



**OPERATING MANUAL
RACK-MOUNT DC/DC CONVERTERS
RADIAN TPCM24 SERIES**

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CONTENTS

1.0	INTRODUCTION	4
2.0	STANDARD FEATURES	5
3.0	PRODUCT LINE	5
4.0	SAFETY WARNINGS	5
5.0	WARRANTY (Summary)	6
6.0	UNPACKING AND INSPECTION	6
7.0	FRONT PANEL DESCRIPTION	7
8.0	MODULE SPECIFICATIONS	7
9.0	DESCRIPTION OF FEATURES & OPTIONS	8
10.0	MECHANICAL SPECIFICATIONS	9
11.0	OPERATING INFORMATION	10
12.0	PARALLEL OPERATION	12
13.0	CONTROL & SUPERVISORY SIGNAL CONNECTIONS (RACK/SHELF)	14
14.0	CONVERTER MODULE CONNECTIONS	15
15.0	DESCRIPTION OF RACK/SHELF CONTROL AND SUPERVISORY SIGNALS	16
16.0	INSTALLATION	17
17.0	MAINTENANCE	17
18.0	DC/DC CONVERTER AND RACK/SHELF SETUP AND TESTING	18
19.0	TROUBLESHOOTING GUIDE	20
	DATASHEETS	APPENDIX

FIGURES

Figure 1 – TPCM24 Series Module & Power Shelf	4
Figure 2 – TPCM24 Series Module Front Panel	7
Figure 3 – TPCM24 Module Dimensions	9
Figure 4 – TPCMQR1U3-24 Rack/Shelf Front & Back Views	10
Figure 5 – Module Dimensions	11
Figure 6 – Remote Sense Connection	11
Figure 7 – Redundant vs. Non-Redundant Output Capacity	12
Figure 8 - Connection Diagram for Parallel Operation	13
Figure 9 – TPCM24 Converter Module Pin Connections	15
Figure 10 – Checking the Remote Adjust Input	18

OPERATING MANUAL

RADIANT TPCM24 SERIES

DC/DC CONVERTERS AND RACK/SHELF

1.0 INTRODUCTION

This operating manual should be read through carefully before installing and operating the RADIANT TPCM24 DC/DC converter systems. UNIPOWER's TPCM24 Series 1U high DC/DC converter systems convert a 24VDC nominal input to 48 at 3,000 watts and 3,600 watts or 54.4VDC at 3,000 watts. The converter system consists of three DC/DC converter modules in a compatible 19-inch rack/shelf, see figure 1. The input is a wide range 20 to 30VDC, and the output has a -25 to +10% adjustment range. In 2+1 redundant operation the output is up to 2,400 watts. In this case a converter module can be hot-swapped without affecting the output. The output voltage can be controlled by a remote analogue input in the range 0 to +5V.

Each TPCM24 module produces 48VDC at 1,000 or 1,200 watts or 54.4VDC at 1,000 watts. The modules, which are connected in parallel in the rack/shelf, have automatic load sharing and ORing diodes so they can be added or replaced while the system is operating. The modules are up to 89% efficient and have up to 15 watts per cubic inch power density.

A 25-pin interface sub-miniature D connector on the back of the rack/shelf provides control and monitoring inputs and outputs. An inhibit input turns the entire rack/shelf output off or on. Remote sensing connections provide precise regulation at the point of load. Other control signals are input power fail, output power good logic signals and analogue voltage remote adjust inputs; all for each individual converter module.

Front-panel green LEDs indicate input power good and output power good for each converter module. The converter modules and rack/shelf are safety agency certified and CE marked.



