ELTEK

Installation Guide

Modular with Smartpack2

Flatpack2 DC Power System

Delta Part No. 5017197601

Doc. No. 370001.033, Issue 2.4
Published 4-Dec-18

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Doc. No. 370001.033, Issue 2.4, December 2018

Published 20 December 2018

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For use in restricted access locations only

Only suitable for mounting on concrete or other non-combustible surface

The Modular DC power system accepts a nominal, single-phase AC voltage between 100 V and 277 V (±10%), depending on rectifier used, 50 to 60 Hz. It is capable of delivering a maximum DC output of 1200 A (depending on the number of rectifiers deployed) at an ambient operating temperature range of -40°C to +50°C. Systems are powered by Flatpack2 HE rectifiers and available for 48V DC output. (Flatpack2 3kW rectifers derate above 45°C.)

WARNING: 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.

WARNING: For safety, the power supply 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. Equipment is intended for deployments where an external Surge Protective Device (SPD) is utilized. The output of the power supply is not intended to be accessible due to energy hazards. Rack mounting must be performed in accordance with instructions provided by the manufacturer to avoid potential hazards.

WARNING: This product is intended to be protected by a surge protector that meets the applicable criteria or GR-974-CORE. Failure to utilize the appropriate surge protector could result in susceptibility to lightning surges or create a potential hazard due to power faults.

WARNING: Keep hands, hardware and tools clear of fans. Fans are thermostatically controlled and will turn on automatically as a function of temperature.

CAUTION: All rectifiers employ internal double pole/neutral fusing. Fuses are not field-replaceable.

WARNING: HIGH LEAKAGE CURRENT! Earth connection is essential before connecting supply.

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

Each power shelf should be fed from a dedicated AC branch circuit of a terra neutral (TN) or isolated terra (IT) power system.

A readily accessible disconnect device shall be incorporated in the building installation wiring for all AC connections. Select wall breakers according to national and local electric codes.

Use Underwriters Laboratories (UL)-listed, double-hole lugs for all DC connections to prevent lug rotation and inadvertent contact with other circuits. Terminal strip connections require only single-hole lugs.

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

Alarm contacts are rated for a maximum voltage of 60 V, SELV (Safety Extra Low Voltage) and a maximum continuous current of 1A. Connection and mounting torque requirements are listed in Table 4.

Heat dissipation greater than the objectives listed in GR-63-CORE may occur. Additional equipment room cooling may be required. To cope with high heat release, aisle spacing may be increased and high heat-dissipating equipment may be located adjacent to equipment generating less heat.

It is recommended practice to ensure that all circuit breakers (including those for DC distribution) are in the OFF position during both installation and removal.

Eltek does not recommend shipping the power shelf with rectifiers installed. Rectifiers should be shipped in separate boxes.

WARNING: Protection of persons against electric shock:

Power cabling may be performed only by qualified personnel in accordance with local and national electric codes. Improper wiring can cause physical damage or injury. Input voltage from the power source might be present. Improper connection may cause damage or serious injury. Ensure that the power source switch is in the OFF position. Use a voltmeter to check the presence of voltage from the source. Ensure that all power switches are in the OFF position – in the system, devices, and at source. Improper wiring may cause bodily injury and equipment damage. Before performing maintenance, either unplug or disconnect the equipment from the power source in order to reduce the risk of electric shock or other possible hazards. When working on electrical equipment in and for applications in Germany, regulations for the prevention of electrical accidents – as stated in DIN VDE 0105 – are summarized in the following five safety rules:

1. De-energize
2. Secure from re-energizing (“lockout”)
3. Verify that the equipment is de-energized
4. Ground and short-circuit
5. Insulate or cover any live or energized areas of nearby equipment

These five safety rules should be followed in order before starting work on electrical systems.

Only qualified electricians are to work on this equipment.

FCC Compliance Statement

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

1. This device may not cause harmful interference, and
2. 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 Eltek could void the user's authority to operate this equipment, as unauthorized changes may invalidate FCC compliance.

Power System Mounting and Wiring

Before installing the power system, note the following safety requirements:

- **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 does not exist 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 overcurrent 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).

1. Overview

The Modular power system consists of Flatpack2 rectifier shelves, Smartpack2 controller units, and a distribution section. Maximum overall system depth is 22.5 inches (571 mm). It is designed for standard 23” wide telecommunications equipment racks.

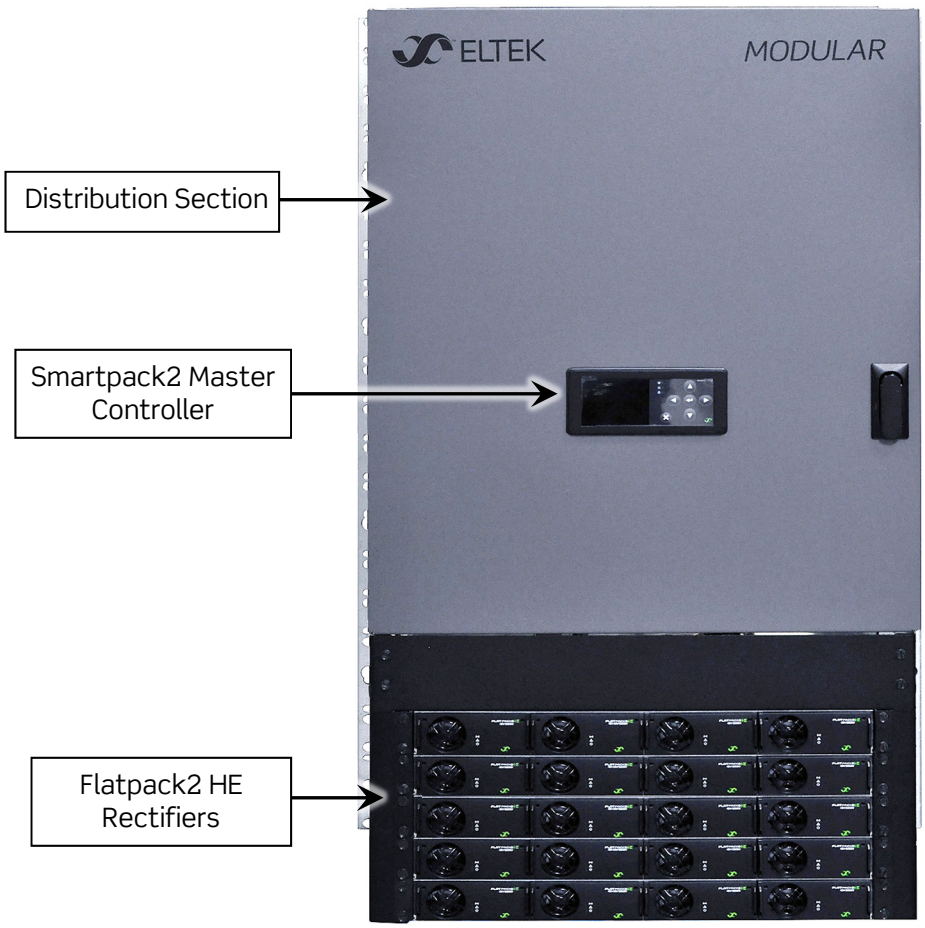

Figure 1 – Modular -48V, 1200A System

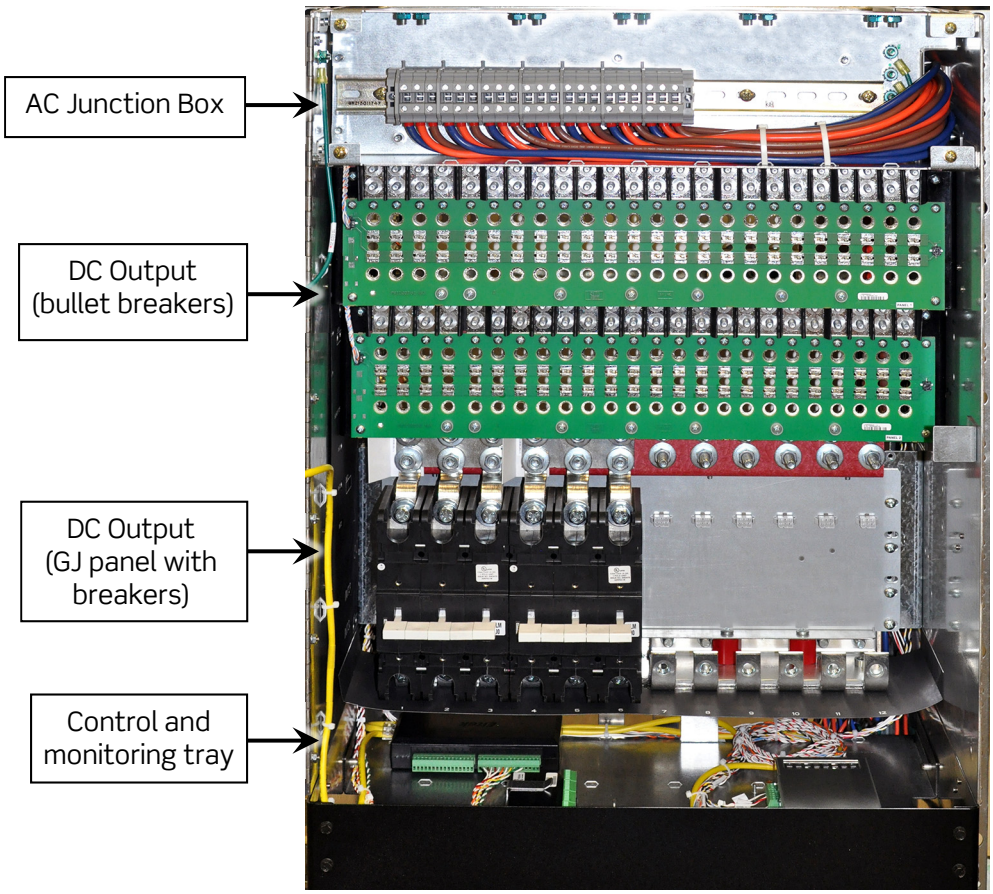

Figure 2 – Modular with Distribution Door Open (example configuration)

Available systems are 48 VDC at a total DC output of 1200A.

Configurations

Modular system configurations are primarily based on the Flatpack2 power modules used. See Table 1 for the available rectifier shelf. Note that there is a significant difference in output current between systems that employ the 48V/2000W rectifiers and those that use the 48V/3000W rectifiers. See Table 3 on page 13 for rectifier specifications.

Table 1 – Maximum System Output by Rectifier Module

Number of Shelves	Rectifier Module Used	
	48V/2000W	48V/3000W
4	640A	960A
5	800A	1200A

Table 2 – Specifications for Modular Systems

Mechanical	Dimensions	**Distribution panel**: 22.08″ D x 21.06″ W* x 38.25″ H (22U) (*Width is for a standard 23″ rack and excludes the mounting brackets)
	Weights	**Approx. empty weight**: 225 lbs. (depending on distribution panels and number of power shelves installed) **Rectifier** (each): 4.3 lbs.
	Clearances	Front clearance required for door (24" recommended). Cable egress from top / rear. Vertical clearance required; dependent on load cable size.
Electrical	Input	**Rectifiers**: See Table 3 on page 13
	Output	**Rectifiers**: See Table 3 on page 13
Connections	AC Input	48V/3000W HE: 208/240/277 V ac 48V/2000W HE: 208/240 V ac **Individual feed**: One feed per rectifier, one-phase to terminal blocks **Dual feed**: Two rectifiers per feed, one-phase to terminal blocks **Three-phase input:** 208 V ac or 240 V ac
	DC Output	48V/3000W HE: 960A (4 shelves), 1200A (5 shelves) 48V/2000W HE: 640A (4 shelves), 800A (5 shelves) **GJ panels**: Two-hole lugs with 3/8″ dia. on 1″ centers **Plug-in circuit breaker panels**: Two-hole lugs with 1/4″ dia. on 5/8″ centers. **Battery and Bulk landings**: Two-hole lugs with 3/8″ dia. on 1″ centers and max width of 2.25″.
	CO Ground	One connection to the return bus recommended, at least the size of the largest connected cable.
Environmental	Operating Temperature	-40°C to +50°C; de-rating above +45°
	Storage Temperature	-40°C to +70°C (-40°F to +158°F)
	Relative Humidity	0-95%, non-condensing
Interface	TCP/IP	10/100BASE-T Ethernet
	Alarm Relays	Six (6) form-C dry contact output relays Six (6) auxiliary alarm inputs
Compliance	NEBS	Level 3 (GR-63-CORE, GR-1089-CORE)
	Safety Standard: CSA	UL 60950-1 (Canada and USA)
	Safety Standard: VDE	EN 60950-1

AC-DC Rectifier Specifications

The Flatpack2 HE rectifiers are high-efficiency modules that typically perform at a 96% conversion rate. Specifications are listed in Table 3.

