



**OPERATING MANUAL
RACK-MOUNT DC/DC CONVERTERS
TPCMQ48/TPCMQ24 SERIES**

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**Manual No. TPCM-Q-051209
TPCMQ-ManRevD-051209**

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OPERATING MANUAL TPCMQ48 & TPCM24 SERIES DC/DC CONVERTERS AND RACK/SHELF

1.0 INTRODUCTION

This operating manual should be read through carefully before installing and operating the TPCM48 and TPCM24 DC/DC converter systems.

Unipower's 1U high DC/DC converter systems convert a 48VDC nominal input to 12 and 13.6VDC at 1800 and 1950 watts, respectively, or to 24 and 27.2VDC at 2,100 watts; or a 24VDC nominal input to 48 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 40 to 60 or 20 to 30VDC, and the output has a -25 to +10% adjustment range. In 2+1 redundant operation the output is 1,400 watts for the TPCM48 or 2,000 watts for the TPCM24. In this case a converter module can be hot-swapped without affecting the output. The output voltage can be controlled by a remote analog input in the range 0 to +5V.

Each TPCM48 converter module produces 12, 13.6, 24 or 27.2VDC at 700 watts, and each TPCM24 module produces 48 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 12.5 watts per cubic inch power density.

A 25-pin interface subminiature 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 and output power good logic signals, and analog 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. TPCMQ48/TPCMQ24 DC/DC Converter Module and Rack/Shelf.

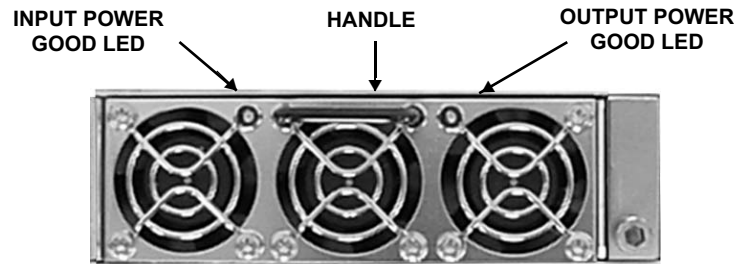


Figure 2. Front Panel of TPCMQ48/TPCMQ24 DC/DC Converter Module.

2.0 FEATURES

The following is a summary of the important features of the TPCMQ 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 12.5 Watts/Cubic Inch
- ◆ Up to 89% Efficiency
- ◆ Wide Range DC Inputs
- ◆ I²C Serial Data Bus Option
- ◆ Remote Sensing
- ◆ Active, Single-Wire Load Sharing
- ◆ 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

3.1 DC/DC Converter Modules

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. SYSTEM CURRENT*
TPCMQ48-12/54	40-60VDC	12VDC	54.2A	150A
TPCMQ48-13/48	40-60VDC	13.6VDC	47.8A	143.4A
TPCMQ48-24/29	40-60VDC	24VDC	29.2A	87.6A
TPCMQ48-27/26	40-60VDC	27.2VDC	25.7A	77.1A
TPCMQ24-48/20	40-60VDC	48VDC	20.8A	62.4A
TPCMQ24-54/18	40-60VDC	54.4VDC	18.4A	55.2A

* For 3 Modules in a rackshelf

3.2 System Rack/Shelves

MODEL	WIDTH	HEIGHT	NO. MODULES
TPCMQR1U3-48	19" (483 mm)	1.72" (43.7 mm)	3
TPCMQR1U3-24	19" (483 mm)	1.72" (43.7 mm)	3

NOTE: System shelf and hot-swap modules must be ordered separately.

3.3 Options

CODE	DESCRIPTION
Z	I ² C Serial Data Bus

NOTE: Add Option Code as suffix to model no. on both modules and rack/shelf.
Contact factory on availability of Option Z.

4.0 SAFETY WARNINGS

- 3.1 **These converter modules and shelf 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 converter system, the frame ground terminal must be connected to safety ground to minimize electrical shock hazard.
- 4.4 The internal voltages are at hazardous potentials. The converter 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 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** These TPCMQ Series DC/DC Converters were carefully tested, inspected and packaged for shipment from our factory. Upon receipt of them they 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 converter 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 converter system without proper packing.

7.0 FRONT PANEL DESCRIPTION

The front panel of a TPCMQ converter module is shown in Figure 2. 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.

