# *THR400048*

## *Installation, Operation, and Maintenance Manual*

## TH Series

September 2008

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LAMBDA

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# 1.Safety and Recommended Practices

## General Practices

For use in restricted-access locations only
Suitable for mounting on concrete or other non-combustible surface only

The power system has an operating AC voltage between 90 V and 264 V, 50–60 Hz, and produces a regulated DC output of 0–56 V. It is capable of delivering a maximum of 200 amps, 100 amps per side, DC, in an ambient operating temperature range of –40°C to +65°C (depending on deployed rectifiers).

HAZARDOUS VOLTAGE AND ENERGY LEVELS CAN PRODUCE SERIOUS SHOCKS AND BURNS. Only authorized, qualified, and trained personnel should attempt to work on this equipment. Refer to datasheets for full product specifications.

Observe all local and national electrical, environmental, and workplace codes.

Each rack should be fed from a dedicated AC branch circuit of a terra neutral (TN) power system.

If a line cord is used as the AC connection means, the plug end of the cord is considered to be the primary disconnection means, and reasonable access must be given to the plug and receptacle area. The receptacle must be fed with a breaker and wires according to specifications in Table 3.

For hard-wired AC connections, a readily accessible disconnection device must be incorporated in the building installation wiring. Select circuit breaker and wire sizes according to specifications in Table 3.

**CAUTION:** ALL RECTIFIERS EMPLOY INTERNAL DOUBLE POLE/NEUTRAL FUSING.

Use Underwriters Laboratories (UL)-listed, double-hole lugs for bulk DC connections, based on shelf circuit, to prevent lug rotation and inadvertent contact with other circuits. Terminal strip connections are made with compression screws.

Wire rated for 90ºC is recommended for all DC connections. In practice, for loop voltage drop considerations, wires of size larger than the minimum safe wire size are selected.

Alarm contacts are rated for a maximum DC voltage of 60 V and a maximum continuous current of 0.5 A.

Connection and mounting torque requirements are listed in Table 5.

Lambda does not recommend transporting or shipping the rack with rectifiers installed. Rectifiers should be transported or shipped in separate boxes provided by Lambda.

# Warning

Changes or modifications to this unit not expressly approved by the party responsible for the compliance could void the user's authority to operate this equipment.

**Protecting personnel against electrical shocks:** The power system cabling must be done by qualified personnel in conformance with local and national electrical codes. Input voltages to rectifiers are at a dangerous level. Ensure that circuit breakers are locked in the OFF position at the AC service panel before attempting to work on the power system. Dangerous voltages may still be present at the terminals even if the rectifiers are OFF. Use a voltmeter to verify the presence of such voltages. Do not switch circuit breakers to ON until the entire system has been assembled and you have been instructed to do so according to the appropriate procedure. Improper wiring can cause bodily harm and equipment damage.

Turn off all power sources before servicing units.

Warnung:

Schuetzen von Personal gegen elektrische Schocks. Die Spannungsversorgungs - Leitungen darf nur durch qualifiziertes Personal in Anpassung mit Oertlichen und nationalen elektrischen Codes ausgefuehrt werden. Unsachgemaesse Verdrahtung kann koerperliche Verletzung und Schaeden verursachen. Eingangsspannungen von der Netzspannungs - Versorgung Ihrer Hausanlage koennen unter Spannung stehen beim Anschluss derLeitungen. Vesorgungsspannungen koennen bei unsachgemaessen Gebrauch gefeahrliche Schaeden verursachen. Sorgen Sie dafür, dass die Cirquite Breaker in der aus position sind. Benutzen Sie ein Spannungsmesser um sicher zu sein das keine Netzspannung mehr vorhanden ist. Vergwissern Sie sich das alle Schalter an Ihrem Gereat und in der Vesorgung beim Anschluss abgeschaltet sind. Unsachgemaesse Verdrahtung kann koerperliche Verletzung und an der Ausstattung Schaeden verursachen.

Vor Wartungsarbeiten am Gerät sind alle Netzkabel vom Stromnetz zu trennen, um die Gefahr eines elektrischen Schlages oder andere mögliche Gefahren zu reduzieren.

