TX

Installation, Operation, and Maintenance Manual

TX Series

May 10, 2010

V005059

TDK·Lambda

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1. Safety and Recommended Practices

General practices

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

This product accepts a single-phase AC operating voltage between 180 and 305 VAC or a three-phase AC voltage between 180 and 264 VAC or 342 and 528 VAC (depending on the rack and modules used). The system accepts a frequency range of 47 to 63 Hz and will operate in an ambient temperature range of -40°C to +52°C.

CAUTION: HAZARDOUS VOLTAGE AND ENERGY LEVELS ARE PRESENT WHICH 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.

A readily accessible disconnect device shall be incorporated in the building installation wiring for all AC connections. Customer shall select AC breakers according to **Table 3** (single phase) and **Table 4** (three phase).

CAUTION: ALL MODULES EMPLOY INTERNAL DOUBLE-POLE/NEUTRAL FUSING.

Use double hole, UL listed lugs for all DC connections to prevent lug rotation and inadvertent contact with other circuits.

The ampacity of the wire must always be greater than or equal to the protection device (fuse or circuit breaker) regulating the wire, regardless of voltage drop calculations.

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

Connection and mounting torque requirements are listed in Table 7**.**

WARNING: For safety, the module is required to be reliably connected to PROTECTIVE GROUND. The equipment is to be connected to supply mains by qualified personnel in accordance with local and national codes (e.g., NEC, CEC, etc). Do not disconnect and reconnect I/O power connectors during lightning storms. The output of the module is not intended to accessible due to energy hazards. Rack mounting must be performed in accordance with instructions provided by the manufacturer to avoid potential hazards.

FCC Compliance Statement

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions:

This device may not cause harmful interference, and

This device must accept any interference received, including interference that may cause undesired operation.

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 Section

This system is intended to be used in applications in which custom bus bars are used to connect to the customer's distribution or equipment. The system provides high density bulk power.Systems are available that will accept single-phase or three-phase commercial power (see section "AC Feed Sizing") and output either 24VDC or 48VDC depending on the rectifiers deployed. Systems are available in both 19" and 23" varieties

For information on installation procedures, see section "Mounting and Wiring" starting on page 16.

Rack Specifications

Modules

AC-DC power rectification is made possible by TDK-Lambda's TX-series modules. **Table 1** lists the specifications of compatible modules.

Model	Nominal DC Voltage (VDC)	DC Voltage (VDC) Range	Max DC Current (Idc)	Nominal AC Voltage (VAC)	AC Voltage (VAC) Range
TX500048	48	42 - 56	100	208	180 - 264
TX7500W48	48	42 - 56	150	277	180 - 305

Table 1 - TX-series module specifications

Heat Dissipation

Table 2 displays the typical heat dissipated for each module. Typical is calculated at 240 VAC and full load.

Model	Typical	
	BTU/hr	Watts
TX5000481	2011	589
TX7500W48	3017	884

Table 2 - Module Heat Dissipation

AC Feed Sizing

The TX-series Power System operates with single-phase modules that are fed with either single-phase or three-phase AC service, depending on the rack purchased. TX-series racks and modules are 2RU (3.5”) in height.

ALWAYS FOLLOW NEC RULES AND LOCAL COMPANY PRACTICES WHEN SELECTING WIRE SIZES AND PROTECTION. In order to properly size AC feed circuit breakers, collect the following pieces of information: Rectifier model, rectifier shelf name, and AC voltage.

Rack Nomenclature

TDK-Lambda’s racks are identified by their power properties. “Input” describes the kind of *AC input* the rack will accept.

TXR3025 – three-phase, delta (three input wires and ground)

TXR3 – single-phase, delta, individual input

TXR3026 – three-phase, WYE (three input wires, one neutral, and ground)

AC input voltage depends on the kind of input the rectifiers are designed to accept:

- Nominal single-phase voltage must be between 200V to 240V
- Three-phase, three-wire delta voltage must be between 200V to 240V
- Three-phase, four-wire wye voltage must be between 380V to 480V

RACKS

Each rack contains an AC input box located in the rear right (when facing the back of the rack).

Two (2) ¾” knockouts (for single-phase input) or one (1) 1¼” knockout (for three-phase input) are provided on the AC box. Two (2) double-hole ¼” studs with ⅝” centers are available inside the rack AC box for terminating the AC input ground connections. AC power connections feed into a compression-style terminal block.

TX-series modules can be fed with phase-to-phase or phase-to-neutral lines. It is important that phase-to-phase AC input feeds used on a single-phase shelf be protected with a double-pole circuit breaker. The TX7500W48 is designed to run on a 480Y/277 VAC phase-to-neutral feed. While this module will operate in an individual feed and three-phase, delta feed system, the three-phase, wye feed system is the only system that allows the module to operate at 480Y/277 VAC.

