



**OPERATING MANUAL  
RADIANT SERIES  
RPCG, RPCM , RPCP & RPCQ  
RECTIFIERS AND SHELVES**

**[www.unipowertelecom.com](http://www.unipowertelecom.com)**

**Manual No. RAD-0409-2**  
Radian-ManRevC-04-20-09.indd

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## OPERATING MANUAL

### RADIAN SERIES RECTIFIERS AND SHELVES

#### 1.0 INTRODUCTION

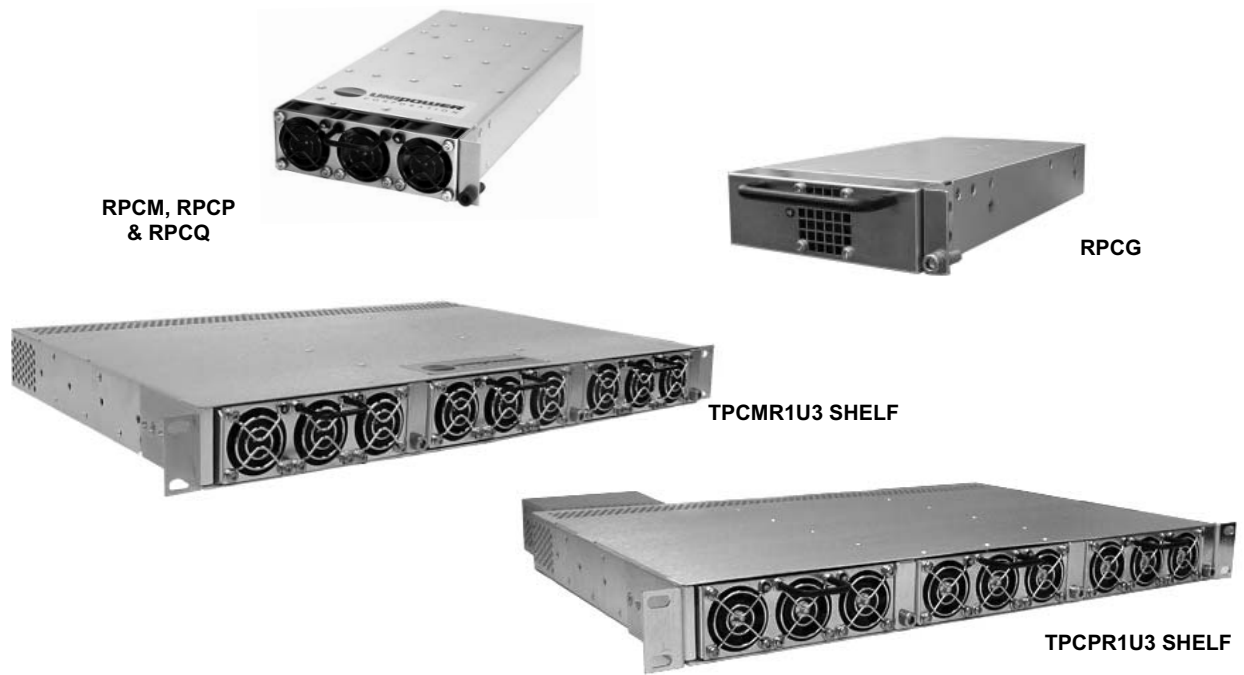
This operating manual should be read through carefully before installing and operating the Radian Series RPCG, RPCM, RPCP and RPCQ rectifiers. The Safety Warnings in Section 4 should be read carefully.

The Radian Series rectifier modules and shelves operate as complete hot-swap power systems for charging a 48V, 24V or 12V lead-acid battery or directly powering a load. See Figure 1. Each rectifier module produces up to 25 amperes at 54.4VDC (48V version), 33 amperes at 27.2VDC (24V version) or 50 amperes at 13.6VDC (12V version). The 48V versions are factory set to 54.4VDC output, the 24V versions are factory set to 27.2VDC and the 12V versions are factory set to 13.6VDC. Three rectifiers in a 19-inch shelf can produce up to 75A at 54.4VDC, 99A at 27.2VDC or 150A at 13.6VDC. The rectifiers have single-wire active load sharing for automatic paralleling and output ORing diodes which permit hot-swap addition or replacement of modules while the power system is operating. A shelf with rectifier modules can also be operated as an N+1 redundant power system with hot-swap, no-downtime replacement of a faulty module.

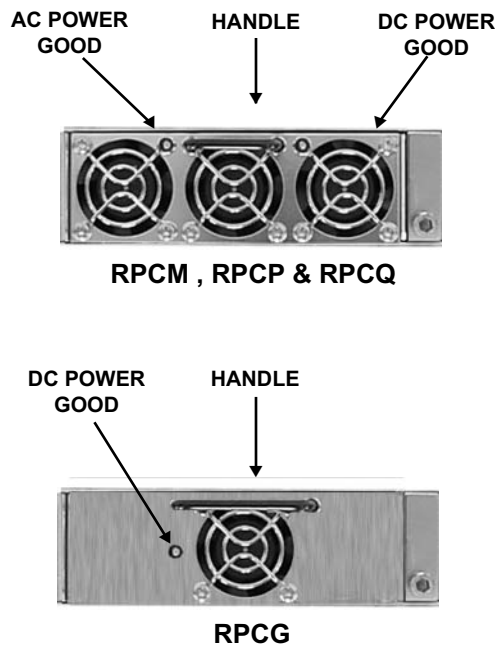
These power systems operate worldwide with an 85 to 264VAC (180 to 264VAC for RPCQ) input range at 47 to 63Hz and a separate AC input connection to each rectifier module. The modules have input power factor correction and Class B EMI input filters. The output voltage is tightly regulated and precisely adjustable over a range of 44 to 58VDC, 22 to 29VDC or 11 to 14.5VDC by means of an external control voltage. Using an external power controller such as UNIPOWER Telecom's PCM500 in conjunction with this input permits automatic battery voltage control of equalize and float voltages together with temperature-compensated charging. The rectifiers can operate into a zero-voltage (dead) battery or short circuit without harm to the system. The output overload characteristic is a constant current output at 105% of rated output current. The output is floating with respect to frame or AC grounds.

A 25-pin interface subminiature D connector on the backplane of the shelf furnishes control and monitoring inputs and outputs. An inhibit input turns the entire shelf output off or on. Remote sensing connections provide precise regulation at the battery or other point of load. Other control signals are AC good and DC good logic outputs, and analog voltage remote adjust inputs - - all for each individual rectifier module.

Front-panel green LEDs indicate AC power good and DC power good for each rectifier module. The rectifier modules and shelves are safety agency certified and CE marked.