Table 3 - Rectifier Operation

Flatpack2 Rectifer Model	48V/3000W HE (241119.105)	48V/2000W HE (241115.105)
AC INPUT		
Operational Input Voltage Range	85 – 305 Vac	85 – 275 Vac
Rated Input Voltage Range	100 – 277 Vac	100 – 250 Vac
Full Power Input Voltage Range	176 – 277 Vac	185 – 275 Vac
AC Input Frequency	45 – 66 Hz	45 – 66 Hz
Maximum Input Current	19 A-rms	12.5 A-rms
DC OUTPUT		
Default Output Voltage	53.5 Vdc	53.5 Vdc
Adjustable Output Voltage Range	43.5 – 57.6 Vdc	43.5 – 57.6 Vdc
Maximum Output Power	3000 W	2000 W
Output Power at 85 Vac Input	1380 W	750 W
Maximum Output Current (at nominal input, full load	56 A	42.2 A
Efficiency	Up to 96.2%	Up to 96.5%

Flatpack2 rectifiers have an operating input voltage range of 85 to 300 VAC (2000W module rated for 100 – 250 VAC; 3000W module rated for 100 – 277 VAC), with a frequency range between 50 and 60 Hz. See the *User's Guide: Flatpack2 Rectifier Modules* (Doc. No. 350002.013) for further details.

NOTE: Flatpack2 modules are assigned a system ID based on order of installation. Therefore, it is recommended to install rectifiers **after** AC power is applied and in the order desired.

AC Input Junction Box

The AC junction box is located in the top front of the distribution section.

There are five sets of ¼"-20 studs on 5/8" centers provided inside the top of the junction box for ground connections. One- and two-hole lugs can be used. Ground leads must be longer than the power leads. **Always make ground connections first!**

Figure 3 – AC Ground Connections

There are two styles of terminals available: compression screw and barrier strip. Compression terminals can be configured for either individual-feed or dual-feed (two rectifiers per feed) input. Barrier strip terminals are dual-feed only. There are six (6) knockouts on the top of the box for 1” conduit.

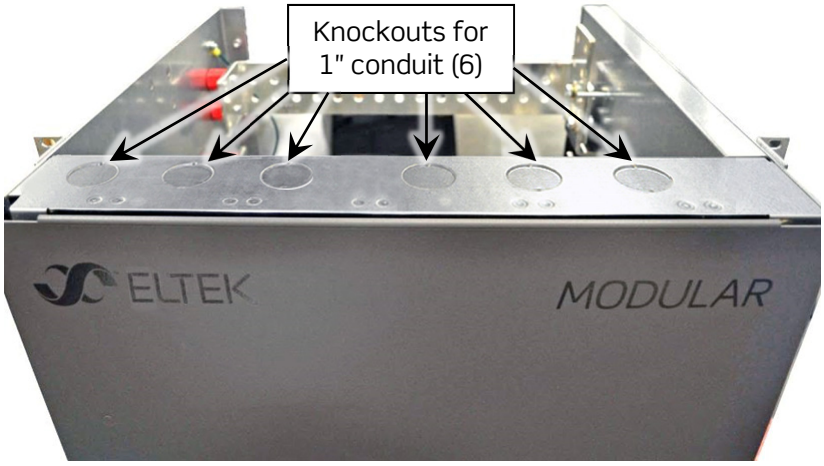

Figure 4 – AC Box Location and Conduit Knockouts

The AC input terminals are labeled numerically from left to right and assigned a rectifier slot. “R” means “rectifier”. Terminals are marked “L1” for “Line 1” and “L2/N” for “Line 2/Neutral”.

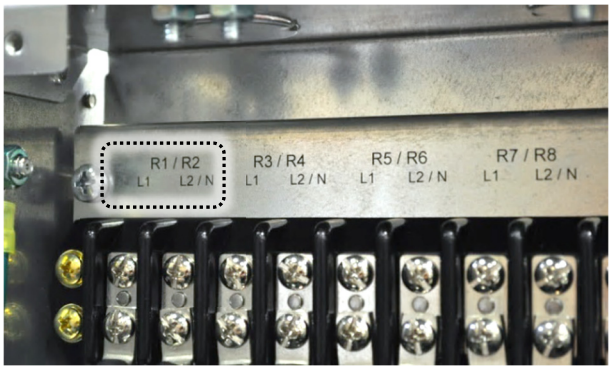

Figure 5 – AC Labels (Barrier Strip Terminals)

Figure 6 shows the location of the rectifier slots that correspond to the AC labels. Notice that the rectifier slots are numbered from bottom to top, left to right. There is an option for a fifth rectifier shelf (for 20 rectifier slots total), which is installed above the topmost shelf if ordered.

Figure 6 – Rectifier Slots

Compression Screw Terminals

Compression terminals can be configured for single-phase individual-feed, single-phase dual-feed (two rectifiers per feed) input, or three-phase input. There are also options for either four shelves (16 rectifiers total, see Figure 8) or five shelves (20 rectifiers total, see Figure 9).

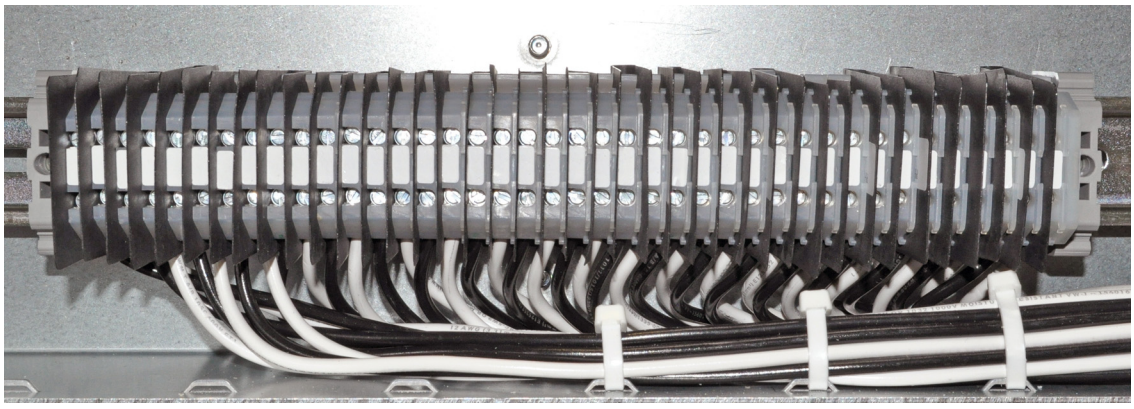

Figure 7 – Compression Screw Terminals

NOTE: In the figures below, "L2" corresponds to the "L2/N" label in the AC box (for "Line 2 or Neutral").

Individual-feed terminals accept a wire size of up to #10 AWG, depending on the current draw of the rectifier used; strip length is approximately 0.3" (8 mm);

recommended torque range is 4.4 in-lbs. to 6.1 in-lbs. (0.5 N·m to 0.7 N·m). (See Figure 8 and Figure 9 below.)

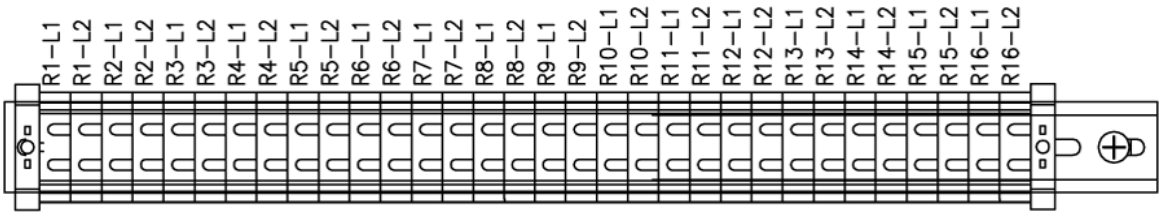

Figure 8 – Compression Screw Terminals (Individual-feed, 4 Shelves)

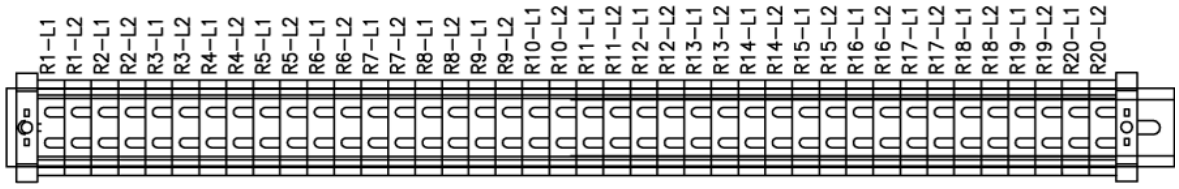

Figure 9 – Compression Screw Terminals (Individual-feed, 5 Shelves)

Dual-feed terminals accept a wire size of up to #6 AWG, depending on the current draw of the rectifier used; strip length is approximately 0.4" (10 mm); recommended torque range is 13.3 in-lbs. to 16.0 in-lbs. (1.5 N·m to 1.8 N·m). (See Figure 10 and Figure 11 below.)

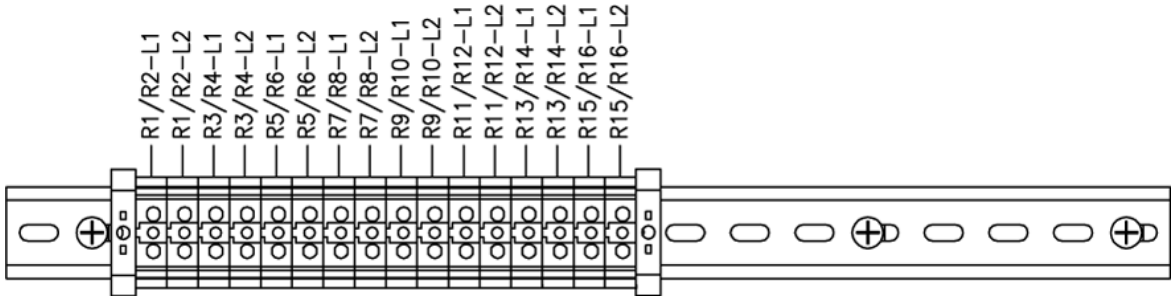

Figure 10 – Compression Screw Terminals (Dual-feed, 4 Shelves)

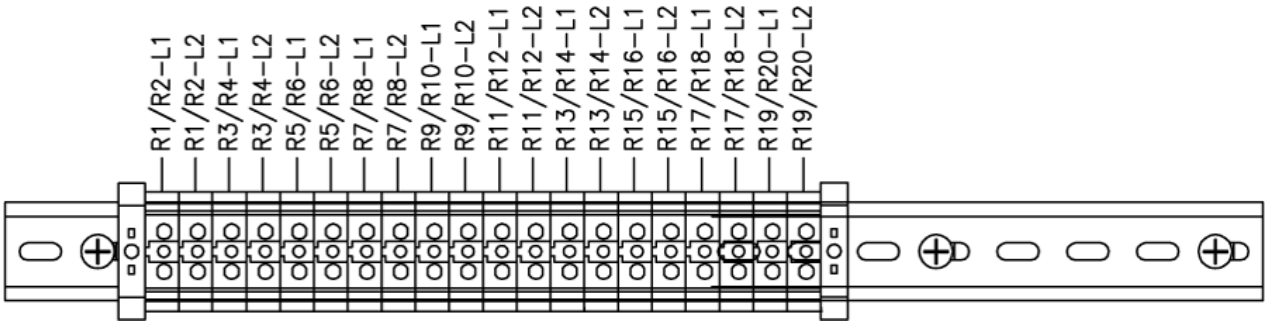

Figure 11 – Compression Screw Terminals (Dual-feed, 5 Shelves)

Three-phase terminals accept a wire size of up to #6 AWG, depending on the current draw of the rectifier used; strip length is approximately 0.4" (10 mm); recommended torque range is 13.3 in-lbs. to 16.0 in-lbs. (1.5 N·m to 1.8 N·m). (See Figure 12 below.)

