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**OPERATING MANUAL**  
**PCM/TPCM SERIES PowerCassette®**  
**FRONT-END SWITCHERS**

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

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## OPERATING MANUAL

### PCM/TPCM SERIES PowerCassette® NEXT GENERATION FRONT-END SWITCHER

#### 1.0 INTRODUCTION

This operating manual should be read through carefully before installing and operating the PCM/TPCM Series PowerCassette®.

The PowerCassette is an advanced-design, front-end switching power supply that employs a unique, new architecture which permits quick factory programming of its output. There is a high current output and a 5VDC ¼ ampere independent standby output. Maximum continuous output power is 650, 700 or 800 watts, with available voltages of 12, 24 or 48VDC, respectively.

The PowerCassette front-end is ultra-compact, only 1.6 inches high, 5 inches wide and 10 inches deep, producing up to 10 watts per cubic inch power density. The unit comes in two versions: the PCM model which is the standard, non-hot-swap version; and the TPCM model, which is the hot-swap version with a handle and mounting bracket with jackscrews. See Figure 1. There is also an IEC AC input connector with switch option and a reverse air flow option. Both of these have reduced output capability.

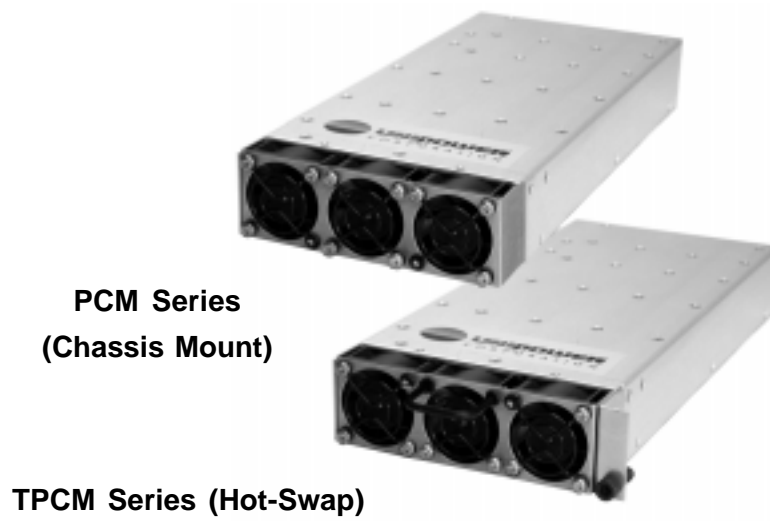
PowerCassette incorporates control and monitoring features including enable and inhibit inputs, AC power fail and DC power good signals, overtemperature warning and remote sensing. The front panel has two LED status indicators: one for AC Power Fail and the other for DC Power Good. The output has a single-wire, current sharing capability.

Two 19-inch, 1U-high racks are available to hold two or three PowerCassette units connected in parallel to give up to 800 watts with 1+1 redundancy or 1600 watts with non-redundant operation for the two-unit rack or up to 1600 watts with 2+1 redundancy or 2400 watts with non-redundant operation for the three-unit rack. The racks feature IEC60320 AC input connections.

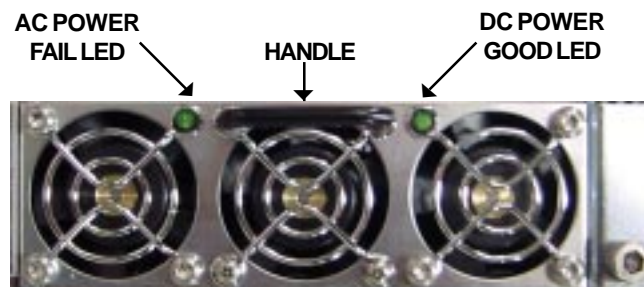
#### 2.0 FEATURES

The following is a summary of the important features of the PowerCassette front-end:

- ◆ Includes Isolated 5V, ¼ A Standby Output



**Figure 1. PowerCassette Front-End Models PCM and TPCM**



**Figure 2. Front Panel of the PowerCassette Front End**



- ◆ Hot-Swap or Chassis Mount Versions
- ◆ IEC 60320 Input Option with Switch
- ◆ 12, 24, or 48 VDC Outputs
- ◆ Integral LED Status Indicators
- ◆ Up to 10 Watts/Cubic Inch Power Density
- ◆ Power Factor Corrected
- ◆ Low Profile: 1.6 Inches High
- ◆ Single Hot-Swappable Connector
- ◆ Staged Pin Lengths
- ◆ ORing Diode on Output
- ◆ 1U, 19" Racks Hold 2 or 3 Units\*
- ◆ Active Current Sharing
- ◆ Universal 85 to 264VAC Input
- ◆ Class B EMI Input Filter
- ◆ Optimized Thermal Management
- ◆ No Minimum Load
- ◆ Control & Monitoring Features

\*TPCM Models

### 3.0 SUMMARY OF PRODUCT LINE

#### 3.1 Standard & Optional Models

Delete "T" prefix to model no. for chassis mount version.

CONFIGURATION	MAX. OUTPUT POWER	OUTPUT VOLTAGE	OUTPUT CURRENT	INPUT VOLTAGE	PFC	MODEL NUMBER
 Standard Rear Input/Output	650W	12VDC	54.2A	85-264VAC	YES	TPCM3000
	700W	24VDC	29.2A	85-264VAC	YES	TPCM5000
	800W	48VDC	16.7A	85-264VAC	YES	TPCM7000
 Optional Front IEC Input	480W	12VDC	40.0A	85-264VAC	YES	TPCM3000E
	525W	24VDC	21.9A	85-264VAC	YES	TPCM5000E
	600W	48VDC	12.5A	85-264VAC	YES	TPCM7000E

**NOTE:** The table does not show the independent 5V, ¼A standby output which is standard on all models.

#### 3.2 Options

SUFFIX CODE	OPTION	OUTPUT DERATING
R	Reverse Air Flow (Back to Front) on Standard Models	20%
R	Reverse Air Flow on "E" Suffix Models	16.6%
Z	I <sup>2</sup> C Serial Data Bus	N/A

**3.3 19-Inch Compatible Racks.** These racks hold two or three TPCM units.

Rack Model No.:    TPCMR1U2 for Two Units  
                          TPCMR1U3 for Three Units

## **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**

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 PowerCassette 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 supply 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 supply without proper packing.

## 7.0 FRONT PANEL DESCRIPTION

The front panel of the PowerCassette is shown in Figure 2. On the left top of the panel is the AC Power Fail LED (green) and on the right top is the DC Power Good LED (green). For the TPCM model there is a handle between the two LEDs. Also for this model there is a mounting bracket on the right side of the front panel. This has a jackscrew (Allen bolt) for securing the unit. Figure 3 shows the front of the IEC input version (Option E).

## 8.0 POWERCASSETTE SPECIFICATIONS

Typical at 120/230VAC Line, Full Load and 25°C Unless Otherwise Noted.