**Figure 1. Radian Rectifier Modules and Shelves**



**Figure 2. Front Panel of Radian Rectifier Modules**

## 2.0 FEATURES

The following is a summary of the important features of the Ranger rectifier modules and shelves:

- ◆ Charges Batteries or Powers Loads Directly
- ◆ Constant Output Voltage
- ◆ Remote Output Voltage Adjustment
- ◆ Wide Range Output Voltage Adjustment
- ◆ Output Overload Protected
- ◆ 48, 24 and 12VDC Versions
- ◆ I2C Serial Data Option
- ◆ Low Profile: One RU (1.72 inches or 44mm) High
- ◆ 19 -Inch Compatible Shelves
- ◆ Shelf Capacity Up to 3 Rectifier Modules
- ◆ High Power Density: Up to 13.6 Watts/Cubic Inch
- ◆ 82-87% Efficiency
- ◆ 0.99 Power Factor
- ◆ Class B EMI Input Filter
- ◆ AC Input: 85-264 (180-264 for RPCQ)
- ◆ Battery Temp. Compensated Charge Regulation\*
- ◆ Remote Sensing
- ◆ Active, Single-Wire Load Sharing
- ◆ Integral ORing Diodes
- ◆ Hot-Swappable Rectifier Modules
- ◆ Redundant or Non-Redundant Operation
- ◆ LED Operating Indicators
- ◆ Control and Monitoring Interface Signals

\* With external power controller

## 3.0 PRODUCT LINE

### 3.1 Ranger Rectifier Modules

MODEL	NOMINAL OUTPUT	FACTORY SET OUTPUT	MAX. OUTPUT CURRENT
RPCQ48/25	48VDC	54.4V	25A
RPCP48/22	48VDC	54.4V	22A
RPCP24/33	24VDC	27.2V	33A
RPCP12/50	12VDC	13.6V	50A
RPCM48/15	48VDC	54.4V	15A
RPCM24/25	24VDC	27.2V	25A
RPCM12/45	12VDC	13.6V	45A
RPCG48/8	48VDC	54.4V	8A
RPCG24/15	24VDC	27.2V	15A
RPCG12/27	12VDC	13.6V	27A

### 3.2 19-Inch Shelves

MODEL	HEIGHT	DEPTH	RECTIFIER MODULES	AC CONN.
TPCMR1U3	1U (1.72")	11.56"	3 RPCM/RPCG	C14
TPCPR1U3A	1U (1.72")	12.66"	3 RPCP	Term. Blk.
TPCPR1U3B	1U (1.72")	13.15"	3 RPCP	C20
TPCPR1U3C	1U (1.72")	14.88"	3 RPCP	C20

### 3.3 Option

CODEL	DESCRIPTION
Z	I2C Serial Data Bus

**NOTE:** Add Option Code as suffix to both module and shelf model number.  
Can only be specified when rectifiers are to be used within UNIPOWER Telecom X100 systems or in conjunction with UNIPOWER Telecom DSC1000 digital system controller.

## 4.0 SAFETY WARNINGS

- 4.1** These rectifier modules and shelves have hazardous external and internal voltages. They should be handled, tested and installed only by qualified technical persons who are trained in the use of power systems and are well aware of the hazards involved.
- 4.2** The input terminals are at hazardous voltage potentials. Do not touch this area when power is applied.
- 4.3** When operating this rectifier system, the frame ground terminal must be connected to safety ground by means of a three-wire AC power line to minimize electrical shock hazard and to ensure low EMI (electromagnetic interference).
- 4.4** The internal voltages are at hazardous potentials. The rectifier module covers should not be removed. There are no user-serviceable components in these units. Removing the covers of the rectifier modules will void the warranty.

## 5.0 WARRANTY

All products of UNIPOWER Telecom, a division of UNIPOWER Corporation, are warranted for two (2) years from date of shipment against defects in material and workmanship. This warranty does not extend to products which have been opened, altered or repaired by persons other than persons authorized by the manufacturer or to products which become defective due to acts of God, negligence or the failure of customer to fully follow instructions with respect to installation, application or maintenance. This warranty is extended directly by the manufacturer to the buyer and is the sole warranty applicable. EXCEPT FOR THE FOREGOING EXPRESS WARRANTY, THE MANUFACTURER MAKES NO WARRANTY, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

As the sole and exclusive remedy under this warranty, the manufacturer, at its option, may repair or replace the non-conforming product or issue credit, provided the manufacturer's inspection establishes the existence of a defect. To exercise this remedy, the buyer must contact the manufacturer's Customer Service Department to obtain a Return Material Authorization number and shipping instructions. Products returned without prior authorization will be returned to buyer. All products returned for repair must be shipped freight prepaid to UNIPOWER. If the buyer fails to fully comply with the foregoing, the buyer agrees that no other remedy (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property or any other incidental or consequential losses) shall be available to the buyer.

## **6.0 UNPACKING AND INSPECTION**

- 6.1** This Radian Series Rectifier System was carefully tested, inspected and packaged for shipment from our factory. Upon receipt of the unit it should be carefully unpacked and inspected for any damage in shipment.
- 6.2** If there is evidence of damage, do not attempt to test the unit. The freight carrier should be notified immediately and a claim for the cost of the rectifier system should be filed with the carrier for direct reimbursement. Be sure to include the model and serial number of the damaged unit in all correspondence with the freight carrier. Also save the shipping carton and packing material as evidence of damage for the freight carrier's inspection.
- 6.3** UNIPOWER Telecom will cooperate fully in case of any shipping damage investigation.
- 6.4** Always save the packing materials for later use in shipping the unit. Never ship the rectifier system without proper packing.

## **7.0 FRONT PANEL DESCRIPTION**

The front panels of Radian RPCG, RPCM , RPCP and RPCQ rectifier modules are shown in Figure 2. At the top left of the RPCM , RPCP and RPCQ is the AC Good LED (green) and at the top right is the DC Good LED (green). Three 40mm fans cool the module. The RPCG module has a DC Good LED (green) to the left of a single 38mm fan.

## 8.0 RECTIFIER MODULE SPECIFICATIONS

Specifications for a Single Rectifier Module. Typical at 120 or 230VAC Line, Full Load and 25°C Unless Otherwise Noted (RPCG/RPCM/RPCP/RPCQ).

### INPUT

Voltage Range .....	85-264VAC (180-264VAC for RPCQ)
Power Factor .....	0.99
Total Harmonic Distortion, Max. ....	5%
Frequency .....	47-63Hz
Inrush Current Limiting .....	50A Peak
Input Current, Full Load .....	4.2/8.1/11.9A@120VAC
.....	2.2/4.2/6.2A@230VAC
EMI Filter, Conducted .....	FCC20780 pt. 15J Curve B
.....	EN55022 Curve B
Fast Transients, Line-Line .....	EN61000-4-4, Level 3
Surges .....	EN61000-4-5
Analog Voltage Adjust .....	0 to +5V

### OUTPUT

Current & Voltage1, 48V Nominal .....	8/15/22/25A@54.4VDC
24V Nominal .....	15/25/33A@27.2VDC
12V Nominal .....	27/45/50A@13.6VDC
Voltage Adjustment Range, 48V Nominal .....	44-58VDC
24V Nominal.....	22-29VDC
12V Nominal.....	11-14.5VDC
Total Regulation, Max. ....	2.0%
Holdup Time .....	20msec.
Overvoltage Protection, 48V Out .....	59V
24V Out .....	29V
12V Out .....	15V
Filtering: Wideband Noise, 20MHz BW	
48V Out, P-P .....	500mV
24V Out, P-P .....	250mV
12V Out, P-P .....	125mV
Voice Band Noise .....	<32dBmC
Current Limit .....	105% Rated Current
Efficiency .....	82-87%

**SAFETY STANDARDS** .....UL60950-1, CSA22.2 No. 60950-1, EN60950-1

### STATUS INDICATORS

AC Good (LED Not on RPCG) .....	Green LED and Logic LO Output
DC Good .....	Green LED and Logic LO Output

### ENVIRONMENTAL

Operating Temp. Range .....	0°C to +70°C
Output Current Derating .....	2.5%/°C, 50°C to 70°C
Storage Temp. Range .....	-40°C to + 85°C
Humidity .....	0% to 95%, Non-Condensing
ESD .....	Bellcore GR-1089-Core and EN61000-4-2
Cooling .....	DC Ball Bearing Fan

### PHYSICAL SPECIFICATIONS

Case Material, Module .....	Aluminum
Shelf .....	Aluminum
Dimensions, Inches (mm)	
Rectifier Module .....	1.60 H x 5.00 W x 10.00 D
.....	(41 x 127 x 254)
19" Shelf, TPCMR1U3 .....	1.72 H x 19.00 W x 11.56 D
.....	(44 x 483 x 294)
Weight	
Rectifier Module .....	3.15 lbs (1.43 kg.)
19" Shelf .....	5.15 lbs (2.33 kg.)

