INSTRUCTION MANUAL

TwinPack Plus® - CE
DC Power System

power conversion products, llc
an Eltek Company
Thank you for purchasing PCP power equipment. Power Conversion Products, LLC designs and manufactures power equipment for the Telecommunications Industry, and is committed to being the best supplier of power equipment in the world. We believe the most important tool needed to make this happen is the QUALITY PERFORMANCE of every employee of Power Conversion Products. We are dedicated to providing TOTAL CUSTOMER SATISFACTION through 100% on-time delivery, continuous quality improvement, innovative product development, flexibility, and quick response to changing customer needs. We welcome your comments and suggestions on our products and literature.
Instruction Manual

This instruction manual provides information for qualified personnel to install, interconnect, operate, and maintain the TwinPack Plus®-CE DC Power Shelf. If you require additional information or assistance, please contact the Customer Service Department, available 24 hours a day, 7 days a week, on our toll-free service helpline, (800) 435-4872. In Canada and elsewhere outside the USA, please call 1 847-658-3740.

Regulatory Statements

For your protection this product has been tested to various national and international regulations and standards. The scope of this regulatory testing includes electrical/mechanical safety, radio frequency interference, ergonomics, acoustics, and hazardous materials. Where required, approvals obtained from third-party test agencies are shown on the product label. In addition, various regulatory bodies require information under the following headings.

For USA Only

The United States Federal Communications Commission (in 47 CFR 15.838) has specified that the following notice be brought to the attention of users of this product.

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested for compliance with the limits of Class A computing devices pursuant to Subpart B of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference.

Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

For Canada

This equipment does not exceed the Class A limits for radio noise emissions as set out in the Radio Interference Regulations of the Canadian Department of Communications.
# TABLE OF CONTENTS

REGULATORY STATEMENT ................................................................. ii

EC DECLARATION OF CONFORMITY ........................................ iv

INTRODUCTION ................................................................. 1-2

SPECIFICATIONS ......................................................... 3-9
- Dimensions ................................................................. 3
- Weight .............................................................................. 3
- Operating Environment ................................................... 5
- EMC .................................................................................. 5
- Acoustic Noise ............................................................... 5
- Seismic Testing ............................................................... 5
- AC Input ........................................................................... 5
- Immunity ........................................................................... 6
- DC Output ........................................................................ 6
- Alarms .............................................................................. 8

INSTALLATION ................................................................. 10-15
- Mounting the TwinPack Plus®-CE .................................. 10
- Wiring ................................................................................ 11-14
- Preliminary Settings ......................................................... 15

OPERATION ................................................................. 16-19
- Normal Operation ........................................................... 18
- Adding, Removing or Replacing Rectifier Modules ............ 18-19

MAINTENANCE ................................................................. 19

WARRANTIES ................................................................. 20
EC DECLARATION OF CONFORMITY

Manufacturer's Name: Power Conversion Products, LLC

Manufacturer's Address: 115 Erick Street
Crystal Lake, IL 60014-4533 USA

declares that the product

Product Name: Rectifiers

Model Numbers:
MOD P4850TC-CE, MOD P24N100TC-CE
MOD P24100TC-CE, MOD P24N50TC-CE
MOD P2450TC-CE, MOD P4825TC-CE
MOD P12N100TC-CE

Product Name: Mounting Shelves

Model Numbers:
TWPP-48-200-CE, TWPP-48-100-CE
TWPP-24N-400-CE, TWPP-24N-200-CE
TWPP-24-400-CE, TWPP-24-200-CE
TWPP-12N-400-CE, TWPP-48-150-CE
TWPP-48-75-CE, TWPP-24N-300-CE
TWPP-24-150-CE, TWPP-24-300-CE
TWPP-24-150-CE, TWPP-12N-300-CE

conforms to the following standards:


The Technical documentation required by Annex IV(3) of the Low Voltage Directive is maintained by:
Power Conversion Products, LLC
115 Erick Street
Crystal Lake, IL 60014-4533 USA

Emissions
EN 50081-2: 1993
EN 55011:1991: Conducted RFI Voltage, 150 kHz - 30 Mhz, Radiated RF Emissions, 30 Mhz - 1000 Mhz, Class A, Group 1
EN 61000-3-2: 1995: Limits for Harmonic Current Emissions
EN 61000-3-3: 1995 Limitation of Voltage Fluctuations and Flicker in Low-Voltage Supply Systems
Immunity/Susceptibility
EN 50082-2: 1995
EN 61000-4-2: 1995, Contact Discharge Mode ±8kV and ±15kV, Performance Criteria B
EN 61000-4-3:1995, Radiated RF @ 10 V/meter for 80 Mhz to 1 Ghz, Radiated RF @ 10 V/meter at 900 Mhz, Performance Criteria A
EN 61000-4-4:1995, Electrical Fast Transient/Burst (EFT/B), 4kV for input AC and output DC and 2kV for signal and control lines exceeding 3 meters, Performance Criteria B
EN 61000-4-5:1995, Fast Surges, 4 kV line to earth, 2 kV line to line, 0.5 kV for signal and control lines, line to earth, Performance Criteria B
EN 61000-4-6:1995, Injected Currents, 150 kHz to 80 Mhz, 10 Vrms, Performance Criteria A
EN 61000-4-8:1993, Power Frequency Magnetic Fields at 50 Hz, 30 A/m, Performance Criteria A
EN 61000-4-11:1994 Voltage Dips and Interruptions, Performance Criteria B, C and C

INTRODUCTION

SCOPE. This manual provides information for the installation, interconnection, operation, and maintenance of the TwinPack Plus®-CE Modular DC Power System. It is comprised of a mounting shelf and rectifier module(s) (23” wide shelf, 4 rectifiers across; 19” wide shelf, 3 rectifiers across). It is built in conformance with Underwriters Laboratories Standards for Safety of Information Technology Equipment, Including Electrical Business Equipment (UL1950). The TwinPack Plus®-CE power system also is built in conformance with the essential requirements of the applicable directives Electromagnetic Compatibility Directive (EMC) 89/336/EEC and Low Voltage Directive (LVD) 73/23/EEC authorized by the European Commission as of May 1, 1997. Both the rectifiers and mounting shelves bear the CE Marking for conformity. The rectifiers are UL Recognized and CSA Certified by Underwriters Laboratory Inc. and bear the UL Recognition mark for the United States and Canada. The system, which includes the mounting shelf, is UL Listed and CSA Certified by Underwriters Laboratory Inc. and bears the UL Listing mark for the United States and Canada. Installation must conform to national, state or local electrical codes. If installation assistance or additional information is required, please call 800-435-4872, our toll-free, 24 hours a day, 7 days a week, Customer Service Helpline. Customers outside the United States, please call 1-815-479-0682.

GENERAL INFORMATION.

Mounting Shelves. The TwinPack Plus®-CE power system series includes four rectifier mounting shelves. The shelves are designed for mounting in standard relay racks; two for 23” racks, and two for 19” racks. The 23” shelves accept up to four rectifier modules while the 19” shelves will accept up to three rectifier modules.

Standard Shelves. Standard shelves are 10.5” (6 RU) high and are 24” deep. Standard shelves require access from both front and rear for installation and for service. These shelves are specified in applications where access to the rear of the shelf after installation is not a problem.

Reduced Depth Shelves. Reduced depth shelves are 12.25” (7 RU) high and are 18.5” deep. Access to the rear of the shelf is required for installation only. These shelves are specified in applications where access to the rear of the shelf after installation is impossible or otherwise not practical.
INTRODUCTION

All TwinPack Plus®-CE rectifier mounting shelves are completely wired internally. All external connections, including AC input, DC output, and alarms, are made at the rear of the shelf. Any TwinPack Plus®-CE rectifier module can be used in any Twin Pack Plus®-CE mounting shelf.

