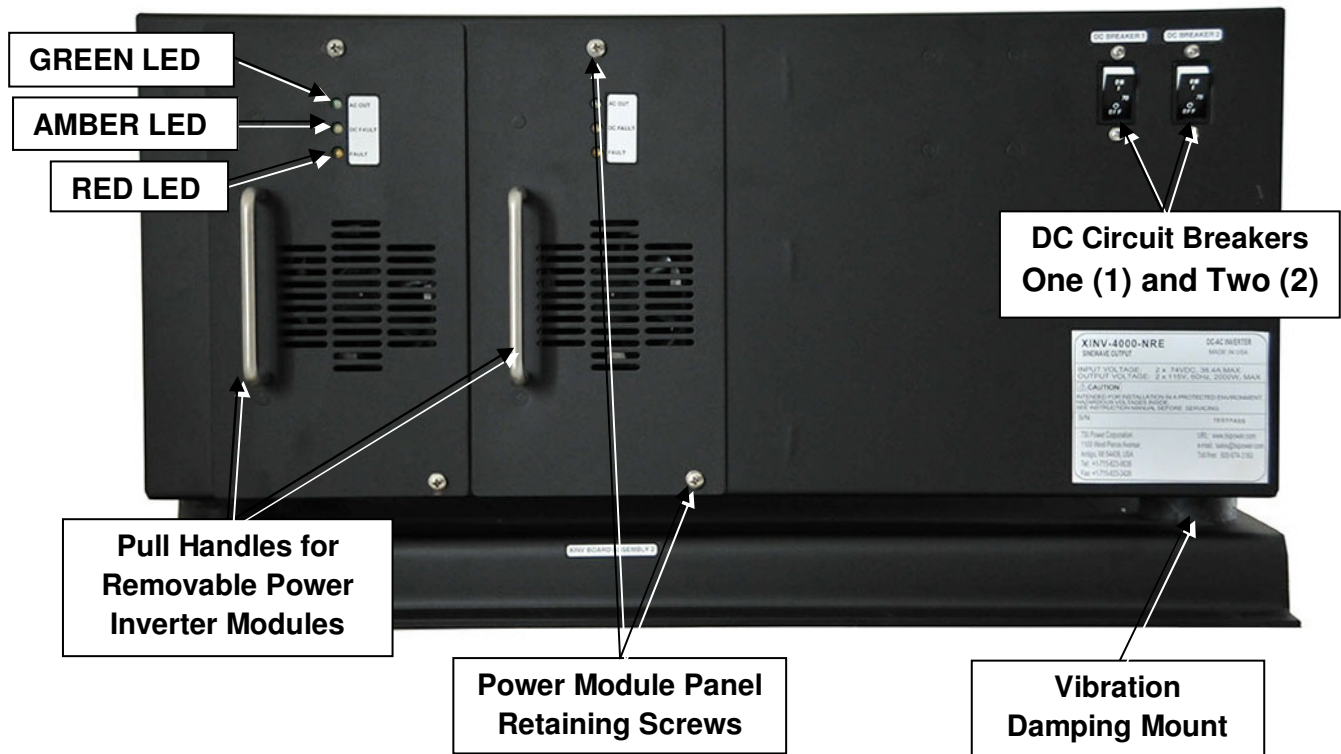


Figure 4: Front View

1.63 LED INDICATORS – See Figure 4

Three (3) LEDs have been provided to indicate the following conditions:

- Green – Inverter On/Off
- Amber – dc input out of range
- Red – Over temperature or current

After all the Input, Output and Control connectors have been attached and the Circuit Breakers 1 and 2 have been turned on, the Amber and Red LEDs will turn-on. After 7 seconds, the Amber and Red LEDs will turn off and the Green LED will turn-on. It will remain on to indicate that the Inverter is functioning properly.

1.64 INPUT PROTECTION – See Figures 3 & 4

The two power inverter modules are protected against reversed input polarity. Two (2) 70 A (DC type) circuit breakers provide on/off switching capability and over-current protection while two (2) contactors provide for input protection and full isolation in case of under/over voltage.

1.65 RIGHT SIDE VIEW - INTERFACE CONNECTORS – See Figure 5

These ITT/Cannon bayonet-lock connectors provide the Input, Output and Control Interfaces with the equipment. The Input connector accepts 74 V DC to the Inverter while the two Output connectors provide separate 120 V AC outputs to power two Air Conditioners. The Control output is in effect an ON/OFF switch to control the output of the Inverter. See Figure 5 for connector location/arrangement.