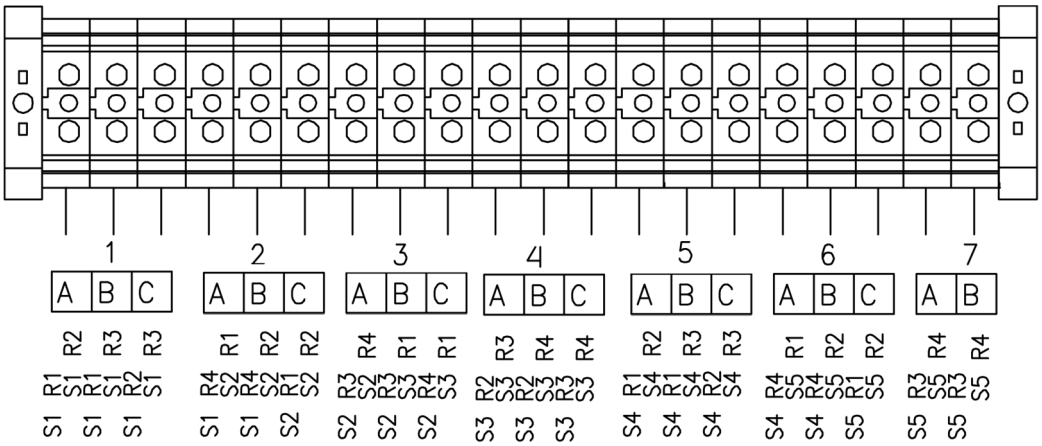

Figure 12 – Compression Screw Terminals (Three-Phase)

Barrier Strip Terminals

Barrier strip terminals are configured for dual-feed input only. There are options for either four shelves (16 rectifiers total, see Figure 13) or five shelves (20 rectifiers total, see Figure 14). One-hole lugs for #10-32 screws and a maximum width of 0.47" are recommended for connecting cable to the barrier strip terminals. Recommended torque is 20 in-lbs (2.3 N·m).

NOTE: In the figures below, "L2" corresponds to the "L2/N" label in the AC box (for "Line 2 or Neutral").

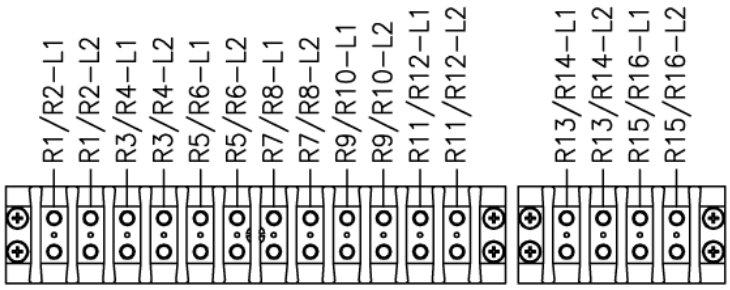

Figure 13 – Barrier Strip Terminals (Dual-feed, 4 Shelves)

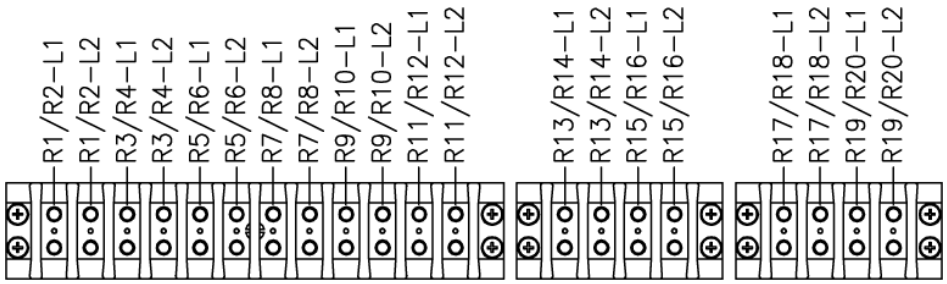

Figure 14 – Barrier Strip Terminals (Dual-feed, 5 Shelves)

Protected DC Output

The Modular system features two distribution tiers that can be configured for a variety of distribution panels. Two types of configurable distribution panels are available:

- GJ panel – for GJ/GS circuit breakers and TPL-style fuses.
- Plug-in board – for bullet-style circuit breakers and fuse adapters; up to two panels can be installed per distribution tier, providing up to 48 one-pole positions per tier; one-, two-, and three-pole breakers can be used.

GJ Panel (GJ/GS-style Breaker and TPL-style Fuse Adapter)

GJ panels are designed for larger load applications and have a single output bus. All GJ panel configurations are rated at 1200A. There are twelve (12) mounting positions. Panel configuration is based on the style of current protection desired. Components for each configuration (e.g., protection devices, adapter plates, shunt monitors) are installed at the factory. A Load Monitor unit is provided when shunts are installed (see Figure 26 on page 24).

Breakers and fuse assemblies require different panel configurations, as explained below. If an unprotected output position is desired (e.g., for a battery string), a bulk output plate with shunt (GS0000) can be installed.

NOTE: Output cable landings accommodate double-hole, narrow-tongue lugs for wire sizes up to 350MCM. Landing stud sets are 1.5” apart side to side.

NOTE: Up to six shunts can monitored in one GJ panel, since there are six shunt sensing connectors on the backplane of the GJ panel. For alarm monitoring, up to twelve devices can be monitored.

By default, the factory load-monitoring positions are every odd position from 1through 12 (1, 3, 5, etc.).

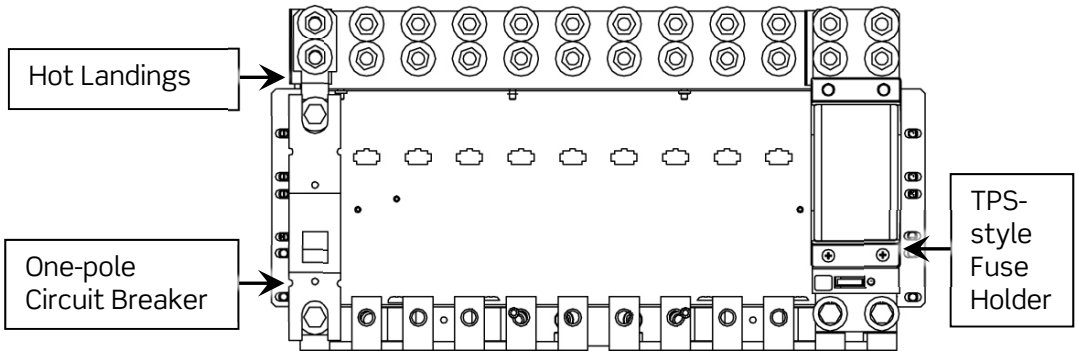

Figure 15 – GJ Panel for GJ/GS-Style Circuit Breakers and TPL-Style Fuses

For return connections, one return bus similar to battery connection bars is provided – regardless of whether there are one or two GJ panels. The return bus for GJ panels is located above the battery buses. See Figure 16.

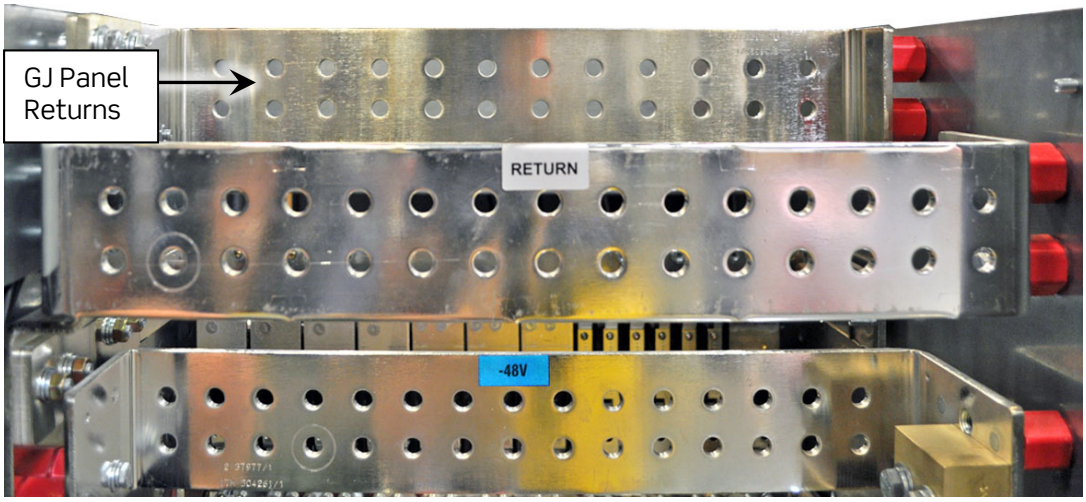

Figure 16 – GJ Panel Return Connections (view from rear of distribution section)

GJ/GS Breaker Configuration

GJ-style breakers have no shunt. A GJ-style breaker with shunt monitoring is designated as a “GS”-style breaker. Shunted breakers (GS) require a monitor cable, which is provided. GJ and GS breaker panel assemblies are available in three (3) styles: one-pole, two-pole and three-pole. Each comes with an adapter plate that connects to the breaker and provides cable landing positions. Adapter plate cable landings have double 3/8” studs with 1” centers that accommodate one 350MCM narrow-tongue lug per contact point.

One-pole breakers take one (1) mounting position and are available in current ratings between 100 – 250A. Two-pole breakers take two (2) mounting positions and are available in current ratings between 275 – 400A. Three-pole breakers take

three (3) mounting positions and are available in current ratings between 450 – 600A.

All connections are double 3/8” studs with 1” centers and should be torqued according to the specifications in Table 4 on page 27. Adapter kits include bus bar assemblies, mounting hardware, and alarm/signal cables.

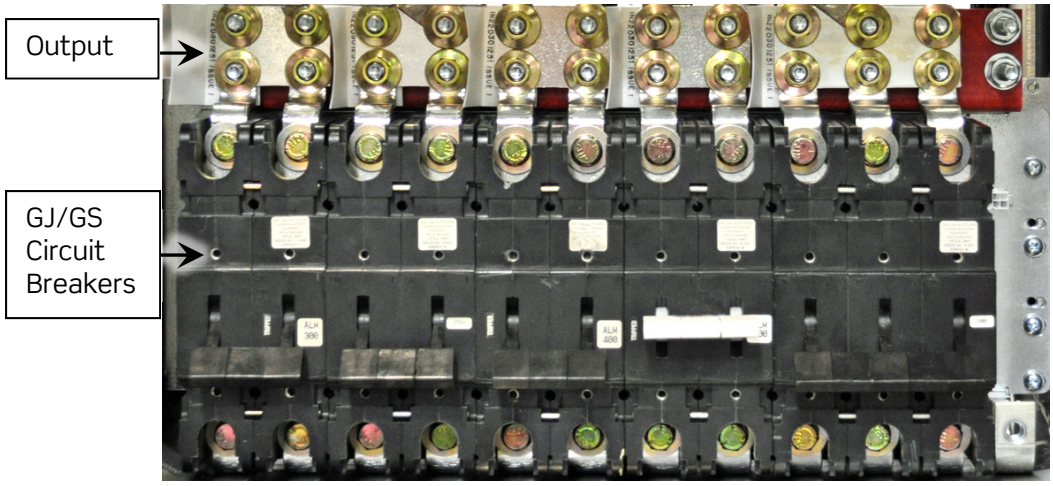

Figure 17 – GJ Panel with GJ/GS-style Breakers

TPL-style Fuse Configuration

TPL-style fuse assemblies (MTPLHS) take up two (2) mounting positions, yielding a total of six (6) fuse assemblies in this configuration. Two (2) sets of double 3/8” studs with 1” centers are provided for each fuse output landing; connections should be torqued according to the specifications in Table 4 on page 27. Fuses come with a puller, but are sold separately from the fuse assembly.