**NOTE:** 1. Voltage set at factory.

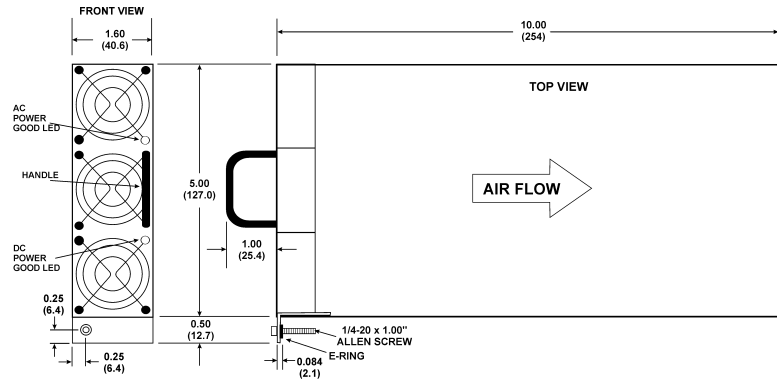
**9.0 DESCRIPTION OF FEATURES & OPTIONS**

FEATURE/OPTION	DESCRIPTION
<b>Power Factor Correction</b>	The input current is a sine wave in-phase with the input voltage to give a power factor of 0.99. Input current total harmonic distortion is less than 5%.
<b>Wide Range AC Input</b>	The AC input range is continuous from 85 to 264VAC, 47-63Hz for worldwide operation (180 to 264VAC for RPCQ).
<b>EMI Input Filter</b>	This filter suppresses conducted noise from the rectifier module back onto the AC line. The filter meets FCC20780 part 15J Curve B and EN55022 Curve B.
<b>Inrush Current Limiting</b>	When the rectifier module is turned on, the initial input current is limited to a peak value of 50 amperes.
<b>Output Voltage Adjustment Range</b>	For a 48V unit the adjustment range is 44V to 58V. Factory voltage setting is 54.4VDC. For a 24V model the adjustment range is 22V to 29V. Factory voltage setting is 27.2VDC. For a 12V unit the adjustment range is 11-14.5V. Factory voltage setting is 13.6VDC. The adjustment is made from the input to the remote adjust terminal.
<b>Remote Output Adjust</b>	This input is used to remotely adjust each rectifier output voltage. An analog voltage from 0 to +5V controls approximately 44-58V output for a 48V rectifier, 22-29V output for a 24V rectifier or 11-14.5V output for a 12V rectifier. This input can be controlled externally by a power control system to precisely control battery charging. The module analog inputs can be connected together so that the external control voltage adjusts all the module outputs simultaneously.
<b>Thermal Protection</b>	If the rectifier module overheats internally, it will automatically shut down. The DC Power Good LED turns off, the DC Power Good signal goes HI and the Overtemperature Warning signal goes HI.
<b>Current Sharing</b>	The Radian rectifier modules are automatically connected to current share with each other when they are inserted into the shelf. A single-wire connection provides this. The modules current share with an accuracy of 10% of their full load output current for total loads of 50% to 100%. The shelf current share pin can be used to current share with another shelf of the same output voltage.

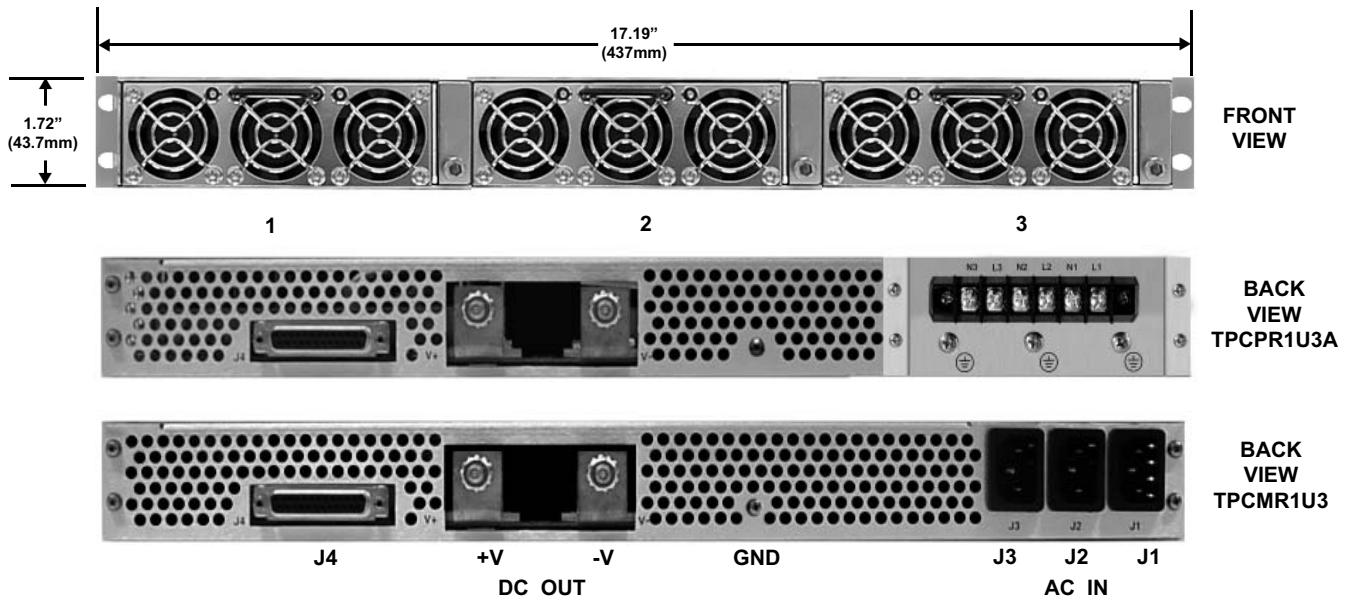
FEATURE/OPTION	DESCRIPTION
<b>ORing Diodes</b>	This diode in series with each module output protects the parallel-connected modules. If the output of one module fails to a short or to a lower than normal output voltage, the other modules are not affected. Also when hot-swapping modules, the diode prevents a glitch in the output voltage while the output is still rising on the inserted module. The 5V 250mA standby output also has an ORing diode.
<b>Overvoltage Protection</b>	The output is protected from overvoltage due to fault conditions in the module. Overvoltage protection is set at approximately 59V for the 48V version, 29V for the 24V version and 15V for the 12V version. The result is a latched shutdown of the rectifier module. It is reset by cycling the AC input off and then back on.
<b>No Load Operation</b>	The module output can be operated down to zero load while maintaining output regulation.
<b>Hot Swap Operation</b>	Hot swap operation means that the rectifier modules can be removed and replaced while the shelf is powering the load. If the shelf is operated in an N+1 redundant mode, hot-swap replacement will not affect the output voltage.
<b>Output Protection</b>	Output current limiting protects the output of each rectifier module from damage due to a dead battery or other short circuit condition. This protection is continuous, without damage, and recovery is automatic when the overload is removed. Current limiting begins at about 105% of rated output current.
<b>LED Indicators</b>	The AC Power Good indicator (not on the RPCG modules) is a green LED, showing that input AC is present and that the PFC converter and internal control supply are operating. The DC Power Good indicator is a green LED showing that the output voltage is present and within operating range.
<b>Control and Monitoring Signals</b>	For a detailed description of Inhibit, Current Share, Remote Sense, Remote Adjust, AC Power Good and DC Power Good signals, see Section 17, Description of Control and Supervisory Signals..