TXR3 and TXR4

The individual-feed rack accepts an AC voltage of 200VAC to 240VAC, with a nominal input of 208VAC for each connection. Each AC feed powers one module. Size the AC breaker for one module on each AC feed according to Table 3. The terminal block will accept wire sizes up to 6 AWG, requires a wire strip length of 0.4", and connections should be torqued to 14 in-lbs.

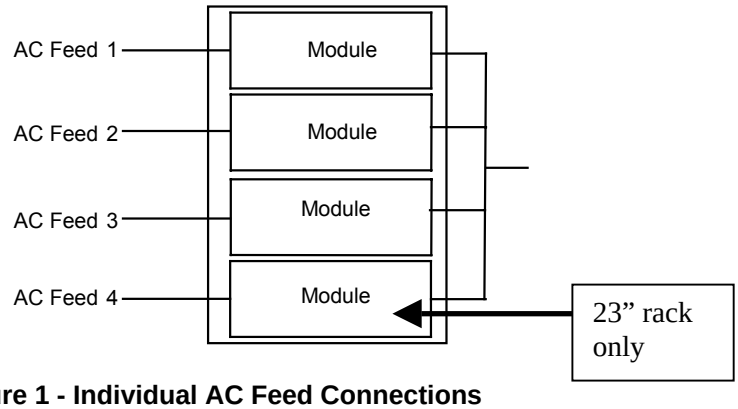

Figure 1 - Individual AC Feed Connections

Module	Single-Phase AC Feed	Nominal AC Voltage	Max AC Current per Feed	Minimum Recommended Breaker Size (per Feed)
TX500048	Individual	208	32	40
		240	27	20
TX7500W48	Individual	208	45	60
		240	39	50
		277	34	50
TX375024	Individual	208	23	30
		240	20	30

Table 3 - Recommended AC Circuit Breaker Sizes for Single Phase Input

TXR3025

The three-phase delta rack accepts an AC voltage of 200VAC to 240VAC, with a nominal input of 208VAC. One three-phase delta AC feed powers three modules, wired internally to combine two phases at each module. You should size the AC breaker for all modules in the rack according to **Table 4**. The terminal block will accept wire sizes up to 1/0 AWG, requires a wire strip length of 0.4", and connections should be torqued to 32.8 in-lbs.

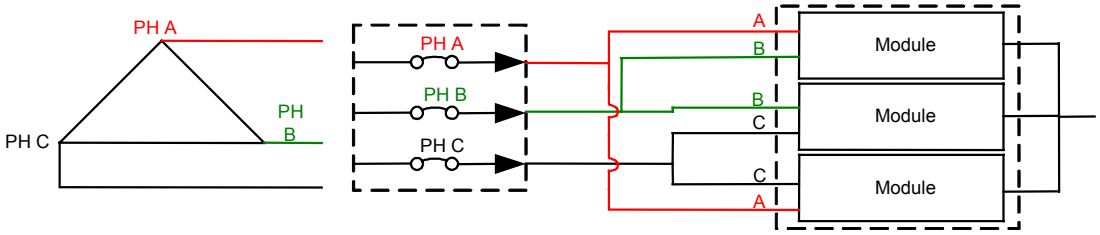

Figure 2 - Three-phase Delta Connections

TXR3026

The three-phase wye rack accepts an AC voltage of 350VAC to 480VAC, with a nominal input of 380VAC or 480VAC. One three-phase wye AC feed powers three modules, wired internally to combine a phase and neutral at each module. Size the AC breaker for all modules in the rack according to **Table 4**. The terminal block will accept wire sizes up to 4 AWG, requires a wire strip length of 0.4", and connections should be torqued to 14 in-lbs.

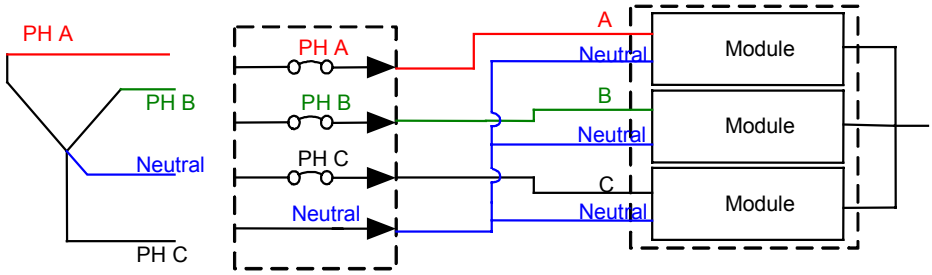

Figure 3 - Three-phase Wye Connections

Module	Three-Phase AC Feed	Nominal AC Voltage	Max AC Current per Feed	Minimum Recommended Breaker Size (per Feed)
TX500048	Delta	208	55.4	70
	Wye	380Y/220	27.0	40
TX7500W48	Delta	208	77.9	100
	Wye	380Y/220	39.0	50
	Wye	480Y/277	34.0	50
TX375024	Delta	240	39.8	50
	Wye	380Y/220	20.0	30

Table 4 - Recommended AC Breaker Sizes for Three-Phase

Conduit sizing

Proper conduit size for AC cables feeding racks is determined by the gauge and numbers of wires feeding AC power to the system.