Each rectifier module has blind-mate connectors at the rear for AC input, DC output and alarm circuits. An AC pre-charge circuit limits current inrush during mating of the AC input connectors. A turn-screw type of device draws the rectifier module into the shelf, seats the connectors and secures the module in place. By design, the rectifier module’s DC output circuit breaker cannot be placed in the ON position unless the module is seated and secured. This feature prevents a rectifier module from being installed with its circuit breaker in the ON position.

The rectifier modules produce +12 VDC, +24 VDC or -48 VDC output from single phase AC input ranging from 176 to 264 VAC, 45 to 65 Hz for 3000 watt modules; 85 to 264 VAC for 1500 watt modules. Each rectifier module has its own controls and indicators. Controls include an ON/OFF switch, a DC output circuit breaker, and a rectifier test (NL/FL) switch. A front-mounted DIP switch provides adjustment for the high voltage shutdown setting, load-share enable/disable and float/equalize switching. Indicators include green LEDs to indicate that AC power is on and the rectifier is operating properly, a green LED ammeter that monitors output current from 10% to 100% of capacity, a green LED for the FLOAT mode, a yellow LED for the EQUALIZE mode, a yellow LED for open remote sense, and red LEDs to indicate rectifier failure, high voltage shutdown, high temperature shutdown, and open DC breaker.

P/N 7002324101
Standard Depth Shelf, 6 RU H x 24” D

P/N 7002324103
Reduced Depth Shelf, 7 RU H x 18.5” D

Figure 1A. 19” Rack Mount Shelves.
SPECIFICATIONS

Dimensions. The TwinPack Plus®-CE mounting shelf is 10-1/2" high (6 RU) x 24" deep. Reduced depth mounting shelves are 12.25" high (7 RU) x 18.5" deep. The four-across shelves are designed to mount in a 23” wide relay rack. The three-across shelves mount in a 19” wide rack.

Weight:
- Mounting shelf only: 49 lb./22.27 kg. (4-across)
- 45 lb./20.45 kg. (3-across)
- Rectifier modules, each:
  - 24 lb./10.90 kg. (3000 watts)
  - 19 lb./8.63 kg. (1500 watts)

Table 1. Rectifier Specifications (3000 Watts, Temperature Hardened). Use in any TwinPack Plus®-CE mounting shelf.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>MOD P4850TC-CE</th>
<th>MOD P24N100TC-CE</th>
<th>MOD P24100TC-CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Number</td>
<td>9155100220</td>
<td>9155100221</td>
<td>9155100222</td>
</tr>
<tr>
<td>Input Voltage Range</td>
<td>176 to 264 VAC</td>
<td>176 to 264 VAC</td>
<td>176 to 264 VAC</td>
</tr>
<tr>
<td>Single Phase</td>
<td>45 to 65 Hz</td>
<td>45 to 65 Hz</td>
<td>45 to 65 Hz</td>
</tr>
<tr>
<td>Output Voltage Range</td>
<td>Single Phase</td>
<td>Single Phase</td>
<td>Single Phase</td>
</tr>
<tr>
<td>Float</td>
<td>-47 to -56 VDC</td>
<td>+22 to +28 VDC</td>
<td>-22 to -28 VDC</td>
</tr>
<tr>
<td>Equalize</td>
<td>-54 VDC</td>
<td>+26 VDC</td>
<td>-26 VDC</td>
</tr>
<tr>
<td>Nominal</td>
<td>-51 to -60 VDC</td>
<td>+24 to +30 VDC</td>
<td>-24 to -30 VDC</td>
</tr>
<tr>
<td>Nominal</td>
<td>-56 VDC</td>
<td>+28 VDC</td>
<td>-28 VDC</td>
</tr>
<tr>
<td>Output Current</td>
<td>50 A (-40°C to +65°C)</td>
<td>100 A (-40°C to +65°C)</td>
<td>100 A (-40°C to +65°C)</td>
</tr>
<tr>
<td>Efficiency (at 2800 watts output and 240 VAC input)</td>
<td>&gt;90%</td>
<td>&gt;90%</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Power Factor (50% to 100% load)</td>
<td>&gt;.98</td>
<td>&gt;.98</td>
<td>&gt;.98</td>
</tr>
<tr>
<td>Total Harmonic Current Distortion (50% to 100% load)</td>
<td>&lt;5%</td>
<td>&lt;5%</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>Static Voltage Regulation (At all line, load and environmental conditions)</td>
<td>0.50%</td>
<td>0.50%</td>
<td>0.50%</td>
</tr>
<tr>
<td>Input Current @ 2600 watts</td>
<td>176 VAC - 16.6 A</td>
<td>176 VAC - 16.9 A</td>
<td>176 VAC - 16.9 A</td>
</tr>
<tr>
<td></td>
<td>208 VAC - 14.0 A</td>
<td>208 VAC - 14.3 A</td>
<td>208 VAC - 14.3 A</td>
</tr>
<tr>
<td></td>
<td>240 VAC - 12.0 A</td>
<td>240 VAC - 12.4 A</td>
<td>240 VAC - 12.4 A</td>
</tr>
<tr>
<td>Maximum Output Power</td>
<td>3000 Watts</td>
<td>3000 Watts</td>
<td>3000 Watts</td>
</tr>
<tr>
<td>Heat Dissipation @ 240 VAC, 2600 watts</td>
<td>980 BTU/Hr.</td>
<td>1040 BTU/Hr.</td>
<td>1040 BTU/Hr.</td>
</tr>
</tbody>
</table>
### SPECIFICATIONS

Table 1 (continued). Rectifier Specifications (1500 Watts, Temperature Hardened). Use in any **TwinPack Plus® -CE** mounting shelf.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>MOD P4825TC-CE</th>
<th>MOD P24N50TC-CE</th>
<th>MOD P2450TC-CE</th>
<th>MOD P12N100TC-CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Number</td>
<td>9155100223</td>
<td>9155100224</td>
<td>9155100225</td>
<td>9155100226</td>
</tr>
<tr>
<td>Input Voltage Range</td>
<td>Single Phase</td>
<td>Single Phase</td>
<td>Single Phase</td>
<td>Single Phase</td>
</tr>
<tr>
<td>Single Phase</td>
<td>85 to 264 VAC</td>
<td>85 to 264 VAC</td>
<td>85 to 264 VAC</td>
<td>85 to 264 VAC</td>
</tr>
<tr>
<td></td>
<td>45 to 65 Hz</td>
<td>45 to 65 Hz</td>
<td>45 to 65 Hz</td>
<td>45 to 65 Hz</td>
</tr>
<tr>
<td>Output Voltage Range</td>
<td>Float</td>
<td>Nominal</td>
<td>Equalize</td>
<td>Nominal</td>
</tr>
<tr>
<td>Float</td>
<td>-47 to -56 VDC</td>
<td>+22 to +28 VDC</td>
<td>-22 to -28 VDC</td>
<td>+11 to +14 VDC</td>
</tr>
<tr>
<td>Nominal</td>
<td>-54 VDC</td>
<td>+26 VDC</td>
<td>-26 VDC</td>
<td>+13 VDC</td>
</tr>
<tr>
<td>Equalize</td>
<td>-51 to -60 VDC</td>
<td>+24 to +30 VDC</td>
<td>-24 to -30 VDC</td>
<td>+12 to +15 VDC</td>
</tr>
<tr>
<td>Nominal</td>
<td>-56 VDC</td>
<td>+28 VDC</td>
<td>-28 VDC</td>
<td>+14 VDC</td>
</tr>
<tr>
<td>Output Current</td>
<td>25 A (-40°C to +65°C)</td>
<td>50 A (-40°C to +65°C)</td>
<td>50 A (-40°C to +65°C)</td>
<td>50 A (-40°C to +65°C)</td>
</tr>
<tr>
<td>Efficiency (at 1400 watts output and 240 VAC input)</td>
<td>&gt;90%</td>
<td>&gt;90%</td>
<td>&gt;90%</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Power Factor</td>
<td>&gt;.98</td>
<td>&gt;.98</td>
<td>&gt;.98</td>
<td>&gt;.98</td>
</tr>
<tr>
<td>(At 120 VAC input, 50% to 100% load)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Harmonic Current Distortion (at 120 VAC input, 50% to 100% load)</td>
<td>&lt;9%</td>
<td>&lt;9%</td>
<td>&lt;9%</td>
<td>&lt;9%</td>
</tr>
<tr>
<td>Static Voltage Regulation (At all line, load and environmental conditions)</td>
<td>±0.5%</td>
<td>±0.5%</td>
<td>±0.5%</td>
<td>±0.5%</td>
</tr>
<tr>
<td>Input Current @ 1300 watts</td>
<td>85 VAC - 16.9 A</td>
<td>85 VAC - 17.5 A</td>
<td>85 VAC - 17.5 A</td>
<td>85 VAC - 17.5 A</td>
</tr>
<tr>
<td></td>
<td>120 VAC - 12.0 A</td>
<td>120 VAC - 12.4 A</td>
<td>120 VAC - 12.4 A</td>
<td>120 VAC - 12.4 A</td>
</tr>
<tr>
<td></td>
<td>176 VAC - 8.3 A</td>
<td>176 VAC - 8.5 A</td>
<td>176 VAC - 8.5 A</td>
<td>176 VAC - 8.5 A</td>
</tr>
<tr>
<td></td>
<td>208 VAC - 7.0 A</td>
<td>208 VAC - 7.2 A</td>
<td>208 VAC - 7.2 A</td>
<td>208 VAC - 7.2 A</td>
</tr>
<tr>
<td></td>
<td>240 VAC - 6.0 A</td>
<td>240 VAC - 6.2 A</td>
<td>240 VAC - 6.2 A</td>
<td>240 VAC - 6.2 A</td>
</tr>
<tr>
<td>Maximum Output Power</td>
<td>1500 Watts</td>
<td>1500 Watts</td>
<td>1500 Watts</td>
<td>1500 Watts</td>
</tr>
<tr>
<td>Heat Dissipation @ 240 VAC, 1300 watts</td>
<td>490 BTU/Hr.</td>
<td>520 BTU/Hr.</td>
<td>520 BTU/Hr.</td>
<td>520 BTU/Hr.</td>
</tr>
</tbody>
</table>
SPECIFICATIONS