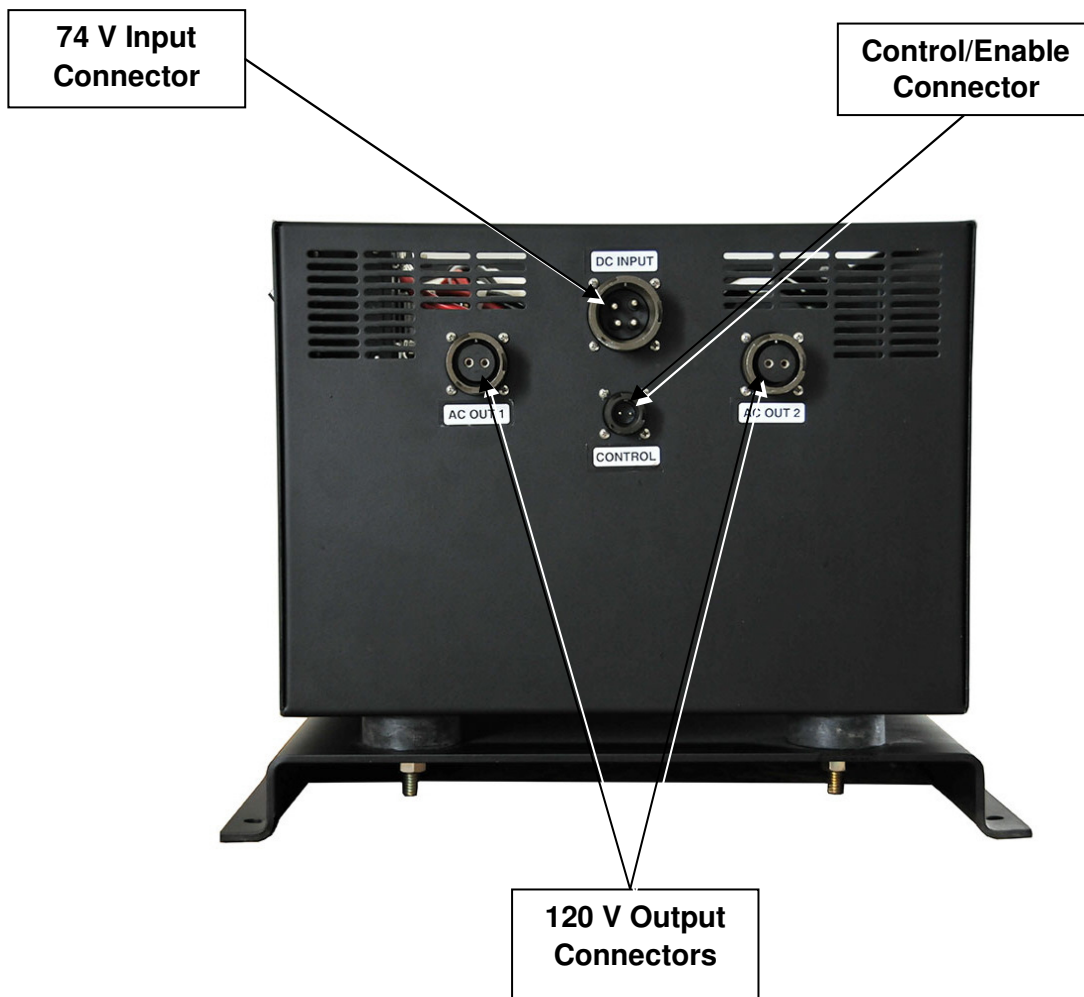


Figure 5: Interface Connectors

2. MAJOR COMPONENT/CIRCUIT DESCRIPTIONS

2.1 XINV-4000-NRE WIRING DIAGRAM – See Figure 6.

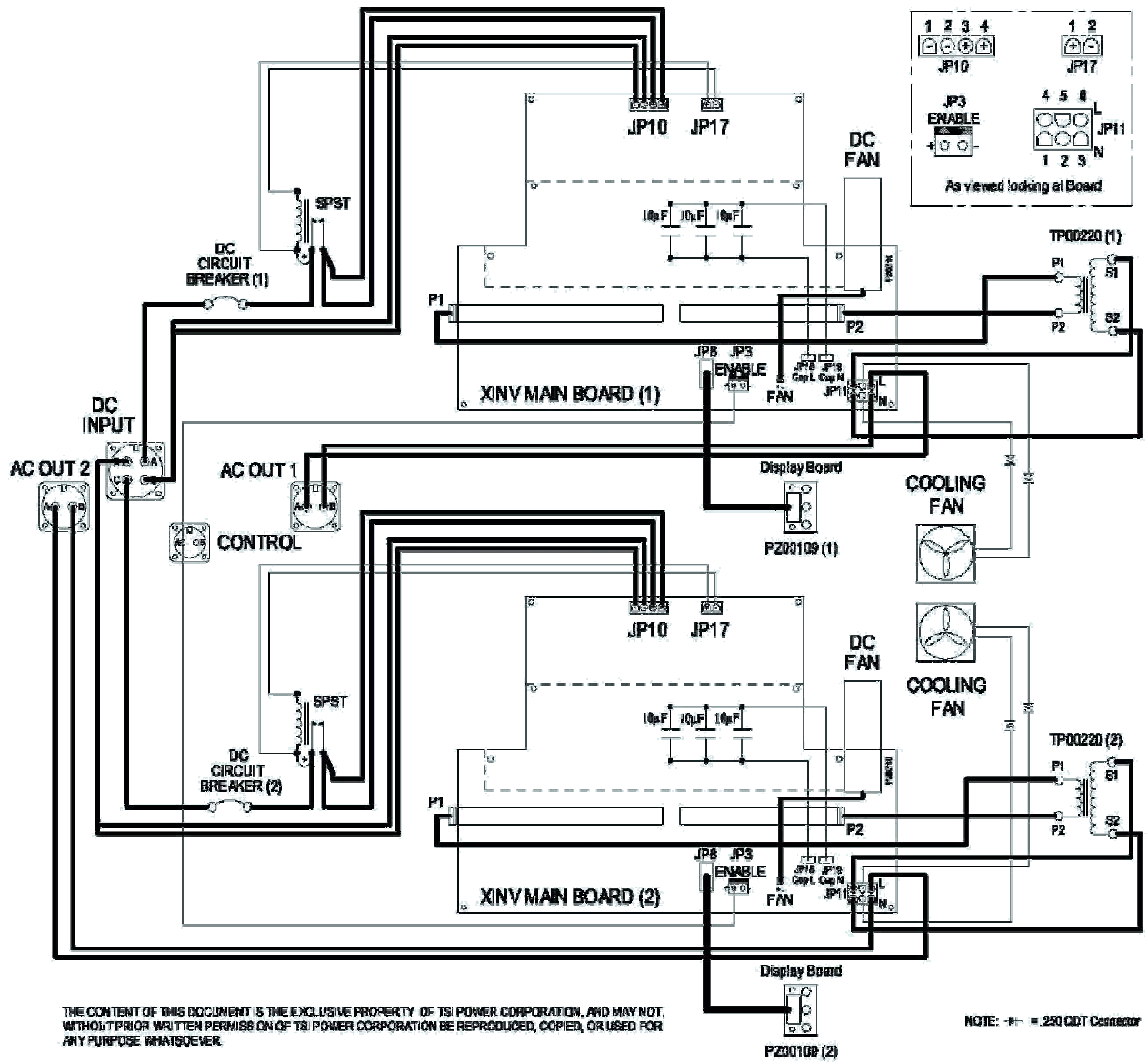


Figure 6: XINV-4000-NRE Wiring Diagram

2.2 INVERTER TRANSFORMER (TP00220): See **Figure 7**. The main two (2) transformers of the XINV-4000-NRE, each rated at 2000 watt, with a 40 V primary and a 120 V secondary, are connected to the main circuit boards and perform three functions:

1. They step up the inverter bus voltage to 120 V,
2. They filter PWM noise superimposed on ac waveform,,
3. They provide full galvanic isolation between input and output.



