PRICE: $25.00

OPERATING MANUAL
TRP/TRR/TRS SERIES
BULK POWER FRONT ENDS

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Manual No. TRS-101-5
TRP-TRR-TRS-Man 03/02/04

UNIPOWER Corporation

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ILLUSTRATIONS

OPERATING MANUAL

TRP/TRR/TRS SERIES BULK POWER FRONT ENDS

1.0 INTRODUCTION

This operating manual should be read through carefully before installing and operating the TRP/TRR/TRS Series hot-swap power systems.

These hot-swap modules and rack form a bulk power front end with high-power outputs at 24, 28 or 48VDC. See Figure 1. Each module has a 1250, 2000 or 2500-watt output. Three modules in a rack produce up to 7500 watts. Using the three modules in a 2+1 redundant configuration produces up to 5000 watts. The modules have single-wire active load sharing for automatic paralleling of outputs, and output ORing diodes permit hot-swap addition or replacement of modules while the system is operating.

The series operate with a 85-264 or 170-264VAC input range at 47-63Hz. Each module has input power factor correction and a Class B EMI filter. The output voltage is tightly regulated and adjustable over a ±10% range by means of a front panel potentiometer. There is a green AC power good LED and green DC power good LED on the front panel. Each module is self-cooled by an 80mm compound, ball bearing fan.

The rack has two copper bus bars for the output and a 25-pin subminiature D connector on the back for the control functions: AC power good, DC power good, thermal alarm, current share, enable, remote sense and remote output adjustment for each module.

The hot-swap modules and racks are safety agency certified and CE marked.

2.0 FEATURES

The following is a summary of the important features of the TRP/TRR/TRS Series modules:

- For Distributed Power Systems
- Tightly Regulated Output Voltage
- 1250, 2000 or 2500-Watt Modules
- Output Overload Protected
- 24, 28 and 48VDC Versions
- Low Profile: 2U(3.5 inches or 88.9mm) Height

Figure 1. TRP/TRR/TRS Series Bulk Power Front End.

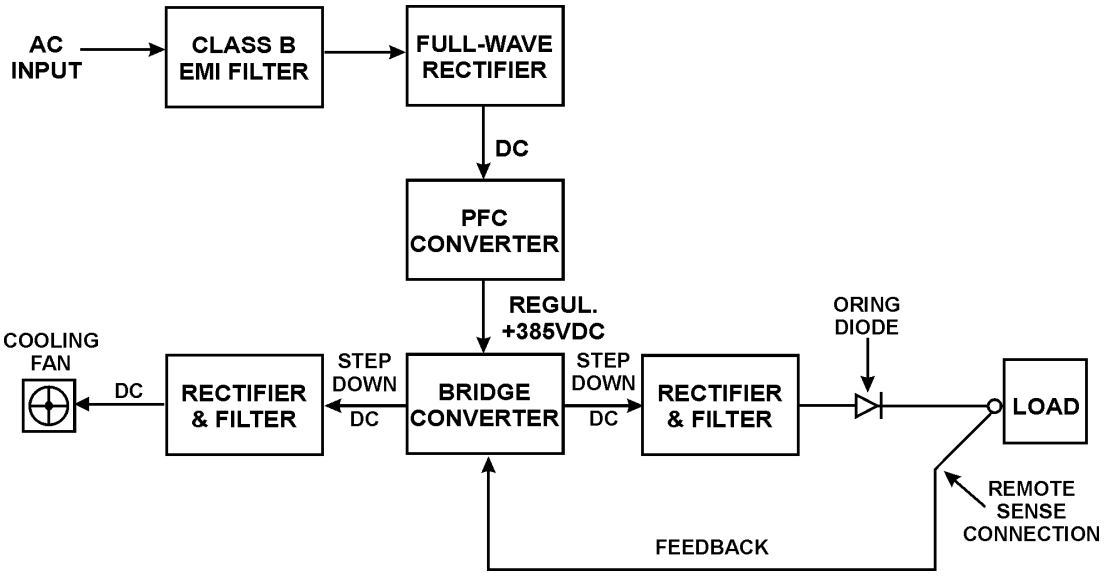


Figure 2. Module Block Diagram.

- 19 -Inch Racks
- Rack Capacity Up to 3 Modules
- High Power Density: 10.9 Watts/Cubic Inch
- 85% Efficiency
- 0.98 Power Factor
- Class B EMI Input Filter
- Input Range: 85-264 or 170-264VAC at 47-63Hz
- Up to 5000W Redundant or 7500W Non-Redundant
- Remote Sensing
- Active, Single-Wire Load Sharing
- Integral ORing Diodes
- Hot-Swappable Modules
- LED Operating Indicators
- Control and Monitoring Interface Signals

3.0 PRODUCT LINE

3.1 Hot-Swap Modules

MODEL	MAX. WATTS	OUTPUT VOLTAGE	MAX. OUTPUT CURRENT
TRP5000	1250	24	52.1A
TRP6000	1250	28	44.6A
TRP7000	1250	48	26.0A
TRR5000	2000	24	83.3A
TRR6000	2000	28	71.4A
TRR7000	2000	48	41.7A
TRS5000	2500	24	104.2A
TRS6000	2500	28	89.3A
TRS7000	2500	48	52.1A

3.2 Rack

MODEL	WIDTH	HEIGHT	NUMBER OF MODULES
RRS2U-19	19” (483MM)	3.5” (89MM)	3

4.0 SAFETY WARNINGS

4.1 These hot-swap modules and racks 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 power 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 module covers should not be removed. There are no user-serviceable components in these units. Removing the covers of the modules will void the warranty.