8.0 DC/DC CONVERTER MODULE SPECIFICATIONS

Specifications for a Single Converter Module. Typical at 24 or 48VDC Input, Full Load and 25°C Unless Otherwise Noted.

INPUT	TPCMQ48	TPCMQ24
Voltage Range	40-60VDC	20-30VDC
Inrush Current Limiting	20A Peak	100A Peak
Input Current, Full Load	16.6A@48VDC	46.8A@24VDC
EMI Filter, Conducted	Standard	Standard
Analog Voltage Adjust Input	0 to +5V	0 to +5V
Input Protection	Internal Fuse, 30A	Internal Fuse, 100A
OUTPUT		
Current & Voltage ¹ ,	54.2A@12VDC	20.8A@48VDC
.....	47.8A@13.6VDC	18.4A@54.4VDC
.....	29.2A@24VDC	
.....	25.7A@27.2VDC	
Voltage Adjustment Range, Remote	-25 to +10%	-25 to +10%
Voltage Trim Pot Adjust	±5%	±4%

OUTPUT (Cont'd)

Total Regulation, Max.	2.0%	2.0%
Oversvoltage Protection	Latched Shutdown	Latched Shutdown
Filtering: Wideband Noise, 20MHz BW, P-P	2.0%	2.0%
Voice Band Noise	<32dBnC	<32dBnC
Current Limit	105% Rated Current	105% Rated Current
Efficiency	86%	89%

SAFETY STANDARDS UL60950, CSA22.2 No.60950, EN60950

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	Aluminum
Rack/Shelf	Aluminum
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.)

NOTE: 1. Voltage set at factory.

9.0 DESCRIPTION OF FEATURES & OPTIONS

FEATURE / OPTION	DESCRIPTION
Wide Range DC Input	The DC input range is from 40 to 60 or 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 $\pm 5\%$.
Remote Output Adjust	This input is used to remotely adjust each converter output voltage. An analog 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 analog 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 TPCMQ 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.

9.0 DESCRIPTION OF FEATURES & OPTIONS (cont'd)

FEATURE / OPTION	DESCRIPTION
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 TPCMQ Series converter modules and the rack/shelves are shown in Fig. 3.

11.0 SAFETY AND INDUSTRY STANDARDS

11.1 The TPCMQ DC/DC Converters and rack/shelves meet the following safety certifications:

STANDARD	AGENCY
UL60950	UL
CSA22.2 No. 60950	CUL
EN60950	DEMKO

11.2 The TPCMQ DC/DC Converters and rack/shelves are CE marked to indicate conformance to the European Union's Low Voltage Directive.

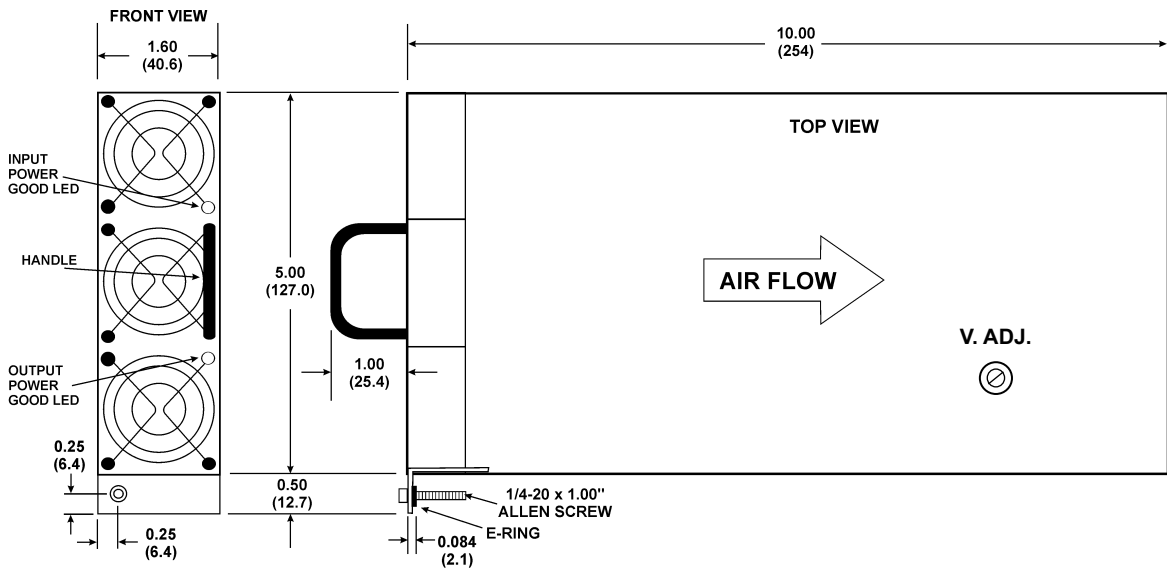


Figure 3. TPCMQ48/TPCMQ24 Series Module Mechanical Dimensions.