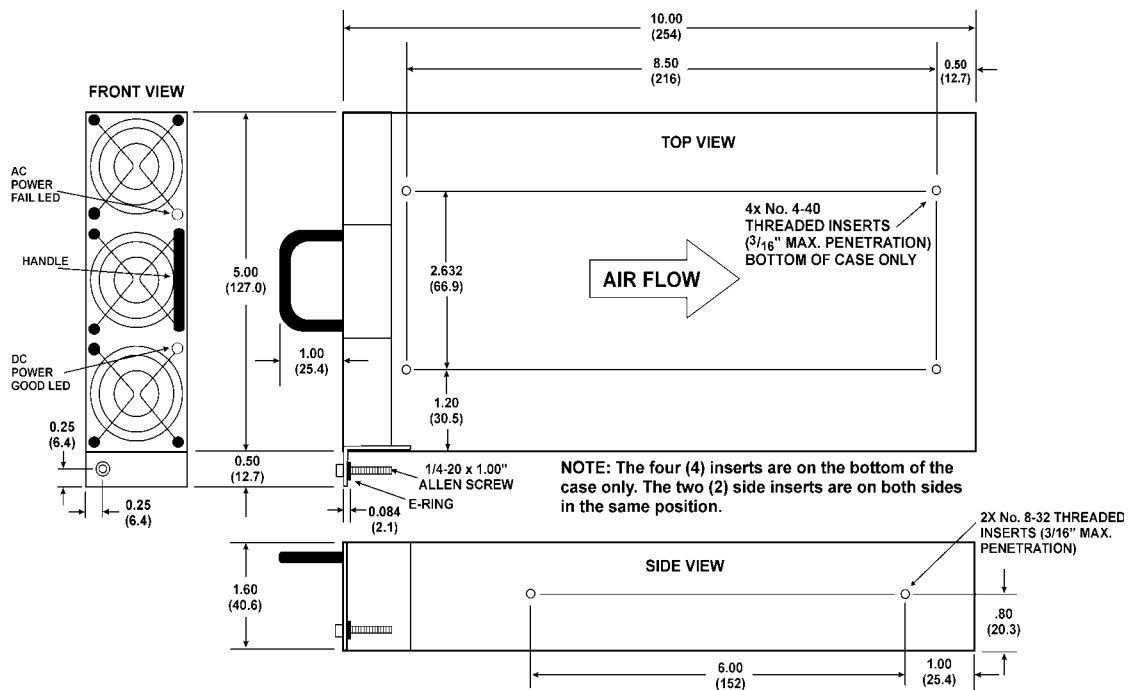
### OUTPUT SPECIFICATIONS

Total Output Power, Continuous, Max. ....	480-800 Watts
Voltage Adjustment Range, Min. ....	±5%
Total Regulation <sup>1</sup> , ....	2.0%
Total Regulation <sup>1</sup> , Standby Supply ....	5.0%
Ripple & Noise, Pk-Pk <sup>2</sup> ....	1%
Holdup Time ....	20mS
Dynamic Response <sup>3</sup> ....	300µS
Temperature Coefficient ....	±0.02%/°C
Minimum Load, Any Output ....	0A
Overload Protection ....	Auto Recovery
Overvoltage Protection ....	Latched Shutdown
Remote Sense ....	Up to 0.25V Per Wire
Current Share ....	±10% Full Load Rating





Figure 3. IEC Input Version (Option E)



NOTE: The TPCM Model is shown. The PCM version does not have handle or mounting bracket with bolt. Maximum torque on the threaded inserts is 6 inch-pounds.

Figure 4. Mechanical Dimensions of PowerCassette

Standby Output .....	+5V, 250mA
DC Power Good Signal .....	Logic Low
AC Power Fail Signal .....	Logic High
Inhibit .....	Logic Low
Enable .....	Logic Low
Thermal Warning .....	Logic High

### INPUT SPECIFICATIONS

Input Voltage Range .....	85-264VAC
Power Factor .....	0.99
Input Frequency .....	47-63Hz
Inrush Current Limiting .....	30A Peak
Input EMI Filter .....	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 .....	±2kV (EN61000-4-5 Level 3)
Surges, Line-Ground .....	±4kV (EN61000-4-5 Level 4)
Input Protection .....	Internal Fuse, 20A

### GENERAL SPECIFICATIONS

Efficiency <sup>4</sup> .....	75-85% at Full Load
Switching Frequency, PFC Converter .....	48-110kHz
Output Converter .....	275kHz Nominal
Isolation, Class I, min. <sup>5</sup>	
Input-Output .....	3000VAC
Input-Ground .....	1500VAC
Output-Ground .....	50VDC
MTBF (Bellcore) .....	200,000 Hours
Safety Standards .....	EN60950, UL1950, CSA22.2 No.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 .....	Integral Ball Bearing Fans

### PHYSICAL SPECIFICATIONS

Case Material .....	Aluminum
Dimensions, Inches(mm) .....	1.6 H x 5.0 W x 10.0 D (40.6 x 127 x 254)
Weight .....	3.15 lbs. (1.43 kg.)