Figure 1 – TPCM24 Series Module & Power Shelf

2.0 STANDARD FEATURES

The following is a summary of the important features of the TPCM24 DC/DC converter modules and rack/shelf:

- ◆ Constant Output Voltage
- ◆ Remote -25 to +10% Output Adjustment
- ◆ Output Overload Protected
- ◆ Six Different Models
- ◆ -20°C to +70°C Operating Temperature
- ◆ Low Profile: 1U (1.72 inches or 44mm) High
- ◆ 19-Inch Compatible Rack/Shelf
- ◆ 19- or 23-Inch Rack Mounting
- ◆ Shelf Capacity Up to 3 Converter Modules
- ◆ Power Density Up to 15 Watts/Cubic Inch
- ◆ Up to 89% Efficiency
- ◆ Wide Range DC Inputs
- ◆ I2C Serial Data Bus Option
- ◆ Remote Sensing
- ◆ Integral Output ORing Diodes
- ◆ Hot-Swappable Converter Modules
- ◆ Redundant or Non-Redundant Operation
- ◆ LED Operating Indicators
- ◆ Control and Monitoring Interface Signals

3.0 PRODUCT LINE

MAXIMUM POWER	OUTPUT VOLTAGE ¹	OUTPUT CURRENT	DC INPUT VOLTAGE	MODULE NUMBER ²	RACK/SHELF NUMBER ^{2,3}
1000W	48.0VDC 54.4VDC	20.8A 18.4A	20-30V	TPCMQ24-48/21 TPCMQ24-54/18	TPCMQR1U3-24
1200W	48.0VDC	25.0A	20-30V	TPCMQ24-48/25	TPCMQR1U3-24

Notes:

1. The table does not show the independent 5V, ¼A standby output which is standard on all modules.
2. To specify the I²C option add -Z to the model number shown.
3. Blanking kit for unused position, order part number 775-1501-0000.

4.0 SAFETY WARNINGS

- 4.1 These power supplies 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 supply, the chassis 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 power supply cover should not be removed. There are no user-serviceable components in these units. Removing the cover of the power supply will void the warranty.

5.0 WARRANTY (Summary)

All products of UNIPOWER LLC, 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.

For a complete text of UNIPOWER's warranty conditions please request a copy from your local Sales Office.

6.0 UNPACKING AND INSPECTION

- 6.1 This unit was carefully tested, inspected and packaged for shipment from our factory. Upon receipt the unit should be carefully unpacked and inspected for any damage in shipment.
- 6.2 If there is evidence of damage, **do not attempt to install the unit.** The freight carrier should be notified immediately and a claim for the cost of the unit 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 LLC 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 this unit without proper packing.

7.0 FRONT PANEL DESCRIPTION

The front panel of a TPCM24 converter module is shown in Figure 2 below. At the top left is the Input Good LED (green) and at the top right is the Output Good LED (green). Three 40mm fans cool the module.

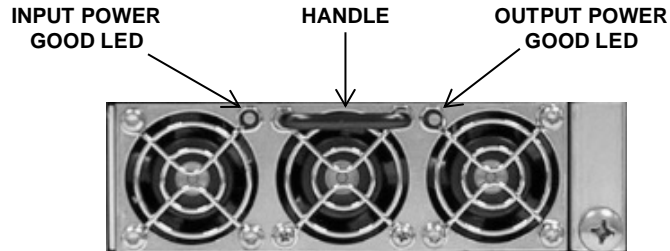


Figure 2 – TPCM24 Series Module Front Panel

8.0 MODULE SPECIFICATIONS

For detailed module specifications please see the relevant datasheet appended to this manual.

The following is a brief summary.

INPUT	TPCM24
Voltage Range.....	20-30VDC
Inrush Current Limiting.....	100A Peak
Input Current, Full Load.....	46.8A@24VDC
EMI Filter, Conducted.....	Standard
Analogue Voltage Adjust Input	0 to +5V
Input Protection.....	Internal Fuse, 100A
OUTPUT	
Current & Voltage ₁	see model table
Voltage Adjustment Range, Remote	-25 to +10%
Voltage Trim Pot Adjust.....	±4%
Total Regulation, Max.....	2.0%
Overvoltage Protection.....	Latched Shutdown
Filtering: Wideband Noise, 20MHz BW, P-P.....	2.0%
Voice Band Noise	<32dBnC
Current Limit	105% Rated Current
Efficiency	89%
SAFETY STANDARDS	UL60950-1, CSA22.2 No. 60950-1, EN60950-1
STATUS INDICATORS	
Input Power Good	Green LED and Logic LO Output
Output Power Good.....	Green LED and 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
Cooling.....	DC Ball Bearing Fans

PHYSICAL SPECIFICATIONS

Case Material, Module	Aluminium
Rack/Shelf	Aluminium
Dimensions, Inches (mm)	
Converter Module	1.60 H x 5.00 W x 10.00 D (40.6 x 127 x 254)
19” Rack/Shelf.....	1.72 H x 19.00 W x 11.56 D (43.7 x 483 x 294)
Weight	
Converter Module	3.15 lbs. (1.43 kg.)
19” Rack/Shelf.....	4.15 lbs. (1.88 kg.)