Fuse assemblies are factory-installed and include a 0.18A GMT indicator fuse for alarm purposes. In addition, fuse assemblies have a 600A, 20mV shunt for monitoring current.

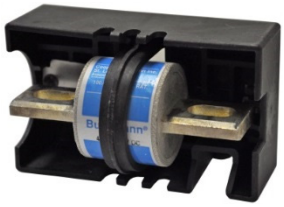

Figure 18 – TPL-style Fuse

Plug-in Board (Bullet-style Breakers/Fuse Adapters)

Plug-in boards facilitate bullet-style plug-in circuit breakers and fuse adapters. Each board has 24 one-pole positions and is rated up to 600A. The boards can accommodate one-pole, two-pole, and three-pole circuit breakers (multi-pole breakers require adapter kits).

Plug-in Circuit Breaker	TPS-style Fuse Adapter
	

NOTE: Multi-pole adapter buses must be cabled before connecting to the panel.

NOTE: Positions 4 and 5 (counting from the left) cannot be used for multi-pole breakers.

All cable landings (both hot/output and return) are two 1/4"-20 studs on 5/8" centers. Hardware is provided.

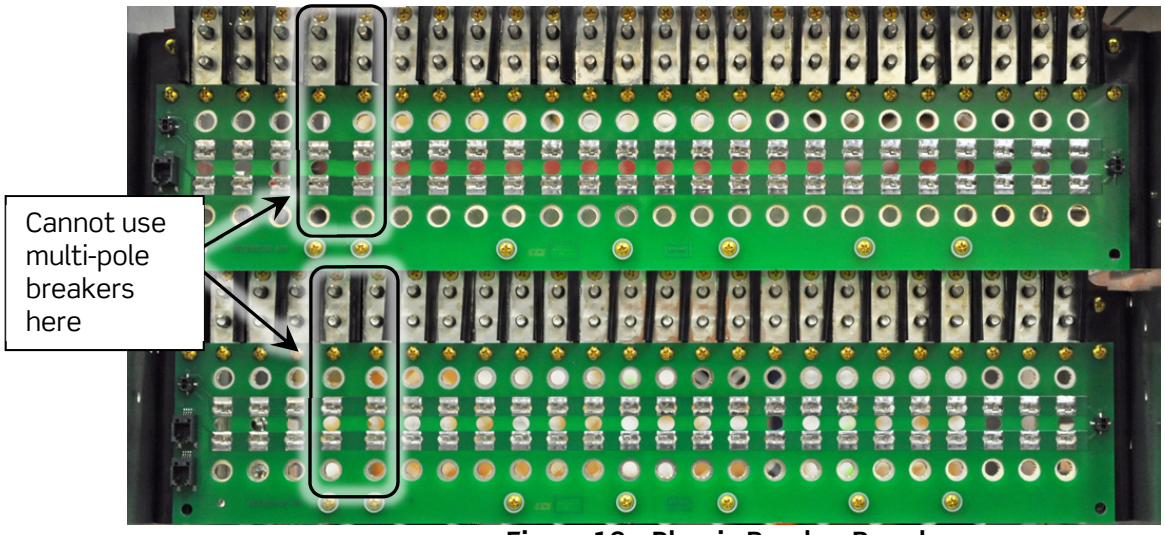

Figure 19 – Plug-in Breaker Board

If **two boards** are installed, there is one return bus structure with 23 landings on both sides and four along the sidewall (for a total of 50 cable landings).

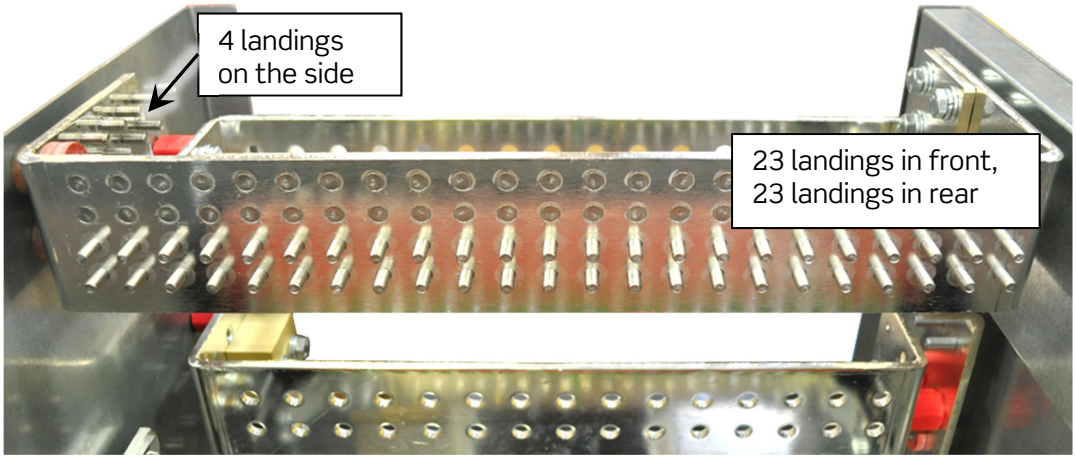

Figure 20 – Return Landings for 2 Plug-in Boards (50 positions)

If **three boards** are installed in a Modular system, then a 72-position return bus structure is also installed in the top of the distribution section (3 boards and 24 positions per board). The return bus structure consists of two bars, one of which has 23 landings on both sides and four (4) along the sidewall; and the other bus has 22 landings on one side.

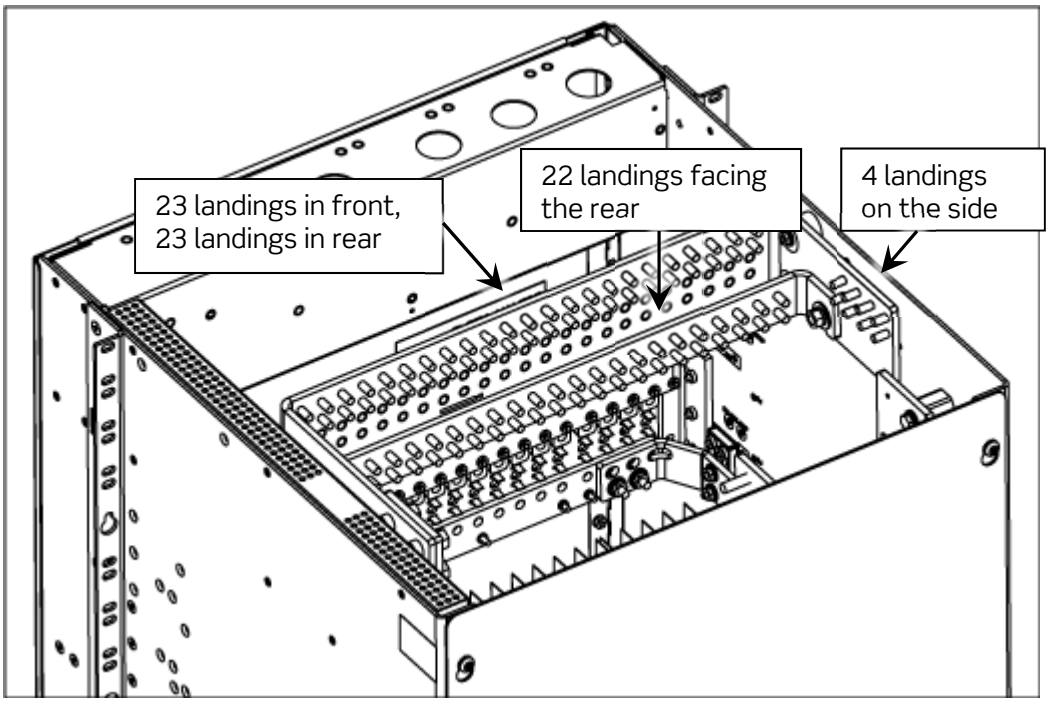

Figure 21 – Return Landings for 3 Plug-in Boards (72 positions)

If **four boards** are installed, **no return landings are provided** for the panels, but the battery and bulk buses are still provided. The rightmost connection on the topmost panel is unusable because of the AC box channel.

Battery Connections

The rear of the distribution section contains battery connections. There are fourteen (14) landings per polarity for battery connections, plus an extra set of landings for CO ground. Each landing consists of two 3/8” studs with 1” spacing.

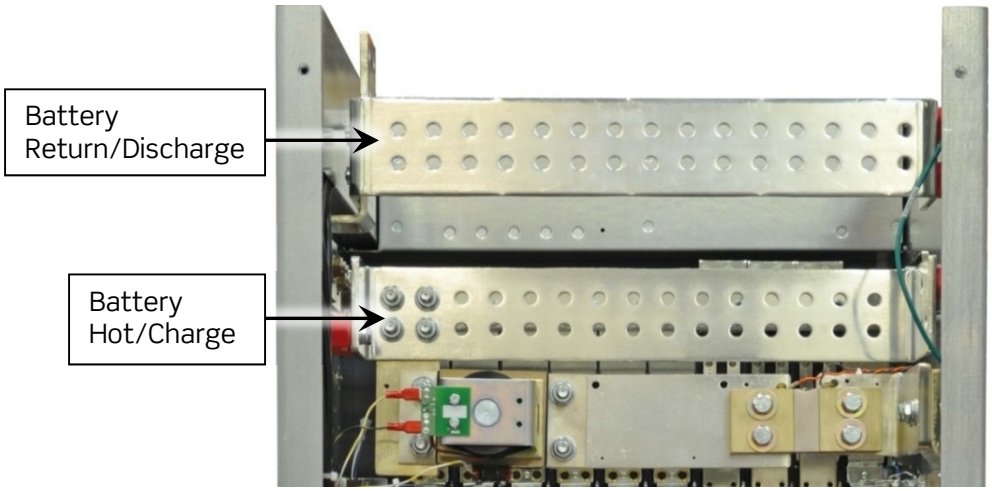

Figure 22 – Battery Connections

Bulk DC Connections

The rear of the distribution section contains bulk connections, near the bottom. There are two (2) landings per polarity. Each landing consists of two 3/8” studs with 1” spacing.

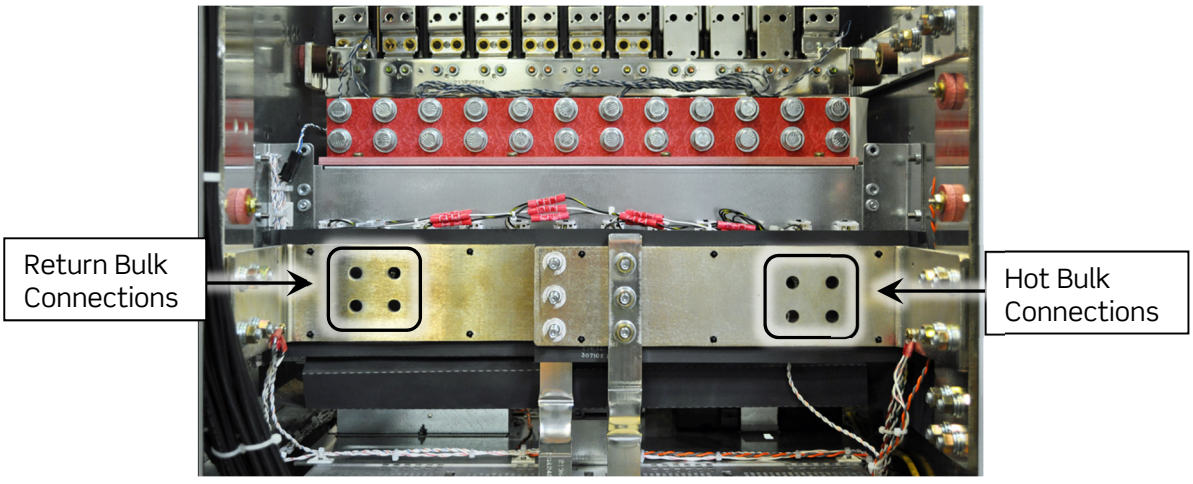

Figure 23 – Bulk Connections

Control and Monitoring

An Ethernet port for LAN connection is provided inside the front of the distribution door.