#### NOTES:

1. No load to full load, including line regulation and load regulation.
2. Whichever is greater. 20MHz bandwidth. Measure with 0.1µF ceramic and 10µF tantalum capacitors in parallel across the output.
3. <4% deviation recovering to within 1% for 25% load change.
4. Typical efficiency is at low end of range for 12V output and at high end of range of 48V output.
5. Input-output isolation figure is for isolation components only. 100% production Hipot tested.

## 9.0 DESCRIPTION OF FEATURES & OPTIONS

FEATURE / OPTION	DESCRIPTION
<b>Power Factor Correction</b>	The input current is a sine wave in-phase with the input voltage to give a power factor of 0.99. Input current total harmonic distortion meets EN61000-3-2.
<b>Wide Range AC Input</b>	The AC input range is continuous from 85 to 265VAC, 47-63Hz, for worldwide operation.
<b>EMI Input Filter</b>	This filter suppresses conducted noise from the supply back onto the AC line. The filter meets FCC20780 part 15J Curve B and EN55022 Curve B.
<b>Inrush Current Limiting</b>	When the unit is turned on, the initial input current is limited to a peak value of 30 amperes AC. This is accomplished by an active current limiting circuit (not a thermistor).
<b>Thermal Protection</b>	If the PowerCassette overheats internally, it will automatically shut down. The DC Power Good LED turns off. The Overtemperature Warning goes HI and the DC Power Good signal goes HI. After a few minutes the unit will cool down and automatically start up again.
<b>Current Sharing</b>	The PowerCassette front end will automatically current share with another identical unit. A single-wire connection provides this. The output actively current shares with an accuracy of 10% of full load output current for a total load of 50% to 100%.
<b>ORing Diodes</b>	A diode in series with the output protects the output of parallel-connected PowerCassettes. If one output fails to a short or to a lower than normal output voltage, the other output is not affected. Also when hot-swapping units in the rack, the diode prevents a glitch in the output voltage while the output is still rising on the inserted supply. The 5V, ¼A standby output also has an ORing diode.
<b>5V, ¼A Standby Output</b>	This is an independent output which is not controlled by the Enable or Inhibit inputs. This output also has an ORing diode and can be paralalled with another PowerCassette Standby Output.
<b>Overvoltage Protection</b>	The output is protected from overvoltage due to fault conditions in the supply. Overvoltage protection is set at approximately 10% above the nominal output voltage level. The result is a latched shutdown of the supply. It is reset by cycling the AC input off and then back on.
<b>No Load Operation</b>	The PowerCassette output can be operated down to zero load while maintaining output regulation.

FEATURE / OPTION	DESCRIPTION
<b>Hot-Swap Connectors</b>	The hot-swap connectors used in both the PowerCassette and rack are specifically designed for hot-swap applications. They have staged pin engagement for safety and optimum operation. The ground (common) and AC pins make first contact and the enable pin makes last contact, turning the unit on (provided it is not “inhibited”).
<b>Hot-Swap Operation</b>	Hot-swap operation means that a PowerCassette can be removed and replaced while the rack is powering the load. If the rack is operated in a redundant mode, hot-swap replacement will not affect the output voltage.
<b>Output Protection</b>	Output current limiting protects the output of the PowerCassette 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.
<b>LED Indicators</b>	The AC Power Fail indicator is a green LED, showing that input power is present. The DC Power Good indicator is a green LED showing that the output voltage is present and within operating range.
<b>Control and Monitoring Signals</b>	For detailed descriptions of Enable/Inhibit, Current Share, Remote Sense, Input Power Fail and Output Power Good signals, see Section 15, Description of Control and Supervisory Signals.
<b>IEC AC Input (Option E)</b>	The Option E version of the PowerCassette front end has an IEC60320 AC front input connector with a switch, and two fans. See Figure 3. Output power is reduced as shown in the model table.