# 2.Product Specifications

## Overview

The system is a unique system with a split bus output, which provides two isolated outputs and communication busses. All communication with the rectifiers is via an alarm and signal cable connected to a rear accessed 20-pin connector. Separate $I^2C$ communication busses are provided for isolated communication to each side. In addition, all alarms including AC and DC fail are available via this cable. There is no support for a GUI interface with this system.

## Rectifier Specification

Rectifiers that work in the power system are listed in Table 1. Specifications for each model are also given.

| Model # | Input Voltage | Output Voltage | Output Current |
|---|---|---|---|
| TH120048 | 100 VAC - 240 VDC | 42 VAC - 56 VDC | 25 amps |
| TH200048 | 200 VAC - 240 VDC | 42 VAC - 56 VDC | 40 amps |
| TH250048 | 200 VAC - 240 VDC | 42 VAC - 56 VDC | 50 amps |
| TH120024 | 100 VAC - 240 VDC | 21 VAC - 28 VDC | 50 amps |
| TH120012 | 100 VAC - 240 VDC | 10.5 VAC - 14 VDC | 100 amps |

**Table 1 – DC Output Ranges**

## Heat Dissipation

Typical and maximum values of heat dissipation for each TH-series rectifier are listed in Table 2. “Maximum” is calculated at minimum AC input voltage, maximum DC voltage, and current values for the rectifier. “Typical” is calculated at nominal AC input voltage, typical DC voltage, and current values for the rectifier.

| Model | Typical BTU/hr | Max BTU/hr |
|---|---|---|
| TH120048 | 451 | 833 |
| TH200048 | 635 | 897 |
| TH250048 | 794 | 1106 |
| TH120024 | 564 | 856 |
| TH120012 | 735 | 992 |

**Table 2 – Heat Dissipation**

# AC Input Requirements

## AC Input Wire Diagram

This system utilizes an individual feed AC architecture (Figure 1).

### Individual feed

A system with an individual feed AC architecture feeds each rectifier slot with an AC feed.

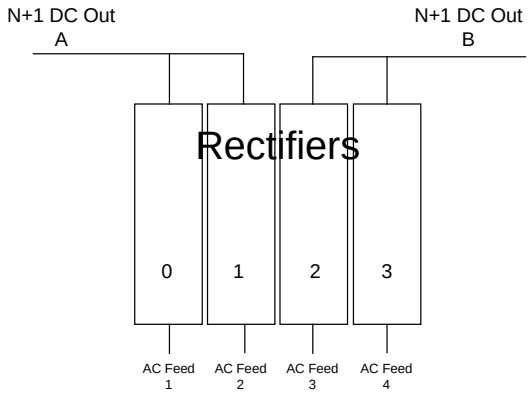


**Figure 1 - Individual feed AC wiring architecture**

### IEC320-C20 Connection

The connection is made via rear-accessed IEC320-C20 socket (see Figure 5) rated at 16A or less. The connections should be sized for AC supply no larger than 20 A. Consider this limitation when sizing the rectifiers. Securing brackets are available to hold the IEC320 AC cords to the shelf (see section AC Cord Brackets on page 15 for more information). Size the AC breaker and wiring according to specifications in section AC Feed Sizing below.

## AC Feed Sizing

To size AC feed properly, follow specifications in Table 3. **Failure to size the AC breaker and wiring properly can result in annoying breaker trips or even fire.** If you anticipate growth, size the AC breaker and wiring for the expected capacity. **ALWAYS FOLLOW NEC (NATIONAL ELECTRICAL CODE) RULES AND YOUR LOCAL COMPANY PRACTICES WHEN SELECTING AC WIRES AND PROTECTION DEVICES.**

See the following example for determining the sizes of the AC breaker and wires.