Table 5 lists the maximum number of wires that 1.25” and 0.75” conduit can accommodate.

Wire Size		1.25" Flexible Tubing Conduit	1.25" Metallic Tubing Conduit	0.75" Flexible Tubing Conduit	0.75" Metallic Tubing Conduit
AWG	mm²	Max # of wires	Max # of wires	Max # of wires	Max # of wires
12	4	38	45	16	16
10	6	24	28	10	10
8	10	10	16	6	6
6	16	10	12	4	4
4	25	6	7	2	2

Note: Taken from NEC Table C1 & C3 for THHN Wire Type

Table 5 - Maximum Wires for Conduit

DC Circuit Drawings

DC circuit 1

Each system is equipped with 2 unprotected bulk output connections as illustrated in Figure 4. Each output has six (6) ¼”-20 threaded holes that are spaced per the dimensions given in Figure 4.

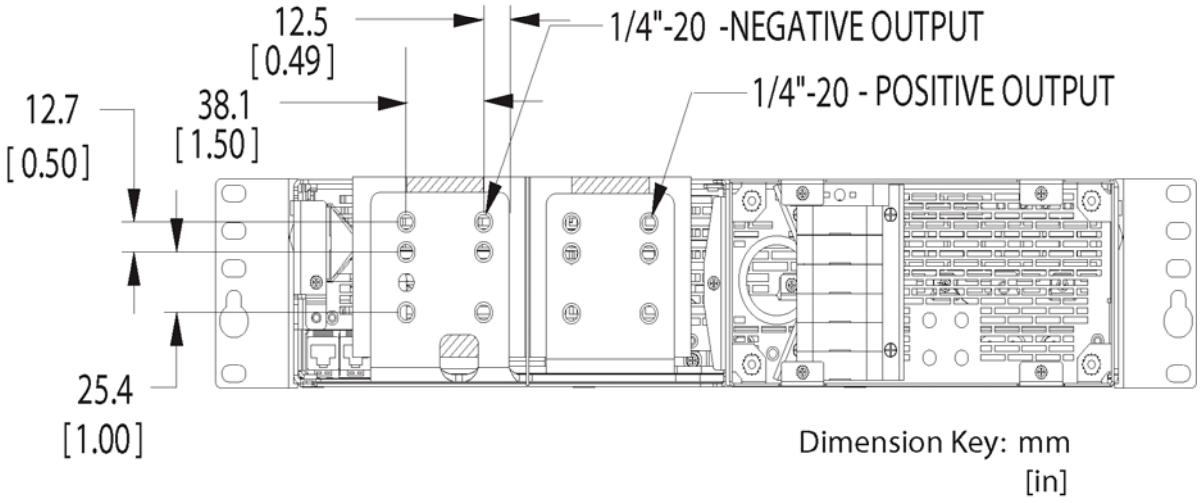

Figure 4 - DC output dimension drawing

DC reference ground

This system is a fully floating system. This means that the output bus bars are not tied to the chassis or an earth ground. It is recommended that an external reference ground be connected to the appropriate bus in an external bus bar. As always follow your company’s guidelines for sizing and attaching a reference ground.

DC output 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 and the National Fire Prevention Association, which publishes the National Electric Code. 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). The National Electric Code 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 module capacity of the rack.

Signal cable

Access to control signals is accomplished via a side mounted connector with a mating cable part number TLRC01 (Figure 13). Table 6 provides a pin functional description.

- The pin out of the connector on the rack is a 180° different from a standard Molex connector, see Figure 12.
- Applying 5 V between pins 16 and 17 will shut all modules down. Removing the 5V will cause the module to power back up.
- Tie pin 9 from multiple racks to current share between racks.