## 10.0 MECHANICAL SPECIFICATIONS

The mechanical dimensions of the PowerCassette are shown in Figure 4. Please note the maximum torque on the threaded inserts.

## 11.0 SAFETY AND INDUSTRY STANDARDS

11.1 The PowerCassette meets the following safety certifications:

<b>STANDARD</b>	<b>AGENCY</b>
UL1950	UL
CSA22.2 No.950	CUL
EN60950	DEMKO

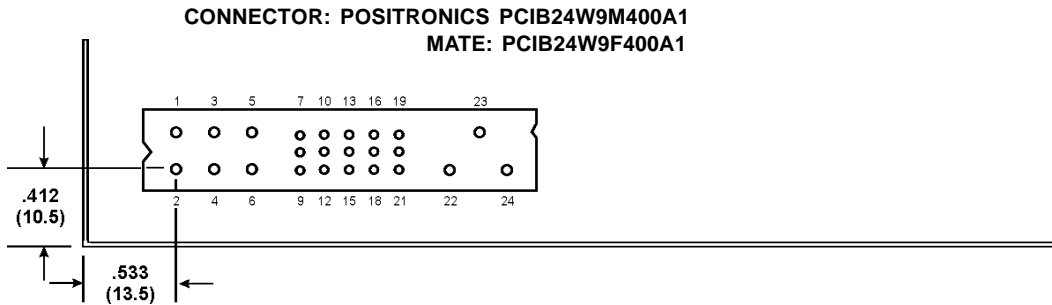
- 11.2 The PowerCassette is CE marked to indicate conformance to the European Union's Low Voltage Directive.
- 11.3 Input conducted EMI meets FCC20780 part 15J Curve B and EN55022 Curve B.
- 11.4 The input immunity, conducted, meets the following. Input fast transients, line-to-line, meet EN61000-4-4 Level 3; input surges, line-to-line, meet EN61000-4-5 Level 3; and input surges, line-to-ground, meet EN61000-4-5 Level 4.

## 12.0 OPERATING INFORMATION

- 12.1 **Input Voltage and Connection.** The PowerCassette operates off world-wide AC input voltages in the range of 85 to 264 VAC at 47 to 63 Hz. The three-wire AC connection is made to pins 22-24 on the Positronics connector. See the connector diagram and Pin Connections table in Figure 5a.
- 12.2 **Output Connections.** The output voltage is provided on pins 1 to 6 of the Positronics connector. Three pins (1 to 3) are connected together internally for the +V Out; three other pins (4 to 6) are connected together internally for the V Return.
- 12.3 **Mating Interface Board.** Figure 5b shows a mating interface board which is available for simplifying the testing of a PCM/TPCM PowerCassette. As shown in the photograph, provision is made for input and output connections, and also for the control and monitoring signals.
- 12.4 **Output Voltage.** The output voltage is factory set to its nominal value to an accuracy of  $\pm 1\%$ . The voltage can be more accurately adjusted to a value within a  $\pm 5\%$  range by means of external components as shown in Figure 6.
- 12.5 **Output Power.** The maximum continuous output power is 650 watts for the 12V output, 700 watts for the 24V output, and 800 watts for the 48V output. For the front IEC input versions (Option E) the output power is 480, 525 and 600 watts, respectively. The 5V standby output produces 1.25 watts.

The maximum output power of a PowerCassette may be drawn up to 50°C ambient temperature. Above 50°C the total output power must be derated by 2.5%/°C. See Figure 7. The maximum operating ambient temperature is 70°C, at which the total output power must be derated by 50%.