Example:

1. Determine the quantity and model number of the rectifiers to be used in the system. Suppose four TH120048 (48 V, 25 A) rectifiers are to be used.
2. As per specifications in Table 3, the system requires a 20 A breaker at low line or a 15 A breaker at high line per rectifier. (Low line corresponds to 100–180 V input and high line corresponds to 200–264 V input.)

| Type of feed | Model Number of Rectifier | Minimum Output Voltage | Maximum rate AC input Current | Minimum recommended circuit breaker |
|---|---|---|---|---|
| | | Volts | Amps | Amps |
| Individual Feed | TH120048 | 100 | 15.4 | 20 |
| | TH120048 | 200 | 8.9 | 15 |
| | TH200048 | 200 | 11.7 | 15 |
| | TH250048 | 200 | 14.7 | 20 |
| | TH120024 | 100 | 15.8 | 20 |
| | TH120024 | 200 | 9.1 | 15 |
| | TH120012 | 100 | 14.3 | 20 |
| | TH120012 | 200 | 8.3 | 15 |

**Table 3 - Recommended AC Circuit Breaker and Wire Sizes**

# DC Output Requirements

## DC Circuit Drawings

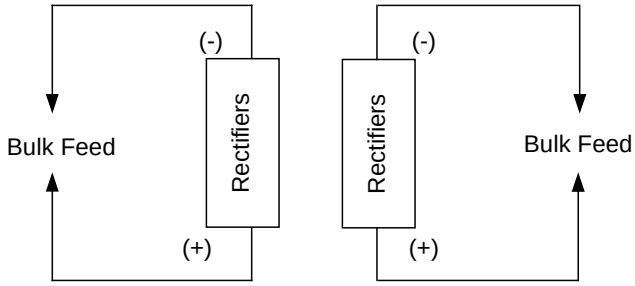


**Figure 2 - DC output schematic**

Each system is equipped with 2 unprotected bulk output connections; one set located on each side of the rear of the shelf that are isolated from each other. Unprotected bulk output connections are double, ¼"-20 studs with 5/8" centers. The maximum tongue width for bulk connections is 0.67". Select a wire or bus bar sized according to the current rating as shown in section 9. Choose lugs according to Table 4. The polarity of the system is universal; therefore the polarity of the output is determined by the system grounding. Circuit is capable of delivering a max of 200 amps total, 100 amps per side.

## DC Reference Ground

The Lambda Power system is a fully floating system. This means that neither the positive nor the negative are tied to the chassis or an earth ground. An external reference or earth ground may be connected to either the positive output or the negative output, depending the desired output polarity. As always follow your company's guidelines for sizing and attaching a reference ground.

## DC Wire Sizing

There are two main considerations for sizing DC wire: ampacity and voltage drop. Ampacity refers to a safe current carrying level as specified by non-profit organizations such as Underwriters Laboratories (UL) and the National Fire Prevention Association (NFPA), which publishes the National Electric Code (NEC). Voltage drop is simply the amount of voltage loss in a length of wire due to ohmic resistance of the conductor. DC wire may be sized for either ampacity or voltage drop depending on branch load loop length and conductor heating. In general, ampacity considerations will drive wire selection for short loop lengths (less than 50 feet) and voltage drop will drive wire selection for long loop lengths (greater than 50 feet). NEC Table 310.16 provides ampacity values for various sizes, bundles, and insulation temperature rated wire. ALWAYS FOLLOW NEC RULES AND YOUR LOCAL COMPANY PRACTICES WHEN SELECTING DC WIRING AND PROTECTION.

Unprotected DC output wires shall be based on the total rectifier capacity of the rack. For example, a system with two TH200048 (48V, 40A) rectifiers per side for a total capacity of 80A per side.

### DC lug requirements

Table 4 below is a list of lug part numbers from Burndy that can be used for DC connections. Wire type should be considered when determining the type of lug to use. These part numbers are based on flex style cable. Follow your company practices when determining the exact lug required. Systems requiring more than a 2 AWG connection will need custom bus bars.

| Wire size | | Burndy Lug | Description |
|---|---|---|---|
| AWG | $mm^2$ | Part number | |
| 10 | 6 | YAV102TC14 | Double hole lug with 1/4" holes and 5/8" centers |
| 8 | 10 | YA8CL2TC14 | Double hole lug with 1/4" holes and 5/8" centers |
| 6 | 16 | YAV6C-L2TC14-FX | Double hole lug with 1/4" holes and 5/8" centers |
| 4 | 25 | YAV4C-L2TC14-FX | Double hole lug with 1/4" holes and 5/8" centers |
| 2 | 35 | YAV2C-L2TC14-FX | Double hole lug with 1/4" holes and 5/8" centers |