Figure 7: Inverter Transformer

2.3 POWER INVERTER MODULE

- The power inverter module of the XINV-4000-NRE utilizes a rugged design with a microprocessor-controlled 20 kHz sine wave inverter. The module is designed for easy field replacement and has been conformally coated for use in severe outdoor environments. See Figure 8.

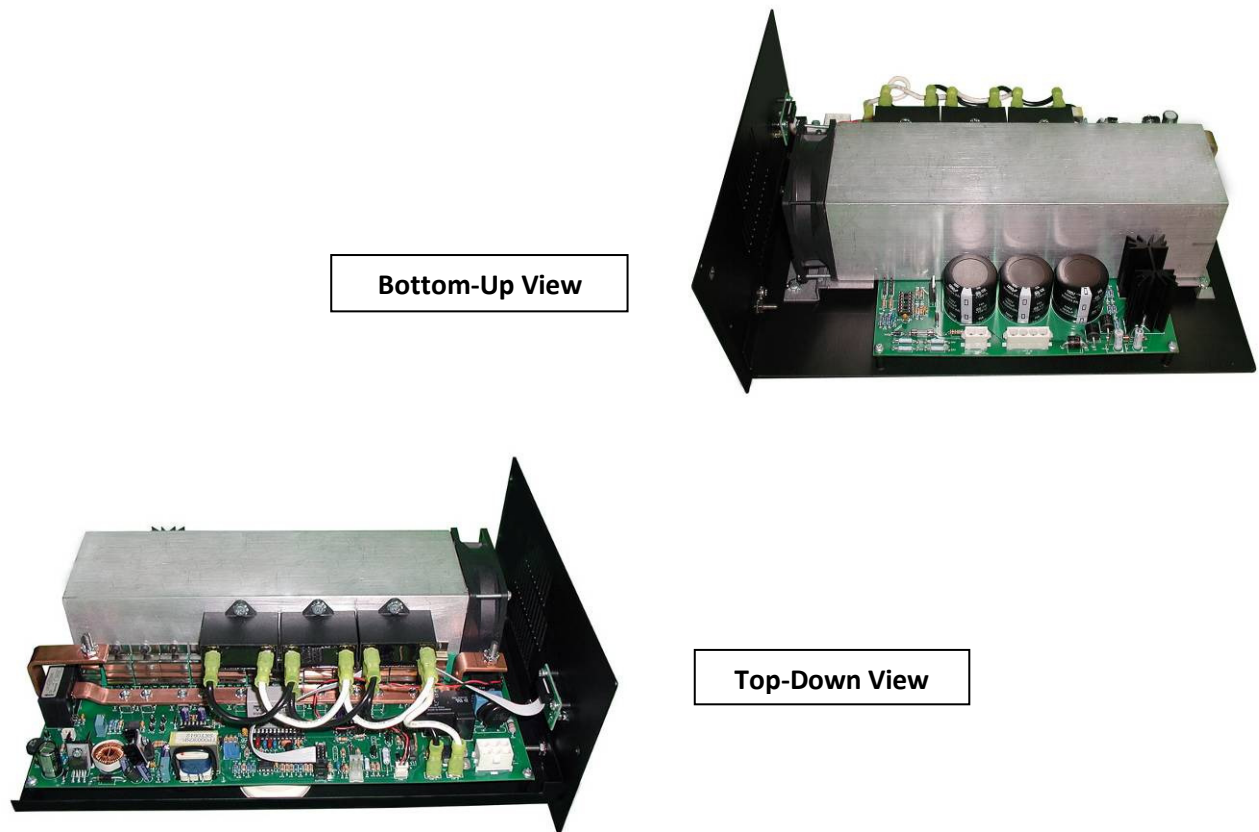


Figure 8: Power Module

2.4 DISPLAY CIRCUIT BOARD (P/N-PZ00109)

- The display panels, pictured in Figure 4, use the circuit boards shown in Figure 9 to monitor both the output current and battery voltage to alert the user to abnormal operating condition.

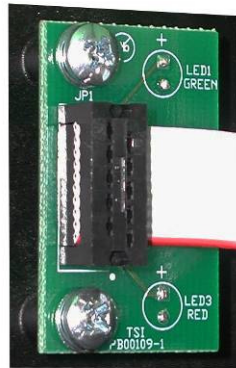


Figure 9: Display Circuit Board

2.5 DC CIRCUIT BREAKER (FC00106)

- The circuit breakers are single-pole, 70 A, 125 V, Flat Rocker, Panel mount Types. They provide ON/OFF switching and over current protection for the incoming 74 V from the locomotive's DC bus and are mounted to the chassis using #6-32 screws and lockwashers. See Figure 10.



Figure 10: DC Circuit Breaker

2.6 DC Contactor (KF00022)

- The 80 A, 80 V Contactors provide for input protection and full isolation in case of under/over voltage. See Figure 11.

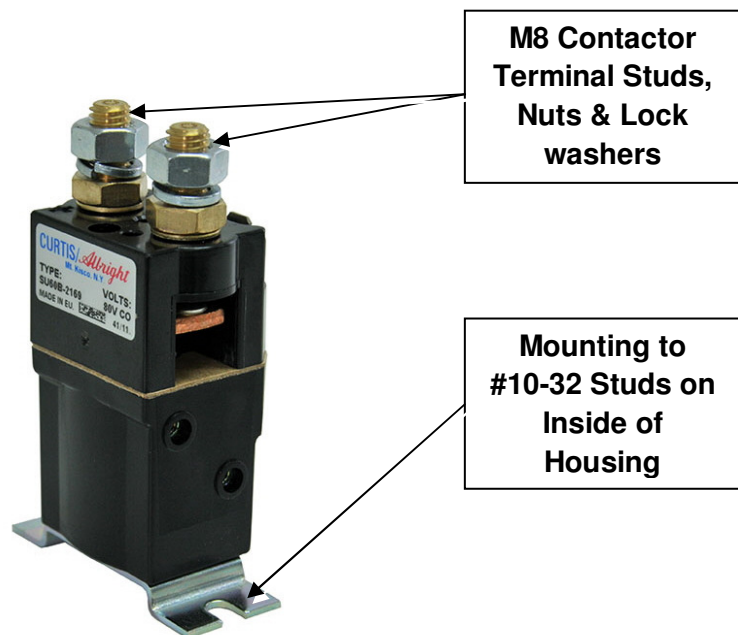


Figure 11: DC Contactor

2.7 AC COOLING FAN: (P/N VF00015)

- The two (2) AC fans are mounted on the inverter dividing panel and are used to circulate air in both the circuit board and transformer compartments. By drawing air into the circuit board compartment, these 80mm, 115 V fans, remove stagnant hot air and exhaust it through the rear of the transformer compartment, see Figure 12.