- 12.6 **Output Overload Protection.** The PowerCassette output is protected from



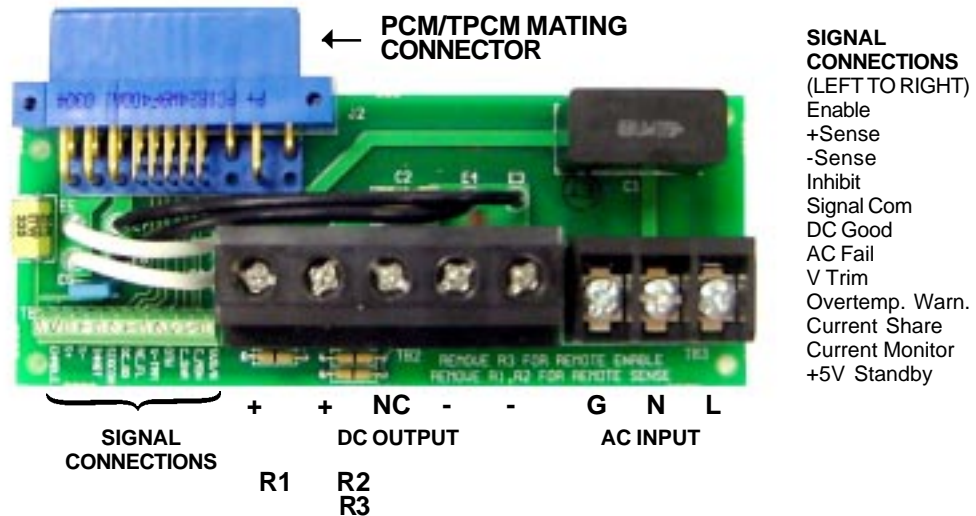
PIN CONNECTIONS			
PIN	FUNCTION	PIN	FUNCTION
1	+V Out	13	Spare
2	+V Out	14	DC Power Good/ ADD GA1*
3	+V Out	15	AC Power Fail
4	V Return	16	V Trim
5	V Return	17	Overtemp. Warning/ ADD GA0*
6	V Return	18	Current Share
7	Enable*	19	Current Monitor/ ADD GA2*
8	+ Sense	20	+5V Standby
9	- Sense	21	Standby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

MATING CONNECTOR KIT
Order Kit No. 775-1449-0000

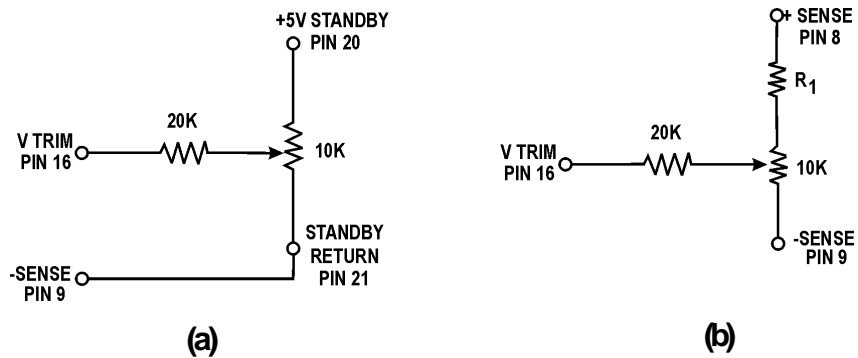
MATING INTERFACE BOARD
Order Kit No. 009-3736-0000

**\*NOTE:** For unit to operate, pin 7 must be at logic LO or shorted to pin 9. For proper operation the following pins must be connected together: All V Out pins (1-3); all V Return pins (4-6). Pins 11, 12, 14, 17 & 19 function as I<sup>2</sup>C outputs when that option is present.

**Figure 5a. Connector and Pin Connections to PowerCassette**



**Figure 5b. Mating Interface Board**



OUTPUT	R1*
12V	12K
24V	33K
48V	75K

\* Resistors are 5%, 1/8W.