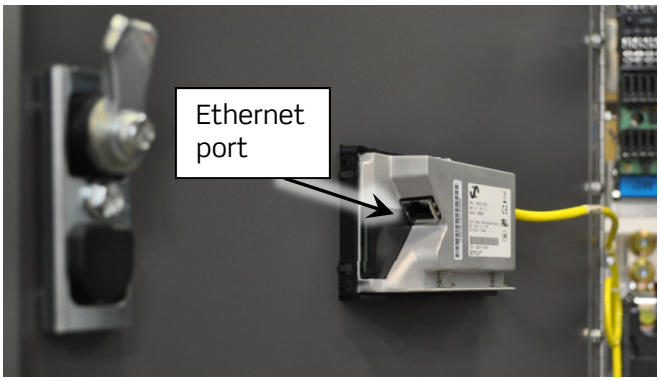

Figure 24 – Ethernet Port of the *Smartpack2 Master*

Figure 25 – Ethernet and CAN Ports

Next to the Ethernet port is a CAN connection for Eltek CAN nodes, which are devices that extend controller monitoring. These devices include a battery monitor unit, I/O alarm monitor, load monitor, and CAN power device (each sold separately). Please refer to the documentation provided with each device for installation instructions. If the CAN port is not used, the CAN termination plug provided must remain in place.

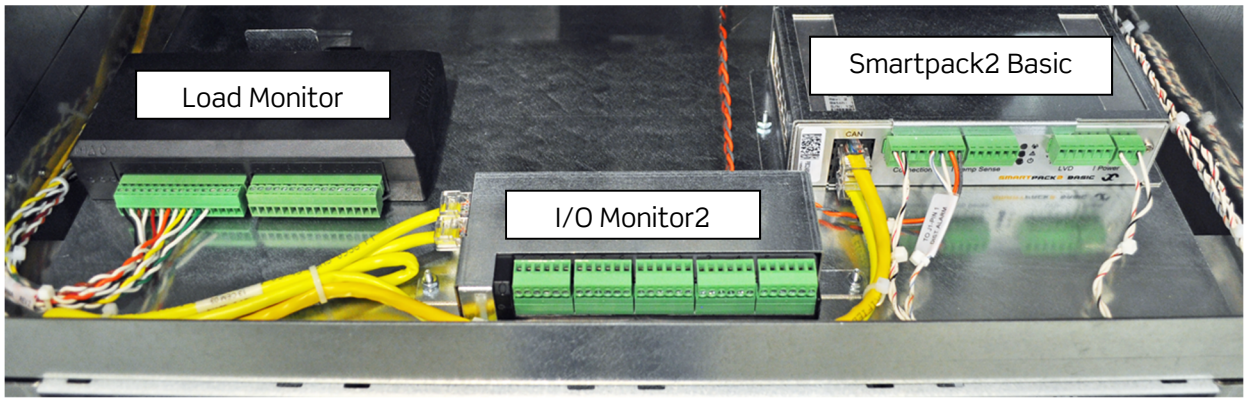

Figure 26 – Control and Monitoring Tray

Alarm connections are made to the I/O Monitor2 unit. Maximum wire size is 16 AWG (1.5 mm^2), strip length is 1/4". Torque each connection to 3 in-lb. (0.2 N·m). There are six input alarms and six output relays.

The control and monitoring tray can slide forward, providing easier maintenance. To slide the tray forward, first remove screws and faceplate, also verify that there are no tie-downs that will impede the movement of the tray.

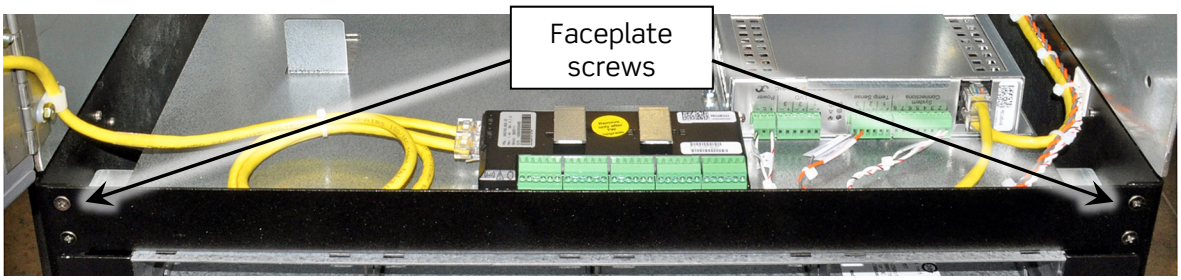

Figure 27 – Removal of Screws and Faceplate

LVD Options

Modular systems can be ordered with a low-voltage battery (LVBD) contactor. Contactor settings are configured through the Smartpack2 controller.

References

This manual provides a comprehensive overview of and installation guidelines for *Modular* power systems. Additional information regarding system components is found in the following documents:

- *User's Guide: Flatpack2 Rectifiers*, Doc. No. 350002.013
- *User's Guide: Smartpack2 Master Controller*, Doc. No. 350020.013
- *User's Guide: Smartpack2 Basic Controller*, Doc. No. 350021.013
- *Installation Guide: I/O Monitor2*, Doc. No. 351509.003
- *Product Guide: Modular 15U System*, Doc. No. 2151062
- *User Guide: Eltek Controller Web Interface*, Doc. No. 370035.013

Additional product information is available online at *eltek.sharefile.com*.

2. Installation

WARNING: The system is to be mounted over a non-combustible surface only and installed in Restricted Access Locations (RAL). Access must be limited by use of tool, e.g. lock and key.

NOTE: Use of fully insulated tools is required when working with any powered AC or DC circuits.

Recommended Tools

The following tools are recommended for installation:

- Standard wrench and/or socket set (1/4" to 1")
- Torque wrench, 10-40 Ft-lb range.
- Torque screwdriver, 5-10 in-lb range.
- Small flat blade screwdriver (3/32" wide)
- Standard blade screwdriver and Phillips tip screwdriver
- Wire cutters / strippers
- Fork-lift truck or similar heavy equipment handling transport
- Hoist with lifting straps
- Electric drill and appropriate bits (a hammer drill may be required for concrete flooring)
- Multimeter

Torque Settings

Table 4 shows recommended torque settings for mechanical and electrical connections according to screw or nut size. Not all screw sizes listed are necessarily present. These are recommendations only. Different torque values may be specified in the installation instructions.

Table 4 – Recommended Torque Settings (in-lbs)

Screw or Nut Size	Minimum	Maximum
#10-32	20	22
#12-24	40	42
¼" - 20	50	58
5/16"-18	110	120
3/8"-16	200	220
Alarm Terminal Block	3	4
#6-32 GMT Fuse Terminal Block	7	8

Power Module Ratings

For installation considerations (e.g., sizing wire and circuit protection), the tables below provide the agency ratings of the Flatpack2 HE rectifier and modules.

Table 5 – Flatpack2 Rectifier Ratings

Flatpack2 Rectifier Model	48V/3000W HE (241119.105)	48V/2000W HE (241115.105)
Rated Input Voltage Range	100 – 277 Vac	100 – 250 Vac
Rated Maximum Input Current	19.0 A-rms	12.5 A-rms
Rated DC Output	53.5V / 56.1A	53.5V / 37.4A
Maximum Output Voltage	57.9 Vdc	57.9 Vdc
Maximum Output Current	62.6 Adc	42.2 Adc

Unpacking

A Modular unit is typically pre-installed in a cabinet or rack, wrapped with a shroud of high-strength plastic, and bolted to a wooden pallet with four anchors. Rectifier modules and expansion options are packed in separate cartons. Exercise care when unpacking and setting the equipment in place.

Mechanical Mounting

Eltek recommends mounting the system on a floor made of a non-combustible material and of sufficient strength to withstand an earthquake. There should be adequate clearance above the system for the AC feeds, as well as adequate free space in front of and behind the rack for air flow.

Concrete expansion anchors should meet the following requirements:

- A maximum embedment depth of 90 mm (3.5”)
- A maximum bolt diameter of 13 mm (0.5”)
- Use steel construction
- Be suitable for all earthquake zones

Use the following generic steps for rack installation:

1. Inspect the floor for compliance.
2. Drill holes 5/8” in diameter.
3. Place anchors into holes.
4. Place the rack over the anchors.

Rack Mounting

CAUTION: Never install a power system without capable assistance. Use capable assistance when lifting and mounting the system.

If the Modular system is ordered without a rack or enclosure, use the following instructions for rack installation:

1. Use proper lifting equipment to position the Modular system so that the holes in the support bracket are aligned with the correct mounting holes in the rack.
2. Use #12-24 screws to mount the system and tighten according to the specifications given in Table 4 on page 27.

Grounding

For electrical safety, it is required to connect the green wire *safety ground* to one of the available locations in the AC junction box.

For CO ground, use one of the positions on either the battery return bus or the bulk return bus.

AC Input Connections

Input connections are made to the junction box. There are six (6) knockouts on the box for 1" conduit. Ground terminals are next to the knockouts and consist of 1/4" on 5/8" studs for two-hole lugs. **Always make ground connections first!**

The rectifier numbers on the terminals are numbered 1-16 for four shelves and 1-20 for five shelves. Insert the rectifiers beginning with the bottom shelf and the leftmost slot. Shelves are numbered from left to right, bottom to top. Refer to Figure 6 on page 15 to identify which rectifier slots are powered by the input terminals.

Make sure to size AC wires according to the maximum input current indicated in Table 3 on page 13 for the rectifier model used. Remember to double the value for dual-feed configurations.

Table 6 – Rectifier AC Input Current

Group	Description	Maximum AC Current (Amps)	Minimum Circuit Breaker
A1	Ind. Feed compression	19A	25
A2	Dual Feed compression	38A	50
A3	Dual Feed lug	38A	50
A4	Three phase compression	32A	40 (3 phase)

Compression Screw Terminals

Terminal connections are covered in the following sections.

- Individual Feed Terminals (next section, below)
- Dual-feed Terminals (page 30)
- Three-Phase Terminals (page 31)

Individual Feed Terminals

Individual-feed terminals accept a **wire** range up to #10 AWG; strip length is approximately 0.3" (8 mm); recommended torque range is 4.4 in-lbs. to 6.1 in-lbs. (0.5 N·m to 0.7 N·m).

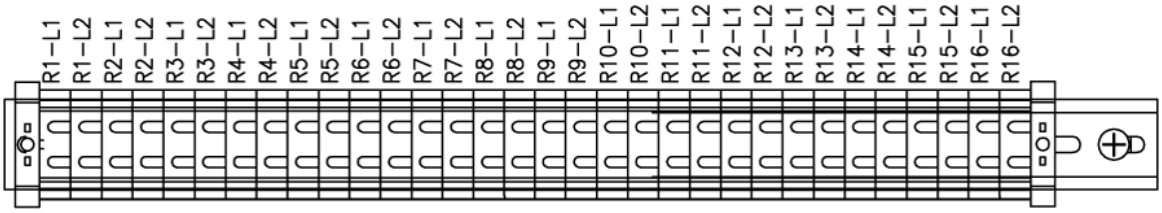

Figure 28 – Individual-feed, 4 Shelves (Compression Screw)

To terminate AC feeds to individual-feed compression screw terminals:

1. Remove the AC junction box cover.
2. Attach one-hole lugs for 1/4" studs to the ground wire of each AC feed and connect them to the 1/4" ground studs in the junction box (inside the top of box, in front of conduit knockouts).
3. Cut the AC lines of each feed shorter than their respective ground wires.
4. Beginning with the feed for R1, connect line 1 of the first AC feed to the terminal block labeled "L1", and connect line 2/neutral to the block labeled "L2/N".
5. Tighten each connection to the recommended torque range of 4.4 in-lbs. to 6.1 in-lbs. (0.5 N·m to 0.7 N·m).
6. Repeat in this manner for each remaining AC feed.