## 10.0 MECHANICAL SPECIFICATIONS

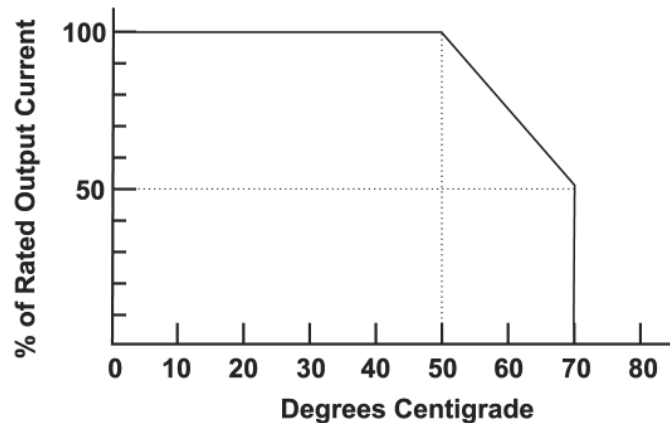
The mechanical dimensions of the Radian Series rectifier modules are shown in Figure 3. The front and back views of two of the shelves are shown in Figure 4.



**Figure 3. Radian Series Module Mechanical Dimensions.**



**Figure 4. Front and Back of Two Radian Series Shelves**



**Figure 5. Rated Output Current vs. Ambient Temperature**

## 11.0 SAFETY AND INDUSTRY STANDARDS

11.1 The Radian rectifiers and shelves meet the following safety standards:

UL60950-1  
CSA22.2 No. 60950-1  
EN60950-1

11.2 The Radian rectifier modules and shelves are CE marked to indicate conformance to the European Union's Low Voltage Directive.

11.3 Input conducted EMI meets FCC20780 part 15J Curve B and EN55022 Curve B.

11.4 Input fast transient specifications meet EN61000-4-4 Level 3; input surges, line-to-line, meet EN61000-4-5 Level 2; and input surges, line-to-ground, meet EN61000-4-5 Level 3.

## 12.0 OPERATING INFORMATION

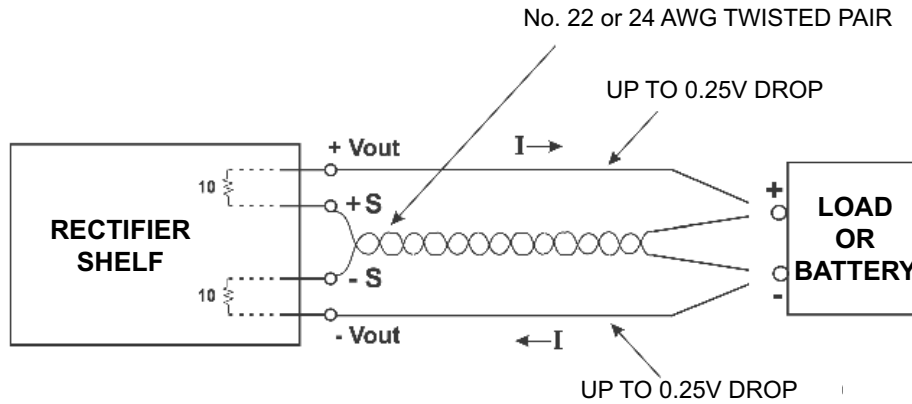
12.1 **Input Voltage.** The Radian Series rectifiers operate off AC input voltages within the range of 85 to 264VAC (180 to 264VAC for RPCQ) at 47 to 63 Hz. There is a separate input connection for each rectifier module at the rear of the shelf. For connection details see Section 18.2 and Figure 10.

12.2 **Output Connection.** The 12V, 24V or 48V output is provided at two copper bus bars. Each bus bar has a no. ¼-20 stud and nut for the output connections. For connection details see Section 18.3 and Figure 10. Both positive and negative outputs are floating and isolated from the chassis.

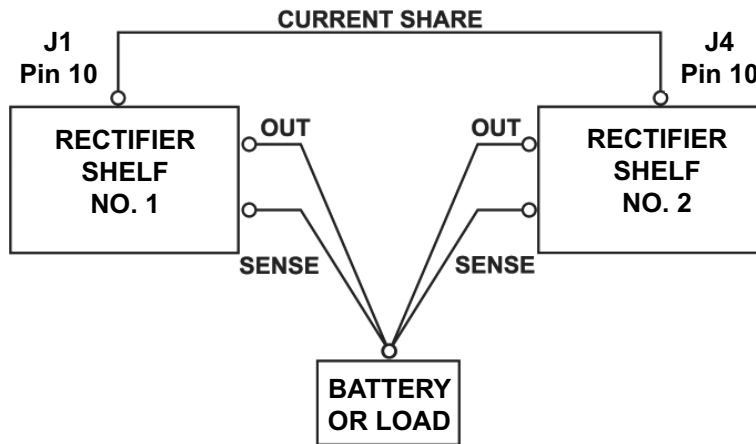
12.3 **Output Voltage.** The output voltage of each rectifier module is factory set to 54.4V for the 48V rectifier, 27.2V for the 24V rectifier and 13.6V for the 12V rectifier. The output voltage can be adjusted to another value by means of the remote adjust input connected to an external voltage source. The adjustment range is 44-58V, 22-29V or 11-14.5V.

12.4 **Output Current.** Maximum output current for the modules is shown in the table of paragraph 3.1. The maximum output power of a module may be drawn at up to 50°C ambient temperature. Above 50°C the output current must be derated by 2.5%/oC. See Fig. 5. The maximum operating temperature is 70°C, at which the output current must be derated by 50%.

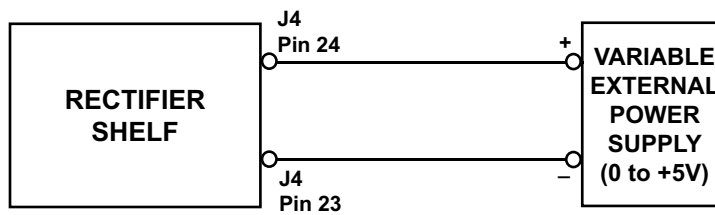
- 12.5 Output Overload Protection.** Each rectifier module output is protected from damage due to overload, a dead battery or another short circuit condition. This protection is continuous and without damage; recovery is automatic when the load is removed. Current limiting takes place at approximately 105% of the rated output current.
- 12.6 Remote Sensing.** Remote sensing connections are made to pins 11 (+Sense) and 23 (-Sense) of the rectifier shelf J4 connector. Remote sensing is used to regulate the output voltage at the point of load, i.e., a battery or other load, by compensating for the voltage drop in the wires to the load. The +Sense lead must be connected to the + side of the load and the -Sense to the - side of the load. The sense leads should be a color-coded, twisted pair of AWG no. 22 or 24 copper wire. See Fig. 6.
- Remote sensing can compensate for a total voltage drop of 0.5V, or 0.25V per load wire. The sense leads should not exceed 10 feet (3 meters) in length. If remote sensing is not required, the sense leads may be left open for local sensing at the output terminals. **Be careful not to reverse the sense lead connections, as this could damage the output.**
- 12.7 Control and Supervisory Signals.** All control and supervisory signals are accessible at J4, a 25-pin subminiature D connector on the back of the rectifier shelf. See Section 17 for a complete description of these input and output signals.
- 12.8 Alarm Signals.** Among the control and supervisory signals are three logic alarms: AC Power Good, DC Power Good and Overtemperature Warning. They are logic signals referenced to -Sense, J4 Pin 23. There are logic alarms for each rectifier module. The first alarm is **AC Power Good**. A logic HI indicates that there is no AC input or that the PFC converter stage has failed. The second alarm is **DC Power Good**. A logic HI indicates a DC output failure. The third alarm is **Overtemperature Warning**. A logic HI indicates the internal air temperature has reached a critical level just prior to the unit shutting down.
- 12.9 I<sup>2</sup>C Serial Data Option.** This data bus provides serial data on the output voltage and current, internal temperature, fan speed, and part number, serial number and date code of the Radian rectifier. It also permits control of the output voltage from the serial data pin. Both the rectifier modules and the shelf must be designated with suffix "Z" for this option. Only available when used with UNIPOWER Telecom X100 or in conjunction with UNIPOWER Telecom DSC1000 digital controller.