Pin #	Wire Color	Description
20	BLK	Shelf Bias: A regulated 12V/100ma bias supply. Referenced to Pin 10.
19	RED	Not Used
18	RED/WHT	Not Used
17	RED/BLK	Logic Ground
16	GRN/WHT	Module Disable: Opto-coupled input. Applying 5V between this pin and Pin 17 will disable all modules in the shelf.
15	LT BL	Not Used
14	LT BL/WHT	Not Used
13	LT BL/BLK	Not Used
12	YLW/WHT	Not Used
11	YLW/BLK	Not Used
10	TAN/WHT	V Main Output (-). DC power ground.
9	TAN/BLK	Not Used
8	TAN	Not Used
7	GRN/BLK	Not Used
6	GRN	Not Used
5	OR/WHT	Not Used
4	OR/BLK	Not Used
3	OR	Not Used
2	WHT	Not Used
1	YLW	Not Used

Table 6 - (TLRC01)

3. Site and Equipment Preparation

After removing DC Power system from boxes and packing material, inspect for shipping and/or other damage. Contact sales TDK-Lambda immediately if any damage is present. Have all tools, wire, cables, hardware, etc., within easy reach. To the extent possible ensure a clean (free of debris, dust, foreign material, etc.) work environment. Ensure all AC and DC power sources are off and disconnected.

Torque settings

Table 7 shows the recommended torque settings for all mechanical and electrical connections according to screw or nut size. Not all screw sizes may be present on a particular rack.

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

Table 7 - Recommended Torque Settings

Required Tools

The racks are designed to be installed with a minimum number of commonly available tools.

Phillips screwdrivers
Flathead screwdrivers
Torque wrench
Box wrenches, sockets, or nut drivers
Wire and Cable Strippers
Wire and Cable Crimpers

4. Mounting and Wiring

Warnings

Before installing the power system the following safety requirements should be considered.

Elevated Operating Ambient - If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) specified by the manufacturer.

Reduced Air Flow - Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised.

Mechanical Loading - Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.

Circuit Overloading - Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on over-current protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.

Reliable Earthing - Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (e.g. use of power strips).

System Overview

The TX-series family of racks are available in both 19” and 23” versions. The racks will accept 3 modules and 4 modules respectively. On the rear side of the rack are located the DC output and AC input sections.

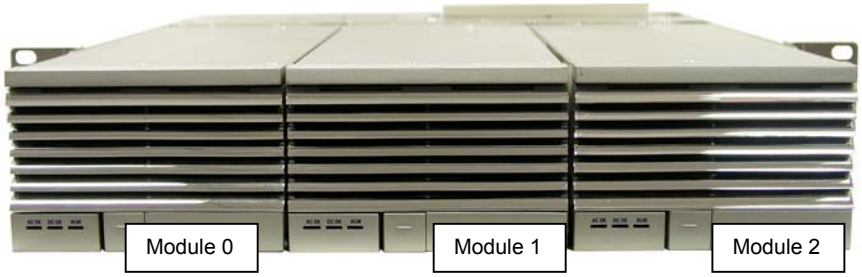

Figure 5 - Front view (19" system)

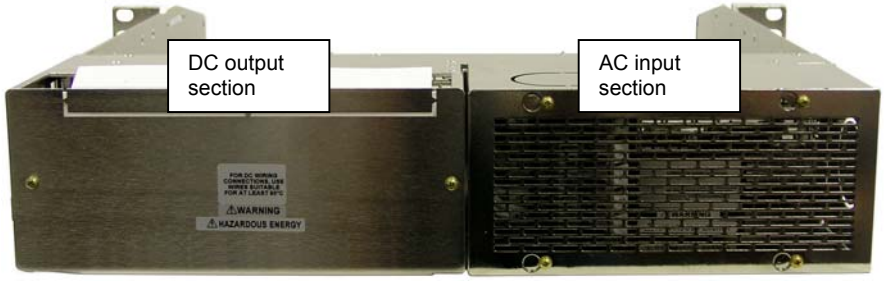

Figure 6 - Rear view (19" system)

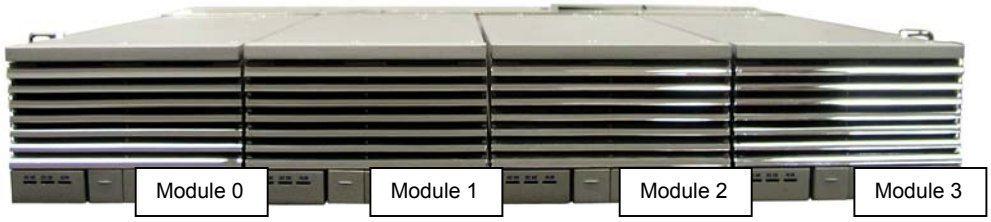

Figure 7 - Front view (23" system)

Figure 8 - Rear view (23" system)

Mechanical mounting

This equipment is intended for normal operations and is to be installed in a standard 19" or 23" telecommunications enclosure. It is recommended that one person lift the rack into place while another installs supplied mounting hardware. Customer should torque all mounting hardware according to Table 7. TDK-Lambda recommends that you use at least two screws per bracket per rack.