9.0 DESCRIPTION OF FEATURES & OPTIONS

FEATURE / OPTION	DESCRIPTION
Wide Range DC Input	The DC input range is from 20 to 30VDC.
EMI Input Filter	This filter suppresses conducted noise from the converter back onto the DC input line.
Inrush Current Limiting	When the converter is turned on, the input inrush current is limited by an electronic circuit.
Output Voltage Adjustment	The output voltage adjustment range for all models is approximately -25 to +10% of the nominal output voltage, made at the input to the remote adjust terminal. There is also a trimming potentiometer on the top of the case which gives a smaller output adjustment range of about ±5%.
Remote Output Adjust	This input is used to remotely adjust each converter output voltage. An analogue voltage from 0 to +5V controls approximately -25 to +10% output range. This input can be controlled externally by a power control system. The module analogue inputs can also be connected together so that the external control voltage adjusts all the module outputs simultaneously.
Thermal Protection	If the converter module overheats internally, it will automatically shut down. The Output Power Good LED turns off, the Output Power Good signal goes HI and the Overtemperature Warning signal goes HI.
Current Sharing	The TPCM24 converter modules are automatically connected to current share with each other when they are inserted into the rack/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 rack/shelf current share pin can be used to current share with another rack/shelf of the same output voltage.
ORing Diode	This diode in series with the 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.

Overvoltage Protection	The output is protected from overvoltage due to fault conditions in the module. Overvoltage protection is set at greater than 110% of the output voltage. The result is a latched shutdown of the converter module. It is reset by cycling the DC input off 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 converter modules can be removed and replaced while the rack/shelf is powering the load. If the system 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 converter module from damage due to an overload or 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.
LED Indicators	The Input Power Good indicator is a green LED, showing that input DC is present. The Output Power 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 Inhibit, Current Share, Remote Sense, Remote Adjust, Input Power Good and Output Power Good signals, see Section 16, Description of Control and Supervisory Signals.

10.0 MECHANICAL SPECIFICATIONS

The mechanical dimensions of the TPCM24 Series converter modules and the rack/shelves are shown in Figures 3 and 4 below.