5.0 WARRANTY

All products 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 Power 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 power 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 Corporation 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 power system without proper packing.

7.0 DESCRIPTION OF OPERATION

7.1 Block Diagram. A diagram of a TRP/TRR/TRS Series Module is shown in Figure 2. The AC input first goes through a Class B EMI filter then to a full-wave rectifier and high-frequency (70kHz) power factor correction (PFC) converter. The output of the PFC converter is a regulated DC voltage at approximately +385V. This voltage is converted down to 24, 28 or 48VDC nominal, depending on the model. This is done by a bridge converter operating at 70 kHz. The output of this converter goes through a rectifier, filter and ORing diode to the module output. Feedback from the remote sense terminals back to the bridge converter pulse-width modulator regulates the output voltage and keeps it constant.

7.2 Power Factor Correction. This high-frequency converter circuit, switching at 70kHz, achieves a power factor of 0.98 by forcing the AC input current into a sinusoidal waveform, in phase with the input voltage. The input current is a smooth sine wave of much lower amplitude than the normal series of high-amplitude, input current pulses that are present in a unit without power factor correction. The result is lower RMS input current for a given output power level.

7.3 Cooling Fan. Another output from the forward converter is rectified, filtered and used to power the compound DC ball bearing cooling fan on the module.

7.4 Interface Signals. The module incorporates a number of interface control and supervisory signals which operate off internal circuits and are brought to the outside. These include remote enable, which enables or inhibits the entire rack, remote sensing, remote output adjust and a current share connection which permits operating the rack in parallel with other racks for increased power. Other signals brought out of the rack for each module are AC good, DC good and thermal alarm.

8.0 FRONT PANEL DESCRIPTION

The front panel of module is shown in Figure 3. On the right side of the panel are the voltage adjustment potentiometer, AC Good LED (green) and DC Good LED (green).

9.0 MODULE SPECIFICATIONS

Specifications for a Single Module. Typical at 120 or 230VAC Line, Full Load and 25°C Unless Otherwise Noted.

OUTPUT SPECIFICATIONS

Total Output Power, Max.	1250, 2000, 2500 watts
Output Voltage	24, 28 or 48VDC
Voltage Adjustment Range	±10%
Total Regulation[1]	1.0%
Ripple & Noise (Pk-Pk)[2]	250mV, 24V & 28V Models
	500mV, 48V Models
Hold-Up Time [3]	20mS
Dynamic Response[4]	1 msec.
Temperature Coefficient.	±0.05%/°C
Minimum Load.	0A
Overload Protection.	Constant Current Limiting
Overvoltage Protection	Latched Shutdown
Active Current Share[5]	10% Differential from Rated Current
Remote Sense	Up to 0.5V Per Wire

INPUT SPECIFICATIONS

Input Voltage Range, TRP	85-264 VAC[6]
TRR, TRS	170-264VAC
Power Factor	0.98
Input Frequency	47-63Hz
Inrush Limiting	25A Peak
Input Current, Full Load, TRS	13.1A@230VAC
TRR	10.4A@230VAC
TRP	12.5A@120VAC
Input EMI Filter, Conducted	EN55022 Curve B
	FCC20780 pt. 15J Curve B
Harmonic Distortion	EN61000-3-2
Input Immunity, Conducted	
Fast Transients, Line-Line	±2kV (EN61000-4-4 Level 3)
Surges, Line-Line	±1kV (EN61000-4-5 Level 2)
Surges, Line-Ground	±2kV (EN61000-4-5 Level 3)
Input Protection	Internal Fuse, 20A

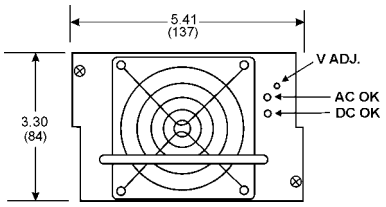
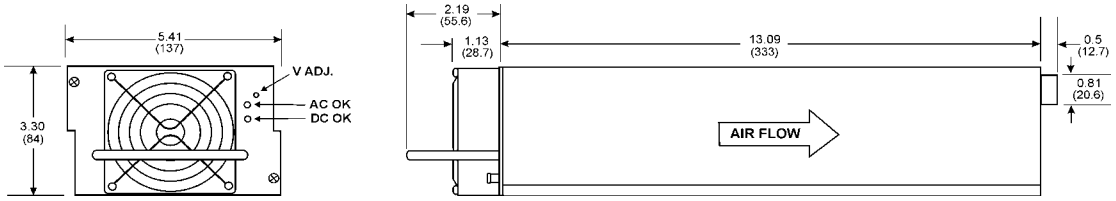


Figure 3. Front Panel of Module

HOT-PLUG MODULE



NOTE: TRP Models are 13.1 inches (333mm) deep with internal fan only. TRR and TRS models are 14.2 inches (361 mm) deep with compound (internal and external) fan.