Single rack mounting

1. Place rack in enclosure at position desired
2. Have second person secure the rack to the enclosure using the provided #12-24 screws
3. Repeat step two until both sides of the rack are secured with two screws each
4. Torque screws to 50 in-lbs

Figure 9 – Single rack mounting (19" shelf shown)

Multiple shelf mounting

Racks are separate and can be mounted directly on top of each other. Mounting kit (TLB0K12-SS) is available separately for connecting rack bus bars together.

1. Place rack in enclosure at position desired
2. Have second person secure the rack to the enclosure using the provided #12-24 screws
3. Repeat step two until both sides of the rack are secured with two screws each
4. Repeat steps 1 – 3 for additional racks
5. Torque screws to 50 in-lbs

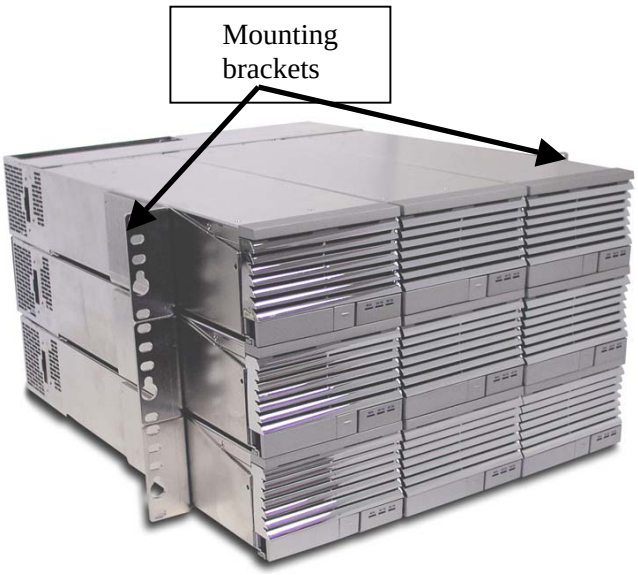

Figure 10 - Multiple rack mounting (19" shelves shown)

6. Connect TLB024C012704 from rack one to rack two for each the positive and negative bus bar and secure to the rack with provided screws.
7. Connect TLB024C012712 from rack one to rack two for each the positive and negative bus bar and secure to the shelf with provided screws, lock washers, and flat washers.
8. Torque connections to 65 in-lbs.
9. Continue in this manner for all racks you are attaching together.

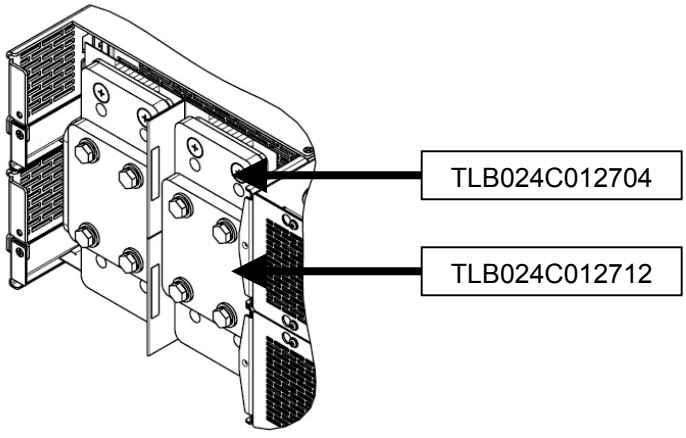

Figure 11 - Multiple rack bus bar connections

Signal Cable

This cable can be used with a single system or multiple systems.

1. Connect the signal cable (TLRC01, sold separately) into the signal connector on the side of the rack, near the rear of the system
2. Repeat step 1 for all racks being connected together
3. Connect wires from cable to signal transport equipment per wiring chart in section on page 14

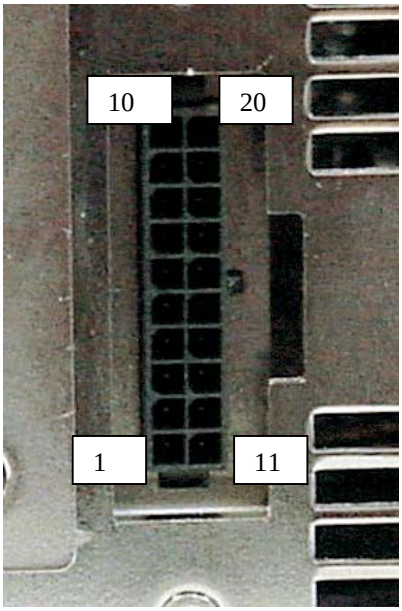

Figure 12 - Connector

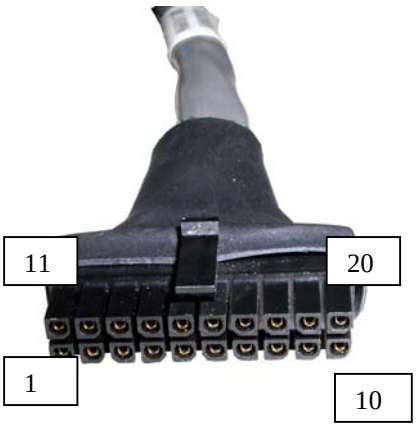

Figure 13 - Pin out (TLRC01)

AC input

IMPORTANT: Refer to the section “AC Feed Sizing” on page 7 to determine the kind of AC feeds the rack receives.