**Table 4 – Lug Part Number for DC output**

## Torque Settings

Table 5 shows recommended torque settings for all mechanical and electrical connections according to screw or nut size.

| Screw or Nut Size | Torque (in-lbs) |
|---|---|
| 4-40 | 6 |
| 6-32 | 12 |
| 8-32 | 22 |
| 10-32 | 37 |
| 12-24 | 50 |
| ¼-20/M6 | 65 |

**Table 5 - Recommended Torque Settings**

# Required Tools

Lambda rectifiers are designed to be installed with a minimum number of commonly available tools:

- #1 & #2 Phillips screwdrivers
- Torque wrench
- 5/16” and 7/16” box wrenches, sockets, and/or nut drivers
- Wire and cable strippers
- Wire and cable crimpers

# Alarm and Signal Cable

Access to alarms and control signals is accomplished via a rear mounted connector with a mating cable part number TLRC01. Table 6 provides a pin functional description.

- The pin out of the alarm connector on the shelf is a 180° different from a standard Molex connector.
- AC fail, DC fail, and Thermal limit fail alarms are all open collector, opto-coupled, active high on failure/active low normally (software or factory configurable), and referenced to pin 7 for A side and 17 for B side. The pin is able to sink 10 mA of current at 5V and 5 mA at TTL voltages.
- Applying 5V between pins 6 and 7 on side A and 16 and 17 on side B will shut all rectifiers down. Removing the 5V will cause the rectifier to power back up.