**Figure 6. Remote Sensing Connection**



**Figure 7. Parallel Connection of Radian Shelves**



**Figure 8. Checking AC Power Good and DC Power Good Outputs**

### 13.0 PARALLEL OPERATION

The rectifier modules in the shelf are all connected in the parallel, current sharing mode by means of a single-wire current share connection among them. A shelf can be operated in either an N+1 redundant mode or non-redundant mode.

**13.1 Redundant Operation.** From Table 13-1, the 19-inch shelf can be operated in a 2+1 redundant mode. This means that the full load current must be carried by two rectifier modules. While operating normally, the current is shared approximately equally among the three modules. If one module fails, however, the output current is then maintained by the two operating modules. The failed unit can then be replaced without affecting the output current to the load. N+1 redundancy with quick replacement of a failed module results in virtually infinite MTBF.

NOMINAL VOLTS	MODE	NUMBER OF MODULES	MAX. CURRENT			
			RPCG	RPCM	RPCP	RPCQ
48	2+1 Redundant	3	16A	30A	44A	50A
48	Non-Redundant	3	24A	45A	66A	75A
24	2+1 Redundant	3	30A	50A	66A	-
24	Non-Redundant	3	45A	75A	99A	-
12	2+1 Redundant	3	54A	90A	100A	-
12	Non-Redundant	3	81A	135A	150A	-

**143.2 Non-Redundant Operation.** Higher output current can be achieved by operating the shelf in a non-redundant mode as seen in Table 13-1. However, in this case if a rectifier module fails, the load will lose power since only part of the required current can be supplied by the remaining modules, and they will go into current limit. The failed rectifier module, however, can be quickly replaced to restore the load current.

**13.3 Multiple Parallel Shelf Operation.** Multiple shelves can also be operated in parallel by interconnecting their current share terminals (J4 Pin 10). The total power can be expanded by several times. In this case N+1 redundant operation is achieved by reserving one module of the total for redundancy. For example, if two full 19-inch shelves are employed with a total of six rectifier modules, then for 5+1 redundancy the full load must be able to be carried by the output of five modules. In such applications each set of remote sense wires must be separately connected to the battery or point of load. See Figure 7 for a simplified illustration of two rectifier shelves connected in parallel.

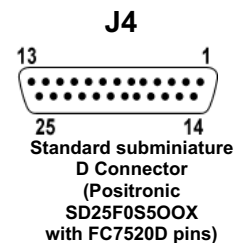
## 14.0 CONTROL & SUPERVISORY SIGNAL CONNECTIONS

**14.1** Connections for control and supervisory signals are made at the shelf rear to connector J4, a standard 25-pin subminiature D connector (Positronics No. SD25F0S5OOX with FC7520D pins). The mating connector is Positronics SD25M00OOZ with MC7520D pins.

**14.2** The pin connections to J4 are shown in the table.

### J4 SIGNAL CONNECTOR

SHELF J4 SIGNAL CONNECTOR			
PIN	FUNCTION	PIN	FUNCTION
1	Inhibit	14	AC Power Good - 1
2	Overtemp. Warning - 1*	15	DC Power Good - 1*
3	Current Monitor - 1*	16	AC Power Good - 2
4	Overtemp. Warning -2*	17	DC Power Good - 2*
5	Current Monitor - 2*	18	AC Power Good - 3
6	Overtemp. Warning - 3*	19	DC Power Good - 3*
7	Current Monitor - 3*	20	Module Present -1
8	+5V Standby	21	Module Present - 2
9	SDA	22	Module Present - 3
10	Current Share	23	- Sense
11	+Sense	24	Remote Adjust - 1
12	Remote Adjust - 2	25	Remote Adjust - 3
13	SCLK		



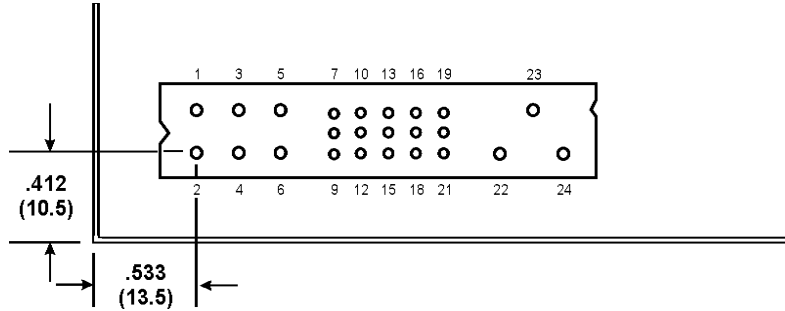
\* These pins are open when I2C option is present.

**NOTE:** Standby return is connected to -Sense lead. Current rating of +5V standby is 250mA. All signals are referenced to -Sense lead.

## 15.0 RECTIFIER MODULE CONNECTIONS

If the rectifier module or modules are used separately from the shelf or in a user-configured shelf, connections should be made to the hot-swap connector or the back of the module with the functions shown in Figure 9. There is a Mating Interface Board available for easy connections to a single rectifier module for testing purposes.

**CONNECTOR:  
POSITRONICS PCIB24W9M400A1  
MATE: PCIB24W9F400A1**



**PIN CONNECTIONS**

PIN	FUNCTION	PIN	FUNCTION
1	+V Out*	13	Module Present
2	+V Out*	14	DC Power Good/ADD GA1*
3	+V Out*	15	AC Power Fail
4	V Return*	16	V Trim
5	V Return*	17	Overtemp. Warning/ADD GA0*
6	V Return*	16	Current Share
7	Enable*	17	Current Monitor/ADD GA2*
8	+ Sense	18	+5V Standby
9	- Sense	19	Standby Return
10	Inhibit	20	Chassis Ground
11	Spare/SDA*	21	AC Line
12	Spare/SCL*	22	AC Neutral

**\*NOTES:** For unit to operate, pin 7 must be at logic LO or shorted to pin 9. For proper operation the following pins must be connected together: All V Out pins (1-3); all V Return pins (4-6). Pins 11, 12, 14, 17 & 19 function as I2C connections when that option is present.

<b>MATING INTERFACE BOARD</b>
Order Part Number 009-3850-0000

**Figure 9. Radian Rectifier Module Pin Connections**

## 16.0 DESCRIPTION OF SHELVES

**16.1** There are four 19-inch compatible shelves for the Radian Series. Each shelf holds three rectifier modules. The TPCMR1U3 shelf is for rectifier modules RPCG and RPCM. The TPCPR1U3 shelf, A, B and C versions, is for RPCP and RPCQ modules. See Figure 10. A summary of these shelves is given in the table following.