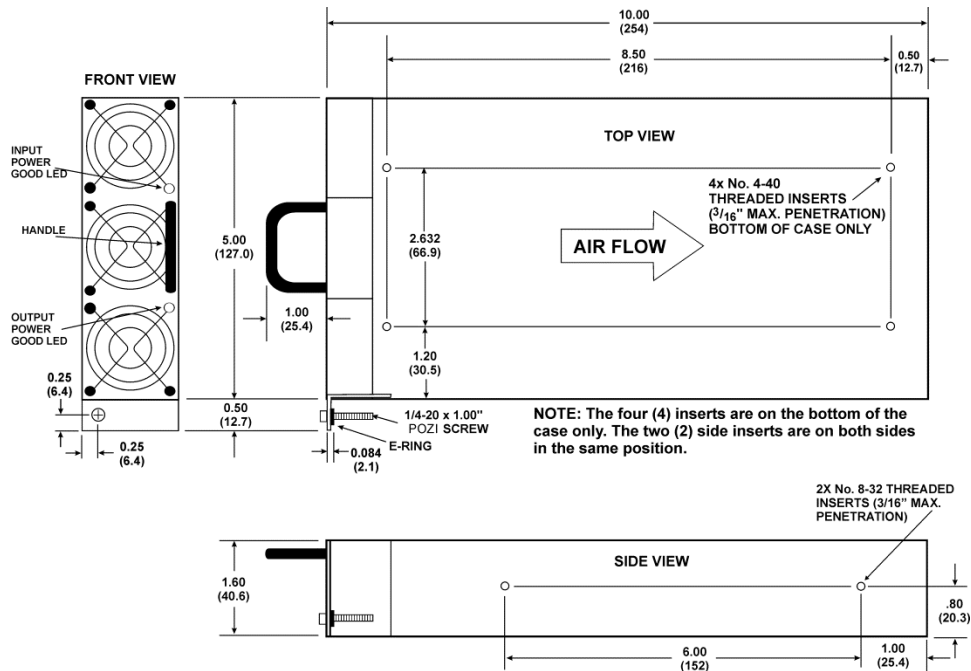


Figure 3 – TPCM24 Module Dimensions

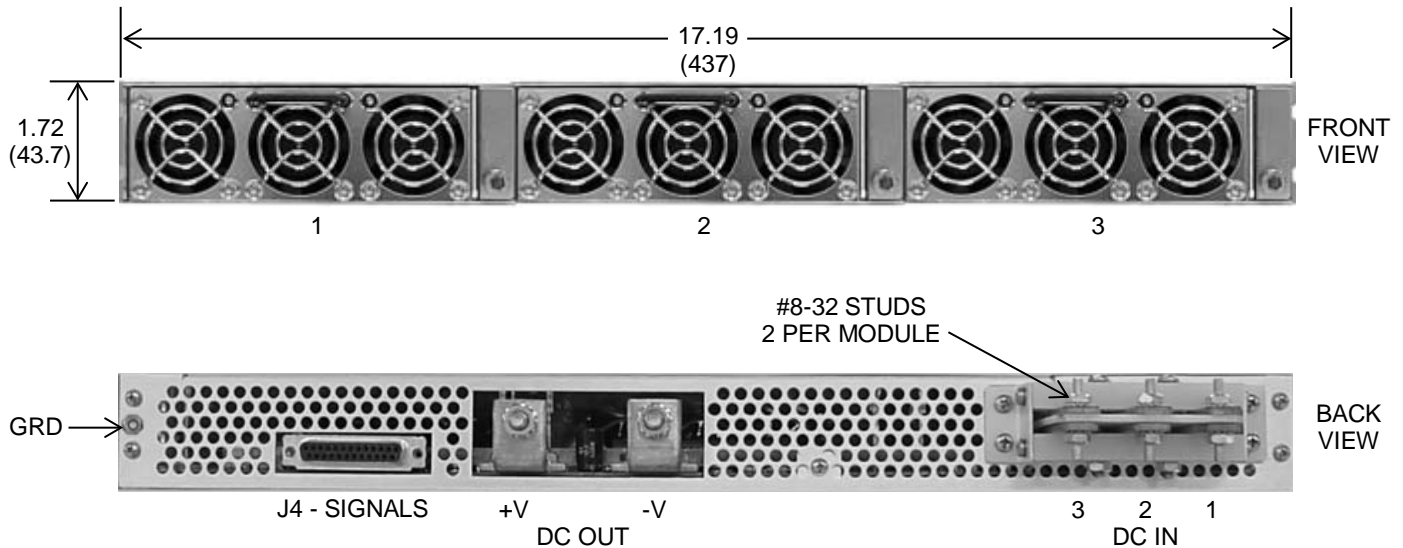


Figure 4 – TPCMQR1U3-24 Rack/Shelf Front & Back Views

11.0 OPERATING INFORMATION

- 11.1 Input Voltage** - The TPCM24 Series converters operate from DC input voltages within the range of 20 to 30VDC. There is a separate input connection for each converter module to bus bars at the rear of the rack/shelf. For complete details see Section 16.2 and Figure 4 above.
- 11.2 Output Connections** - The DC output of the rack/shelf is provided at two copper bus bars. Each bus bar has a no. ¼-20 stud and nut for the output connections. For complete details see Section 17.3 and Figure 4 above. Both positive and negative outputs are floating and isolated from the chassis.
- 11.3 Output Voltage** - The output voltage of each converter module is factory set to its specified voltage. This voltage can be adjusted in two ways. First, there is a V adjust potentiometer at the top of the module case. This adjustment has a range of approximately $\pm 4\%$.

Second, there is a wide-range adjustment of approximately -25% to +10% by means of the Remote Adjust input to each converter module. This is found at pin 29 of the modules connector. On the rack/shelf the Remote adjust is found at J4 pins 12, 24 & 25 for each module. A zero to +5V input to these pins adjusts the output from -25% to +10%. An input voltage of +2.5V, or an open, gives the factory-set voltage at the output. The output voltage can actually go above +10%, but this could trip the overvoltage protection (OVP) circuit.