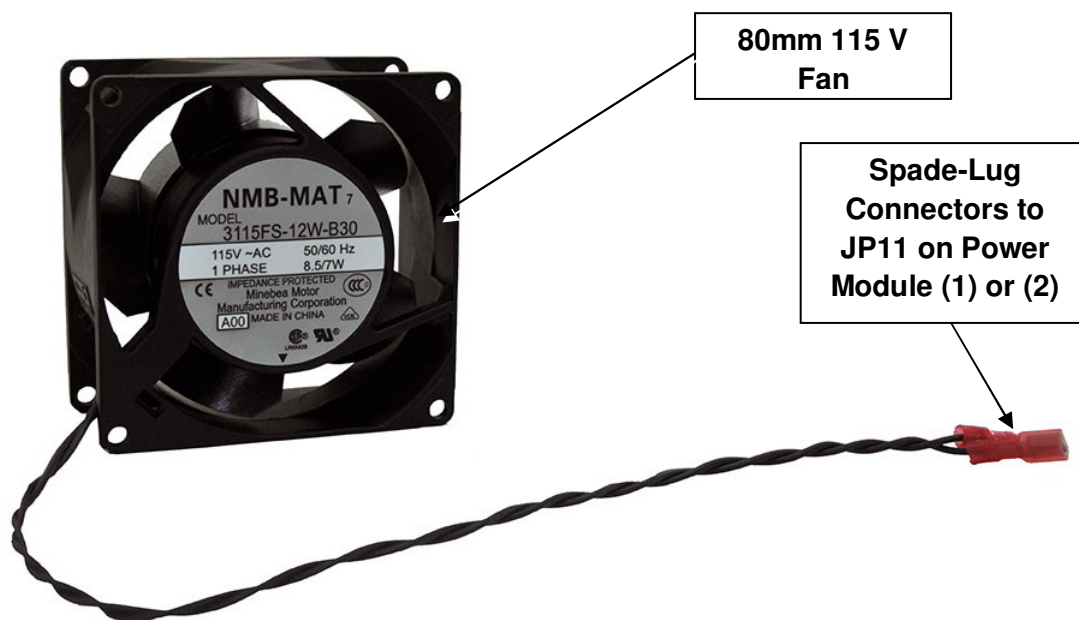


Figure 12: AC Fan

3. INSTALLATION

3.1 REQUIRED TOOLS

- A standard socket wrench set and standard mechanic tools
- Appropriate lifting equipment to lift and seat the unit onto the mounting bracket legs in the locomotive compartment [The weight of the Inverter is 153 lbs. (69.4 kg.)]

3.2 UNPACKING & INSPECTION

- 3.2.1** The units are shipped in wooden crates, each containing one to four units. The units are placed on a pallet, back-to-back, with protective material between them.
- 3.2.2** Carefully open the crates, making sure not to damage the units, and remove the protective wrap and packing material.

3.23 Before the units are removed from the crates, inspect them for physical damage.

3.24 If no damage is found, remove the units from the crates, open the top cover and again inspect for damage. If damage is found in either steps 3.23 or 3.24, do not accept the shipment and file a claim with the carrier. Contact TSi Power for assistance if necessary.

3.3 INSTALLING THE INVERTER

3.31 After the unit has been unpacked and inspected, lift the unit onto the customer supplied angle brackets that have been welded to the locomotive compartment.



CAUTION: Make sure that appropriate lifting equipment is used and that company safety practices are followed.

3.32 Mount the unit to the bracket by means of eight (8) fasteners that mirror the hole-patterns as shown in the top view of Figure 2.

3.33 Mount the unit in the horizontal direction only. Vertical mounting may result in component damage and void the warranty.



CAUTION: Make sure that stainless steel lock-washers are used with each stainless steel fastener to prevent the chassis from loosening during operation.

4. TROUBLESHOOTING

4.1 Background

The XINV is designed to be repaired by replacing PCB assemblies and major components. PCB board level repair in the field is not encouraged by TSi Power. Therefore, the information below is designed to allow simple fault diagnosis and replacement of failed PCB assemblies and major components by technician level individuals.

4.2 Fault Tracing (Bench Test)

When the XINV is energized the sequence of LEDs will be as those described in section 1.63. Once the green LED is displayed the inverter output should be activated and provide a steady power output. If the XINV is not working properly, the following basic troubleshooting guide addresses some of these possible failures by recommending steps to correct the problems.

4.21 Problem: No AC Output – Both Sides

Cause: Loss of one of the two required 74 V DC inputs

Resolution: Connect both 74 V DC inputs

4.22 Problem: No AC Output – One Side

Cause: Loss of one of the two required 74 V DC inputs

Resolution: Contact TSi Power and possibly replace one of the power modules

4.23 Problem: Immediate failure when energized

Cause: Not known

Resolution: Contact TSi Power

4.24 Problem: Other

Cause: Not known

Resolution: Contact TSi Power

5. COMPONENT REPLACEMENT PARTS



DANGER: Prior to the replacement of the Power Module , make sure that the DC INPUT CONNECTOR AND CONTROL CONNECTOR (see Figure 5) have been disconnected and that the DC CIRCUIT BREAKERS (see Figure 10) have been shut off.

5.1 POWER INVERTER MODULE REPAIR AND REPLACEMENT

If all the LEDs of either Power Inverter Module 1 or 2 are extinguished, it means that the power inverter module is not functioning and that it needs to be removed and replaced. See paragraphs 5.11 through 5.13

5.11 TOP VIEW w/COVER OFF - See Figure 13

- Removal of the top cover exposes the two Power Modules and the main wiring. Before removing the top cover, make sure that both DC circuit breakers are in the “OFF” position.