NOTE: Always connect ground wires *first*.

AC Input Terminal Blocks

The following sections show AC input terminal block connections for different racks. A small flathead screwdriver is required to loosen and tighten the clamps. Terminal block labels are in the form xLy, where “x” is the feed number and “y” is the line number. So “1L2” means Feed 1, Line 2. This is an important point for single-phase AC input.

All input boxes have two sets of 1/4” studs for double-hole lugs with 5/8” centers for ground terminations. They are located just to the right of the terminal block.

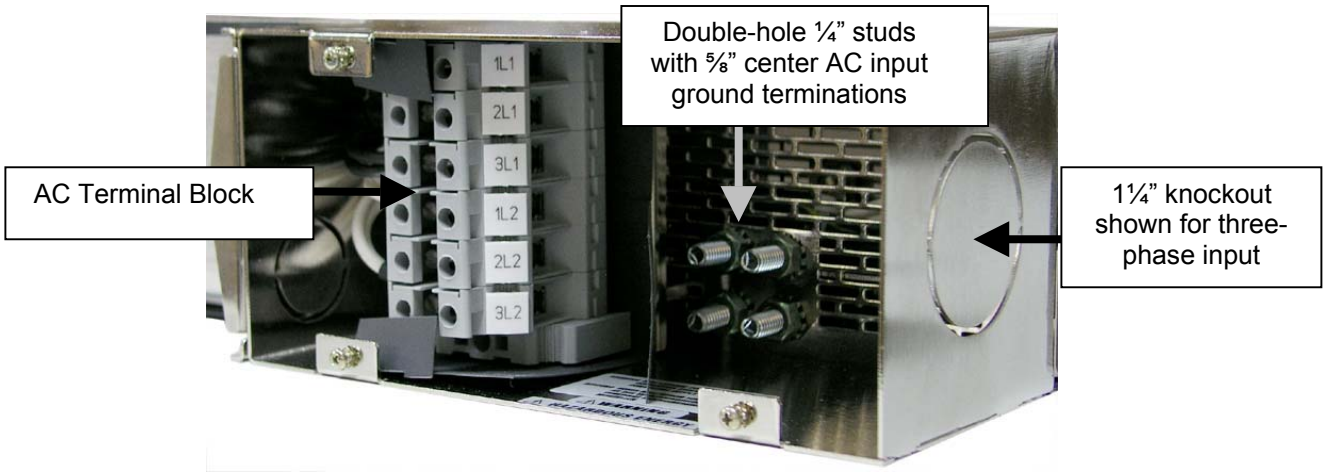

Figure 14 – Individual AC Feed Connection (19” Rack)

IMPORTANT: Make sure all AC breakers are in the OFF position before making connections.

NOTE: Phase-to-phase feeds powering single-phase rack must be protected with double-pole circuit breakers.

Single-Phase, Individual Feed (TXR3)

1. Remove AC input box cover.
2. Remove conduit knockout(s).
3. Attach wire conduit(s) to AC box.
4. Attach ground to the provided grounding studs in the AC input box.
5. Strip wires to a length of 0.4”.
6. Insert the lines of the first AC feed into “Feed 1, Line 1” (1L1) and “Feed 1, Line 2” (1L2) of the terminal block.
7. Tighten compression screw to 14 in-lbs.
8. Repeat steps 6 to 4 for the remaining two AC lines, using their respective terminals.
9. Replace AC box cover.

Figure 15 - Individual AC feed connection (19” rack)

Single-Phase, Individual Feed (TXR4)

1. Remove AC input box cover.
2. Remove conduit knockout(s).
3. Attach wire conduit(s) to AC box.
4. Attach ground to the provided grounding studs in the AC input box.
5. Strip wires to a length of 0.4”.
6. Insert the lines of the first AC feed into “Feed 1, Line 1” (1L1) and “Feed 1, Line 2” (1L2) of the terminal block.
7. Tighten compression screw to 14 in-lbs.
8. Repeat steps 6 to 4 for the remaining three AC lines, using their respective terminals.
9. Replace AC box cover.