**Operating Environment.** The mounting shelf and modular rectifier system is designed to operate in ambient temperatures ranging from **-40°C (-40°F)** to **+65°C (149°F)** and at altitudes ranging from 200 feet (61 m) below Mean Sea Level (MSL) to 13,000 feet (3,962 m) above MSL. Between 5,000 feet (1,524 m) and 13,000 (3,962 m) above MSL the ambient operating temperature is de-rated by 2°C (3.6°F) for each 1,000 feet (302 m) increase in altitude. Relative humidity range is from 0% to 95% noncondensing. Pollution degree 2 as defined in UL 1950.

**Cooling.** Rectifier modules are fan-cooled with a horizontal air flow pattern. Air is drawn in the front and exhausted out the back. The fan is field replaceable. *TwinPack Plus*-CE mounting shelves can be stacked without heat deflectors. Rectifier modules are equipped with a high temperature shutdown circuit that monitors the temperature of the rectifier’s hottest semiconductor’s heatsink. If this temperature exceeds 120°C (248°F) the rectifier will shut down for approximately 12 minutes. The rectifier will then automatically restart. A red LED on the front panel of the rectifier illuminates to indicate a high temperature shutdown condition.

**EMC.** The rectifier and mounting shelf system meets FCC Regulation Part 15, Subpart B for Radio Frequency Devices. The system complies with Class A radiated and Class B conducted. The system also complies with the Generic Standard EN50081-1 (1992). The system complies with IEC-1000-3-2 Conducted harmonic currents 0 to 2khz (old IEC555-2 spec). EN55022 Class A: EMC Conducted 0.15Mhz-30Mhz. EN55022 Class A: EMC radiated 0.03-16Ghz.

**Warning:** This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

**Regulatory and Dielectric.** It is built in conformance with the Underwriters Laboratories Standards for Safety of Information Technology Equipment, Including Electrical Business Equipment (UL 1950). The rectifiers are UL Recognized and CSA Certified by Underwriters Laboratory Inc. and bear the UL Recognition mark for the United States and Canada. The system, which includes the mounting shelf, is UL Listed and CSA Certified by Underwriters Laboratory Inc. and bears the UL Listing mark for the United States and Canada. The output to ground isolation is tested at 707Vdc for 1 second, the input to output isolation is tested at 4242Vdc for 1 second and the input to ground isolation is tested at 4242Vdc for 1 second.

**Acoustic Noise.** The noise generated by the converter shall not exceed 54 dBa when measured with a suitable meter 3 feet in front of the unit.

**Seismic Testing.** The mounting shelf and rectifier module system are designed to pass seismic testing in accordance with Bellcore TR-NWT-000063 (Zone 4) and Pacific Bell/Nevada Bell Publication L-780074/PB/NB (pending).

**AC Input**

The shelf/rectifiers accept a wide AC voltage range. The specific rectifiers installed in the shelf determine the exact AC input voltage range as follows:

- **1500 watt modules** accept single phase AC input ranging from 85 to 264 VAC, 45-65 Hz.
- **3000 watt modules** accept single phase AC input ranging from 176 to 264 VAC, 45-65 Hz.

The operation of the rectifier is not jeopardized by line voltages below the minimum, down to and including zero.
SPECIFICATIONS

Immunity. The rectifier and mounting shelf system meets the Bellcore immunity criteria stated in GR-1089-CORE, Issue 1, Nov. 1994, "Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunication Equipment". The system also complies with the Generic Standard EN50082-2 (1994).

- IEC1000-4-2: ESD Level 4; 8kv contact, 15kv air discharges.
- IEC1000-4-3: RF field immunity: Level 3; 10v/m.
- IEC1000-4-4: Electrical fast transient/burst immunity: Level 4;
  ac input: 4kv, 2.5kzh
  dc output: 4kv, 2.5kzh
  control lines: 2kv, 5kzh
- IEC1000-4-5: Surge immunity test 1.2/50µs (voltage) 8/20µs (current): Level 4;
  ac input (line to line): 2kVpk 1.2/50 (8/20)µs
  ac input (line to Gnd): 4kVpk 1.2/50 (8/20)µs
  dc output (line to line): 2kVpk 1.2/50 (8/20)µs
  dc output (line to Gnd): 4kVpk 1.2/50 (8/20)µs
  control signals (line to Gnd): 0.5kVpk 1.2/50 (8/20)µs
- ANSI/IEEE C62.41-1991. Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits. IEEE Location B3/C1 both combination waveform (1.2/50µs - 8/20µs) at 6.0 kV, 3.0 kA and ring waveform (0.5µs - 100 kHz) at 6.0 kV, 0.5 kA.

DC Output Voltage. The following ranges apply to all line and load conditions except when the rectifiers are in current limit:

<table>
<thead>
<tr>
<th>12 Volt Unit</th>
<th>FLOAT</th>
<th>EQUALIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 to 14 VDC</td>
<td>at nominal 13 VDC</td>
<td>12.5 to 15 VDC at nominal 14 VDC</td>
</tr>
</tbody>
</table>

DC Output Current Rating. The following ranges apply to the rectifiers indicated:

<table>
<thead>
<tr>
<th>Rectifier Module</th>
<th>Output Current Rating (Ampere)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOD P4850TC-CE</td>
<td>50 A from -40°C to +65°C</td>
</tr>
<tr>
<td>MOD P24N50TC-CE</td>
<td>100 A from -40°C to +65°C</td>
</tr>
<tr>
<td>MOD P4825TC-CE</td>
<td>25 A from -40°C to +65°C</td>
</tr>
<tr>
<td>MOD P24N100TC-CE</td>
<td>25 A from -40°C to +65°C</td>
</tr>
<tr>
<td>MOD P24100TC-CE</td>
<td>100 A from -40°C to +65°C</td>
</tr>
<tr>
<td>MOD P12N100TC-CE</td>
<td>100 A from -40°C to +65°C</td>
</tr>
</tbody>
</table>

Current Limit and Short Circuit Protection. The rectifier protects itself from an output short circuit by automatically limiting output current to, typically, 105% of rated current. The rectifier automatically resumes normal operation when the short circuit condition is removed. This rectifier is also able to start into a short circuit condition.