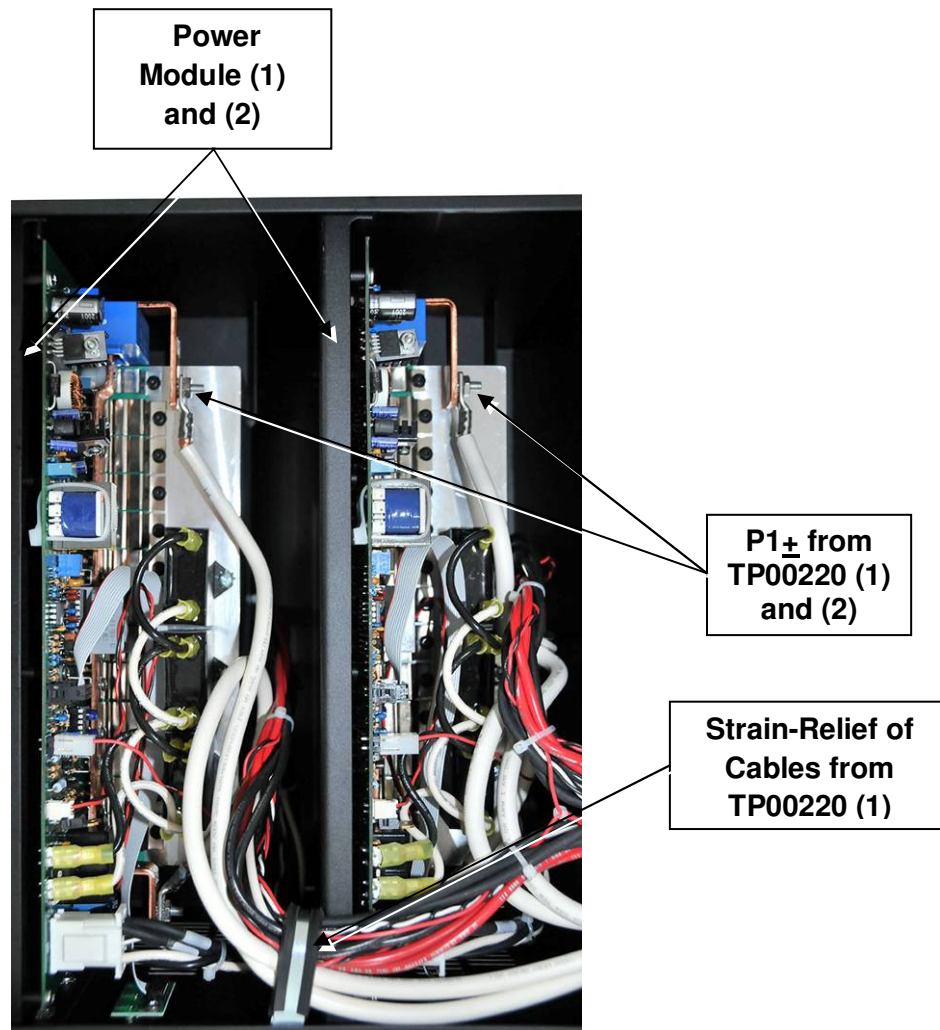


Figure 13: Inverter with Top Cover Removed

5.12 FRONT ACCESS FOR POWER INVERTER MODULE REPLACEMENT: – See Figures 13 and 14

- Prior to removing the Power Inverter Module make sure that both DC circuit breakers are in the “OFF” position.
- Disconnect the 74 V DC Input Plug from the Input connector, see Figure 5.
- Next loosen the screws at the top cover and remove, and front panel retaining screws of the Power Inverter Module, see Figure 14.