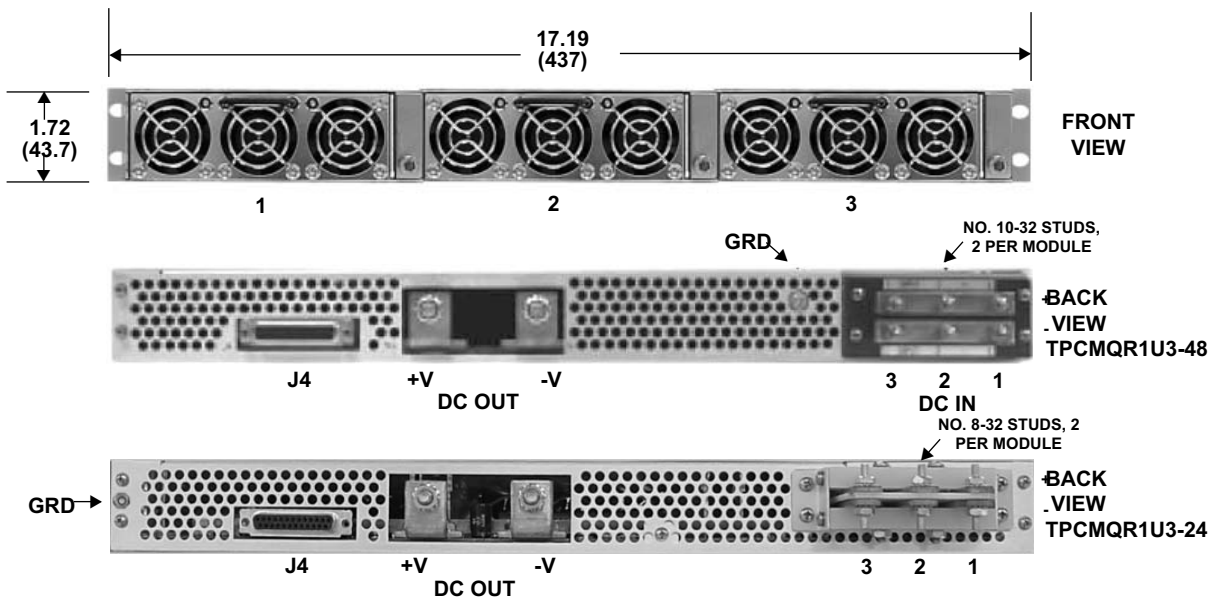


Figure 4. Front and Back of TPCMQ Series Rack/Shelves

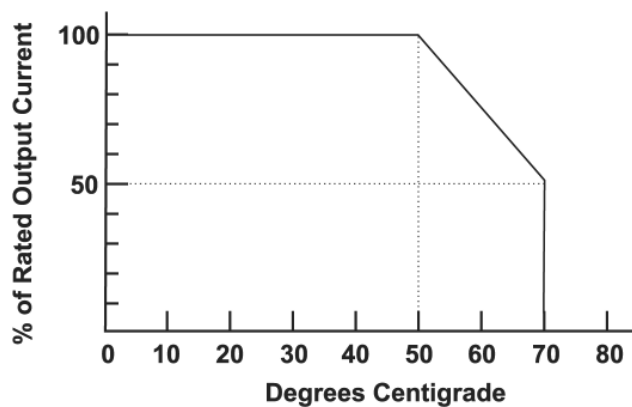


Figure 5. Rated Output Current vs. Ambient Temperature

12.0 OPERATING INFORMATION

- 12.1 Input Voltage.** The TPCMQ Series converters operate off DC input voltages within the range of 40 to 60 or 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 17.2 and Figure 4.
- 12.2 Output Connection.** 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. Both positive and negative outputs are floating and isolated from the chassis.
- 12.3 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. See Figure 3. This adjustment has a range of approximately $\pm 5\%$ for the TPCMQ48 and $\pm 4\%$ for the TPCMQ24.