Test Jacks. Two pairs of positive (+) and negative (-) plug-in jacks are located on the front of each rectifier to provide connection points for an external digital voltmeter. The test jacks are protected from a short circuit with 5k resistors. The left hand pair of jacks measures the output voltage before the DC circuit breaker. The right hand pair of jacks measures the voltage on the remote sense leads.

Output Voltage Adjustment. The potentiometers for setting the FLOAT and EQUALIZE output voltages are used in conjunction with the test jacks. Preliminary adjustment is done with the DC output circuit breaker OFF using the left hand pair of positive (+) and negative (-) test jacks. Final adjustment is done with the DC output circuit breaker ON using the right pair of test jacks. Slide number 1 of the six-position DIP.
SPECIFICATIONS

switch mounted on the front of each rectifier module is used to toggle between FLOAT (down) and EQUALIZE (up) modes. LEDs illuminate to signify the specific mode, green for FLOAT; yellow for EQUALIZE.

Adjustable High Voltage Shutdown with Automatic Restart. Each rectifier module is equipped with a high voltage shutdown (HVS) circuit having customer adjustable limits. This HVS circuit will only shut down a rectifier supplying greater than 10% of the rated output current. A red LED on the front of the rectifier module illuminates to indicate shutdown due to an HVS condition. When shut down, restart is induced automatically by a built-in restart circuit. The rectifier will automatically attempt to restart itself between 5 to 7 times at intervals of 500 to 1000 milliseconds (six restart attempts at intervals of 750 milliseconds is typical).

If the high voltage condition continues to exist during the restart attempts, the rectifier will latch off. Once the rectifier has latched off, it is necessary to induce restart. This is accomplished at the rectifier by cycling the switch on the front of the rectifier OFF then ON again, or from a remote location by connecting the remote rectifier restart pin to ground in the shelf wiring compartment. Either method resets the lockout feature of the HVS circuit causing the rectifier to attempt restart. This restart will not affect operating rectifiers.

A backup high voltage shutdown circuit built into each rectifier will shut the rectifier down regardless of the output load. This circuit is factory set at 62.0 VDC ±2.0 volts for the 48 volt rectifiers; 31.0 VDC ±2.0 volts from the 24 volt rectifiers; 15.5 VDC ±1.0 volt for 12 volt rectifiers.

Paralleling. Rectifiers are equipped with a forced paralleling circuit. This circuit will force the parallel rectifiers to share the load up to a difference in rectifier voltage of 0.7 volt. The tolerance on the load share circuit is 10%. This circuit can be disabled by moving slide number 2 of the DIP switch on the front of the rectifier to the down or OFF position.

Remote Rectifier Shutdown. Each rectifier has a terminal (pin) in the wiring compartment that, when connected to ground, will shut down the rectifier. This terminal can be grounded on site in the wiring compartment or it may be connected to a switch at another location to effect remote shutdown. The rectifier will automatically restart when this terminal is removed from ground.

Remote Rectifier Restart. Each rectifier has a terminal (pin) in the wiring compartment that, when connected to ground, will reset the rectifier’s HVS lockout circuit causing the rectifier to attempt to restart. This terminal may be connected to a switch at another location to induce remote restart. All remote restart pins may be connected together. Grounding this pin will not affect rectifiers operating normally.

Filtering. Output ripple and noise measured at all line and load conditions:
Wide Band: less than 100 mv peak to peak from 0 to 20 Mhz;
less than 200 mv peak to peak from 0 to 100 Mhz;
less than 19 mv RMS from 0 to 10 Mhz;
less than 5 mv RMS from 0 to 100 Khz.
Voice Band: less than 26 dBnC.

Static Voltage Regulation. The voltage regulation at the remote sense terminals of the rectifier over all line, load and environmental conditions is ±0.5%.

Dynamic Load Response. Step changes in load from 10 to 90 percent or from 90 to 10 percent within 50 microseconds shall not cause the voltage measured at the point of regulation to overshoot more than 5%
SPECIFICATIONS

of the regulated output level within 250 ±10 microseconds. The output voltage will typically return and stay within the ±0.5% regulation band within 4 milliseconds.

Rectifier ON/OFF Switch. Each rectifier is equipped with an ON/OFF switch that turns the output section of the rectifier on and off. During normal operation the ON/OFF switch must be in the ON position. This switch is also used to locally reset all shutdown circuits.

DC Output Circuit Breaker. Each rectifier is equipped with a DC output circuit breaker. A blocking device prohibits this circuit breaker from being turned ON prior to or during rectifier installation into the mounting shelf. During normal operation this circuit breaker is in the ON position. This switch is also used to locally reset all shutdown circuits.

NL/FL Test Switch. This momentary switch is used with the rectifier ON and the DC output circuit breaker ON to simulate NO LOAD (NL) and FULL LOAD (FL) conditions during normal operation with the rectifier connected to the system. When held in the FL position, the rectifier’s output voltage will increase by one (1) volt, and the rectifier will attempt to supply all the current the system will allow. When pushed to the NL position, the rectifier’s output voltage will decrease by one (1) volt and the rectifiers will not supply any current to the system with other rectifiers operating. The forced load share circuit is disabled when this switch is in use.

ALARMS.
The TwinPack Plus®-CE power shelf is equipped with an alarm circuit board in the wiring compartment at the rear side of the shelf. The remote alarm/control circuits of the rectifier(s) are interconnected to the alarm board blindmate connectors. Each rectifier is equipped with its own alarm indicators. LEDs on the face of each rectifier provide local indication of specific alarm conditions. Terminal blocks are provided on the shelf’s alarm board for connecting to the external alarm system for remote indication of specific alarm conditions.

Rectifier OK LED. During normal operation the green LED labeled RECT OK is illuminated to indicate that the rectifier is functioning normally. In the event of rectifier failure, this LED extinguishes.

Rectifier Failure Alarm. In the event a rectifier fails or its DC output circuit breaker is in the OFF position, the red LED labeled RECT FAIL ALARM on the front of the rectifier illuminates and a non-isolated signal is sent to the mounting shelf’s alarm board to activate a remote rectifier failure alarm.

High Output Voltage Shutdown Alarm. In the event of a high output voltage shutdown, the red LED labeled HIGH VOLT SD on the face of the specific rectifier illuminates to provide local alarm indication and a non-isolated signal is sent to the mounting shelf’s alarm board to activate a remote rectifier failure alarm. Additionally, the red LED labeled RECT FAIL ALM illuminates to provide local indication that the rectifier has failed.

High Temperature Shutdown. In the event the temperature of the rectifier’s hottest semiconductor’s heatsink exceeds 120°C (248°F), the red LED labeled HIGH TEMP SD illuminates to provide local alarm indication and a non-isolated signal is sent to the shelf’s alarm board to activate a remote rectifier failure alarm. Additionally, the red LED labeled RECT FAIL ALM illuminates to provide local indication that the rectifier has failed.

Open DC Breaker Alarm. In the event the DC output circuit breaker is in the OFF position, a red LED labeled OPEN DC BRKR illuminates to provide local alarm indication and a non-isolated signal is sent to the shelf’s alarm board to activate a remote rectifier failure alarm.

Open Sense Alarm. In the event one (or both) remote sense lead connection is lost, a yellow LED labeled OPEN RS illuminates to provide local alarm indication. If one or both remote sense leads become disconnected, the rectifier automatically reverts to local sensing.
SPECIFICATIONS

Fan Failure Alarm. In the event the cooling fan of the rectifier fails, the red LED labeled FAN FAIL on the front of the rectifier illuminates, the rectifier shuts down and the red LED labeled RECT FAIL ALM also illuminates. Simultaneously a non-isolated signal is sent to the shelf’s alarm board to activate a remote rectifier failure alarm.