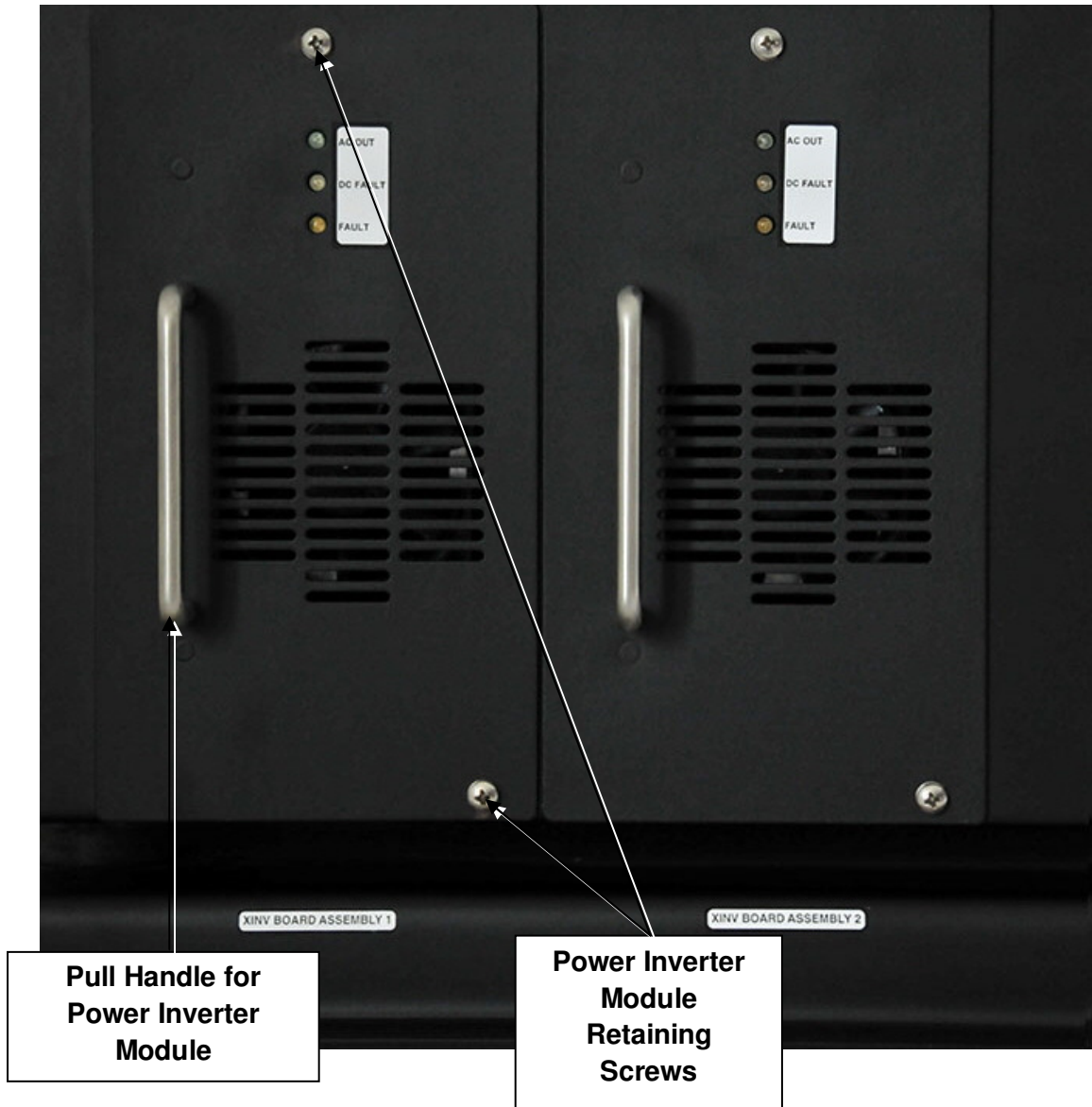


Figure 14: Front Access Power Module Panels

- With the Power Module partially pulled out, and making sure no wires are pinched, disconnect the following from the circuit board, see Figures 6 and 15:

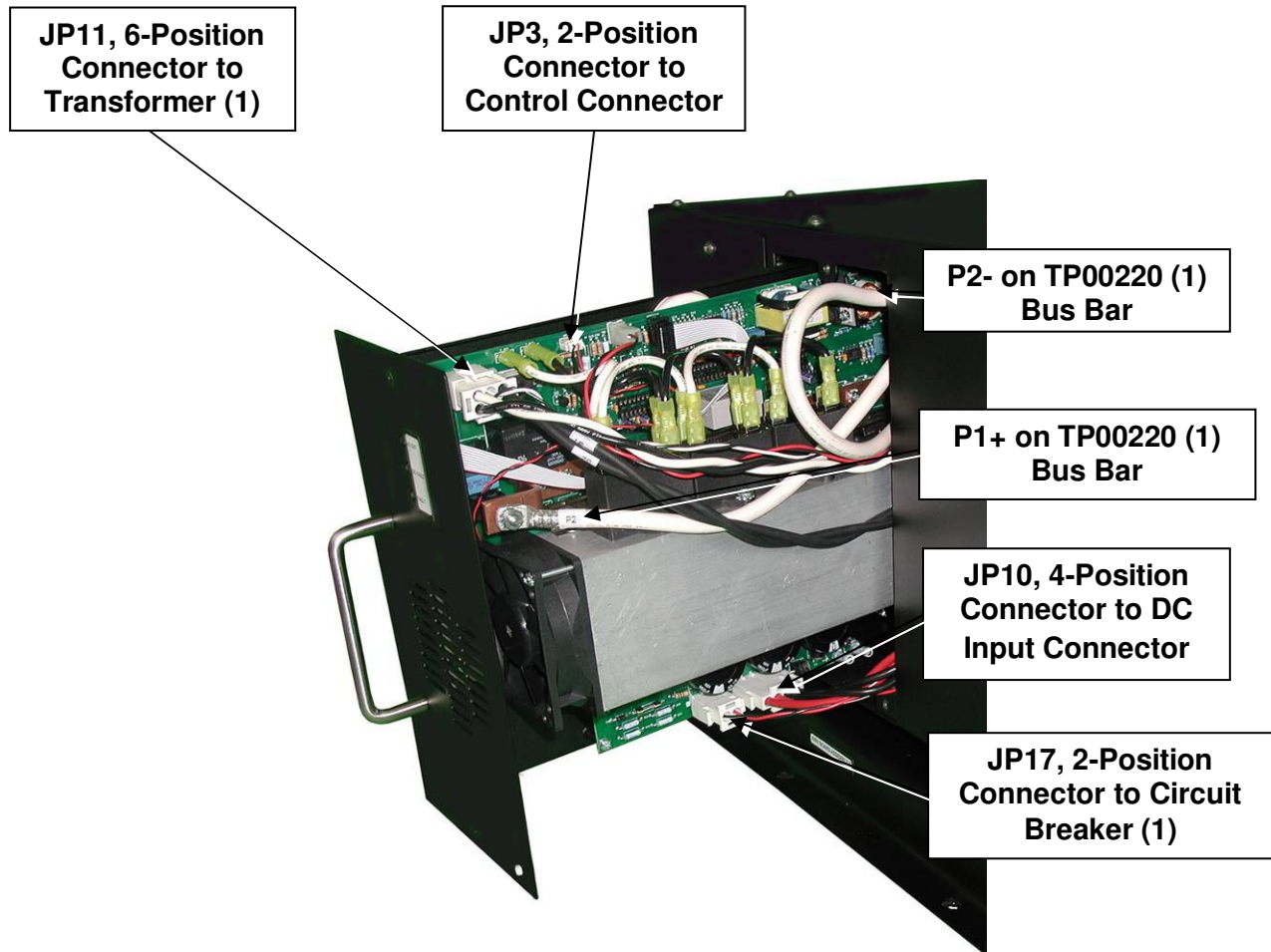


Figure 15: Removing Power Inverter Module

- Once the the wires have been disconnected, the Power Inverter Module can be removed.

5.13 INSTALLING REPLACEMENT POWER INVERTER MODULE: – See Figure 15

- Insert the replacement Power Inverter Module into the housing by engaging it into the groove of the guide rail on the bottom of the compartment, see Figure 16.
- Next connect all the wires/connectors previously disconnected as shown in Figure 14 and 15. Once all the wires/connectors have been connected, slide the Power Module back into the compartment, making sure that it is retained in the guide rail groove and the rear of the bracket is seated on the guide pin in the rear of the housing. Also look to make sure that no wires/cables are kinked or pinched.

- Once this has been determined, fasten the front panel to the housing with the two (2) screws and lockwashers previously removed.