MATING RACK-MOUNT

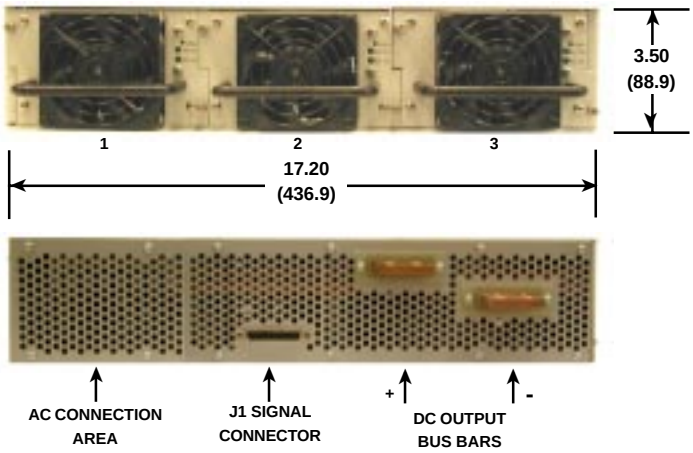


Figure 4. Mechanical Dimensions

GENERAL SPECIFICATIONS

Efficiency	85% at Full Load
Switching Frequency	70kHz Nominal
Overtemperature Protection	Power Shutdown
Isolation, Class I [7], min.	3000VAC Input-Output
	1500VAC Input-Ground
	50VDC Output-Ground
Safety Standards	EN60-950, UL1950, CSA22.2-950

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature	0°C to 70°C Ambient
Derating	2.5% / °C, 50°C to 70°C
Storage Temperature	-40°C to +85°C
Cooling	Compound Ball Bearing Fan

PHYSICAL SPECIFICATIONS

Case Material, Module	Aluminum & Copper
Rack Mount	Steel
Finish, Rack Mount	Powder Coat Gray
Dimensions, Inches (mm)	
Hot-Swap Module, TRR & TRS	3.30 H x 4.90 W x 14.22 D
	(84 x 124 x 361mm)
TRP	3.30 H x 4.90 W x 13.1 D
	(84 x 124 x 333mm)
3-Module Rack	3.5 H x 17.20 W x 19.90D
	(89 x 437 x 505)
Module Weight	10.15 lbs. (4.60kg.)

NOTES:

1. At remote sense point, over full line range and 0-100% load change.
2. 20MHz bandwidth. Measured with 0.1µF ceramic and 10µF tantalum capacitors in parallel across the output.
3. Full output power at nominal AC line.
4. <5% deviation recovering to within 1% for 50% load change.
5. Using single-wire current share with remote sense connected.
6. Below 90VAC input, derate output power by 10%; full rated power from 90-264VAC.
7. Input-output isolation figure is for isolation components only.
   100% production Hipot tested.

10.0 DESCRIPTION OF FEATURES & OPTIONS

FEATURE / OPTION	DESCRIPTION
Power Factor Correction	The input current is a sine wave in-phase with the input voltage to give a power factor of 0.98. Input current total harmonic distortion meets EN61000-3-2.
Wide Range AC Input	The AC input range is continuous from 85 to 264 or 170 to 264VAC, 47-63Hz, depending on model.
EMI Input Filter	This filter suppresses conducted noise from the module back onto the AC line. The filter meets FCC20780 part 15J Curve B and EN55022 Curve B.
Inrush Current Limiting	When the module is turned on, the initial input current is limited to a peak value of 25 amperes.
Output Voltage Adjustment Range	The output voltage adjustment range is ±10%. The adjustment is made from the front panel by means of a 12-turn potentiometer or from the input to the remote adjust terminal.
Remote Output Adjust	This input is used to remotely adjust each module output voltage. An analog voltage from 0 to +5V controls approximately ±10% output for a module. The analog inputs can also be connected together at the rack so that the external control voltage adjusts all the module outputs simultaneously.
Thermal Protection	If the module overheats internally, it will automatically shut down and give a thermal alarm output logic LO. The DC Good LED also turns off.
Current Sharing	The modules are automatically connected to current share with each other when they are inserted into the rack. 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 rack current share pin can be used to current share with another rack of the same output voltage.
ORing Diodes	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.