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 16 of the TPCMQ48 and pin 29 of the TPCMQ24. On the rack/shelf the Remote adjust is found at J4 pins 12, 24 & 25 for each module. A zero to $+5\text{V}$ input to these pins adjusts the output from -25% to $+10\%$. An input voltage of $+2.5\text{V}$, 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 analog control voltage by connecting J4 pins 12, 24 & 25 together.

- 12.4 Output Power.** Maximum output power for the TPCMQ48 modules is 700 watts for the 24 or 27.2V output models and 650 watts for the 12 or 13.6V models. The maximum output power for the TPCMQ24 modules is 1,000 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 $2.5\%/^\circ\text{C}$. 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 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.

- 12.6 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 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 at the back of the converter rack/shelf. See Section 16 for a complete description of these input and output signals.

- 12.8 Alarm Signals.** Among the control and supervisory signals are three logic alarms: Input Power Fail, Output Power Good and Overtemperature 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 Overtemperature Warning. A logic HI indicates the internal air temperature has reached a critical level just prior to the unit shutting down.

13.0 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.

- 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 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

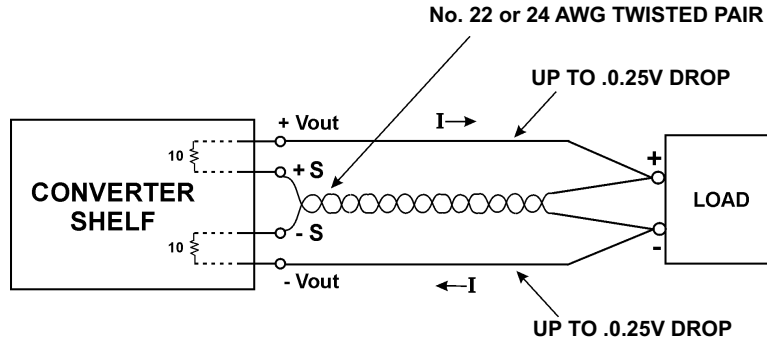


Figure 6. Remote Sensing Connection

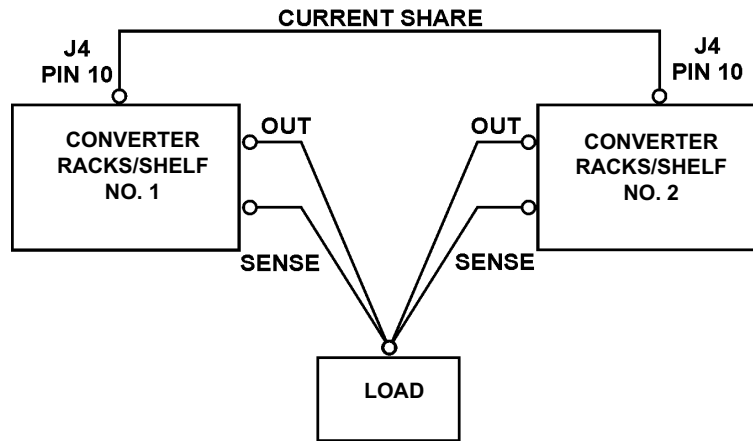


Figure 7. Parallel Connection of TPCMQ Rack/Shelves.

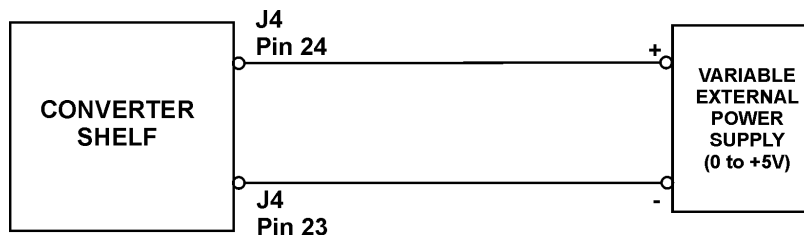


Figure 8. Checking the Remote Adjust Input

the output current to the load. N+1 redundancy with quick replacement of a failed module results in virtually infinite MTBF.