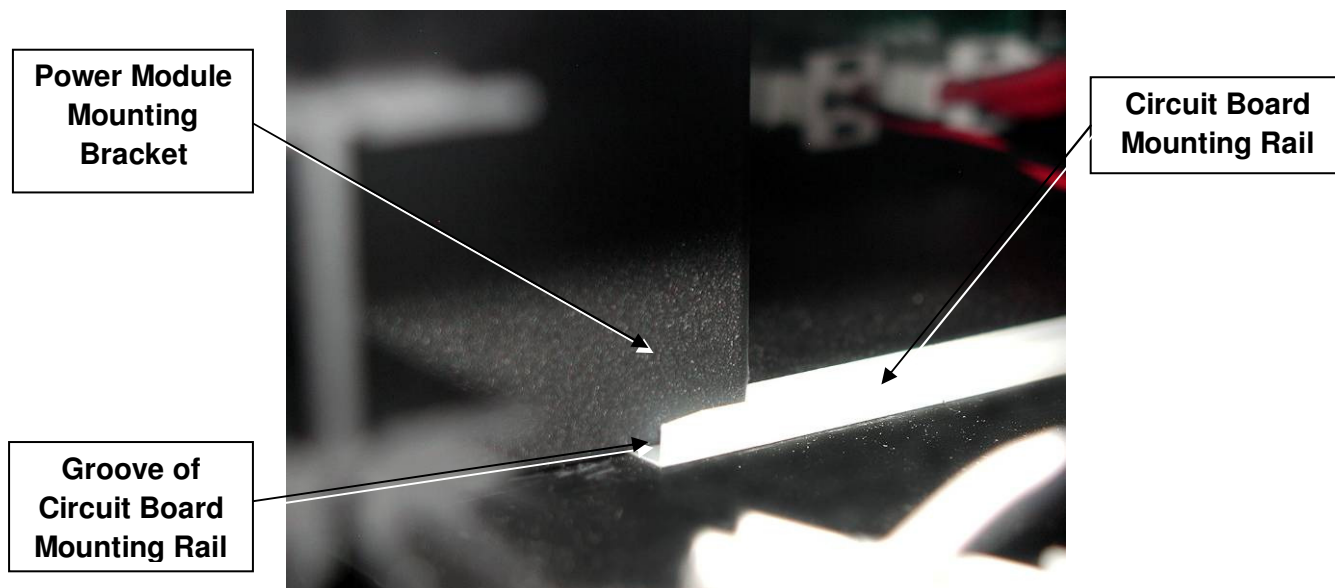


Figure 16: Reinstalling the Power Module

5.14 RETURNING POWER MODULES FOR REPAIR OR REPLACEMENT

The XINV-4000-NRE is designed to facilitate quick replacement of the Power Module. Consequently, the trouble-shooting procedures described in this manual are limited to visual inspection and component replacements. More detailed trouble-shooting, repair and calibration can only be done at the TSi Power factory.

- Contact TSi Power via telephone, fax or e-mail to obtain a Return Material Authorization number (RMA). TSi Power's phone/fax/e-mail and address information is provided in Section 6.
- Make sure that returned Power Inverter Modules are properly protected with anti-static bags and bubble packs, and packed in a sturdy shipping box which will not be crushed when another heavy box is placed on top of it.
- Mark the shipping box with the RMA number, using an indelible marker pen.

- We recommend that FedEx 2nd or 3rd day service be used for shipment of failed & repaired Power Inverter Modules. Outside North America customers may use DHL, FedEx or UPS.
- After receiving the failed or damaged part, TSi Power will determine if it is covered by TSi's Limited Warranty. Warranty repair or replacement is performed without charge. TSi will quote repair costs for out-of-warranty parts before starting any repair work. If repair is not cost effective, TSi will quote the cost of a replacement part.
- Shipping costs, duty and brokerage costs are the responsibility of the customer for all warranty and out-of-warranty repair or replacement services provided by TSi Power.
- Since TSi Power can repair most Power Modules that are returned, and in an effort to minimize downtime, it is recommended that the customer keep at least 3% (three Power Inverter Modules for every 100 units in operation) in inventory while the Power modules are being repaired.

5.2 REPLACING DC CIRCUIT BREAKERS (P/N FC00106): SEE FIGURES 17 AND 18

- Turn both circuit breakers OFF, see Figure 17.
- Disconnect the 74 V DC Input Plug from the Input connector, see Figure 5.

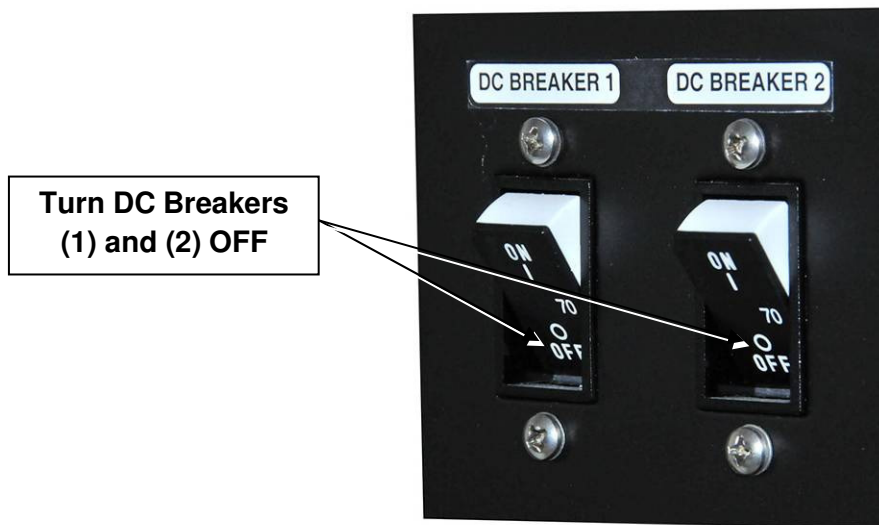


Figure 17: DC Circuit Breakers (1) and (2)

- Unfasten both cables from the rear of the circuit breakers by removing the nuts and washers from the rear studs, see Figure 18. Remove circuit breaker.



Figure 18: Removing Rear Wires of Circuit Breaker

- Replace circuit breaker, attach wires, attach breaker, attach DC Input Plug and turn-on circuit breaker.
- Make sure that all wires are correctly terminated and that no wires will be pinched when the cover of the housing is reinstalled.

5.3 REPLACING THE DC CONTACTOR (P/N KF00022): - SEE FIGURES 11 & 19.

- Turn both circuit breakers OFF, see Figure 17.
- Disconnect the 74 V DC Input Plug from the Input connector, see Figure 5.
- Remove the #10-32 nuts and lockwashers from the mounting studs.
- Remove all the wires from the contactor to be replaced.
- Install the new contactor as described above in reverse order.
- Make sure that all wires are correctly terminated and that no wires will be pinched when the cover of the housing is reinstalled.