All three converter modules in a rack/shelf can be controlled from a single analogue control voltage by connecting J4 pins 12, 24 & 25 together.

11.4 Output Power - The maximum output power for the TPCM24 modules is 1,200 watts. 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 5 below. The absolute maximum operating temperature is 70°C, at which the output current must be derated by 50%.

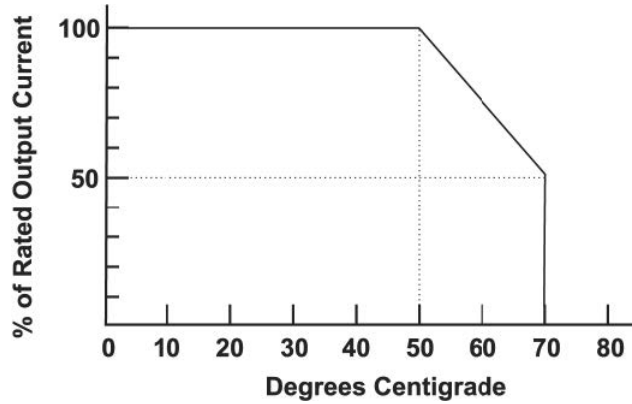


Figure 5 – Module Dimensions

11.5 Output Overload Protection - Each converter module output is protected from damage due to overload or short circuit conditions. 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.

11.6 Remote Sensing - Remote sensing connections are made to pins 11 (+Sense) and 23 (-Sense) of the converter rack/shelf J4 connector. Remote sensing is used to regulate the output voltage at the point of 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 Figure 6 below.

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.

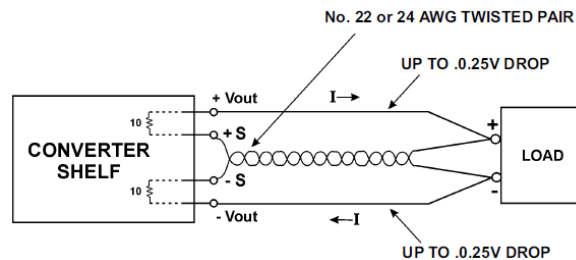


Figure 6 – Remote Sense Connection

11.7 Control & Supervisory Signals – All control and supervisory signals are accessible at J4, a 25-pin sub-miniature D connector at the back of the converter rack/shelf. See Section 16 for a complete description of these input and output signals.

11.8 Alarm Signals – Among the control and supervisory signals are three logic alarms: Input Power Fail, Output Power Good and Over Temperature Warning.

They are logic signals referenced to -Sense, J4 Pin 23. There are logic alarms for each converter module. The first alarm is Input Power Fail. A logic HI indicates that there is no DC input. The second alarm is Output Power Good. A logic HI indicates a DC output failure. The third alarm is Over Temperature Warning. A logic HI indicates the internal air temperature has reached a critical level just prior to the unit shutting down.

12.0 PARALLEL OPERATION

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

MODULE MODEL	OUTPUT VOLTAGE	MODE	# OF MODULES	MAX. OUTPUT CURRENT	OUTPUT WATTS
TPCMQ24-48/21	48.0VDC	2+1 Redundant	3	41.6A	2000
		Non-Redundant		62.4A	3000
TPCMQ24-54/18	54.4VDC	2+1 Redundant	3	36.8A	2000
		Non-Redundant		55.2A	3000
TPCMQ24-48/25	48.0VDC	2+1 Redundant	3	50.0A	2400
		Non-Redundant		75.0A	3600

Figure 7 – Redundant vs. Non-Redundant Output Capacity

12.1 Redundant Operation - 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 converter 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.

See Figure 7.

12.2 Non-Redundant Operation - Higher output current can be achieved by operating the rack/shelf in a non-redundant mode. However, in this case if a converter 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 converter module, however, can be quickly replaced to restore the load current.

See Figure 7.

12.3 Multiple Parallel Shelf Operation - Multiple rack/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 rack/shelves are employed with a total of six converter 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 point of load.