AC Power Failure Alarm. Each rectifier has a separate line feed from the AC power source. A green LED labeled AC OK on the front of the rectifier illuminates to indicate that the rectifier is receiving AC power. In the event of an AC power failure, the green LED extinguishes and a non-isolated signal is sent to the shelf’s alarm board to activate a remote AC failure alarm.

Temperature Compensated Battery Charging. Each rectifier is equipped with circuitry to provide temperature compensated battery charging. The System Status/Control Panel version 2 (SSD2) provides the interface for this feature. Post headers P4 and P5, and Pins 7 and 8 labeled Thermal Bus (THMBUS) and Thermal Sense (THMSENSE) connect to the SSD2 panel. Also connecting to the SSD2 panel are the battery thermal sensors that measure the battery’s post temperature.

Theory of Operation. When the battery temperature reaches 30°C, the output voltage of the rectifiers will decrease by -4.16 mv/°C per cell until the battery temperature reaches 57°C. When the battery reaches 57°C, the output voltage of the rectifier(s) stops decreasing.

Current Walk-In. Whenever the AC power to the rectifier is interrupted due to an AC power failure, restoration of the AC power activates a “current walk-in” feature. This feature provides for a gradual increase in output current to its quiescent point at an elapsed time consistent with the following table.

<table>
<thead>
<tr>
<th>Percentage of Full Load Current</th>
<th>Minimum Elapsed Time (Seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>---</td>
</tr>
<tr>
<td>50</td>
<td>2.5</td>
</tr>
<tr>
<td>75</td>
<td>5.0</td>
</tr>
<tr>
<td>90</td>
<td>8.0</td>
</tr>
</tbody>
</table>

When the quiescent point is reached the “current walk-in” feature is disabled until the next AC power failure.
INSTALLATION

Introduction. Normally, the TwinPack Plus®-CE power shelf is supplied as a part of a DC power system and is factory installed and interconnected. If the TwinPack Plus®-CE is supplied separately, follow the installation instructions provided below. The following information is provided to allow qualified personnel to unpack, install and interconnect the TwinPack Plus®-CE power shelf. NOTE: Installation must conform to applicable national, state and local electrical codes.

Equipment Lost/Damaged in Transit. Upon receipt of the shipment compare the number of containers received with the number of containers indicated on the shipping papers. Inspect each container for visible signs of damage. Clearly note all shortages and/or damage on the shipping papers before signing them. By doing this you are accepting the shipment with exceptions as noted and a claim for reimbursement of the damage can be filed with the delivering carrier.

Shipping Container Removal. The mounting shelf (when shipped separately) is securely packed in a corrugated carton. To unpack the mounting shelf, open the top of the carton being careful to remove and discard the closure staples. Lift out the upper portion of the packaging material. Firmly grasp the shelf and lift it from the carton. The rectifier modules are packed in separate shipping cartons. Carefully open each carton being careful to remove and discard the closure staples. Remove the packaging material and lift out the rectifier modules.

Hidden Damage. If, during uncrating, the equipment is discovered to be damaged and there is no visible damage to the shipping container, contact the delivering carrier to make an inspection of the hidden damage that has been discovered. Be sure to set aside the damaged equipment and to save all packaging materials and have them available for the inspector. When you receive a copy of the inspection report, a claim for damages can be filed.

Report all damages and shortages to:
Power Conversion Products, LLC
115 Erick Street
Crystal Lake, IL 60014-4533

Returned Goods. If it is necessary to return any equipment please notify the factory before doing so. Returned equipment cannot be accepted unless a Return Authorization has been issued and a reference thereto is included with the shipment. It is also helpful if you reference your purchase order number, the serial number of the equipment, and the date the shipment was received.

Storage of Equipment. If the power shelf and rectifier modules must be stored for a period of time prior to installation they should be left in their original shipping containers and stored in a clean, dry area where the ambient temperature is between -50°C (-45°F) and +85°C (185°F) and where the relative humidity is between 0% and 95%, non-condensing.

MOUNTING THE TwinPack Plus®-CE

Tools Required. The following tools are needed to mount the TwinPack Plus®-CE in the rack:

1. Small flat-blade screwdriver.
2. Medium flat-blade screwdriver.
5. Socket set, 3/8” drive ratchet with socket sizes ranging from 1/4” to 3/4”.
6. Set of open end wrenches with sizes ranging from 1/4” to 3/4”.
7. Crimper with dies ranging from #4 AWG to 2/0 AWG wire sizes.
8. Crimper for #14 AWG to #6 AWG wire sizes.
9. Electrically insulated mats.
INSTALLATION

**Shelf to Rack.** TwinPack Plus®-CE shelves are designed for mounting in standard relay racks. Shelves that accept four rectifier modules mount in 23” racks while shelves that accept three rectifier modules mount in 19” racks. All shelves have mounting brackets attached to the sides 5” back from the front of the shelf. (If flush mounting is desired, it is necessary to remove these brackets and reinstall them using the forward holes provided.)

Lift the shelf to its mounting position in the rack, align the holes in the mounting brackets with the appropriate holes in the rack and secure in place using 12-24 x 1/2” pan head screws, flat washers and lock washers. Tighten to a recommended torque value of 36-42 inch-pounds. NOTE: For ease of installation we recommend mounting the shelf in the rack before installing the rectifier module(s) into the shelf.

**Installing Rectifier Module(s).** Install the rectifier module(s) in the shelf beginning with the left hand (rectifier number 1) position. Place the module into the shelf and push it back until it stops. Using a 7/16” or 11 millimeter nut driver or socket wrench, turn the nut located at the bottom front of the rectifier clockwise until it stops. This nut drives a mechanism that engages the shelf, pulls the rectifier into position and securely seats the blind-mate input, output and alarm connectors. Repeat for the second through fourth rectifiers if so equipped.

**WIRING**

AC input, DC output, and remote alarm and control connections are made at the rear of the shelf.

NOTE: TwinPack Plus®-CE shelves are normally supplied as part of a complete power system. As such, DC output connections and the shelf’s alarm connections are usually interconnected within the overall system. AC power must be connected to the shelf, one feed per rectifier.

We recommend connecting separate AC feeds from the source panel to each rectifier position at the time of installation even if all rectifier positions are not initially used. This allows increasing load capacity simply by plugging in another rectifier module.

**AC Input.** At the rear of the shelf, remove and set aside the AC wiring compartment cover by removing its attaching screws.

*Standard Shelves (6 RU high)*

Standard shelves have a separate terminal block (identified) for each rectifier position in the shelf. A pair of entrance knockouts for 1” conduit are located at the left as you face the shelf from the rear.

![Four Rectifier Shelf](image1)

![Three Rectifier Shelf](image2)

**Figure 2. AC Terminal Blocks, Standard Shelves.**
INSTALLATION

Reduced Depth Shelves (7 RU high)
Reduced depth shelves have a single terminal block with
terminal designations for each rectifier position in the
shelf. A pair of entrance knockouts for .75” conduit are
located at the left as you face the shelf from the rear.

All terminals are equipped with 8-32 screws to terminate
AC wiring and will accept wires with corresponding
crimp ring connectors ranging from #14 to #6 AWG. We
recommend using #10 AWG wire with corresponding
Panduit crimp lug terminals, P/N PNF10-8R-D, installed
with General Purpose Cycle Crimping Tool, P/N CT 550
or equivalent.

Connect the AC wires to the terminals as indicated and
tighten the #8 terminal screws to a recommended torque
of 15-18 inch-pounds.

Grounding. The TwinPack Plus®-CE power shelf must
be grounded. The rectifier modules are internally
grounded to the mounting shelf.

Locate the 1/4-20 ground stud immediately above the
AC terminal blocks in the wiring compartment. Connect
ground wiring to the ground stud using the hardware
provided. The recommended torque requirement is 51-
58 inch-pounds. Minimum recommended wire size is
#10 AWG.
INSTALLATION

DC Output Connections.  
NOTE: The mounting shelf is normally supplied as part of a complete DC power system and is factory installed and interconnected to the system.