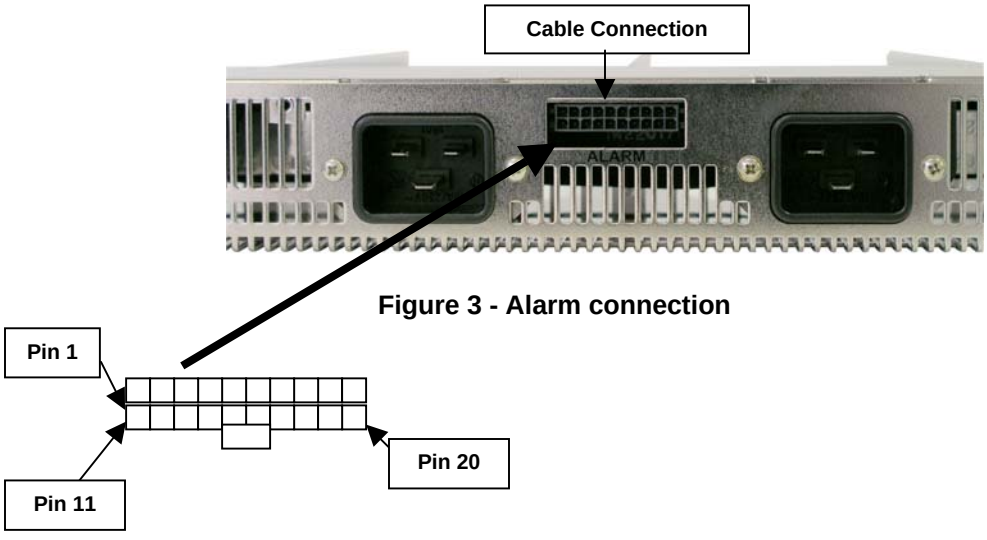


**Figure 3 - Alarm connection**

| Pin # | Wire Color | Description |
|---|---|---|
| 20 | BLK | B Side V Main Output (-). DC power ground. |
| 19 | RED | B Side SCL: $I^2C$ clock line. Referenced to Pin 10. |
| 18 | RED/WHT | B Side SDA: $I^2C$ data line. Referenced to Pin 10. |
| 17 | RED/BLK | B Side Logic Ground: Isolated ground for opto-coupled alarms. |
| 16 | GRN/WHT | B Side Module Disable: Opto-coupled input. Applying 5V between this pin and Pin 17 will disable all modules in the rack. |
| 15 | LT BL | A Side Module 0 AC Fail |
| 14 | LT BL/WHT | A Side Module 1 AC Fail |
| 13 | LT BL/BLK | B Side Module 2 AC Fail |
| 12 | YLW/WHT | B Side Module 3 AC Fail |
| 11 | YLW/BLK | B Side Module Thermal Limit Failure |
| 10 | TAN/WHT | A Side V Main Output (-). DC power ground. |
| 9 | TAN/BLK | A Side SCL: I2C clock line. Referenced to Pin 10. |
| 8 | TAN | A Side SDA: I2C data line. Referenced to Pin 10. |
| 7 | GRN/BLK | A Side Logic Ground: Isolated ground for opto-coupled alarms. |
| 6 | GRN | A Side Module Disable: Opto-coupled input. Applying 5V between this pin and Pin 17 will disable all modules in the rack. |
| 5 | OR/WHT | A Side Module 0 DC Fail |
| 4 | OR/BLK | A Side Module 1 DC Fail |
| 3 | OR | B Side Module 2 DC Fail |
| 2 | WHT | B Side Module 3 DC Fail |
| 1 | YLW | A Side Module Thermal Limit Failure |

**Table 6 - Alarm and Signal Interconnections**

# 3.Site and Equipment Preparation

After unpacking the DC Power Plant, note any physical package damage that could indicate potential damage to the contents. After removing DC Power Plant from boxes and packing material, inspect for shipping and/or other damage. Contact sales or technical support immediately if any damage is present. Have all tools, wire, cables, and hardware within easy reach. To the extent possible, ensure a clean (free of debris, dust, and foreign material) work environment. Care should be taken in the installation process to prevent exposure of the equipment to wire clippings. If possible, the rectifiers should remained sealed in their shipping boxes until the rack wiring is complete. Ensure all AC and DC power sources are off and disconnected.

# 4.Power Plant Mounting and Wiring

## Mechanical Mounting

The power system is intended for normal operations and should be installed in a standard 19" telecommunications enclosure. Lambda recommends that one person should hold the rack into position on the enclosure while another person should secure the rack to the enclosure with the mounting hardware shipped with the system. Torque the mounting hardware according to specifications in Table 5.

Observe the following instructions:

- Elevated operating ambient temperature: If the system is installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than the room ambient temperature. Therefore, the system should be installed in an environment compatible with the maximum ambient temperature (Tma) specified for the system.
- Proper air flow: Installation of the system in an enclosure should be such that the amount of air flow required for the safe operation of the system is not compromised.
- Mechanical loading: Mounting of the system in the enclosure should be done carefully so that there are no hazards due to uneven mechanical loading.
- Circuit overloading: Read the ratings on system labels carefully and consider these while connecting the system to the supply circuit. Be aware of the effect that overloading of the circuits might have on over-current protection and supply wiring.
- Reliable earthing: The rack-mounted system must have reliable earthing.