See Figure 8 for a simplified illustration of two converter rack/shelves connected in parallel.

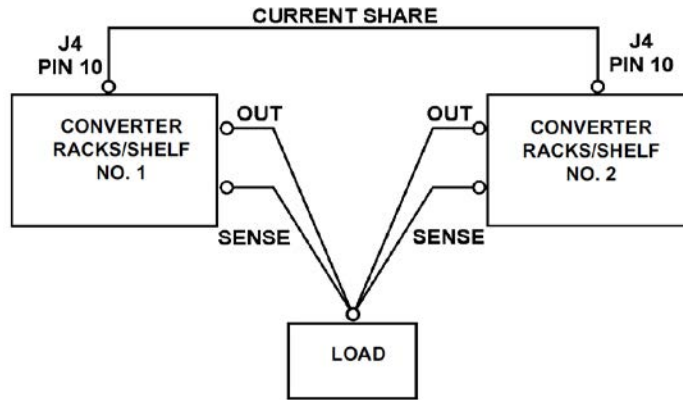


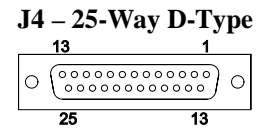
Figure 8 - Connection Diagram for Parallel Operation

13.0 CONTROL & SUPERVISORY SIGNAL CONNECTIONS (RACK/SHELF)

13.1 Connections for control and supervisory signals are made at the rack/shelf rear to connector J4, a standard 25-pin sub-miniature D connector (Positronics No. SD25F0S500X with FC752OD pins). The mating connector is Positronics SD25M0000Z with MC752OD pins.

13.2 The pin connections to J4 are shown in the table below.

PIN	FUNCTION	PIN	FUNCTION
1	Inhibit	14	Input Power Fail - 1
2	Over temp. Warning - 1	15	Output Power Good - 1
3	Current Monitor - 1	16	Input Power Fail - 2
4	Over temp. Warning - 2	17	Output Power Good - 2
5	Current Monitor - 2	18	Input Power Fail - 3
6	Over temp. Warning - 3	19	Output 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	SCL		



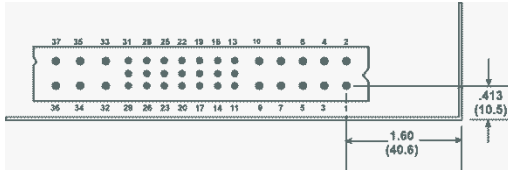
NOTE: Standby return is connected to -Sense lead. Current rating of +5V standby is 250mA. All signals are referenced to -Sense lead. Pins 9 & 13 are I²C functions when that option is fitted. When I²C is present, pins 2-7 and 14-19 have no function.

13.3 I²C Serial Data Bus - The I²C serial data bus (Option Z) is available on both the TPCM24 and TPCM48 modules and rack/shelves. It must be ordered on both. Pin 9 of J4 on the rack/shelf is the SDA (serial data) output and pin 13 is the SCL (serial clock) output. The I²C data output provides output voltage, output current, internal temperature and manufacturing data on each module (model no., serial no., etc.). When this option is present, pins 2 to 7 and 14 to 19 do not function. For complete information on the I²C option, please see the relevant datasheet.

14.0 CONVERTER MODULE CONNECTIONS

If the converter module or modules are used separately from the rack/shelf or in a user configured rack/shelf, connections should be made to the hot-swap connector on the back of the module with the functions shown in Figure 9 for the TPCM24 and Figure 10 for the TPCM48. There is a Mating Interface Board available, providing easy connection for testing purposes.

CONNECTOR: POSITRONICS PCIB37W16RM400A1
MATE: PCIB37W16RF400A



NOTES: For unit to operate, pin 17 must be at logic LO or shorted to pin 30. For proper operation the following pins must be connected together: All +V Out pins (35-37); all -V Out pins (32-34). Pins 24-28 carry I²C functions when the I²C option is fitted.