Dual-feed Terminals

Dual-feed terminals accept a **wire** range up to #6 AWG; strip length is approximately 0.4" (10 mm); recommended torque range is 13.3 in-lbs. to 16.0 in-lbs. (1.5 N·m to 1.8 N·m).

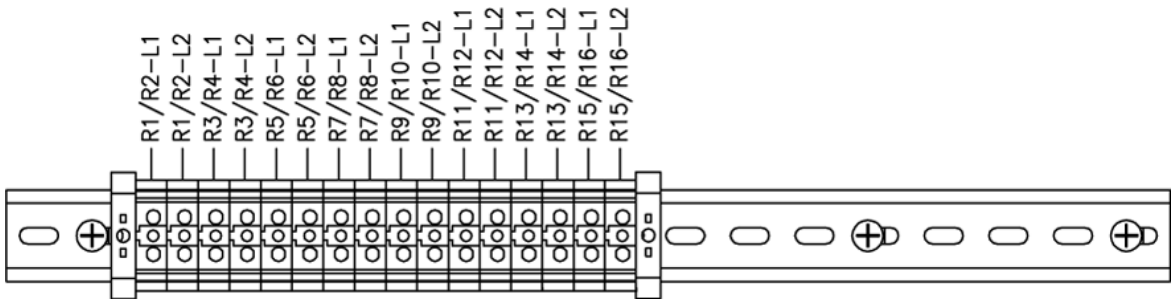

Figure 29 – Dual-feed, 4 Shelves (Compression Screw)

To terminate AC feeds to dual-feed compression screw terminals:

1. Remove the AC junction box cover.
2. Attach one-hole lugs for 1/4” studs to the ground wire of each AC feed and connect them to the 1/4” ground studs in the junction box (inside the top of box, in front of conduit knockouts).
3. Cut the AC lines of each feed shorter than their respective ground wires.
4. Beginning with the feed for R1/R2, connect line 1 of the first AC feed to the terminal block labeled “L1”, and connect line 2/neutral to the block labeled “L2/N”.
5. Tighten each connection to the recommended torque range of 13.3 in-lbs. to 16.0 in-lbs. (1.5 N·m to 1.8 N·m).
6. Repeat in this manner for each remaining AC feed.

Three-Phase Terminals

Three-phase terminals accept a wire size of up to #6 AWG, depending on the current draw of the rectifier used; strip length is approximately 0.4" (10 mm); recommended torque range is 13.3 in-lbs. to 16.0 in-lbs. (1.5 N·m to 1.8 N·m).

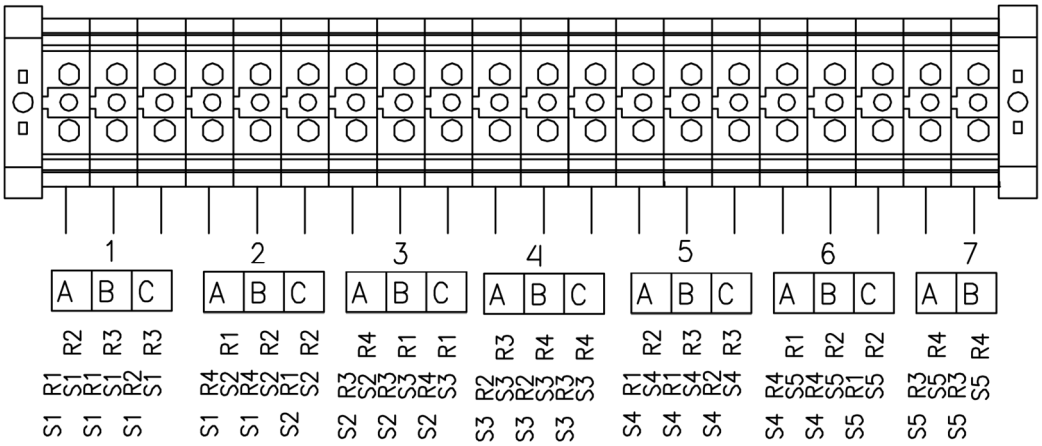

Figure 30 – Compression Screw Terminals (Three-Phase)

To terminate AC feeds to three-phase compression screw terminals:

1. Remove the AC junction box cover.
2. Attach one-hole lugs for 1/4” studs to the ground wire of each AC feed and connect them to the 1/4” ground studs in the junction box (inside the top of box, in front of conduit knockouts).
3. Cut the AC lines of each feed shorter than their respective ground wires.
4. Connect the Phase A line to terminal A of Input #1.

5. Connect the Phase B line to terminal B of Input #1.
6. Connect the Phase C line to terminal C of Input #1.
7. Tighten each connection to the recommended torque range of 13.3 in-lbs. to 16.0 in-lbs. (1.5 N·m to 1.8 N·m).
8. Repeat in this manner for each remaining AC feed.

Barrier Strip Terminals

WARNING: Each AC feed must be grounded. For safety, make ground leads longer than the lines, and always terminate the ground wire before connecting the lines to the terminal block.

CAUTION: Ensure that all AC feeds are not energized (i.e., breakers are in the OFF position, or fuses are removed). Do not apply AC power until all electrical connections are terminated and verified. Use of lockout/tagout is recommended.

AC terminal blocks accept a maximum wire size of #10 AWG. One-hole lugs for #10 screws are recommended. Connections should be tightened to a maximum torque of 20 in-lbs. (2.3 N·m).

To terminate AC feeds to barrier strip terminals:

1. Remove the AC junction box cover.
2. Attach one-hole lugs for 1/4" studs to the ground wire of each AC feed and connect them to the 1/4" ground studs in the junction box (inside the top of box, in front of conduit knockouts).
3. Cut the AC lines of each feed shorter than their respective ground wires.
4. Install one-hole lugs for 1/4" screws to each AC line cable.
5. Beginning with the feed for R1/R2, connect line 1 of the first AC feed to the terminal block labeled "L1", and connect line 2/neutral to the block labeled "L2/N". Tighten each connection to a torque of 20 in-lbs (2.3 N·m).
6. Repeat in this manner for each remaining AC feed.

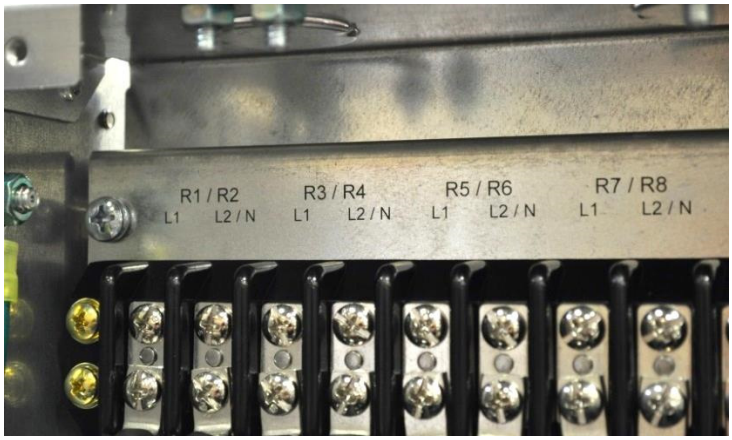

Figure 31 – Barrier Strip Terminals

Protected DC Output Connections

WARNING: Shock hazard! Use insulated tools, especially when working on live systems.

CAUTION: Significant extraction force is required to remove distribution devices due to the contact pressure required for proper connections. Do not use any type of clamps, pliers, or similar tools as the housing can be cracked by excessive force. Damaged devices represent an operational hazard and should never be used. Use the breaker extraction tool provided inside the distribution door.

NOTE: When installing distribution devices, make sure circuit breakers are in the OFF position, and do not install fuses until instructed to do so during system startup.

GJ/GS Panel

GJ/GS breakers are installed at the factory.

1. Make sure each breaker is in the OFF position.
2. Double-check polarity.
3. Route DC output wires through the top of the panel.
4. Make output connections to the hot connections ("landings") immediately above the breakers and torque according to the specifications given in Table 4 on page 27..

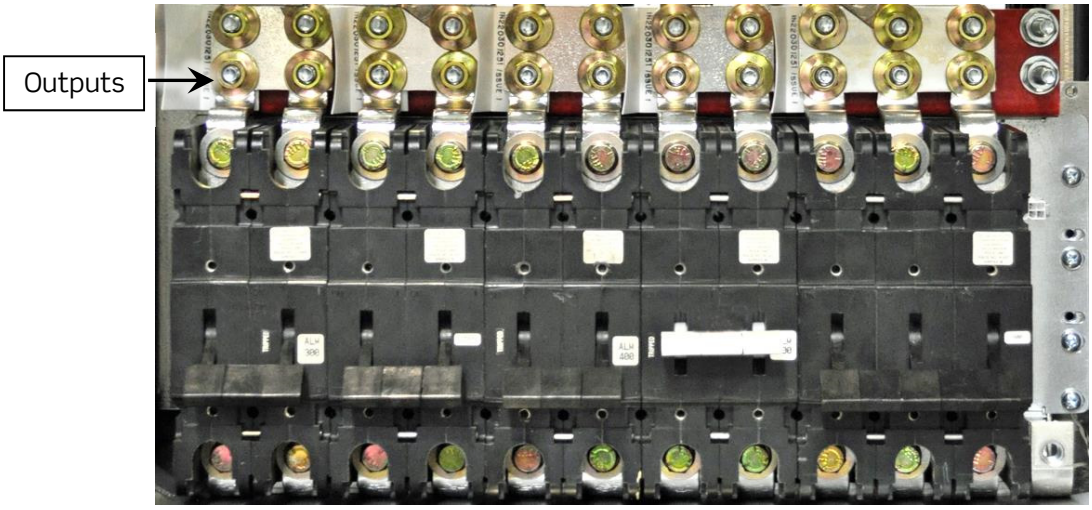

Figure 32 – GJ Panel (with breakers installed)

5. Make return connections to the return bus bars at the top of the distribution section and torque according to the specifications given in Table 4 on page 27.

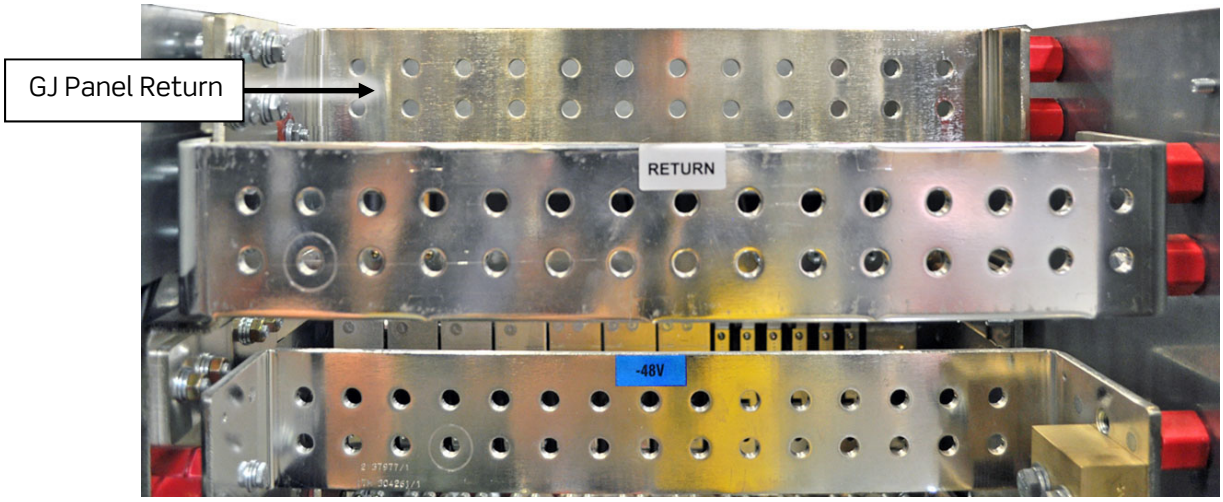

Figure 33 – GJ Panel Return Bar (view from rear of distribution section)

TPL fuses are typically installed in the fuse holders at the factory. They should be removed before cabling.