The shelf has one common output regardless of the number of rectifiers installed in it. Connection is made at the bus bars labeled GRD (Ground) and BATT (Battery) located at the right rear of the mounting shelf as you face it from the rear. The bus bars are protected by a metal shroud. To gain access, remove the metal shroud surrounding the bus bars by removing the attaching screws.

Standard Shelves (6 RU high).  
The bus bars of the standard shelf are each fitted with 3/8-16 press nuts arranged in two pairs on 1” centers to accept one to four single or two-hole crimp connectors. The output connection of the mounting shelf is a 2” x 0.25” bus bar fitted with 3/8-16 press nuts arranged in two pairs on 1” centers. Attach the output connection to the appropriate bus bar using 3/8-16 hardware and tighten to 15-38 foot-pounds of torque. The attached cover is designed to accept a bus duct with a 3.5” x 3.25” cutout. For a maximum of 30°C rise, a 0.25” x 0.5” bus bar is recommended for a 200 ampere load; a 0.25” x 1.0” is recommended for a 400 ampere load.

Reduced Depth Shelves (7 RU high).  
The bus bars of the reduced depth shelves are each fitted with one pair of 3/8-16 press nuts on 1” centers to accept a single wire or two wires with a one or two-hole crimp connector.

Re-install the metal shroud, place the red insulating cover pieces over the top hole in the shroud and around the wires. Affix using the screws provided.

Remote Alarm/Control Connections.  
There are several customer accessible wiring connections on the shelf’s interface board in the wiring compartment. Most are used either to interconnect alarms between the shelf and a remote alarm system or to interconnect the shelf to an external controller. Following is a summary of customer accessible connections on the interface board’s terminal blocks and post headers. (Refer to the schematic diagram.)

Postheaders P7 and P8 provide customer connection points if no external controller is used. NOTE: In most instances the TwinPack Plus®-CE power shelf will be installed in a system and used in conjunction with a System Status/Control (SSD2 or SSD3) Panel. In this case, most of the remote alarm connections are factory interconnected to the SSD2 or SSD3 panel. (Refer to schematic diagram for the SSD2 or SSD3 panel for location of the remote alarm connection points.) Terminal designation of the various Postheaders are shown on the following page.

Remote Alarm/Control Connections  
Standard Shelves (6 RU high).  
Post headers P7 and P8 are located in the alarm wiring section at the rear of the shelf. Access is gained by removing the AC/Alarm wiring compartment cover.

Reduced Depth Shelves (7 RU high).  
Post headers P7 and P8 are located on the rear of the shelf immediately below the DC output bus bars.
INSTALLATION

Post Header P7, P8. Can be used for customer connections to remote alarm/control system and SSD2 or SSD3. Also used to interconnect (“daisy chain”) the alarms/controls of two or more TwinPack Plus®-CE power shelves installed in the same system.

**Post Headers P7 and P8**

<table>
<thead>
<tr>
<th>Post/Terminal Number</th>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+REM SENSE</td>
<td>Remote sensing, positive lead</td>
</tr>
<tr>
<td>2</td>
<td>RECT FAIL ALM</td>
<td>Rectifier failure alarm, non-isolating</td>
</tr>
<tr>
<td>3</td>
<td>REM FLT/EQL</td>
<td>Remote FLOAT/EQUALIZE switching lead</td>
</tr>
<tr>
<td>4</td>
<td>THERMAL SENSE</td>
<td>Used for temperature compensated battery charging</td>
</tr>
<tr>
<td>5</td>
<td>REM HVS RESET</td>
<td>Remote high voltage shutdown reset</td>
</tr>
<tr>
<td>6</td>
<td>REM SHTDN 2</td>
<td>Remote shutdown, rectifier number 2</td>
</tr>
<tr>
<td>7</td>
<td>REM SHTDN 4</td>
<td>Remote shutdown, rectifier number 4</td>
</tr>
<tr>
<td>8</td>
<td>-REM SENSE</td>
<td>Remote sensing, negative lead</td>
</tr>
<tr>
<td>9</td>
<td>LOAD SHARE</td>
<td>Load sharing between shelves</td>
</tr>
<tr>
<td>10</td>
<td>AC FAIL ALM</td>
<td>AC failure alarm, non-isolating</td>
</tr>
<tr>
<td>11</td>
<td>THERMAL BUS</td>
<td>Used for temperature compensated battery charging</td>
</tr>
<tr>
<td>12</td>
<td>REM SHTDN 1</td>
<td>Remote shutdown, rectifier number 1</td>
</tr>
<tr>
<td>13</td>
<td>REM SHTDN 3</td>
<td>Remote shutdown, rectifier number 3</td>
</tr>
<tr>
<td>14</td>
<td>None</td>
<td>Not used</td>
</tr>
</tbody>
</table>

Load Sharing Between Shelves. Terminal number 9 (labeled LOAD SHARE) of terminal block P7, P8 is used for load sharing between shelves. Connecting the LOAD SHARE terminal of one TwinPack Plus®-CE shelf to the LOAD SHARE terminal of another TwinPack Plus®-CE shelf forces the shelves to share load equally.

When all external connections are completed, reinstall the wiring compartment panel and the front cover.

**Post Header P9 can be used for remote sense connection.**

**Post Header P9**

<table>
<thead>
<tr>
<th>Post/Terminal Number</th>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+REM SENSE</td>
<td>Remote sensing, positive lead</td>
</tr>
<tr>
<td>2</td>
<td>-REM SENSE</td>
<td>Remote sensing, negative lead</td>
</tr>
</tbody>
</table>
INSTALLATION

PRELIMINARY SETTINGS

High Voltage Shutdown (HVS) Setting. Each rectifier has its own HVS setting. The voltage at which the rectifier will automatically shut down due to a high output voltage condition is adjustable. Switch slides 3 through 6 of the Dual In-Line Package (DIP) switch on the front of each rectifier module are used for setting the HVS voltage. See Figure 3.

DIP Switch Settings. Determine the voltage at which the HVS circuit will automatically shut down the rectifier. Locate this desired voltage in Table 2 and, using a small, thin-blade screwdriver, move slides 3 through 6 of the DIP switch to the “1” (UP) or “0” (DOWN) position as indicated.

Table 2. DIP Switch Settings.

<table>
<thead>
<tr>
<th>Switch 3 Slide Position</th>
<th>Switch 4 Slide Position</th>
<th>Switch 5 Slide Position</th>
<th>Switch 6 Slide Position</th>
<th>48 Volt HVS Setting, Volts DC</th>
<th>24 Volt HVS Setting, Volts DC</th>
<th>12 Volt HVS Setting, Volts DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>61.0</td>
<td>30.5</td>
<td>15.25</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>60.5</td>
<td>30.0</td>
<td>15.00</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>60.0</td>
<td>29.5</td>
<td>14.75</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>59.5</td>
<td>29.0</td>
<td>14.50</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>59.0</td>
<td>28.5</td>
<td>14.25</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>58.5</td>
<td>28.0</td>
<td>14.00</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>58.0</td>
<td>27.5</td>
<td>13.75</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>57.5</td>
<td>27.0</td>
<td>13.50</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>57.0</td>
<td>26.5</td>
<td>13.25</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>56.5</td>
<td>26.0</td>
<td>13.00</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>56.0</td>
<td>25.5</td>
<td>12.75</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>55.5</td>
<td>25.0</td>
<td>12.50</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>55.0</td>
<td>24.5</td>
<td>12.25</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>54.5</td>
<td>24.0</td>
<td>12.00</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>54.0</td>
<td>23.5</td>
<td>11.75</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>53.5</td>
<td>23.0</td>
<td>11.50</td>
</tr>
</tbody>
</table>

A backup HVS circuit is built into every rectifier module to ensure that the output does not go high. Factory preset values are 62.0 VDC ±2.0 VDC for the 48 volt rectifier modules, 31.0 VDC ±2.0 VDC for the 24 volt rectifier modules, and 15.5 VDC ±1.0 VDC for 12 volt rectifier.
INTRODUCTION. This section contains information for the start-up, normal operation and shutdown of the TwinPack Plus®-CE power shelf. Prior to performing any of the operating procedures, verify that the equipment is properly installed and that the input/output wiring is terminated as specified in the Installation Section of this manual.