FEATURE / OPTION	DESCRIPTION
Overvoltage Protection	The output is protected from overvoltage due to fault conditions in the module. Overvoltage protection is set at approximately 29V for the 24V version, 34V for the 28V version and 59V for the 48V version. The result is a latched shutdown of the module. It is reset by cycling the AC input off for about 20 seconds and then back on.
No Load Operation	The module output can be operated down to zero load while maintaining output regulation.
Hot Swap Operation	Hot swap operation means that the modules can be removed and replaced while the rack is powering the load. If the rack is operated in an N+1 redundant mode, hot-swap replacement will not affect the output voltage.
Output Protection	Output current limiting protects the output of each module from damage due to overload or other short circuit condition. This protection is continuous, without damage, and recovery is automatic when the overload is removed. The current limit characteristic is essentially a constant current above 40V or 20V (depending on model). Current limiting begins at about 105% of rated output current.
LED Indicators	The AC Good indicator is a green LED, showing that input AC is present and that the PFC converter and internal control supply are operating. The DC Good indicator is a green LED showing that the output voltage is present and within operating range.
Control and Monitoring Signals	For detailed description of Remote Enable, Thermal Alarm, Current Share, Remote Sense, Remote Adjust, AC Good and DC Good signals see Section 17, Description of Control and Supervisory Signals.

11.0 MECHANICAL SPECIFICATIONS

The mechanical dimensions of the TRP/TRR/TRS Series modules and rack are shown in Figure 4.

12.0 SAFETY AND INDUSTRY STANDARDS

12.1 The modules and racks meet the following safety certifications:

STANDARD	AGENCY
UL1950	UL
CSA22.2 No.950	CUL
EN60950	DEMKO

12.2 The modules and racks are CE marked to indicate conformance to the European Union's Low Voltage Directive.

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

12.4 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.

13.0 OPERATING INFORMATION

13.1 Input Voltage. The modules operate off AC input voltages within the range of 85 to 264 or 170 to 264 VAC at 47 to 63 Hz. There is a separate input connection for each module to a terminal block at the rear of the rack mount. For complete details see Section 18.2 and Figure 5.

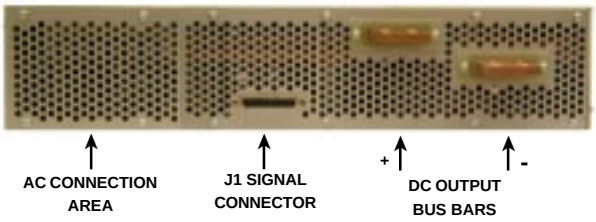
13.2 Output Connection. The 24V, 28V or 48V output is provided on two copper bus bars. Each bus bar has four 1/4-inch holes. Connection should be made by means of 1/4-inch diameter bolts. For complete details see Section 18.3 and Figure 5. Both positive and negative outputs are floating and isolated from the chassis.

13.3 Output Voltage. The output voltage of each module is factory set to 24, 28 or 48 volts, ±1%. The voltages, however, may be adjusted by means of the front panel potentiometer or the voltage adjust input pin.

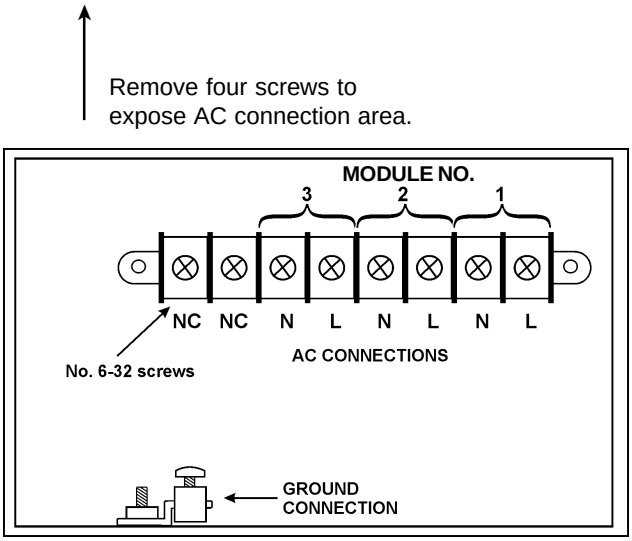
13.4 Output Power. Maximum output current for a module is shown in the table in Section 3.1. The maximum output power of a module may be drawn at up to 50°C ambient temperature. Above 50°C the output current must be derated by 2.5%/°C. See Figure 6. The maximum operating temperature is 70°C, at which the output current must be derated by 50%.

13.5 Output Overload Protection. Each module output is protected from damage due to overload or other short circuit condition. This protection is continuous and without damage; recovery is automatic when the overload or short is removed. The current limit characteristic is a constant current above 40V, 23V or 20V (depending on model). Current limiting takes place at approximately 105% of the rated output current.

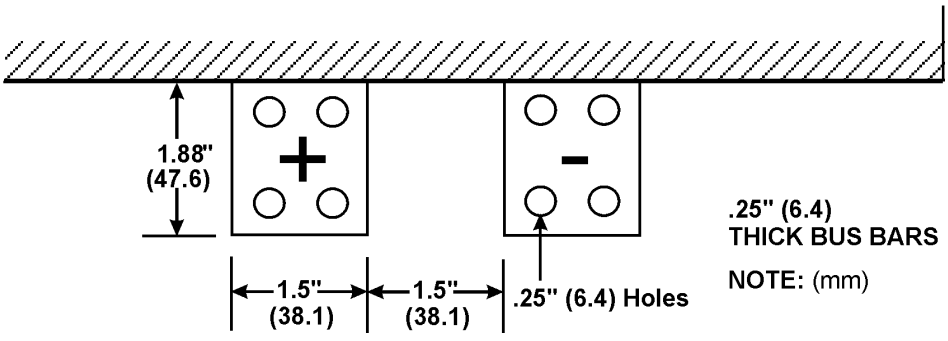
13.6 Remote Sensing. Remote sensing connections are made to pins 11 (+Sense) and 23 (-Sense) of the rack J1 connector. Remote sensing is used to regulate the output voltage at the point of load by compensating