1. Make sure the fuses are removed before making connections.
2. Double-check polarity.
3. Route DC output wires through the top of the panel.
4. Make output connections to the hot connections ("landings") immediately above the fuse and torque according to the specifications given in Table 4 on page 27.

5. Make return connections to the return bus bars at the top of the distribution section and torque according to the specifications given in Table 4 on page 27 (same as shown in Figure 16).

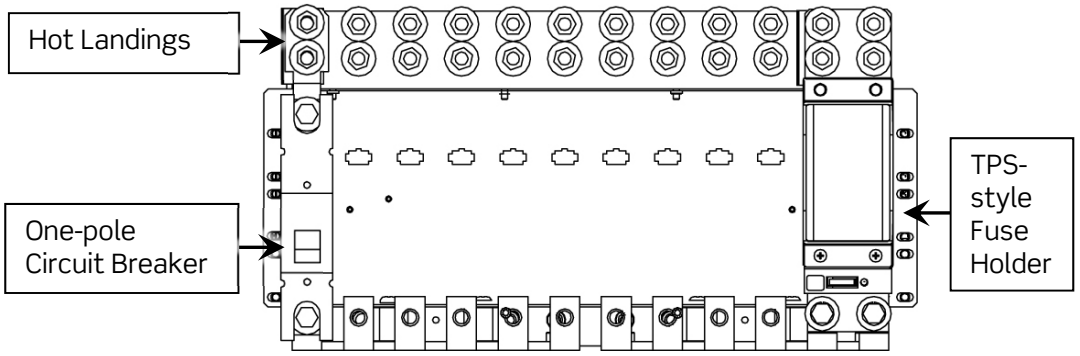

Figure 34 – GJ Panel Devices and Connections

Plug-in Board

NOTE: The distribution alarm circuit requires the use of breakers provided by Eltek.

To make cable connections:

1. Make the return connection first to the position on the return bus (directly above the breaker holders) corresponding to the desired breaker position. Use a maximum #1 AWG cable with two-hole lugs having 1/4" diameter holes on 5/8" centers; 1/4"-20 fastening hardware is provided.
2. Torque connections according to the specifications given in Table 4 on page 27.

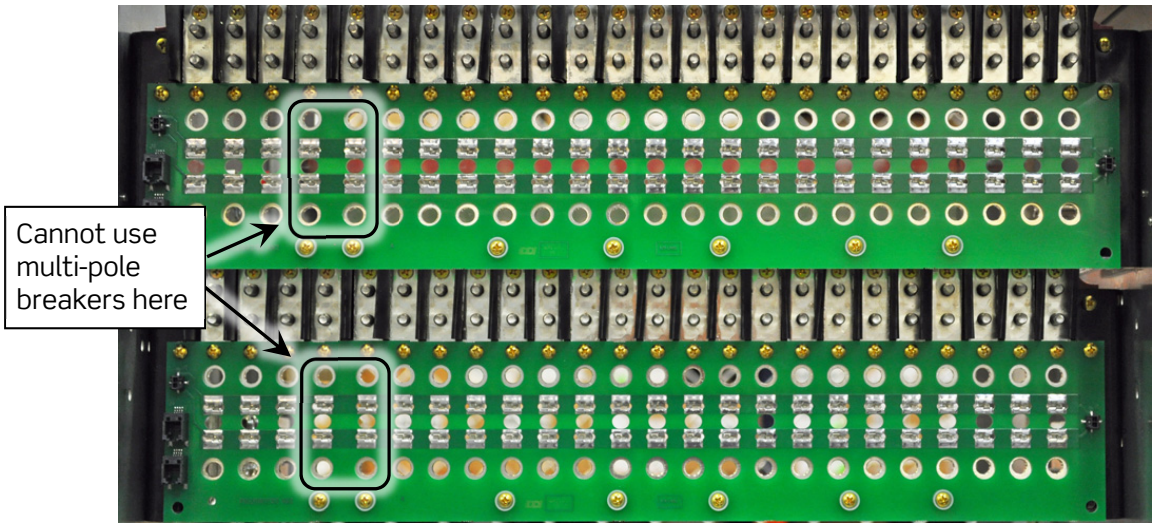

Figure 35 – Plug-in Breaker Board

3. Make connection to the corresponding breaker position in the same manner as the return position. For details on the variety of return connections available, see Figure 20 and Figure 21 beginning on page 22.

   NOTE: A distribution with four plug-in boards does NOT include returns. The battery and bulk return buses are available as collection points.

4. Make a note for each position on the label provided on the distribution door.

Bulk (DC) and Battery Connections

DANGER: Improper battery connections can cause permanent damage to electrical equipment, serious personal injury, and/or death. Always check polarity before making battery connections.

WARNING: Shock hazard! Use insulated tools, especially when working on live systems.

CAUTION: Do not connect batteries until system startup. It is required that inline circuit breakers or fuses be used with bulk/battery connections.

Batteries should be connected **after** making AC connections and powering rectifiers. The system must be powered to check polarity on the battery bus. Wiring battery output panels may help facilitate later battery connection.

To make battery cable connections:

1. After successful system startup, remove the screws holding the rear cover in place.
2. Make connections using two-hole, 3/8”-16 lugs on 1” centers. Fastening hardware is provided.
3. Torque connections according to the specifications given in Table 4 on page 27.
4. Replace the cover.

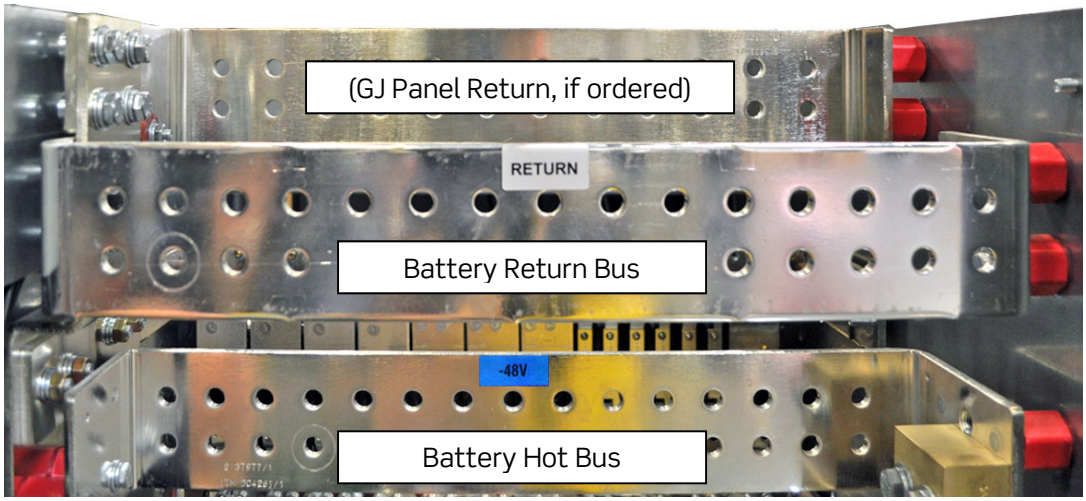

Figure 36 – Battery Buses

Circuit Breaker and Fuse Installation

CAUTION: Significant extraction force is required to remove distribution devices due to the contact pressure required for highly-reliable, low-temperature rise connections. DO NOT use pliers or tools other than the breaker extraction tool.

CAUTION: Circuit breakers (both load and battery) should be in the "OFF" position when installed in the system.

Plug-in Breakers

Auxiliary contact circuit breakers are the standard over-current protection devices used in the distribution section. Breakers are connected to system alarming through the holder so that an open breaker (whether tripped or manually placed in the OFF position) triggers a "Load Distribution Alarm" in the Smartpack *controller*. Circuit breakers should be removed from any unused positions to prevent nuisance alarms. One-pole circuit breakers rated up to 100A can be installed. For the plug-in board, straps are available to make use of two-pole breakers rated up to 175A and three-pole breakers rated up to 250A.

Plug-in Fuse Holders

Plug-in fuse modules may also be installed. The same considerations regarding insertion and removal of breakers should be observed.

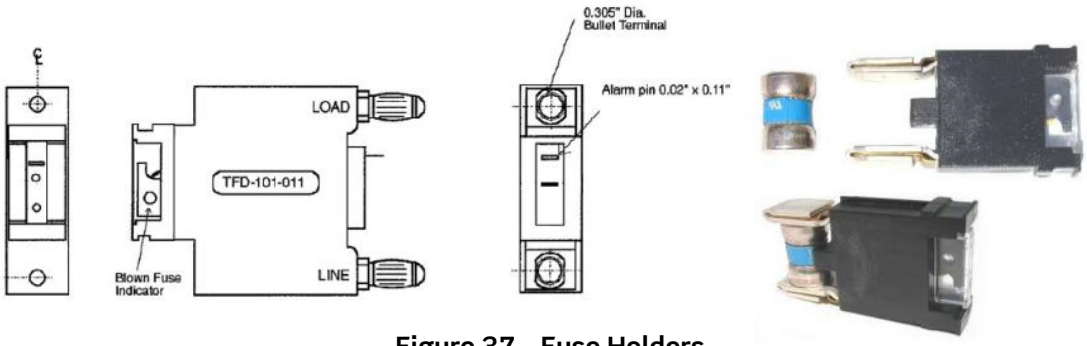

Figure 37 – Fuse Holders

A plug-in fuse assembly consists of three main parts: A fuse, an alarm fuse indicator, and a plug-in module. If the main fuse element opens, the alarming fuse also opens, giving a visible indication of a fault condition; a signal is then sent via the *Smartpack* alarm board that activates the remote system monitor. The alarming fuse must be replaced whenever a new main fuse is required. A fuse holder may be removed and inserted into the plug-in module at any time; it is not necessary to remove the plug-in module to replace the fuse.

Device Installation and Extraction

To install plug-in breakers or fuse-holders in device holder:

1. Remove fuses from adapters and turn breaker actuators OFF until system startup.
2. Orient the device correctly to the device holder (line is the bottom receptacle, load is the top); securely insert device into the receptacles.

A distribution device extraction tool can be ordered from Eltek. It is shaped like a handle and has two Phillips-head screws. This item is for convenience and should not be necessary for all extractions.

Figure 38 – Circuit Breaker and Fuse Adapter Extraction Tool

To remove plug-in breakers or fuse-holders:

1. Align the extraction tool to the device to be removed.
2. Use a Phillips screwdriver to secure the device.

3. Firmly pull the device out from the holder. Avoid using excessive force or motion to extract an over-current protection device.

Temperature Probe Connections

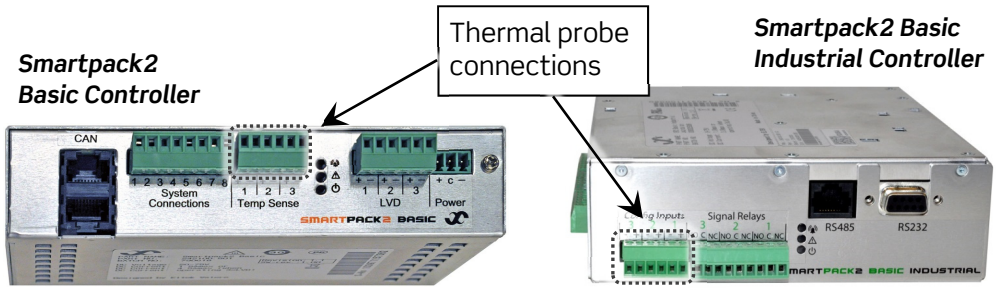

Figure 39 –Temperature Probe Inputs

To install temperature probes:

1. Identify temperature probe connections that are necessary for your installation.
2. Connect the red wire of the temperature probe to the positive (+) input; connect the black wire of the temperature probe to the negative (–) input.
3. Torque each connection according to 3 in-lbs.
4. If batteries are present, route the temperature probe cable to the batteries, and connect to the positive terminal at the center of the string.
5. Repeat steps, as necessary, for additional connections.
6. Enable Temperature compensation and temperature requirements in Webpower via: **System Config›Battery›TempComp** and select “enable and save.