Table 13-1 Redundant and Non-Redundant Operation

MODULE MODEL NO.	OUTPUT VOLTS	MODE	NO. OF MODULES	MAX. OUTPUT CURRENT	OUTPUT WATTS
TPCMQ48-12/54	12V	2+1 Redundant	3	108.4A	1300
TPCMQ48-12/54	12V	Non-Redundant	3	150.0A	1800
TPCMQ48-13/48	13.6V	2+1 Redundant	3	95.6A	1300
TPCMQ48-13/48	13.6V	Non-Redundant	3	143.4A	1950
TPCMQ48-24/29	24V	2+1 Redundant	3	58.4A	1400
TPCMQ48-24/29	24V	Non-Redundant	3	87.6A	2100
TPCMQ48-27/26	27.2V	2+1 Redundant	3	51.4A	1400
TPCMQ48-27/26	27.2V	Non-Redundant	3	77.1A	2100
TPCMQ24-48/20	48V	2+1 Redundant	3	41.6A	2000
TPCMQ24-48/20	48V	Non-Redundant	3	62.4A	3000
TPCMQ24-54/18	54.4V	2+1 Redundant	3	36.8A	2000
TPCMQ24-54/18	54.4V	Non-Redundant	3	55.2A	3000

13.2 Non-Redundant Operation. Higher output current can be achieved by operating the rack/shelf in a non-redundant mode as also seen in Table 13-1. 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.

Note that the rack/shelf output current is limited to 150A, and therefore the output of three 12V modules is not 162.6A as is their capability.

13.3 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 7 for a simplified illustration of two converter rack/shelves connected in parallel.

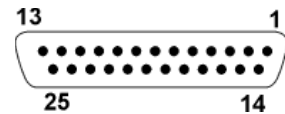
14.0 CONTROL & SUPERVISORY SIGNAL CONNECTIONS

14.1 Connections for control and supervisory signals are made at the rack/shelf rear to connector J4, a standard 25-pin subminiature D connector (Positronics No. SD25F0S5OOX with FC752OD pins). The mating connector is Positronics SD25M00OOZ with MC752OD pins.

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

J4 SIGNAL CONNECTOR

J4 PIN CONNECTIONS			
PIN	FUNCTION	PIN	FUNCTION
1	Inhibit	14	Input Power Fail -1
2	Overtemp. Warning -1	15	Output Power Good -1
3	Current Monitor -1	16	Input Power Fail -2
4	Overtemp. Warning -2	17	Output Power Good -2
5	Current Monitor -2	18	Input Power Fail - 3
6	Overtemp. 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		



Standard subminiature D Connector
 (Positronic SD25F0S5OOX with FC752OD pins)

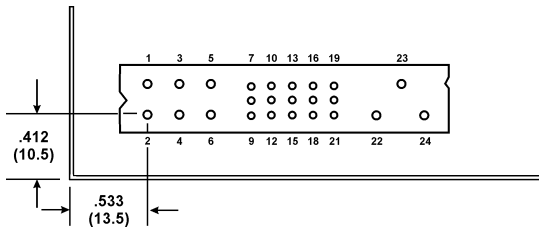
NOTES: Standby return is connected to -Sense lead. Current rating of +5V standby is 250mA. All signals are referenced to -Sense lead. Pins 9 & 13 are I²C functions when that option is fitted. When I²C is present, pins 2-7 and 14-19 have no function.

14.3 I²C Serial Data Bus. The I²C serial data bus (Option Z) is available on both the TPCMQ48 and TPCMQ24 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 contact the factory.

15.0 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 TPCM48 and Figure 10 for the TPCM24. There is a Mating Interface Board available for the TPCM48 module (but not the TPCM24), providing easy connections for testing purposes.

CONNECTOR: POSITRONICS PCIB26W11M400A1
MATE: PCIB26W11F400A



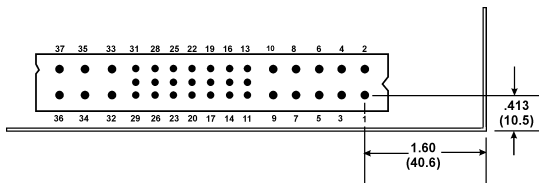
NOTES: For unit to operate, pin 7 must be at logic LO or shorted to pin 9. For proper operation the following pins must be connected together: All V Out pins (1-3); all V Return pins (4-6). Pins 11, 12, 14, 17 & 19 carry I²C functions when the I²C option is fitted.