**Table 16-1 Radian Compatible Shelves**

SHELF MODEL	REDT. MOD. MODEL	NO. OF MODULES	MAX. CURRENT 48/24/12V	AC INPUT	SHELF DEPTH INCHES (MM)S
TPCMR1U3	RPCG	3	24/45/81A	3 C14 Inlets	11.56 (294)
TPCMR1U3	RPCM	3	45/75/135A	3 C14 Inlets	11.56 (294)
TPCPR1U3A	RPCP/RPCQ	3	75/66/99/150A	Terminal Block	12.66 (322)
TPCPR1U3B	RPCP/RPCQ	3	75/66/99/150A	3 C20 Inlets	13.15 (334)
TPCPR1U3C	RPCP/RPCQ	3	75/66/99/150A	3 C20 Inlets*	14.88 (378)

\*Has AC line filter with each inlet.

**16.2** The Radian shelves have the following features:

- ◆ Standard 19-Inch Mounting
- ◆ Only 1U-High (1.72")
- ◆ Hot-Swap Operation
- ◆ Hold Three Radian Modules
- ◆ Module Outputs are Paralleled
- ◆ Active Current Sharing Between Modules
- ◆ I<sup>2</sup>C Serial Data Bus Option
- ◆ AC Inlet or Terminal Block Inputs
- ◆ Optional 23-Inch Mounting (with brackets)
- ◆ Module Present Signal

Further detailed information is given in Figure 10.



**17.0 DESCRIPTION OF SHELF CONTROL AND SUPERVISORY SIGNALS**

SIGNAL	PIN	DESCRIPTION
Inhibit	1	A logic LO or short to Pin 23 turns off all rectifier modules in the shelf. This input is referenced to -Sense, Pin 23.
Overtemp. Warn. - 1 Overtemp. Warn. - 2 Overtemp. Warn. - 3	2 4 6	A logic HI indicates an overtemperature condition inside the unit. The HI occurs a few milliseconds before the unit shuts down. This signal is referenced to -Sense, Pin 23.
Current Monitor - 1 Current Monitor - 2 Current Monitor - 3	3 5 7	An analog output voltage is proportional to the output current. This signal is referenced to -Sense, Pin 23
+5 Standby Supply	8	This is a +5V 250mA output. It is referenced to the -Sense, Pin 23. This output is not controlled by the inhibit function.
Current Share	10	This is an analog control signal made up of the current share signals of all rectifier modules connected together. This pin is used to connect to Pin 10 of another identical rectifier shelf to share output currents. Output currents between shelves are shared within an accuracy of 10% of full load current over a 50% to 100% load range. This signal is referenced to -Sense, Pin 23.
+ Sense - Sense	11 23	These remote sense leads should be connected as a twisted pair to the respective + and - load points to provide regulation at the point of load. Removal of the sense leads transfers regulation control to the output terminals of the rectifier shelf. The correct polarities must be maintained.
AC Power Good - 1 AC Power Good - 2 AC Power Good - 3	14 16 18	A logic LO indicates the AC input is present and the PFC converter stage has output. A logic HI indicates AC input or PFC converter failure. This signal is referenced to -Sense, Pin 23.
DC Power Good - 1 DC Power Good - 2 DC Power Good - 3	15 17 19	A logic LO indicates that the unit is operating properly with output voltage in its controllable range. A logic HI indicates the output is outside the 44-58V range for a 48V rectifier, outside the 22-29V range for a 24V rectifier or outside the 11-14.5V range for a 12V rectifier, the unit has failed or is in current limit. This signal is referenced to -Sense, Pin 23.

**17.0 DESCRIPTION OF SHELF CONTROL AND SUPERVISORY SIGNALS (cont'd)**

SIGNAL	PIN	DESCRIPTION
Module Present - 1 Module Present - 2 Module Present - 3	20 21 22	A logic LO indicates a module is present; an open indicates a module is absent. This signal is referenced to -Sense, Pin 23.
Remote Adjust - 1 Remote Adjust - 2 Remote Adjust - 3	24 12 25	These are analog voltage inputs to the designated rectifier modules by which the output voltage is adjusted. A zero to + 5V input represents approximately 44 to 58V output for a 48V rectifier module, 22 to 29V for a 24V module or 11 to 14.5V for a 12V module. This input should be driven from a source impedance less than 100 ohms and is referenced to -Sense, Pin 23.
-Sense	23	This is the reference pin for the above logic signals.

## 18.0 INSTALLATION

- 18.1 Mounting.** The Radian Series rectifier shelves are mounted in a rack by means of mounting brackets on each side of the shelves. One set of standard brackets is supplied with each shelf. There are seven different bracket positions on the side of the shelf, from front position to 6 inches from the front. When mounting, the shelf should first be securely mounted to the rack, then the rectifier modules inserted into the shelf. The rectifier modules should be secured by tightening the jack screw on each module.
- 18.2 AC Input Connections.** The AC input connections to the rectifier shelf are shown in Figure 10. As shown, there are separate connections for each rectifier module. The connectors are labeled by rectifier module number.
- 18.3 DC Output Connections.** The DC output connections are shown in Figure 10. The positive and negative output connections are made to the copper bus bars as shown. The left bar is positive and the right one negative. Each bus bar has a no. ¼ - 20 stud with nut. The output wires or bus bars should be sized in accordance with the load current and length of conductor.
- 18.4 Contact Resistance.** Connection to the output bus bars should be clean and tight to minimize contact resistance.
- 18.5 Control and Supervisory Signal Connections.** These connections are made to J4, a subminiature D 25-pin connector (Positronics No. SD25F0S500X), by means of the mating connector. Details for these connections are given in Section 14.
- 18.6 Cooling.** Each rectifier module is cooled by DC ball bearing fan(s). For proper cooling, the area in front of the fan and around the air exits should be kept clear for unimpeded air flow.

## 19.0 MAINTENANCE

No routine maintenance is required on the Radian Series except for periodic cleaning of dust and dirt around the fan(s). A small vacuum nozzle should be used for this.

## 20.0 RECTIFIER AND SHELF SETUP AND TESTING

- 20.1 The rectifier modules and shelf can be initially tested mounted in a rack or on a test bench. The rectifier system is initially tested one rectifier module at a time in the shelf.
- 20.2 Connect a three-wire AC power line to rectifier module no. 1 connector on the back of the shelf. Do not plug the AC line into the 230VAC source yet.
- 20.3 Connect a resistive power load across the DC output terminals. This load can be a DC electronic load that is set to the resistive mode or a high-power resistor that has the proper power capacity and cooling. For this test the load should be between 10% and 50% of the full load rating of the rectifier module.
- 20.4 Connect a color-coded, twisted wire pair (no. 22 or 24 AWG) from the remote sense pins to the load. The +Sense lead (J4 Pin 11) **must go** to the positive side of the load and the - Sense lead (J4 Pin 23) must go to the negative side of the load.
- 20.5 Insert one of the rectifier modules into slot 1 of the shelf (leftmost slot.) Plug the AC power line into a 120 or 230VAC source and measure the voltage across the load at the remote sense points with a digital voltmeter. The voltage should be approximately 54.4V for a 48V rectifier, 27.2V for a 24V rectifier or 13.6V for a 12V rectifier.
- 20.6 **Checking the Front Panel LEDs.** The AC Good (not on RPCG) and DC Good LEDs should both be green.
- 20.7 **Checking the Inhibit Input.** Next, connect a wire going from J4 Pin 1 to Pin 23. The rectifier output should turn off, giving zero volts across the load. The DC Good LED should go off. Disconnect the wire.
- 20.8 **Checking the AC Good and DC Good Outputs.** Measure the output voltage at both J4 Pins 14 and 15 with respect to -Sense (Pin 23) with a digital voltmeter. Both voltages should be less than 0.5VDC, indicating a logic LO.
- 20.9 **Checking the Remote Adjust Input.** Connect a variable external power supply as shown in Figure 8. With its output voltage set to zero, check the output voltage of the rectifier module with a digital voltmeter. For a 48V unit it should be approximately 44V, for a 24V unit it should be approximately 22V

and for a 12V unit it should be approximately 11V. Next, adjust the supply output to +5V and check the output voltage of the rectifier module. For a 48V unit it should be approximately 58V, for a 24V unit it should be approximately 29V and for a 12V unit it should be approximately 14.5V. Unplug the external 5V supply and unplug the AC input to the rectifier shelf. put to the rectifier shelf.