(a) Rear Connections to Rack



(b) Uncovered AC Input Connection Area



(c) Top View of DC Output Bus Bars

Figure 5. Rear Rack Input and Output Connections

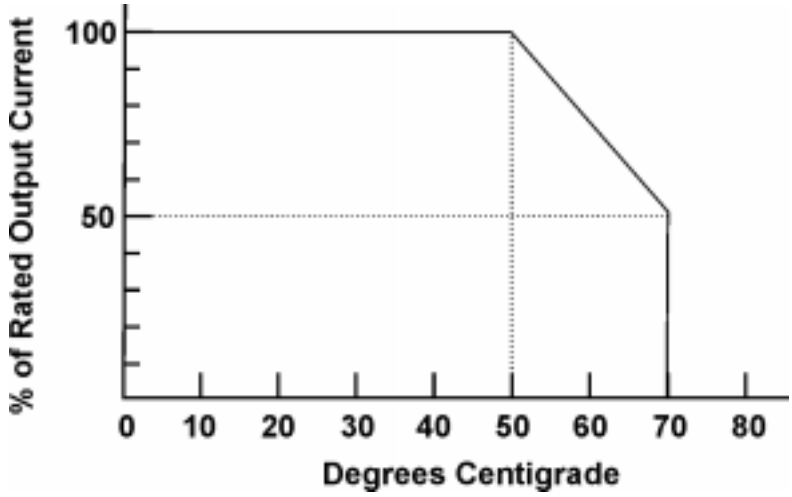


Figure 6. Rated Output Current vs. Ambient Temperature

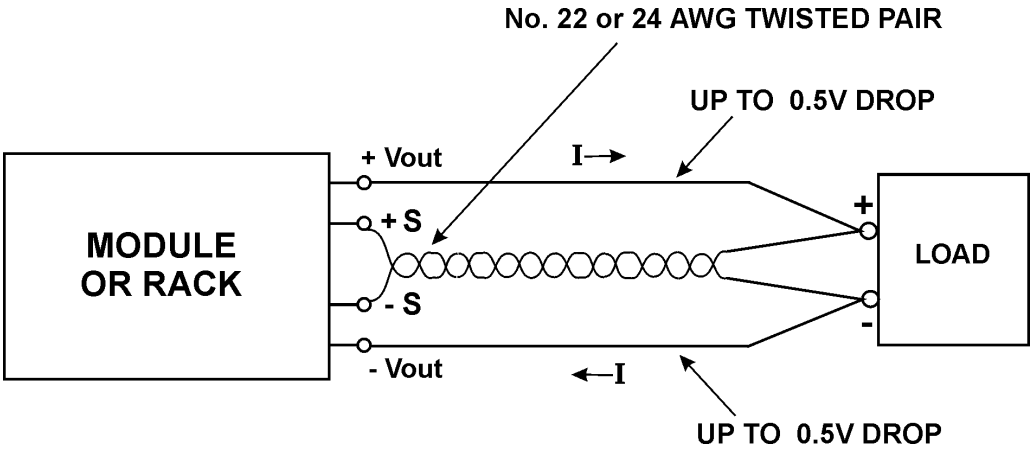


Figure 7. Remote Sensing Connection

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 Figure 7.

Remote sensing can compensate for a total voltage drop of 1.0V, or 0.5V 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; there is an internal 10-ohm resistor connected from each output to its remote sense lead. **Be careful not to reverse the sense lead connections**, as this will blow the 10-ohm resistors.

13.7 Control & Supervisory Signals. All control and supervisory signals are accessible at J1, a 25-pin subminiature D connector on the back of the rack. See Section 17 for a complete description of these input and output signals.

13.8 Alarm Signals. Among the control and supervisory signals are three logic alarms for each module: Thermal Alarm, AC Good and DC Good. They are open collector, TTL-compatible signals referenced to Signal Common, J1 Pin 22, on the rack. **Thermal Alarm:** When a module internally overheats, this logic signal goes LO 100 msec. before the module automatically shuts down. **AC Good:** A logic HI or open indicates that there is no AC input or that the PFC converter stage has failed. **DC Good:** A logic HI or open indicates a DC output failure.

14.0 PARALLEL OPERATION

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

14.1 Redundant Operation. From Table 14-1, the 19-inch rack mount can be operated in a 2+1 redundant mode. This means, for example, that the full load current must be carried by two 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 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.