Figure 19: Replacing Contactors from Rear

5.4 REPLACING THE AC FANS (P/N VF00015): - SEE FIGURES 12 & 20

- Disconnect the fan from the two (2) wire connectors coming from JP11, see Figure 6.
- Remove the four (4), #6-32 x 1-3/4" mounting screws, nuts and lockwashers that retain each fan to the divider plate, and remove fan, see Figure 20.

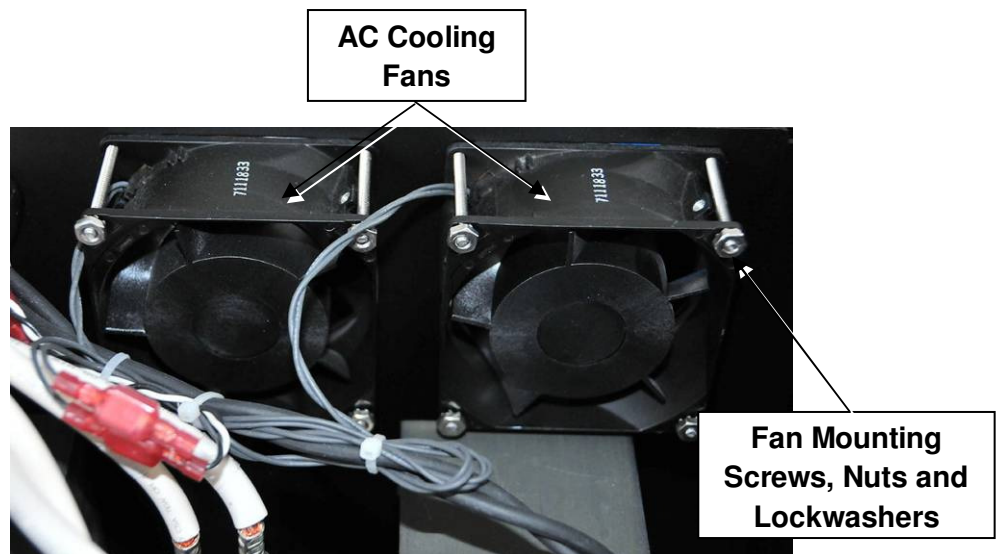


Figure 20: Replacing AC Cooling Fans from Divider plate

- Reinstall the fan in reverse order and re-attach the 2-wire connector.

5.5 REPLACING INCOMING/OUTGOING AND CONTROL CABLES: See Figures 21, 22 and 23.

The connectorized cable assemblies are 20 feet long and can be ordered by specifying the following Part Numbers:

<u>Item</u>	<u>P/N</u>	<u>Req./Assy</u>	<u>Description</u>
1	CA-CB6E22-NRE	1	DC Input Socket Plug Connector Cable Assy.
2	CA-CB6E18-NRE	2	AC Output Pin Plug Connector Cable Assy.
3	CA-CB6E12S- NRE	1	Control Socket Plug Connector Cable Assy.

5.51 DC Input Cable (P/N CA-CB6E22-NRE)

This cable provides the input voltage from the DC bus of the locomotive. See Figure 21.



Figure 21: DC Input Cable Replacement

5.52 AC Output Cables (P/N CA-CB6E18-NRE)

These two (2) cables provide the output power to the air conditioners in the locomotive control cab. See Figure 22.



Figure 22: AC Output Cable Replacements

5.53 Control (Enable) Cable (P/N CA-CB6E12S-NRE)

This cable controls the output of the inverter and is in effect an ON and OFF switch. See Figure 23.

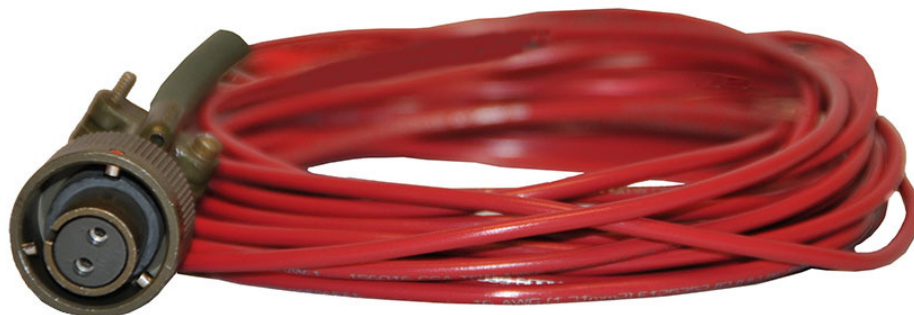


Figure 23: Control Cable Replacement

5.6 REPLACING OTHER COMPONENTS

Contact TSi Power via telephone, fax or e-mail to order spare parts such as fans, circuit breakers, etc. TSi Power's phone/fax/e-mail and address information is provided in Section 6.

6. REFERENCE

6.1 SPECIFICATIONS

Input	
Nominal Voltage	74 V DC
Voltage Range	55 to 89 V DC
Nominal Current	2 x 30 A
Protection / Circuit Breaker	Reverse Polarity / 2 x 70 A (AC/DC type)
DC Input Connector	Pin-type, twist lock
Output	
Output Voltage	120 V \pm 3%
Output Frequency	60 Hz \pm 1 Hz
Nominal Current	2 x 16.7 A
Efficiency	92% typical
Harmonic Distortion	< 4%
Overload Current	50 A for 2 seconds; peak current: 70 A for 2 seconds; 50% overload, 25 A for 2 seconds; 20.9 A for 60 seconds.
Overload Recovery	Shuts-down after fault event, recovery after 30 seconds from current fault.
Thermal Shutdown	Inverter shuts-down if the heat sink temperature reaches 140 °F (60 °C)
LED Indicators	

Inverter On/Off	Green
Dc Input Out Of Range	Amber
Over Temperature Or Current	Red
Mechanical	
Dimensions (in/mm)	12.575H x 23.375W x 16.715D / 319H x 595W x 425W
Weight (lb / kg)	153 / 69.4
Environmental	
Ambient Temperature	-40°F to 122°F (-40°C to 50°C)

6.2 TSi POWER CONTACT INFORMATION

TSi Power Corporation
1103 West Pierce Avenue
Antigo, WI 54409
Tel: 800-874-3160 Fax: 715-623-2426
URL: www.tsipower.com e-mail: sales@tsipower.com