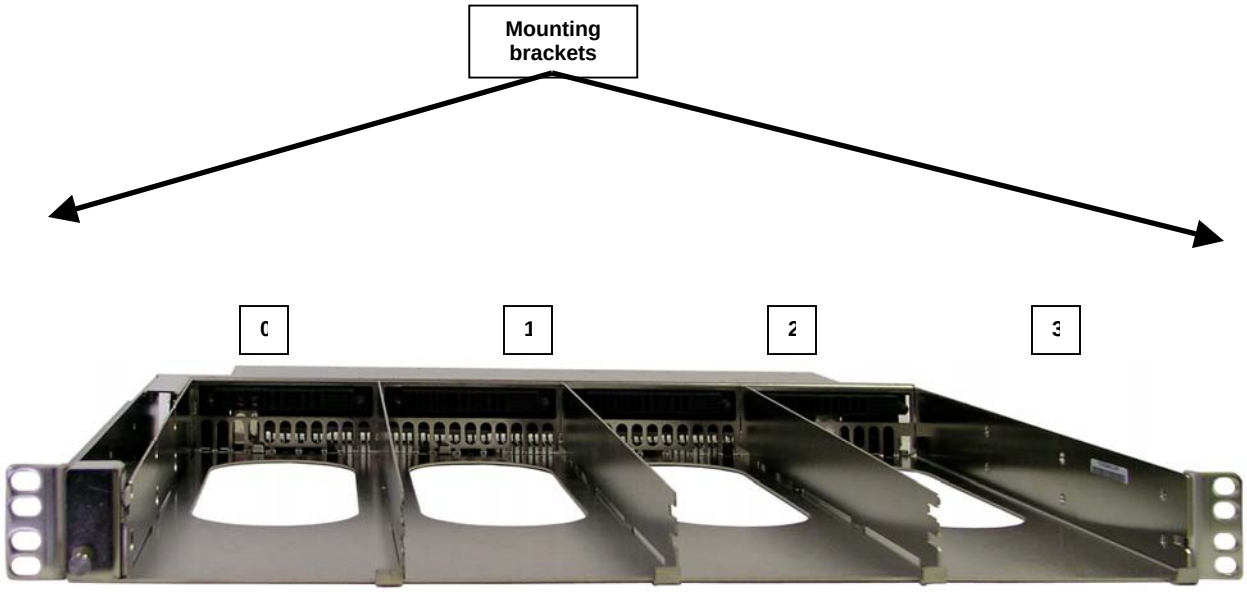


**Figure 4 - System Overview**

# AC input

## IEC320-C20 Connection

Plug in the appropriate cord into the AC connections on the back of the rack and secure AC wiring to safety brackets (see section AC Cord Brackets on page 15).

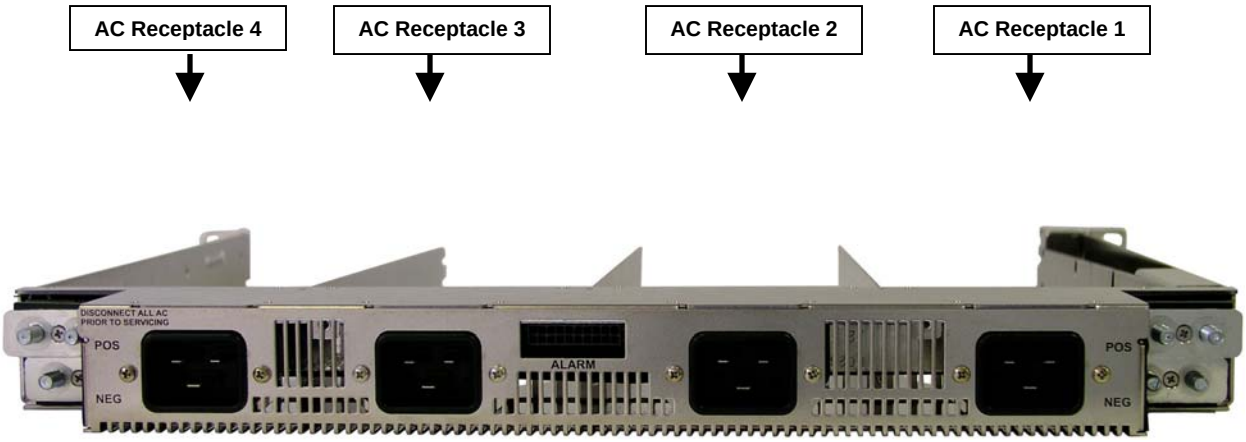


**Figure 5 - Rear View (IEC320-C20)**

## AC Cord Brackets

Optional brackets are available in the mounting kit to secure the IEC320 plugs to the rack in an individual feed system. Follow these instructions for using the brackets:

Place the bracket on the plug as shown in Figure 6. You can secure it to the plug by tightening the screw on the bracket.