Table 14-1 Redundant and Non-Redundant Operation

MODE	NUMBER OF MODULES	NOM. VOLTS	TRS AMPS MAX.	TRR AMPS MAX.	TRP AMPS MAX.
Redundant, 2+1	3	24	208.4	166.6	104.2
Non-Redundant	3	24	312.6	249.9	156.3
Redundant, 2+1	3	28	178.6	142.8	89.2
Non-Redundant	3	28	267.9	214.2	133.8
Redundant, 2+1	3	48	104.2	83.4	52.0
Non-Redundant	3	48	156.3	125.1	78.0

14.2 Non-Redundant Operation. Higher output current can be achieved by operating the rack in a non-redundant mode as seen in Table 14-1. However, in this case if a 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 module, however, can be quickly replaced to restore the load current.

14.3 Multiple Parallel Rack Operation. Multiple racks can also be operated in parallel by interconnecting their current share terminals (J1 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 racks are employed with a total of six modules, then 5+1 redundancy is achieved and 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 point of load. See Figure 8 for a simplified illustration of two racks connected in parallel.

15.0 RACK CONTROL & SUPERVISORY SIGNAL CONNECTIONS

15.1 Connections for control and supervisory signals are made at the rack rear to connector J1, a standard 25-pin subminiature D connector (AMP747846-4). The mating connector is AMP747912-2.

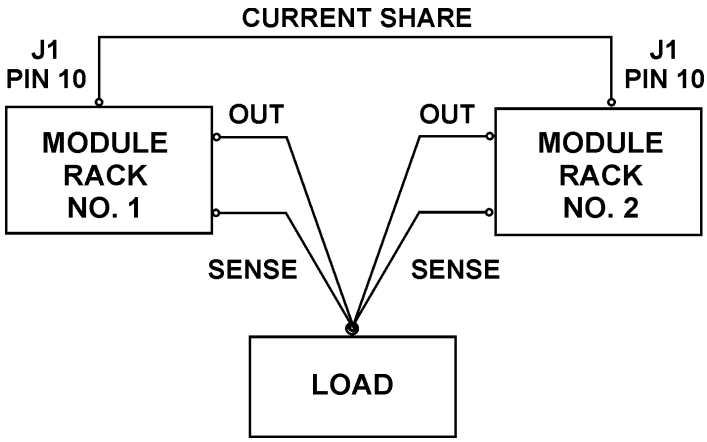
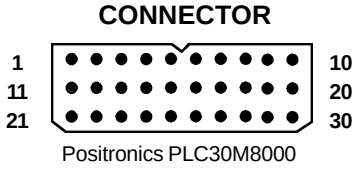


Figure 8. Parallel Connection of Racks.



MATING CONNECTOR KIT
Mating Connector: Positronics PLC30F7000 **Order Kit No**.: 775-1427-0000 $ 40.00

PIN CONNECTIONS					
PIN	**FUNCTION**	**PIN**	**FUNCTION**	**PIN**	**FUNCTION**
1	AC Neutral	11	N.C.	21	AC Line
2	N.C.	12	AC Ground	22	N.C.
3	+5V 100mA Aux.	13	-Sense	23	Current Monitor
4	DC Good	14	AC Good	24	Thermal Warning
5	Inhibit	15	Enable/Interlock	25	Current Share
6	+Sense	16	-Sense	26	Remote Adjust
7	- DC Out	17	- DC Out	27	- DC Out
8	- DC Out	18	- DC Out	28	- DC Out
9	+ DC Out	19	+ DC Out	29	+ DC Out
10	+ DC Out	20	+ DC Out	30	+ DC Out

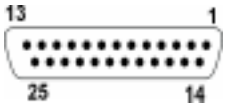
Figure 9. Module Pin Connections.

15.2 The pin connections to J1 are shown in the table.

J1 SIGNAL CONNECTOR

PIN	FUNCTION	PIN	FUNCTION
1	Inhibit	14	AC Good-1
2	Thermal Alarm-1	15	DC Good-1
3	Current Monitor-1	16	AC Good-2
4	Thermal Alarm-2	17	DC Good-2
5	Current Monitor-2	18	AC Good-3
6	Thermal Alarm-3	19	DC Good-3
7	Current Monitor-3	20	N.C.
8	N.C.	21	N.C.
9	N.C.	22	N.C.
10	Current Share	23	-Sense
11	+ Sense	24	Remote Adjust-1
12	Remote Adjust-2	25	Remote Adjust-3
13	N.C.		

J1



Standard subminiature D Connector AMP747846-4

MATING CONNECTOR KIT
Mating Connector: AMP747912-2 **Order Kit No**.: 775-1441-0000 $ 5.00

16.0 MODULE CONNECTIONS

If the TRP/TRR/TRS module or modules are used separately from the rack or in a user configured rack, connections should be made to the high-reliability hot swap connector on the back of the module with the functions as shown in Figure 9.