Alarm Connections

Alarm connections, both input and output, are made to the I/O Monitor2 device located in the controller tray (bottom of the distribution section).

To make alarm connections:

1. Strip alarm wires back 0.25 in (6-7 mm).
2. Make input/output alarm connections. Maximum wire size is 16 AWG (1.5 mm2). Torque each connection to 3 in-lb. (0.2 N·m).

NOTE: Each of the five terminal blocks can be removed from the I/O Monitor2 by pulling them straight up from the unit. This makes terminations easier to make. Simply plug the block back into the I/O Monitor2 after making alarm connections.

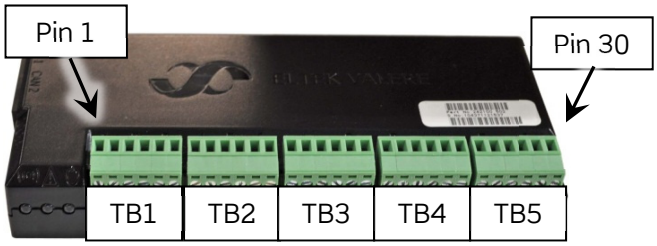

Figure 40 – I/O Monitor2 Terminal Blocks and Terminals

Table 7 – Terminals for I/O Monitor2

Terminal Block	1						2						3						4						5					
Pin Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Designation	Input 1 (–)	Input 1 (+)	Input 2 (–)	Input 2 (+)	Input 3 (–)	Input 3 (+)	Input 4 (–)	Input 4 (+)	Input 5 (–)	Input 5 (+)	Input 6 (–)	Input 6 (+)	Output 1 (NC)	Output 1 (C)	Output 1 (NO)	Output 2 (NC)	Output 2 (C)	Output 2 (NO)	Output 3 (NC)	Output 3 (C)	Output 3 (NO)	Output 4 (NC)	Output 4 (C)	Output 4 (NO)	Output 5 (NC)	Output 5 (C)	Output 5 (NO)	Output 6 (NC)	Output 6 (C)	Output 6 (NO)

Alarm I/O can be configured through either the display or the Ethernet connection after startup. If making a change through the display (where a “Change” option is available), a PIN is required to execute a change. **The default PIN for the display is “0003”.**

For additional information regarding configuration, see “Controller and Alarm Configuration,” on page 44. For an explanation of common configuration tasks, see the *Configuration Guide: Eltek Controllers,* Doc. No. 370013.063.

Default Parameters

The following tables show the default parameters for the Modular HE power system.

Table 8 – Default Parameters for Alarm Relays

Alarm	Relay 1 (Major)	Relay 2 (Minor)	Relay 3 High Voltage	Relay 4 Low Voltage	Relay 5 RFA	Relay 6 (Critical)
Power Major	X					
Power Minor		X				
High Voltage (HV1)		X	X			
High Voltage (HV2)	X		X			
Battery Discharge		X		X		
Very Low Voltage (Battery Discharge)	X			X		X
Rectifier Alarm		X			X	
Dual Rectifier Alarm	X				X	
Controller Fail	X					
DC 1 Fuse Alarm	X					X
AC Mains	X					

Controller CAN Connections

Connections for Eltek CAN monitoring devices are made to the CAN port of the I/O Monitor2 in the distribution panel (left wall). This provides a communication link to the *Smartpack2* controller system.

To install a CAN device:

1. Remove the CAN termination plug from the port.
2. Install one end of the communication cable into the port.
3. Install the other end of the cable into one of the CAN ports on the device.
4. Install the CAN termination plug in the unused CAN port on the device.
5. For multiple CAN devices, simply daisy-chain them together using the two ports provided on each device. The last device in the chain MUST have the CAN termination plug installed in the unused port.

For installation and operation details for each CAN device, consult the documentation provided with it.

Rectifier Module Installation

NOTE: Flatpack2 rectifier modules are assigned a system ID based on order of installation. Therefore, it is recommended to install rectifiers AFTER system startup, in the order desired.

The Flatpack2 family of power modules features a locking mechanism for security in the shelf.

CAUTION: Never carry Flatpack2 modules by the handles, even if they are warm. The handles must be fully extended before installing or removing Flatpack2 modules to prevent damage to either the shelf or module.

To install Flatpack2 modules:

1. Release the handles by inserting a small flat-blade screwdriver into the release slots and pressing the tip upward; extend each handle.

Figure 41 – Release Handles on Modules

2. Slide the module firmly into the shelf. Wait for green LED to illuminate.
3. Latch the handles to lock the rectifier in place.
4. Allow a 2 second delay before inserting the next module.

To remove Flatpack2 modules:

1. Release the handles by inserting a small flat-blade screwdriver into the release slots and pressing up.
2. Use the handles to pull the module out just far enough to where the body can be gripped.
3. Slide the module out the rest of the way. Do not carry it by the handles. Flatpack2 modules weigh just over 4 lbs (1.9 kg) each.

3. Startup

Ensure that all AC and DC cable connections are properly sized and secure. Then, activate all AC input breakers.

Rectifier Installation

Once AC power is activated, install each module as follows:

1. Release the latches by inserting a small flat-blade screwdriver into the release slots and pressing the tip upward; extend each handle.

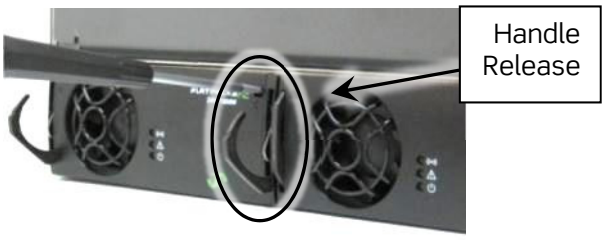

Figure 42 – Releasing the Rectifier Latches

2. Beginning with the first rectifier position (as determined by site policy), slide the first rectifier firmly into the shelf. Wait for green LED to illuminate.
3. Close the latches to lock the rectifier in place.
4. Allow a 2 second delay before inserting the next module.
5. Continue installing rectifiers in the order desired.
6. Repeat steps 1 to 5 until all rectifiers to be used are installed.

Once the first rectifier is properly installed and powered, the controller starts up.

NOTE: Any DC circuit breakers left in the off position may trigger a distribution alarm after the first rectifier is installed. If the load device can be powered at this point, simply switch the breaker ON to clear the alarm.

Connecting Batteries

DANGER: Improper battery connections can cause permanent damage to electrical equipment, serious personal injury, and/or death. Always check polarity before making battery connections.

WARNING: Shock hazard! Use insulated tools, especially when working on live systems.

CAUTION: Do not connect batteries until system startup. It is strongly recommended that inline circuit breakers or fuses be used with bulk/battery connections.

Batteries should be connected **after** making AC connections and activating rectifiers. The system must be powered to check polarity on the battery bus. Then, power off the system to connect batteries.

To make cable connections:

1. After successful system startup, remove the screws holding the rear cover in place.
2. Make connections using two-hole, 3/8”-16 lugs on 1” centers. Fastening hardware is provided.
3. Torque connections according to the specifications in Table 4 on page 27.
4. Replace the rear cover.

DC Breakers and Fuses

Once the system and the controller power up properly, the DC load breakers can be activated and fuses installed.

Controller and Alarm Configuration

Controllers are covered in earlier sections, “Control and Monitoring,” on page 24; and in the installation section, beginning on page 39. For information regarding controller configuration, see the printed copy of the default configuration that shipped with your system.

The Smartpack2 Master Controller provides flexibility for monitoring and configuration, using either the display on the face of the controller, or by using a web browser interface on a computer connected to the controller with an Ethernet cable.

For an explanation of common configuration tasks, see the *Configuration Guide: Eltek Controllers,* Doc. No. 370013.063. For more extensive information, you can also consult the *User Guide: Eltek Controller Web Interface* (Doc. No. 370035.013).

If you make any changes to the default configuration, Eltek recommends that you make a backup copy of your configuration, by following the instructions in the *Configuration Guide*.

4. Startup Checklist

Quick Startup Checklist	
Pre-start Check (Power is OFF)	
☐	Installation site prepared ○ Mounting location is well-ventilated and provides adequate room for airflow ○ Floor is level and capable of supporting the system (Individual system weights vary; see product flyer for more information) ○ Suitable insulated tools available
☐	AC input supply prepared ○ AC supply is compatible with rectifier shelves ○ Supply fuses and/or circuit breakers and wires are properly rated
☐	System components inspected ○ All parts, equipment, documentation, etc. accounted for ○ Components checked for damage; if damaged, contact Eltek
☐	Rack anchored to suitable location
☐	Distribution circuits open ○ Circuit breaker actuators switched OFF ○ Fuses REMOVED
☐	Make AC input connections (power is OFF) ○ Circuit breaker actuators switched off or fuses removed ○ AC ground connections terminated (always connect ground first) ○ AC supply lines are correctly configured to the rectifier shelf terminals
☐	DC load connections made (EXCEPT BATTERIES) ○ Load cables properly connected to system output and return busbars
☐	System alarm cable connected to “Alarm” port on controller
☐	External devices connected to controller (if applicable) ○ PM device(s) (use provided terminators in any open CAN ports) ○ Battery thermal probe cables ○ Auxiliary alarms terminated
Startup Procedure	
☐	Turn on AC breakers and verify proper input voltage
☐	Insert rectifiers in the desired order; system will power up
☐	Verify system startup ○ Controller display turns on ○ Controller and rectifier LEDs turn on ○ Rectifier fans activate
☐	Check controller interface ○ Check display functionality ○ Connect PC to controller ○ Insert provided CD into laptop (program will automatically start) ○ Verify controller appears in LAN Configuration Utility (no need to log in at this time)
☐	Once alarms are cleared, run relay/alarm tests
Battery Connections (if applicable)	
☐	Measure battery string voltage; adjust system DC output voltage to equal battery voltage
☐	Disconnect (but do not remove from shelves) all but one rectifier
☐	CHECK POLARITY and attach batteries to system ○ Terminate cable connections to designated battery landings ○ Switch battery circuit breaker actuators ON and/or insert battery fuses (if applicable)

Quick Startup Checklist	
☐	Reconnect all rectifiers
☐	Adjust DC output voltage to equal required battery float voltage
☐	Configure battery settings (if desired) via front display or graphical interface ○ Battery boost ○ Thermal compensation ○ Battery current limit
Load Distribution	
☐	Once battery management is configured, activate load distribution circuits ○ Switch circuit breaker actuators to the ON position ○ Insert fuses

5. Basic Troubleshooting

In case of alarm conditions, verify the following:

- All AC and DC connections are secured properly.
- All rectifiers are installed and seated properly.
- The controller is installed and seated properly.
- Distribution breakers are in the ON position; fuses are installed and intact (not blown).

Specific rectifier and controller alarm conditions can be found in the following documents:

- *User's Guide: Flatpack2 Rectifiers*, Doc. No. 350002.013
- *User's Guide: Smartpack2 Master Controller*, Doc. No. 350020.013
- *User's Guide: Smartpack2 Basic Controller*, Doc. No. 350021.013
- *Installation Guide: I/O Monitor2*, Doc. No. 351509.003
- *Product Guide: Modular 15U System*, Doc. No. 2151062

Additional product information is available online at ***eltek.sharefile.com***.

For assistance with technical questions and solutions, please contact Technical Support by email at techsupport.us@deltaww.com or by phone at 1-800-435-4872.

Revision List

Revision	Published	Description	CO
1	7/29/13	First release.	N/A
2	2/14/14	Updated photos (to reflect changes in product labels) and tables.	131113UA
2.1	8/11/2014	Added details on alarm parameters; new photos; updated display procedures.	140811UA
2.2	3/28/2017	Added thermal probe connections; updated torque values; updated photos and branding	N/A
2.3	01/18/2017	Added information for graphic of three-phase terminals.	N/A
2.4	12/20/2018	Updated to reflect current product line. Updated branding and support contact info.	N/A

For assistance with technical questions and solutions, please contact Technical Support by email at techsupport.us@deltaww.com or by phone at 1-800-435-4872.

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Doc. No. 370001.033, Issue 2.4
Published 20 December 2018

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