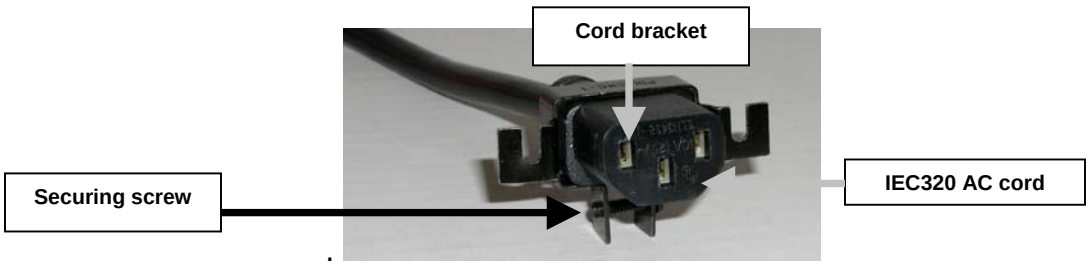


**Figure 6 - AC Cord Bracket (IEC320 Connectors)**

After plugging the cords into the rack, secure the brackets to the rack with #4-40 screws provided as shown in Figure 7.

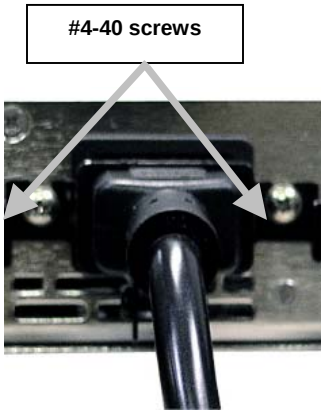


**Figure 7 - Securing the Bracket to the Shelf**

# DC Output

DC connections are accomplished via the two rear bulk output connection as shown in Figure 8. Torque connections according to Table 5. DO NOT exceed the current rating of the rack from section DC Circuit Drawings on page 9.

## Circuit 34

Connect lugged wires or bus bars to the rear accessed bulk outputs. Verify polarity of connections before power units on. Outputs are labeled positive (pos) and negative (neg). A DC reference ground should be connected to the appropriate output for desired polarity of the system. Repeat connections for the other side.

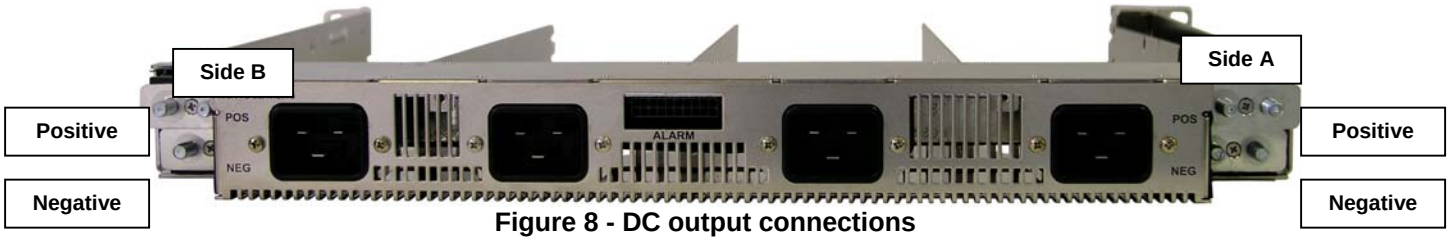


**Figure 8 - DC output connections**

## DC ground

Due to the universal capabilities of this system a specific location has not been provided for a DC ground. If an open output connection point is available on either side, a ground may be attached to the appropriate connection for the desired output polarity. If an output connection point is not available a ground will have to be connected to an external distribution point.

# Alarm Connections

Access to the alarm and control signals is accomplished by plugging an alarm cable (TLRC01) into the connector as shown on Figure 9. See section Alarm and Signal Cable on page 11 for more information on alarms.