17.0 DESCRIPTION OF CONTROL AND SUPERVISORY SIGNALS

SIGNAL	PIN	DESCRIPTION
Inhibit	1	A TTL LO (sinking 5mA) or short to Pin 23 inhibits (turns off) all modules in the rack. A TTL HI or open enables (turns on) all modules. This input is referenced to -Sense, Pin 23.
Thermal Alarm - 1 Thermal Alarm - 2 Thermal Alarm - 3	2 4 6	An open collector TTL HI, or open, is normal. A TTL LO (sinks 2mA) indicates thermal shutdown and occurs 100 msec. before the module shuts down. These outputs are referenced to -Sense, Pin 23.
Current Monitor -1 Current Monitor -2 Current Monitor -3	3 5 7	This output gives an analog voltage proportional to the module output current. The range is approximately 0V to +5V, corresponding to zero to rated output current.
Current Share	10	This is an analog control signal made up of the current share signals of all modules connected together. This pin is used to connect to Pin 10 of another identical rack to share output currents. Output currents between racks 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.

SIGNAL	PIN	DESCRIPTION
+ 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 rack via internal 10-ohm sense resistors. The connections should not be reversed.
Remote Adjust - 1 Remote Adjust - 2 Remote Adjust - 3	24 12 25	These are analog voltage inputs to the designated modules by which the output voltage is adjusted. A zero to + 5V input represents approximately ±10% output change. This input should be driven from a source impedance less than 100 ohms and is referenced to -Sense, Pin 23.
AC Good - 1 AC Good - 2 AC Good - 3	14 16 18	A TTL LO (sinks 2mA) indicates the AC input is present and the PFC converter stage has output. A TTL HI, or open, indicates AC input or PFC converter failure. This signal is referenced to -Sense, Pin 23.
DC Good - 1 DC Good - 2 DC Good - 3	15 17 19	A TTL LO (sinks 2mA) indicates that the unit is operating properly with output voltage in its controllable range. A TTL HI, or open, indicates the output is outside the ±10% range, the unit has failed or is in current limit. This signal is referenced to -Sense, Pin 23.

18.0 INSTALLATION

18.1 Mounting. See Figure 4. The TRP/TRR/TRS Series chassis is mounted in a rack by means of mounting brackets on each side of the chassis. When mounting, the chassis should first be securely mounted to the rack, then the modules should be inserted into the chassis. The modules are secured by tightening the two captive screws on each module.

18.2 AC Input Connections. The AC input connections to the racks are shown in Figure 5(b). As shown, there are separate connections for each module on the eight-terminal strip. All connections must be AC three-wire with the safety ground wires going to the ground connection terminal at the bottom of the chassis. The connections are labeled by module number.

18.3 DC Output Connections. The DC output connections are shown in Figure 5(a) and (c). The positive and negative output connections are made to the copper bus bars as shown. The upper left bar is positive, and the lower right one is negative. Each bus bar has four ¼ - inch holes. Connection to the bus bars should be made by means of ¼ - inch bolts with nuts. The output wires or bus bars should be sized in accordance with the load current and length of conductor.

18.4 Contact Resistance. The connecting wires or lugs should be clean, and a tight, firm connection should be made to the output bus bars to minimize contact resistance.

18.5 Control and Supervisory Signal Connections. These connections are made to J1, a subminiature D 25-pin connector (AMP747846-4), by means of the mating connector. Details for these connections are given in Sections 15.1 and 15.2.

18.6 Cooling. Each TRR/TRS module is cooled by an 80mm, compound DC ball bearing fan. Each TRP module is cooled by a single, internal 80mm DC ball bearing fan. 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 this series except for periodic cleaning of dust and dirt around the fan. A small vacuum nozzle should be used for this.

20.0 MODULES AND RACK SETUP AND TESTING

20.1 The modules and rack can be initially tested mounted in a rack or on a test bench. The power system is initially tested one module at a time in the chassis.

20.2 Connect a three-wire AC power line to module no. 1 on the back of the rack. Be sure to connect the AC safety ground wire to the rack ground terminal. Do not plug the AC line into the AC 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 about 10% and 50% of the full load rating of the module.

20.4 Connect a color-coded, twisted pair (no. 22 or 24 AWG) from the remote sense pins to the load. The +Sense lead (J1 Pin 11) **must go** to the positive side of the load and the - Sense lead (J1 Pin 23) **must go** to the negative side of the load. **Connect a wire from the Inhibit input (J1 Pin 1) to -Sense (Pin 23). This connection must be made for the module to operate.**

20.5 Insert one of the modules into slot 1 of the rack (leftmost slot). Plug the AC power line into a 230VAC source and measure the voltage across the load at the remote sense points with a digital voltmeter. The voltage should be at the rated output voltage of the module, i.e., 24, 28 or 48V, ±1%.

20.6 **Checking the Front Panel LEDs**. The AC Good and DC Good LEDs should both be green.

20.7 **Checking the Remote Enable Input.** Next, disconnect the Inhibit wire from J1 Pin 1 to Pin 23. The module output should turn off, giving zero volts across the load. The DC Good LED should go off.

20.8 **Checking the AC Good and DC Good Outputs**. Connect the -lead of an external 5V power supply to -Sense (J1 Pin 23). Connect one end of a 10K resistor to the +lead of the 5V supply and the other end to the AC Good output (J1 Pin 14). Connect one end of another 10K resistor to the +lead of the 5V supply and the other end to the DC Good output (J1 Pin 15). See Figure 10. Reconnect the Inhibit wire. Measure the output voltage at both J1 Pins 14 and 15 with respect to Signal Common (Pin 22) with a digital voltmeter. Both voltages should be less than 0.5VDC, indicating a TTL LO.