PIN	FUNCTION	PIN	FUNCTION
1	-DC Input	20	Module Present
2	-DC Input	21	N.C.
3	-DC Input	22	Input Power Fail
4	-DC Input	23	N.C.
5	+DC Input	24	GA2
6	+DC Input	25	GA1
7	+DC Input	26	SCL
8	+DC Input	27	SDA
9	Chassis Ground	28	GA0
10	Chassis Ground	29	V. Adjust
11	N.C.	30	-Sense
12	Standby Return	31	+Sense
13	+5V Standby	32	-V Out
14	Output Power Good	33	-V Out
15	Over temp. Warning	34	-V Out
16	Inhibit	35	+V Out
17	Enable	36	+V Out
18	Current Share	37	+V Out
19	Current Monitor		

Figure 9 – TPCM24 Converter Module Pin Connections

15.0 DESCRIPTION OF RACK/SHELF CONTROL AND SUPERVISORY SIGNALS

SIGNAL	PIN	DESCRIPTION
Inhibit	1	A logic LO or short to Pin 23 turns off all converter modules in the rack/shelf. This input is referenced to -Sense, Pin 23.
Over temp. Warn. – 1	2	A logic HI indicates an over temperature condition inside the indicated module. The HI occurs a few milliseconds before the unit shuts down. This signal is referenced to -Sense, Pin 23.
Over temp. Warn. – 2	4	
Over temp. Warn. – 3	6	
Current Monitor – 1	3	An analogue output voltage of the indicated module is proportional to its output current. This signal is referenced to -Sense, Pin 23.
Current Monitor – 2	5	
Current Monitor – 3	7	
+5V Standby	8	This is a +5V, 250mA output. It is referenced to the -Sense, Pin 23.
Current Share	10	This is an analogue control signal made up of the current share signals of all converter modules connected together. This pin is used to connect to Pin 10 of another identical converter 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 converter shelf. The correct polarities must be maintained.
Input Power Good – 1	14	A logic LO indicates the DC input is present at each indicated module. A logic HI indicates DC input failure. This signal is referenced to -Sense, Pin 23.
Input Power Good – 2	16	
Input Power Good – 3	18	
Output Power Good – 1	15	A logic LO indicates that the indicated module is operating properly with output voltage in its controllable range. A logic HI indicates the output is outside the -25 to +10% output range for the converter, the unit has failed or is in current limit. This signal is referenced to -Sense, Pin 23.
Output Power Good – 2	17	
Output Power Good – 3	19	
Module Present – 1	24	These are analogue voltage inputs to the designated converter modules by which the output voltage is adjusted. A zero to +5V input represents approximately -25 to +10% output change for a converter. This input should be driven from a source impedance less than 100 ohms and is referenced to -Sense, Pin 23.
Module Present – 2	12	
Module Present – 3	25	
-Sense	23	This is the reference pin for the above signals.

16.0 INSTALLATION

16.1 Mounting - The TPCM24 Series converter rack/shelves are mounted in a rack by means of mounting brackets on each side. One set of standard brackets is supplied with each rack/shelf. The rack/shelf mounts in a 19-inch rack, but brackets are available for mounting in a 23-inch rack (order no. 775-1451-0000, set of two). There are seven different bracket positions on the side of the rack/shelf, from front position to 6 inches from the front.

When mounting, the rack/shelf should first be securely mounted to the rack, then the converter modules inserted into the rack/shelf. The converter modules should be secured by tightening the jack screw on each module.

16.2 Input Power Connections - The DC input connections to the converter rack/shelf are shown in Figure 4. As shown, there are separate bus bar connections for each converter module. The stud connections, labelled by converter module number, are no. 8-32. Shorting bars are available for each rack/shelf so that all three inputs are in parallel. See data sheets in Appendix for ordering information.

16.3 DC Output Connections - The DC output connections are shown in Figure 4. 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. The bus bars has no. ¼ - 20 studs with nut. The output wires or bus bars should be sized in accordance with the load current and length of conductor. UNIPOWER can supply various pre-made DC load cables; see the current datasheet for available options. Users wishing to fabricate their own DC cables should note that such cables should be rated to handle at least 200A.

16.4 Contact Resistance - Connection to the input and output bus bars should be clean and tight to minimize contact resistance.

16.5 Control and Supervisory Signal Connections (Rack/Shelf) - These connections are made to J4, a sub-miniature D, 25-pin connector (Positronics No. SD25F0S500X) by means of the mating connector. Details for these connections are given in Section 13.