Figure 6. Output Voltage Adjustment Methods

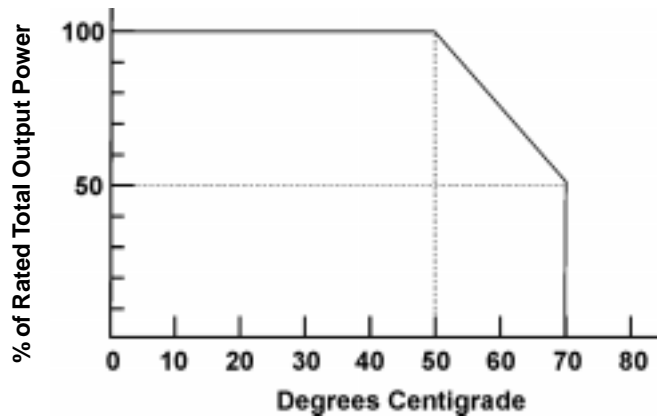


Figure 7. Rated Total Output Power vs. Ambient Temperature

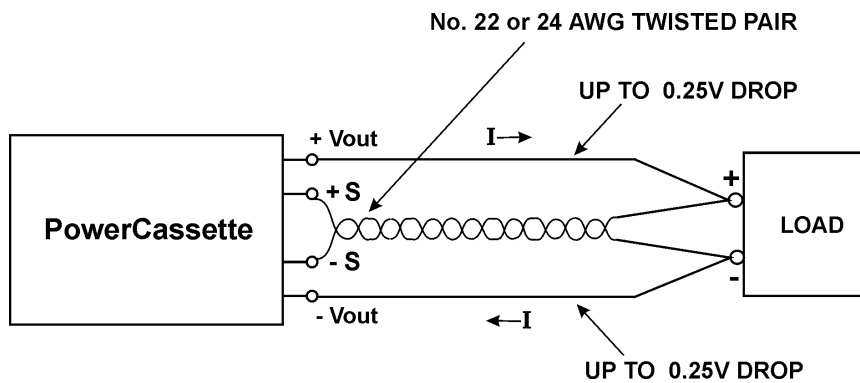


Figure 8. Remote Sensing Connection

damage due to an overload or short circuit condition. This protection is continuous and without damage; recovery is automatic when the overload or short circuit condition is removed. PowerCassette incorporates a “straight line” method of current limiting. When the output current reaches an overload threshold, the voltage begins to drop sharply so that the current, with a given overload impedance, forces the voltage to a level which maintains the current at an equilibrium point.

- 12.7 Remote Sensing.** Remote sensing connections are made to pins 8 and 9 on the Positronics connector. Remote sensing is not available on the Standby +5V, ¼ ampere output. 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 (Pin 8) must be connected to the + side of the load and the -Sense lead (Pin 9) 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 8.

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.**

- 12.8 Control & Supervisory Signals.** All control and supervisory signals are accessible at the Positronics connector on the back of the unit. See Figure 5. See Section 15 for a complete description of these input and output signals.

- 12.9 Alarm Signals.** Among the control and supervisory signals are three logic alarms: AC Power Fail, DC Power Good and Overtemperature Warning. These are logic signals referenced to -Sense, Pin 9 on the Positronics connector. AC Power Fail is a logic LO when AC input power is present. This signal goes to a HI 4 milliseconds before the outputs go out of regulation and stays HI for typically 15 msec. DC Power Good is a logic LO when the output is present and in regulation and goes to a HI when there is output failure. Overtemperature Warning is normally a logic LO but goes to a HI when the internal air temperature reaches a critical level just prior to the unit shutting down.