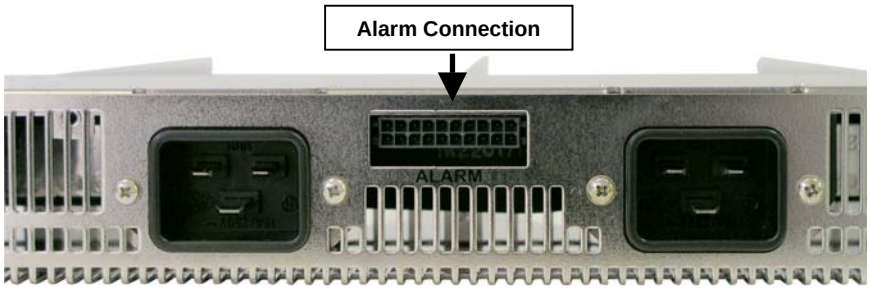


**Figure 9 - Alarm connection**

# 5.Test and Turn-Up

After all input and output connections have been secured and checked, activate all input breakers. When input breakers are on, install rectifiers sequentially by sliding each rectifier into position and closing the latch as shown in Figure 11. **Rectifier latches must be open for installation. Attempting to install rectifiers with latches closed can result in mechanical damage to the rectifiers and the rack.** In addition, rectifier slots are keyed, and keys may be repositioned within the slot to accommodate the rectifier model being used. Rectifier fans will start in high-speed mode and reduce their speed according to the ambient and plant conditions within 10 seconds.

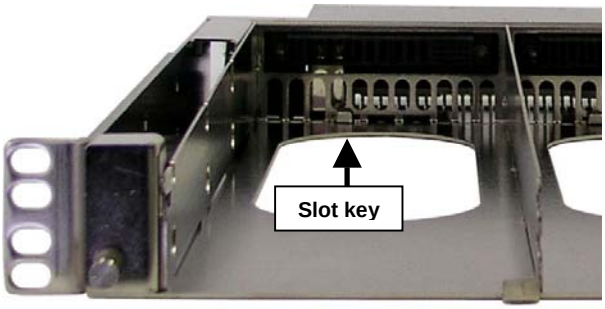


**Figure 10 - Rectifier slot key**

# 6.Replacement Items

If a rectifier needs to be removed, press the latch button on the front of the unit, and pull the handle until the unit slides out of the slot. With the latch open (Figure 11), slide a new rectifier into the open slot until it connects with the backplane. After the rectifier is inserted, close the latch by pressing it. The rectifier will power up automatically. No further setup is required.


**Figure 11 - Rectifier removal**

# 7.Troubleshooting

## Problems and Solutions

Follow these instructions for different scenarios:

- AC **OK off, DC OK off, ALM on or off, and AC Fail alarm from the alarm cable:** Verify that proper AC voltage has been supplied to the rectifiers being used. Refer to Table 1 for AC input voltage requirements. Reseat the rectifiers, and if problems continue, replace the rectifiers.
- AC **OK on, DC OK off, ALM LED on, and DC Fail alarm from the alarm cable:** Check DC output connections for any short circuit. Reseat rectifiers, and if problems continue, replace the rectifiers.
- AC **OK on, DC OK on, and Thermal Limit Failure alarm from the alarm cable:** Rectifiers are over-heating. Cool down environmental conditions.

## Short Circuit and Current Limit

Figure 12 represents the behavior of the output voltage in relation to the output current as load requirements exceed the $I_{Limit}$ setpoint. $I_{Limit}$ can be adjusted up to +105% of the rated current of the rectifier. The system output voltage will remain constant up to $I_{Limit}$ at which point it will drop quickly to 0 V, as shown in Figure 12. If the output voltage of a 48 V rectifier drops below 12 V for more than 5 seconds, the system will shut down. The system will automatically restart after 60 seconds, and will continue to restart and shut down until the short circuit is cleared.

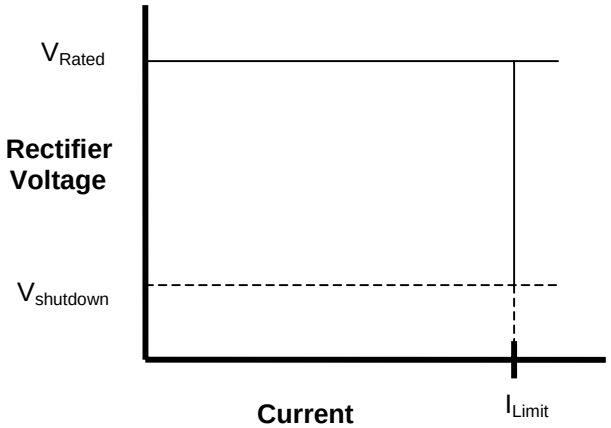


**Figure 12 - Short Circuit and Current Limit**