20.9 **Checking the Remote Adjust Input.** Connect a variable external power supply as shown in Figure 11. With the output voltage set to zero, check the output voltage of the module with a digital voltmeter. It should be approximately 10% below its nominal value. Next, adjust the external supply output to +5V and check the output voltage of the module. It should be approximately 10% above its nominal value. Unplug the external 5V supply and unplug the AC inputs to the rack.

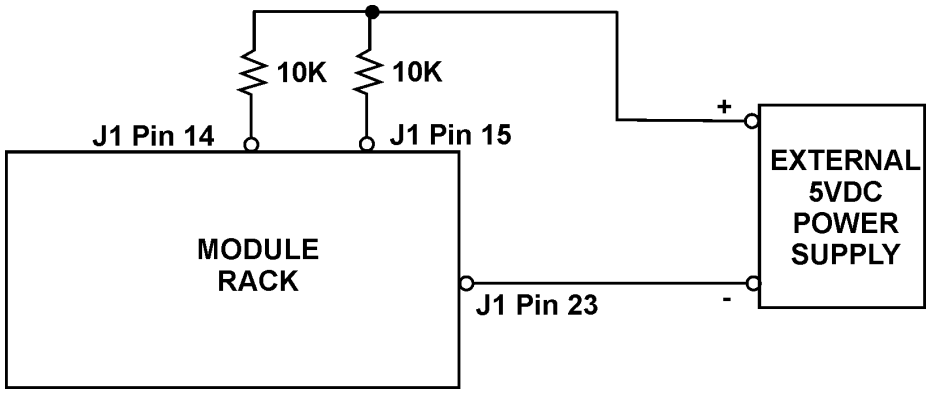


Figure 10. Checking AC Good and DC Good Outputs

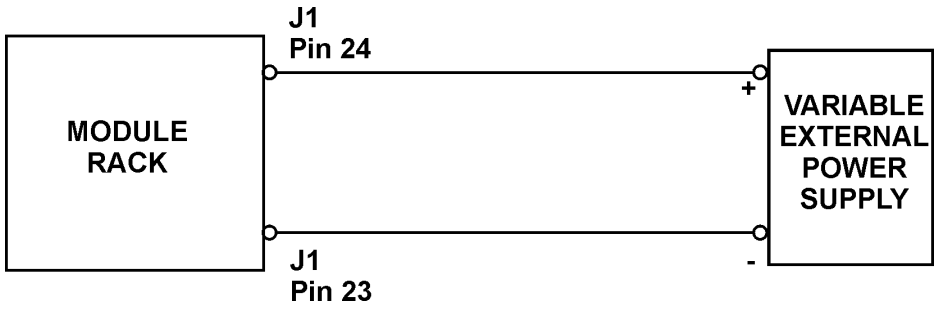


Figure 11. Checking Remote Adjust Input

20.10 Checking the Other Modules. Each 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 modules have been verified.

20.11 Checking the Complete Rack. Confirm that the output voltages of the individual modules are all accurately set to 24, 28 or 48V. The voltages between modules should be within ±1% of each other for best performance of the current sharing circuitry. Insert all modules into the rack. Connect a power load - - high-power resistor or electronic load in resistive mode -- equal to 1.5 to 2 times the full rated load for a single module, to the output of the rack. See Section 3.1. Connect the + and - Sense leads to + and - sides of the load, respectively, as in Section 20.4.

Note that on the back of the rack each module has its own AC power connection. For this test each module should be connected to a separate 15A, 230VAC circuit. Plug the rack into the 230VAC power sources.

Check the load voltage with a digital voltmeter. It should be very close to 24, 28 or 48VDC (±1%), depending on the model tested. The AC Good and DC Good LEDs should both be green on each module.

20.12 While the rack is operating, pull Module No. 1 out while monitoring the output voltage with a digital voltmeter. The voltage should remain the same. Insert the module back into the rack. 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 rack, check the Inhibit input for the entire rack. Disconnect the Inhibit wire from J1 Pin 1 to Pin 23.
The rack output should turn off and the output voltage should go to zero.

Reconnect the Inhibit wire. This completes the rack setup and testing.

21.0 TROUBLESHOOTING GUIDE

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

21.2 Table 21-1. Module and Rack 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 J1 Pin1 (Inhibit) is connected to Pin 23 (-Sense) or is at a TTL LO.
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 for 20 seconds and then back ON.
No output, DC Good LED off, AC Good LED on.	Overtemperature protection is activated on one or more modules.	Allow modules to cool down for about 10 minutes. They will then start up automatically. Check to see if the cooling fans are operating.
No output, DC Good LED off, AC Good LED on.	Output load is too great for the number of modules.	Reduce load to proper level.

21.3 If none of the above actions solves the problem, call UNIPOWER Corporation at 954-346-2442 Ext. 400 for help and try to resolve the problem over the telephone.