**20.10 Checking the Other Rectifier Modules.** Each rectifier module should be tested in the above manner to verify its operation. Go back to Section 20.5 and proceed through the tests one by one until all rectifier modules have been verified.

**20.11 Checking the Complete Rectifier Shelf.** Confirm that the output voltages of the individual rectifier modules are all set to approximately 54.4, 27.2 or 13.6 volts (for 48V, 24V or 12V rectifier modules respectively). Insert all rectifier modules into the shelf. Connect a power load - - high-power resistor or electronic load in resistive mode -- equal to approximately 150% of a single module maximum load, to the output of the shelf. Connect the + and - Sense leads to + and - sides of the load, respectively, as in Section 20.4.

Note that on the back of the shelf each rectifier module has its own AC power connection. For this test each rectifier module should be connected to a separate 15A, AC circuit. Plug the rectifier shelf into the AC power sources.

Check the load voltage with a digital voltmeter. It should be very close to 54.4, 27.2 or 13.6VDC, depending on the model tested. The AC Power Good (not on RCPG) and DC Power Good LEDs should both be green on each rectifier module.

**20.12** While the shelf is operating, pull Module no. 1 out while monitoring the output voltage with a digital voltmeter. It should remain the same. Insert the module back into the shelf. Repeat this for each of the other modules. This test determines that hot-swapping is functioning properly in the N+1 redundant mode.

**20.13** With all the modules inserted into the shelf, check the Inhibit input for the entire shelf. Connect a wire from J4 Pin 1 to Pin 23. The shelf output should turn off and the output voltage should go to zero. Reconnect the wire. This completes the shelf setup and testing. Unplug the AC power sources.

## 21.0 TROUBLESHOOTING GUIDE

**21.1** If you encounter difficulties in getting the rectifier modules or shelf to operate properly, go through the following troubleshooting guide.

### 21.2 Table 21-1. Radian Rectifier Troubleshooting

SYMPTOM	POSSIBLE CAUSE	ACTION TO TAKE
No output, AC Good and DC Good LEDs off.	No input power.	Check connection to AC source Check AC source circuit breakers.
No output, DC Good LED off, AC Good LED on.	Inhibit in OFF mode.	Make sure J4 Pin 1 (Inhibit) is not connected to Pin 23, -Sense, or to ground.
No output, DC Good LED off, AC Good LED on.	Shorted output.	Check for short and remove.
No output, DC Good LED off, AC Good LED on.	Overvoltage protection (OVP) has latched.	Reset output by cycling the AC input OFF and then back ON.
No output, DC Good LED off, AC Good LED on.	Overtemperature protection is activated on one or more rectifier modules.	Allow module to cool down for about 10 minutes. Check to see if the cooling fans are operating.
Low or no output, DC Good LED off, AC Good LED on.	Output load is too great for the number of rectifier modules.	Reduce load to proper level.

**21.3** If none of the above actions solves the problem, call UNIPOWER Telecom (US) +1-954-346-2442 or UK +44 1903 768200 for help and try to resolve the problem over the telephone.

**DESCRIPTION**

Unipower Telecom's Radian Series are hot-swappable, modular rectifiers which produce up to 1360 watts output. There are 19 different models with different output voltages and power levels. The modules are ultra-compact with power density up to 17 watts per cubic inch. Companion 19-inch shelves hold up to three rectifiers which can also be operated in a 2+1 redundant mode. The modules have automatic load sharing and output ORing diodes so they can be hot-swapped while the system is operating. Module output voltage can be controlled by 0V to +5V analog input.

Green LEDs indicate AC and DC power good. The rectifiers also have control and monitoring features and a +5V standby output. Operating temperature range is -20°C to +70°C.

**FEATURES**

- ◆ 1U- High: 1.72"
- ◆ -20°C to +70°C Operation
- ◆ Wide Range AC Input
- ◆ Up to 1360W Module Output
- ◆ Up to 4080W Shelf Output
- ◆ 0.99 Power Factor
- ◆ Output Voltages: 12 to 54.4VDC
- ◆ 80-87% Efficiency
- ◆ Power Density to 17W/Cu. Inch
- ◆ Hot Swappable
- ◆ Integral ORing Diodes
- ◆ Class B EMI Filter
- ◆ LED Indicators
- ◆ I<sup>2</sup>C Serial Data Option
- ◆ 19- or 23-Inch Rack Mounting

**TWO-YEAR WARRANTY**
**SAFETY STANDARDS**

UL60950-1  
CSA22.2, No. 60950-1  
EN60950-1

[www.unipowertelecom.com](http://www.unipowertelecom.com)

NORTH AMERICA CALL: 954-346-2442 • EUROPE CALL: +44 (0)1903 768200



RPCM, TPCM,  
RPCP, TPCP, RPCQ

RPCG, TPCG



1U-High  
Shelf

LVD73/23/EEC

**RECTIFIER MODULES**

OUTPUT VOLTAGE	OUTPUT CURRENT	MAX. POWER	VAC INPUT RANGE	MODEL NUMBER
54.4VDC	25.0A	1360W	180-264	RPCQ48/25
	22.0A	1200W	90-264	RPCP48/22
	15.0A	800W	85-264	RPCM48/15
	8.0A	435W	85-264	RPCG48/8
48.0VDC	25.0A	1200W	85-264	TPCP7000
	16.7A	800W	85-264	TPCM7000
	9.4A	450W	85-264	TPCG7000
27.2VDC	33.0A	900W	85-264	RPCP24/33
	25.0A	690W	85-264	RPCM24/25
	15.0A	400W	85-264	RPCG24/15
24.0VDC	41.7A	1000W	85-264	TPCP5000
	29.2A	700W	85-264	TPCM5000
	16.7A	400W	85-264	TPCG5000
13.6VDC	50.0A	680W	85-264	RPCP12/50
	45.0A	600W	85-264	RPCM12/45
	27.0A	370W	85-264	RPCG12/27
12.0VDC	66.7A	800W	85-264	TPCP3000
	54.2A	650W	85-264	TPCM3000
	30.8A	370W	85-264	TPCG3000

**OPTION**

CODE	DESCRIPTION
-Z	I <sup>2</sup> C Serial Data Bus

**NOTES:**

1. Add Option Code as suffix to model number.
2. In the case of RPCG/RPCM/RPCP/RPCQ, only for use with DSC1000 and Gravitas Systems.