Figure 16 - Single phase, individual AC feed connection (23” rack)

Three-Phase Delta (TXR3025)

1. Remove AC input box cover.
2. Remove conduit knockout.
3. Attach wire conduit to AC box.
4. Attach ground to the provided grounding studs in the AC input box.
5. Strip wire to a length of 0.4”.
6. Insert the Phase A line into Line 1 (1L1) of the terminal block.
7. Tighten compression screw to 14 in-lbs.
8. Repeat steps 6 and 7 for phases B and C (1L2 and 1L3, respectively).
9. Replace the AC box cover.

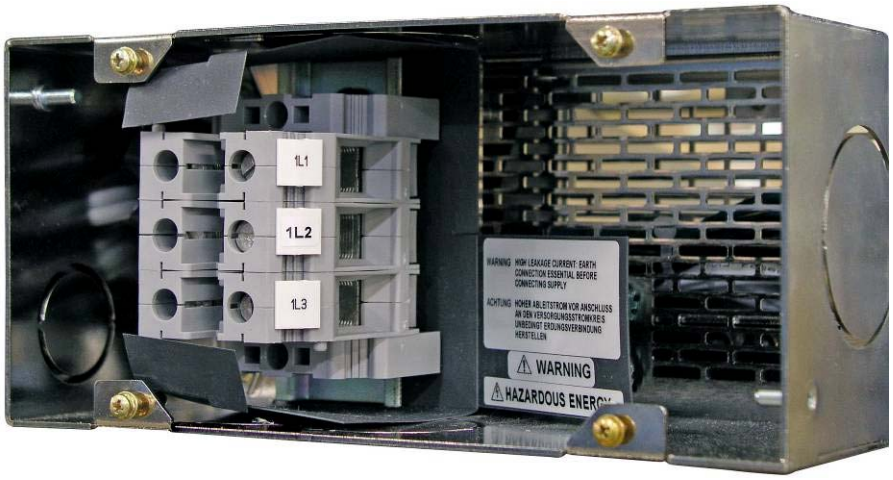

Figure 17 - Three phase, Delta AC feed connection

Three-Phase WYE (TXR3026)

1. Remove AC input box cover.
2. Remove conduit knockout.
3. Attach wire conduit to AC box.
4. Attach ground to the provided grounding studs in the AC input box.
5. Strip wire to a length of 0.4”.
6. Insert the Phase A line into Line 1 (1L1) of the terminal block.
7. Tighten compression screw to 14 in-lbs.
8. Repeat steps 6 and 7 for phases B and C (1L2 and 1L3, respectively).
9. Insert the neutral line into “N” of the terminal block.
10. Tighten compression screw to 14 in-lbs.
11. Replace the AC box cover.

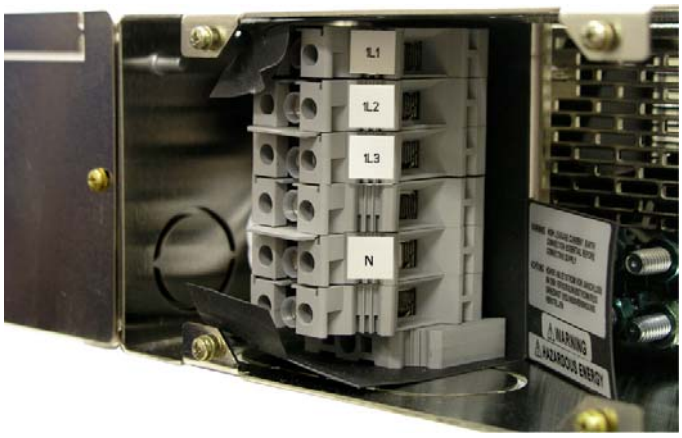

Figure 18 - Three phase, WYE AC feed connection

DC output

WARNING: Do not install DC connections with rectifiers energized. Always use insulated tools.

Follow your company and local standards for connecting lugs to DC wire, heat shrinking, and dressing wire properly. Wiring can be directed from either the top or the bottom of the system. Verify polarity before attaching connections. Attach lugged wire to the proper DC output, either positive or negative, with supplied lock washers, flat washer, and ¼" bolts. Torque connections according to Table 7.