MATING INTERFACE BOARD
Order Kit Number
009-0280-0009

PIN CONNECTIONS			
PIN	FUNCTION	PIN	FUNCTION
1	+V Out	14	Output Power Good/ADD GA1
2	+V Out	15	Input Power Fail
3	+V Out	16	V Trim
4	V Return	17	Overtemp. Warning/ADD GA0
5	V Return	18	Current Share
6	V Return	19	Current Monitor/ADD GA2
7	Enable	20	+5V Standby
8	+ Sense	21	Standby Return
9	- Sense	22	Chassis Ground
10	Inhibit	23	Chassis Ground
11	Spare/SDA	24	-DC Input
12	Spare/SCL	25	-DC Input
13	- Sense	26	+DC Input

Figure 9. TPCM48 Converter Module Pin Connections

CONNECTOR: POSITRONICS PCIM37W16RM400A1
MATE: PCIM37W16RF400A1



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 CONNECTIONS			
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	Overtemp. Warning	34	-V Out
16	Inhibit	35	+V Out
17	Enable	36	+V Out
18	Current Share	37	+V Out
19	Current Monitor		

Figure 10. TPCM24 Converter Module Pin Connections

16.0 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.
Overtemp. Warn. - 1 Overtemp. Warn. - 2 Overtemp. Warn. - 3	2 4 6	A logic HI indicates an overtemperature condition inside the indicated module. 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 of the indicated module is proportional to its 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.
Current Share	10	This is an analog 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 Input Power Good - 2 Input Power Good - 3	14 16 18	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.
Output Power Good - 1 Output Power Good - 2 Output Power Good - 3	15 17 19	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.

16.0 DESCRIPTION OF RACK/SHELF CONTROL AND SUPERVISORY SIGNALS

SIGNAL	PIN	DESCRIPTION
Module Present - 1 Module Present - 2 Module Present - 3	20 21 22	A logic LO means the indicated module is present; an open indicates the 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 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.
-Sense	23	This is the reference pin for the above signals.

17.0 INSTALLATION

- 17.1 Mounting.** The TPCMQ 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.
- 17.2 DC Input 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, labeled by converter module number, are no. 10-32 for TPCMQR1U3-48 and no.8-2 for TPCMQR1U3-24. Shorting bars are available for each rack/shelf so that all three inputs are in parallel. See data sheets in Appendix for ordering information.
- 17.3 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. Each bus bar has a no. $\frac{1}{4}$ - 20 stud with nut. The output wires or bus bars should be sized in accordance with the load current and length of conductor.
- 17.4 Contact Resistance.** Connection to the input and output bus bars should be clean and tight to minimize contact resistance.
- 17.5 Control and Supervisory Signal Connections.** These connections are made to J4, a subminiature D, 25-pin connector (Positronics No. SD25F0S5OOX) by means of the mating connector. Details for these connections are given in Section 14.
- 17.6 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.

18.0 MAINTENANCE

No routine maintenance is required on the TPCM48 or TPCM24 Series except for periodic cleaning of dust and dirt around the fans. A small vacuum nozzle should be used for this.

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

- 19.1** 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.
- 19.2** 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.
- 19.3** 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.
- 19.4** 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.
- 19.5** Insert one of the converter modules into slot 1 of the rack/shelf (left-most slot.) Connect the DC power wires to the appropriate source (24 or 48VDC) 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 (12, 13.6, 24, 27.2, 48 or 54.4VDC).
- 19.6** **Checking the Front Panel LEDs.** The Input Power Good and Output Power Good LEDs should both be green.
- 19.7** **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.

- 19.8 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.
- 19.9 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 converter module with a DC digital voltmeter. 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.
- 19.10 Checking the Other Converter Modules.** Each converter module should be tested in the above manner to verify its operation. Go back to Section 19.5 and proceed through the tests one by one until all converter modules have been verified.
- 19.11 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 Table 13-1. Connect the + and - Sense leads to the + and - sides of the load, respectively, as in Section 19.4.

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 connection. 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.

- 19.12** 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.
- 19.13** 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.

20.0 TROUBLESHOOTING GUIDE

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

20.2 Table 20-1. TPCMQ48/TPCMQ24 Converter System Troubleshooting

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.
No output, Output Good LED off, Input Good LED on.	Shorted output.	Check for short and remove.
No output, Output Good LED off, Input Good LED on.	Overtoltage protection (OVP) has latched.	Reset output by cycling the DC input OFF and then back ON.
No output, Output Good LED off, Input Good LED on.	Overtemperature 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.
Low or no output, Output Good LED off, Input Good LED on.	Output load is too great for the number of converter modules.	Reduce load to proper level.