**19-INCH SHELVES**

RECTIFIER MODULES	HEIGHT	DEPTH	AC CONN.	MODEL NO.
RPCG, TPCG RPCM, TPCM	1U (1.72")	11.56"	C14	TPCMR1U3
RPCP, TPCP RPCQ	1U (1.72")	12.66" 13.15" 14.88"	Term. Blk. C20 C20*	TPCPR1U3A TPCPR1U3B TPCPR1U3C

\*Has extra input filter

**Rack Adaptor Modules & Accessories: Order by Part No.**

Type	Function	PART NO.
Relay Adaptor	Converts TTL level DC Good signal to Form-C dry contact. (See separate datasheet for details.)	009-1005-0000
I <sup>2</sup> C Adaptor	Required when using RPCG, RPCM, RPCP or RPCQ rectifiers with DSC1000 Controller. Specify -Z option. (See DSC1000 Manual for full details.)	009-1001-0000
Blanking Kit	Used to blank off unused module slots. One fitted as standard.	775-1450-0000

# SPECIFICATIONS, RADIAN SERIES MODULES

Typical at Nominal Line, Full Load and 25°C Unless Otherwise Noted.

## INPUT

Voltage Range .....	See Table
Power Factor .....	0.99
Total Harmonic Distortion, Max. ....	5%
Frequency .....	47-63Hz
Inrush Current Limiting, Max. ....	50A Peak
EMI Filter, Conducted .....	FCC20780 pt. 15J Curve B
.....	EN55022 Curve B
Fast Transients .....	EN61000-4-4
Surges .....	EN61000-4-5
Analog Voltage Adjust .....	0 to +5V
Input Protection .....	Internal Fuse, 20A

## OUTPUT

Current & Voltage .....	See Table
Output Power .....	370-1360W
Voltage Adjustment Range, Approx. ....	+/- 5%
Standby Output .....	+5V@250mA
Line & Load Regulation, Max. ....	2.0%
Holdup Time .....	20msec.
Overvoltage Protection .....	Latch Off
Filtering: Wideband Noise, 20MHz BW	
48V Out, P-P .....	500mV
24V Out, P-P .....	250mV
12V Out, P-P .....	125mV
Voice Band Noise .....	<32dBmC
Current Limit .....	105% Rated Current
Efficiency .....	80-87%

**SAFETY STANDARDS** ..... UL60950-1, CSA22.2 No. 60950-1, EN60950-1

## STATUS INDICATORS

AC Good <sup>1</sup> .....	Green LED & Logic LO Output
DC Good .....	Green LED & Logic LO Output

## ENVIRONMENTAL

Operating Temp. Range .....	-20°C to +70°C
Output Current Derating .....	2.5%/°C, 50°C to 70°C
Storage Temp. Range .....	-40°C to + 85°C
Humidity .....	0% to 95%, Non-Condensing
ESD .....	Bellcore GR-1089-Core and EN61000-4-2
MTBF, 35°C (Bellcore) .....	200,000 Hours
Cooling .....	Integral Ball Bearing Fans

## PHYSICAL SPECIFICATIONS

Case Material, Rectifier Module .....	Aluminum
Shelf .....	Steel
Dimensions, Inches (mm)	
Rectifier Module <sup>2</sup> .....	1.60 H x 5.00 W x 10.00 D (40.6 x 127 x 254)
19" Shelf, TPCMR1U3 .....	1.72 H x 19.00 W x 11.56 D (44 x 483 x 294)
19" Shelf, TPCPR1U3 .....	1.72 H x 19.00 W x 13.15 D (44 x 483 x 334)
Weight	
Rectifier Module .....	3.15 lbs. (1.43 kg.)
19" Shelf .....	3.75 lbs. (1.70 kg.)

- NOTES:** 1. RPCG & TPCG do not have this.  
 2. RPCG & TPCG depth is 10.16 inches (258mm), RPCQ depth is 10.32" (262mm).  
 RPCQ protrudes ~0.32" (~8.1mm) plus handle at front of shelf.

## SHELF J4 SIGNAL CONNECTOR



Positronic SD25F0S500X  
with FC7520D pins

J4 PIN CONNECTIONS			
PIN	FUNCTION	PIN	FUNCTION
1	Inhibit	14	AC Power Good - 1
2	Overtemp. Warning -1*	15	DC Power Good - 1*
3	Current Monitor - 1*	16	AC Power Good - 2
4	Overtemp. Warning - 2*	17	DC Power Good - 2*
5	Current Monitor - 2*	18	AC Power Good - 3
6	Overtemp. Warning - 3*	19	DC Power Good - 3*
7	Current Monitor - 3*	20	Module Present - 1
8	+5V Standby	21	Module Present - 2
9	SDA	22	Module Present - 3
10	Current Share	23	- Sense
11	+ Sense	24	Remote Adjust - 1
12	Remote Adjust - 2	25	Remote Adjust - 2
13	SCL		

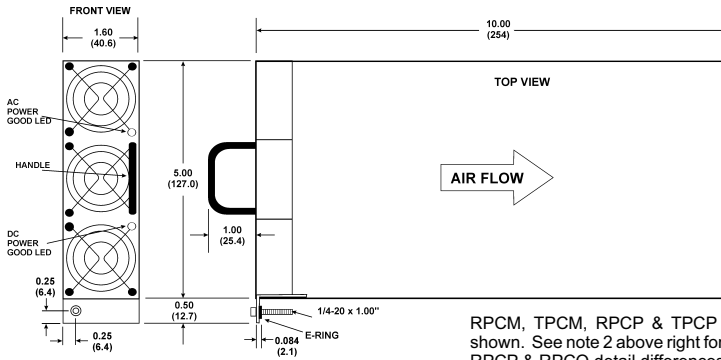
\* These pins are open when I<sup>2</sup>C option is used.

**NOTE:** Standby return is connected to -Sense lead. Current rating of +5V standby is 250mA. All signals are referenced to -Sense lead.

## RADIAN 19-INCH SHELVES

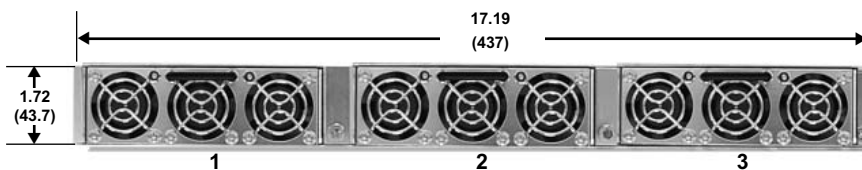
There is one shelf model for the RPCG, TPCG, RPCM and TPCM modules, and three shelf models for the RPCP, TPCP & RPCQ modules. The A, B, and C versions of the TPCPR1U3 shelf have rear housings that extend 1.10"(27.9mm), 1.59" (40.4mm) and 3.32" (84.3mm), respectively, beyond the 11.56" (294mm) shelf depth. The "C" version of the TPCPR1U3 shelf includes an AC line filter with each IEC 60320 C20 AC inlet. For further information, see the shelf data sheets. Universal brackets permit 19-inch or 23-inch rack mounting.

## HOT-SWAP RECTIFIER MODULE



RPCM, TPCM, RPCP & TPCP case is shown. See note 2 above right for RPCG, RPCP & RPCQ detail differences.

## SHELVES



TPCPR1U3A



TPCMR1U3

TPCPR1U3B

TPCPR1U3C

AC In  
C20 inlets for TPCPR shown  
TPCMR1U3 has C13 inlets

**ALL DIMENSIONS IN INCHES (mm).**

All specifications subject to change without notice.

Radian-ds-revN-05-10-08.indd