The following tools and test equipment are required to perform the start-up procedure.

2. Potentiometer adjustment tool (GC Electronics model 8727 or equivalent).
3. Precision digital voltmeter (+1% accuracy or better).

Figure 4 provides a front view of the TwinPack Plus®-CE and depicts the various controls and indicators. Table 3 provides detailed descriptions of the controls and indicators, their operation and function.

Table 3. Controls and Indicators.

<table>
<thead>
<tr>
<th>Type of Control/Indicator</th>
<th>Markings</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rocker Switch</td>
<td>POWER ON/OFF</td>
<td>Provides manual ON/OFF switching for the rectifier and also serves as manual reset for high voltage shutdown latch off.</td>
</tr>
<tr>
<td>Rocker Switch</td>
<td>FL/NL TEST (Full Load/No Load Test)</td>
<td>Used to force the rectifier into a full load (FL) or no load (NL) condition by raising or lowering output by one (1) volt.</td>
</tr>
<tr>
<td>Green LED</td>
<td>RECT OK (Rectifier OK)</td>
<td>Illuminates during normal operation.</td>
</tr>
<tr>
<td>Green LED</td>
<td>AC OK</td>
<td>Illuminates to indicate that AC power is received by the rectifier.</td>
</tr>
<tr>
<td>Yellow LED</td>
<td>OPEN RS (Open Remote Sense)</td>
<td>Illuminates if one of the remote sensing leads becomes disconnected.</td>
</tr>
<tr>
<td>Red LED</td>
<td>FAN FAIL (Fan Failure)</td>
<td>Illuminates if the rectifier’s cooling fan fails.</td>
</tr>
<tr>
<td>Red LED</td>
<td>RECT FAIL ALM (Rectifier Failure Alarm)</td>
<td>Illuminates if the rectifier module fails.</td>
</tr>
<tr>
<td>Red LED</td>
<td>OPEN DC BRKR (Open DC Breaker)</td>
<td>Illuminates if the DC output circuit breaker is in the OFF position.</td>
</tr>
</tbody>
</table>
## OPERATION

Table 3. Controls and Indicators (continued).

<table>
<thead>
<tr>
<th>Type of Control/Indicator</th>
<th>Markings</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red LED</td>
<td>HIGH TEMP SD (High Temperature Shutdown)</td>
<td>Illuminates if the rectifier shuts down due to the temperature of the monitored semiconductor’s heatsink within the rectifier reaching 120°C (248°F).</td>
</tr>
<tr>
<td>Red LED</td>
<td>HIGH VOLT SD (High Voltage Shutdown)</td>
<td>Illuminates if the rectifier shuts down due to a high output voltage condition</td>
</tr>
<tr>
<td>Green LEDs (Column of 10)</td>
<td>OUTPUT CURRENT 100% - 10% (LED-type Ammeter)</td>
<td>From 1 to 10 LEDs illuminate to indicate the percentage of current being output. Each successive LED represents 10% additional.</td>
</tr>
<tr>
<td>Yellow LED &amp; Potentiometer</td>
<td>EQUALIZE/VOLT ADJ. (Equalize voltage indicator and adjustment point)</td>
<td>LED illuminates when rectifier is in the “equalize” mode of operation. Potentiometer allows adjustment of “equalize” voltage setting.</td>
</tr>
<tr>
<td>Green LED &amp; Potentiometer</td>
<td>FLOAT/VOLT ADJ. (Float voltage indicator and adjustment point)</td>
<td>LED illuminates when rectifier is in the “float” mode of operation. Potentiometer allows adjustment of “float” voltage setting.</td>
</tr>
<tr>
<td>Test Jacks</td>
<td>RECTIFIER VOLTAGE +/-</td>
<td>Connection points for a precision external digital voltmeter to measure/set the rectifier’s output voltage.</td>
</tr>
<tr>
<td>Test Jacks</td>
<td>REMOTE SENSE VOLTAGE +/-</td>
<td>Connection points for a precision external digital voltmeter to measure voltage on the remote sense leads.</td>
</tr>
<tr>
<td>Six-Position DIP Switch</td>
<td>Position 1: EQ/FL (Equalize/Float)</td>
<td>Used to toggle between EQUALIZE and FLOAT operating modes.</td>
</tr>
<tr>
<td></td>
<td>Position 2: LOAD SHARE ENABLE/DISABLE</td>
<td>Used to ENABLE or DISABLE load sharing between rectifiers in the same mounting shelf.</td>
</tr>
<tr>
<td></td>
<td>Positions 3, 4, 5 &amp; 6: HVS (High Voltage Shutdown)</td>
<td>Used to set or adjust the high voltage shutdown circuit.</td>
</tr>
</tbody>
</table>

### OPERATION.

1. **Startup.** Start only one rectifier module at a time. Use a 7/16” or 11 millimeter socket to make sure the rectifier is fully seated in the shelf.

   **At the power shelf.** Make sure the ON/OFF switch and the DC output circuit breaker on the front of each rectifier module is OFF. Also observe that the green LED (labeled AC OK) on the front of each rectifier module is illuminated. Using the DIP switch on the front of the rectifier module, set the HVS setting to the desired voltage, set the rectifier for FLOAT, and DISABLE the load sharing circuit.

   Turn the ON/OFF switch to the ON position. This turns on the DC section of the rectifier. Keep the DC circuit breaker in the OFF position. All voltage settings can be made before the unit is supplying power to the load.
OPERATION

Observe that the green LED labeled FLOAT is illuminated and that the red LED labeled OPEN DC BREAKER is illuminated.

Adjust the FLOAT voltage to the desired level. Using the test jacks labeled RECTIFIER VOLTAGE, plug the positive (+) lead of the digital voltmeter into the positive (+) test jack and the negative (-) lead into the negative (-) test jack on the front of rectifier 1. This measures the output voltage before the circuit breaker. While monitoring the voltmeter reading, use the potentiometer adjustment tool to slowly turn the FLOAT potentiometer to the desired setting. Clockwise rotation of the potentiometer raises voltage; counterclockwise rotation decreases voltage.

With the external voltmeter still in place, move slide number one of the DIP switch to the “1” or UP position. The EQUALIZE yellow LED will illuminate. While monitoring the voltmeter reading, use the potentiometer adjustment tool to slowly turn the EQUALIZE potentiometer to the desired setting. Clockwise rotation of the potentiometer raises voltage; counterclockwise rotation decreases voltage. Return slide number one of the DIP switch to the “0” or DOWN (FLOAT) position.

Turn the DC circuit breaker ON. Observe that the green LED labeled RECT OK is illuminated and the LED ammeter is working. (The red LED labeled OPEN DC BREAKER is now extinguished.) Plug the digital voltmeter into the Remote Sense test jacks and verify that the desired voltage is present.

Enable the forced paralleling circuit of the rectifier by moving slide number 2 of the front-mounted DIP switch to the “1” or ON (ENABLE) position.

Turn OFF the rectifier’s DC output circuit breaker and its POWER ON/OFF rocker switch.

This completes the startup procedure. Repeat the preceding steps for all other rectifiers.

NORMAL OPERATION.

During normal operation, the condition of controls and indicators on each rectifier module are as follows:

- AC OK green LED Illuminated
- Rectifier ON/OFF rocker switch ON
- RECT OK green LED Illuminated
- OUTPUT CURRENT Ammeter 1 to 10 green LEDS Illuminated
- FLOAT green or EQUALIZE yellow LED Illuminated
- RECT FAIL ALM red LED Extinguished
- HIGH VOLT SD red LED Extinguished
- HIGH TEMP SD red LED Extinguished
- OPEN DC BRKR red LED Extinguished
- OPEN RS red LED Extinguished

Shutdown. Shut down or turn off the TwinPack Plus® CE power shelf one rectifier module at a time. Place the DC output circuit breaker in the OFF position and place the ON/OFF toggle switch in the OFF position. Repeat for each rectifier module.