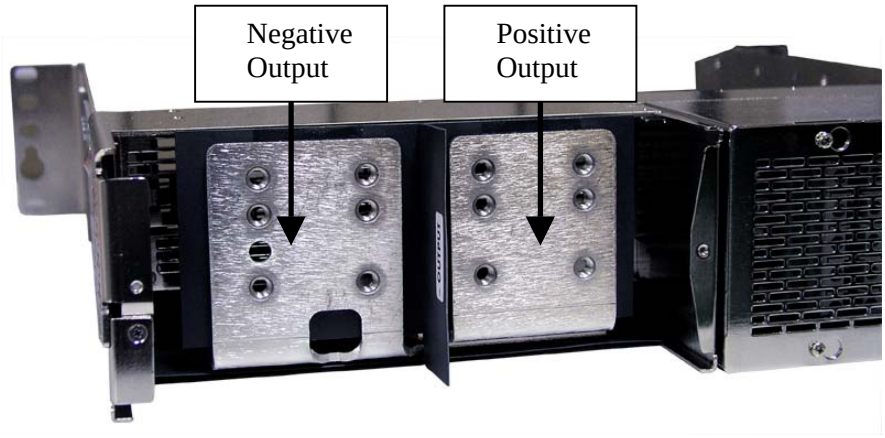

Figure 19 - DC Connections

DC Reference ground

Connect your reference ground to either the negative output or positive output (Figure 19) depending on the desired output polarity. It is recommended that a DC reference ground be connected to an external bus bar or distribution system that is tied to the TX-series system bulk outputs

5. Test and Turn-Up

IMPORTANT: Modules and racks are keyed to prevent the wrong modules from being inserted into the wrong racks. Check each rack and module for compatibility before attempting to install.

NOTE: DO NOT attempt to combine 24V and 48V modules in the same rack.

IMPORTANT: Modules have locking latches that **must be open** for installation. Attempting to install modules with the latches closed will result in mechanical damage to modules and racks. Open each latch by depressing the latch release button in the center-left of the bottom front panel.

Module Installation

The TX-series DC Power System is designed to power up when a module is properly installed. Before installing power modules, first ensure that all AC and DC connections are secure.

1. Turn all AC breakers to the ON position.
2. Unlatch each module; carefully insert each module into its respective rack by sliding it all the way into the slot. If you notice any resistance preventing the module from sliding all the way in and mating with the contacts in the back of the shelf, remove the module immediately and check for the following possible problems:
   - The module may be incompatible with the rack. Modules are keyed to prevent modules from being installed into converter racks and converters from being installed into module racks.
   - The module latch may be closed. Push the button in the center-left of the bottom front panel to release the latch, and then pull the latch as far open as it will go.
3. Close the latch to lock the module in place
4. Each power module will start in a high-fan speed mode and adjust its speed according to ambient temperature and plant conditions within 10 seconds.
5. Verify that no alarms are present and operation is as intended.

Note: Default output voltage of the modules will be 24V or 48V depending on type of modules used (see Table 1)

6. Replacing Items

The modules are designed as modular units that can be replaced in the field.

Modules

Use the following steps to replace modules:

1. Press the latch button on the front of the unit, and pull the handle until the unit slides out of the slot.
2. Slide a new module with the latch open into the open slot until it mates with the backplane.
3. Close the latch by pressing it after the module is inserted.
4. The module will power up and the controller will configure it automatically. No further setup is required.

7. Troubleshooting

Follow these instructions for modules alarms:

- **AC OK off, DC OK off, ALM on or off:** Verify that proper AC voltage has been supplied to the modules being used. Refer to **Table 1** for AC input voltage requirements. Reseat the modules, and if problems continue, replace the modules.
- **AC OK on, DC OK off, ALM LED on:** Check DC output connections for any short circuit. Reseat modules, and if problems continue, replace the modules.

Short circuit & Current Limit

The system voltage will remain constant up to I_{Limit} at which point the system voltage will drop quickly toward 0 VDC , as in Figure 20. Once a 24V or 48V module drops below 12 VDC for more than 5 seconds, the system will shut down. The system will automatically restart after 60 seconds, and will continue until the short circuit is cleared.

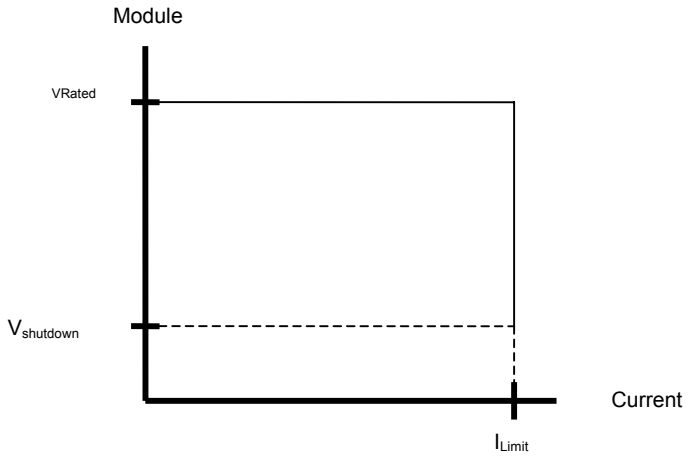

Figure 20 - Short Circuit & Current Limit