16.6 Cooling - Each converter module is cooled by three 40 mm DC ball bearing fans. For proper cooling, the area in front of the fan and around the air exits should be kept clear for unimpeded air flow.

17.0 MAINTENANCE

No routine maintenance is required on the TPCM24 series except for periodic cleaning of dust and dirt around the front ventilation grill. A small vacuum nozzle should be used for this purpose.

18.0 DC/DC CONVERTER AND RACK/SHELF SETUP AND TESTING

- 18.1 The converter modules and rack/shelf can be initially tested mounted in a rack or on a test bench. The converter system is initially tested one converter module at a time.
- 18.2 Connect DC power wires to converter module no. 1 bus bar connector on the back of the rack/shelf. Do not connect the DC wires to the DC source yet.
- 18.3 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 converter module.
- 18.4 Connect a color-coded, twisted 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.
- 18.5 Insert one of the converter modules into slot 1 of the rack/shelf (leftmost slot.) Connect the DC power wires to the appropriate source and measure the voltage across the load at the remote sense points with a DC digital voltmeter. The voltage should be approximately the specified voltage for the module (48 or 54.4VDC).
- 18.6 **Checking Front Panel LEDs** - The Input Power Good and Output Power Good LEDs should both be green.
- 18.7 **Checking the Inhibit Input** - Next, connect a wire going from J4 Pin 1 to Pin 23. The converter output should turn off, giving zero volts across the load. The Output Power Good LED should go off. Disconnect the wire.
- 18.8 **Checking the Input Power Fail and Output Power Good Signals** - Measure the output voltage at both J4 Pins 14 and 15 with respect to -Sense (Pin 23) with a DC digital voltmeter. Both voltages should be less than 0.5VDC, indicating a logic LO.
- 18.9 **Checking the Remote Adjust Input** - Connect a variable external power supply as shown in Figure 11 below. With its output voltage set to zero, check the output voltage of the converter module with a DC digital voltmeter.

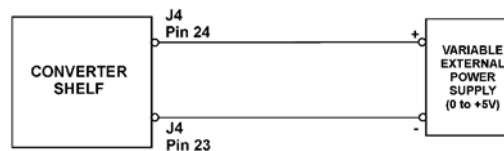


Figure 10 – Checking the Remote Adjust Input

The output voltage should be approximately 25% below its nominal value. Disconnect the external 5V supply and disconnect the DC input to the converter rack/shelf.

- 18.10 **Checking the Other Converter Modules** - Each converter module should be tested in the above manner to verify its operation. Go back to Section 18.5 and proceed through the tests one by one until all converter modules have been verified.

- 18.11** Checking the Complete Converter Rack/Shelf - Confirm that the output voltages of the individual converter modules are all set to approximately their specified output voltages. Insert all three converter modules into the rack/shelf. Connect a power load to the output—high-power resistor or electronic load in resistive mode—to give 50% of the maximum output current for the non-redundant mode of the modules shown in Figure 7. Connect the + and - Sense leads to the + and - sides of the load, respectively, as in Section 18.4.

Note that on the back of the rack/shelf each converter module has its own DC power connection. Connect the rack/shelf inputs to the DC power source: Shorting bars may be used for a single input correction. Check the load voltage with a DC digital voltmeter. It should be close to the specified value for the model tested. The Input Power Good and Output Power Good LEDs should both be green on each converter module.

- 18.12** While the rack/shelf is operating, pull Module no. 1 out while monitoring the output voltage with a DC digital voltmeter. It should remain the same. Insert the module back into the rack/shelf. Repeat this for each of the other modules. This test determines that hot-swapping is functioning properly in the N+1 redundant mode.
- 18.13** With all the modules inserted into the rack/shelf, check the Inhibit input for the entire system. Connect a wire from J4 Pin 1 to Pin 23. The system output should turn off, and the output voltage should go to zero. Reconnect the wire. This completes the rack/shelf setup and testing. Disconnect the DC power source.

19.0 TROUBLESHOOTING GUIDE

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

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

In the event that you are unable to rectify the fault using the above guide please contact technical support for assistance:

Tel: US - +1 954 346 2442 or UK - +44 1903 768200

Email: customer.services@unipowerco.com

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