ADDING, REMOVING OR REPLACING RECTIFIER MODULES

Rectifier modules can be added, removed or replaced while the shelf is operating. It is not necessary to shut down the entire shelf or system to add, remove or replace rectifier modules.

Add A Module.

Place the ON/OFF switch of the rectifier module to be added in the OFF position. (Its DC output circuit breaker is automatically in the OFF position.) Place the rectifier in the FLOAT mode by moving slide 1 of the front-mounted DIP switch in the “0” or DISABLE (down) position. Determine the desired High Voltage Shutdown setting and, referring to Table 2, move slides 3 through 6 of the front-mounted DIP switch to the appropriate positions.
OPERATION

Set the module into the first available space (from the left) and slide back into position. Using a 7/16” or 11 millimeter nut driver or socket wrench, turn the bolt head at the bottom front of the rectifier module clockwise until it stops. This drives the module’s engaging mechanism that seats the blind-mate connectors and secures the module in place. NOTE: An AC pre-charge circuit limits current inrush during mating of the AC input connectors.

NOTE: Observe that the green LED labeled AC OK on the rectifier module is illuminated. If it is extinguished, open the wiring compartment cover at the rear and make sure that AC input wiring is connected to the terminals of the terminal block for the rectifier. If wires are connected, turn ON the AC circuit breaker at the AC distribution panel. If wires are not connected to these terminals, it will be necessary to bring another set of AC leads to the shelf from the AC distribution panel.

Once the rectifier module is mounted on the shelf, follow the startup procedure.

Remove and Replace a Rectifier Module.

Remove a Module. Place the specific rectifier’s DC output circuit breaker in the OFF position and place the rectifier’s ON/OFF switch in the OFF position. Allow the rectifier to set idle for one minute before proceeding. This allows capacitors within the rectifier to discharge. Using a 7/16” or 11 millimeter nut driver or socket wrench, turn the bolt head at the bottom front of the rectifier module counterclockwise until it stops. This completely disengages the module’s engaging mechanism and disconnects the blind-mate connectors. Slide the rectifier module forward out of the shelf.

Replace a Module. See “Add a Module” above.

NOTE: It is not necessary to shut down the entire shelf to swap the failed module for a new one. Simply follow the above removal procedure to remove the failed module and then follow the procedure for adding a module to install a new one.

MAINTENANCE

Periodic. Twice a year open the wiring compartment at the rear of the shelf and tighten all the screws in the terminal blocks.
WARRANTIES

POWER CONVERSION PRODUCTS, LLC

WARRANTY IS ONE YEAR ON LABOR AND THREE FULL YEARS ON PARTS.

One Year Full Warranty

Power Conversion Products, LLC warrants to the customer for a period of one year from date of shipment (unless otherwise indicated) that Power Conversion Products, LLC goods will be free from defects of material and workmanship at the time of shipment and will be in accordance with specifications which are made a part of the sales contract by reference thereto. Power Conversion Products, LLC’s sole obligation under this warranty is limited to either repairing or replacing defective goods or refunding the purchase price for such goods, at Power Conversion Products, LLC's sole option, and the customer’s sole and exclusive remedy under this warranty will be limited to said repair, replacement or refund.

This warranty (a) extends only to, and is intended for the benefit only of, customer (original purchaser), and does not obligate, and shall not be construed to obligate, Power Conversion Products, LLC to any person or organization other than customer; (b) is effective only when the customer returns such defective part or parts to Power Conversion Products, LLC factory, transportation prepaid, immediately upon customer’s discovery of the defect in question; (c) is not effective when the part or product in question is or has been operated beyond rated capacity, used or applied negligently or improperly, or used with parts which are not made or recommended by Power Conversion Products, LLC; and (d) does not render Power Conversion Products, LLC liable for any claim or claims for damages which may result, either directly or indirectly, from any defect in any part or parts manufactured by Power Conversion Products, LLC, including consequential damages.

In lieu of returning the defective part or parts to Power Conversion Products, LLC factory as specified in subparagraph (b) above, the customer may request Power Conversion Products, LLC to make necessary repairs on site when, in the sole discretion of Power Conversion Products, LLC, such repairs on site are practicable. Labor shall be billed to the customer at one-half the service rate in effect at the time, and the customer shall reimburse Power Conversion Products, LLC for all travel and living expenses incurred by Power Conversion Products, LLC in connection with an on-site repair, in accordance with current rates (please see Bulletin 717, Revision K or later).

Three Year Limited Warranty

In addition to the One Year Full Warranty described above, Power Conversion Products, LLC further warrants that any parts, except lamps and fuses, found defective in the second and third year following date of shipment, will either be repaired or replaced, at Power Conversion Products, LLC's sole option, at no charge to the customer, subject to the following limitation.

Power Conversion Products, LLC's sole obligation under this extended warranty is limited to repairing or replacing the defective part or parts. If the customer requests on-site repair of a defective part, or installation of a replacement part by Power Conversion Products, LLC, labor will be billed to the customer at service rates in effect at the time.

The foregoing One Year Full Warranty and Three Year Limited Warranty do not extend to goods subjected to misuse, neglect, accident or improper installation or maintenance, or which have been altered or repaired by anyone other than Power Conversion Products or its authorized representative.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, AND OF ANY OTHER TYPE, WHETHER EXPRESS OR IMPLIED. THESE WARRANTIES APPLY ONLY IN THE CONTINENTAL UNITED STATES.

Factory Service

Trained factory personnel are available for service, installation, and maintenance in connection with equipment manufactured by Power Conversion Products, LLC and in some cases, for work on related equipment. Service is normally available on 48 hours notice, but every effort will be made to provide immediate attention for emergency situations customer service assistance. The Helpline is answered 24 hours a day, seven days a week, and 365 days a year. The 800 number is conveniently displayed on all our power equipment. To help us respond quickly to your service needs, please have the equipment’s part number, serial number, and model number available when you call. The 24-Hour International Service Helpline is +1-815-479-0682.

Field Service Rates: All rates are portal to portal and are based on a minimum of 5 hours, not including transit time and living expenses. Please see Bulletin 717, Revision K or later.

Toll-Free 24-Hour Domestic PCP Service Helpline (800) 435-4872. PCP’s 24-hour Helpline is available exclusively for customer service assistance. The Helpline is answered 24 hours a day, seven days a week, and 365 days a year. The 800 number is conveniently displayed on all our power equipment. To help us respond quickly to your service needs, please have the equipment’s part number, serial number, and model number available when you call. The 24-Hour International Service Helpline is +1-815-479-0682.
# SPARE PARTS ORDER FORM

**Date**

**Note:** Spares ordered at time of equipment order receive a 10% discount.

**Company:**

**P.O. No.:**

**Name:**

**Telephone:**

**Fax:**

**Equipment**

**Model Number:**

**Serial Number:**

<table>
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<tr>
<th>Qty.</th>
<th>Part Number</th>
<th>Description</th>
<th>Unit Price</th>
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Standard Delivery - Stock to 6 Weeks.
Transformers, Chokes, and Reactors - 8 to 12 weeks.
Special Circuit Breakers - 18 to 30 Weeks.
ExpEDITed Service Available Upon Request.

**Requested Ship Date:**

**Bill To:**

**Ship To:**

**Ship Via:**

- [ ] Best Way  
- [ ] Air
SERVICE INFORMATION

Trained Service Engineers are available 24 hours a day, seven days a week, 365 days a year on our toll-free service Helpline (800) 435-4872.

In Canada and elsewhere outside the U.S.A., please call 1-815-479-0682.

To help us respond quickly to your service needs, please have the following information available when you call:

Part Number: __________________________________________________

Serial Number: __________________________________________________

Model Number: __________________________________________________