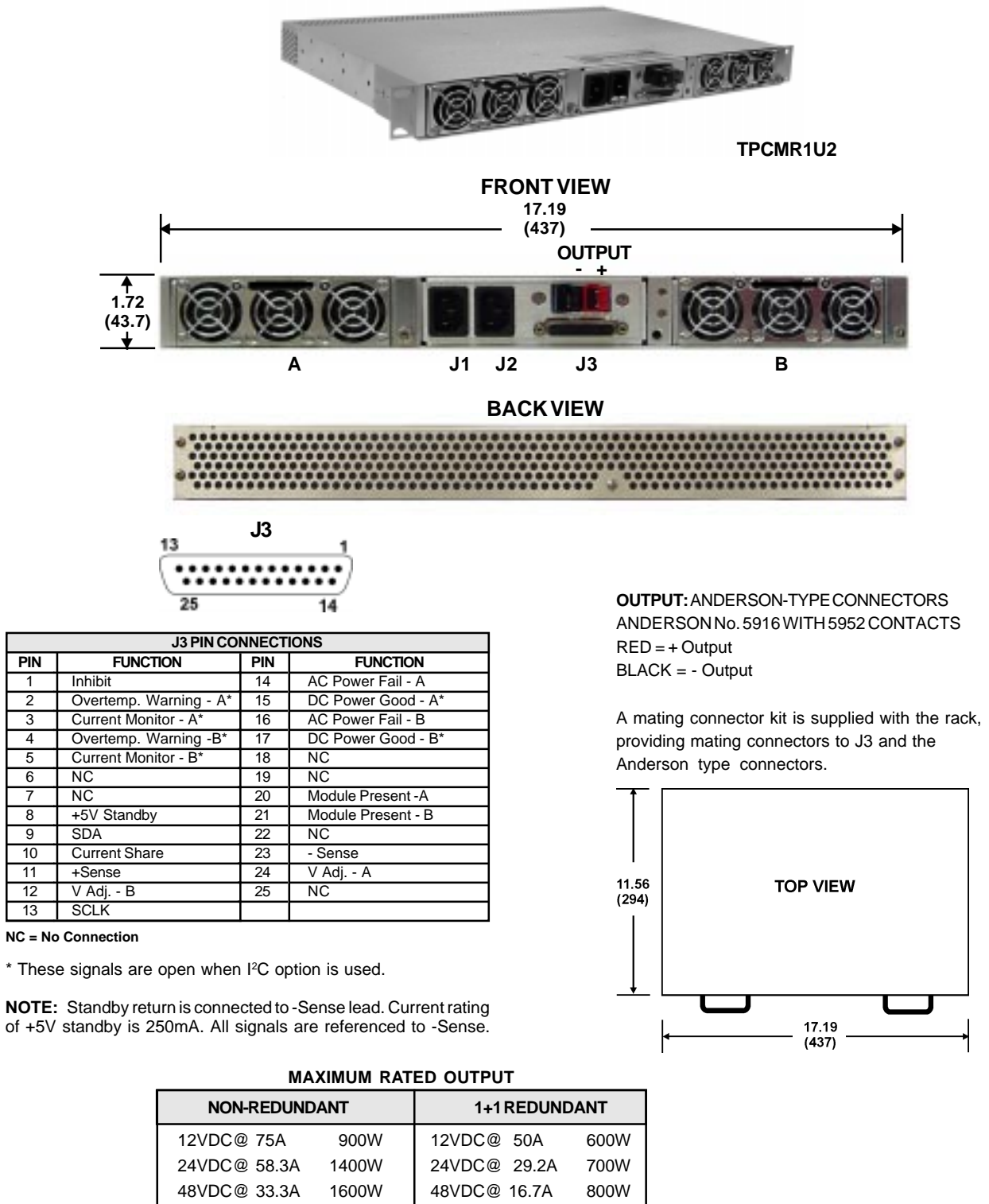


## 13.0 PARALLEL OPERATION

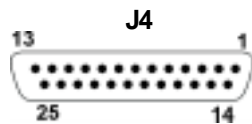
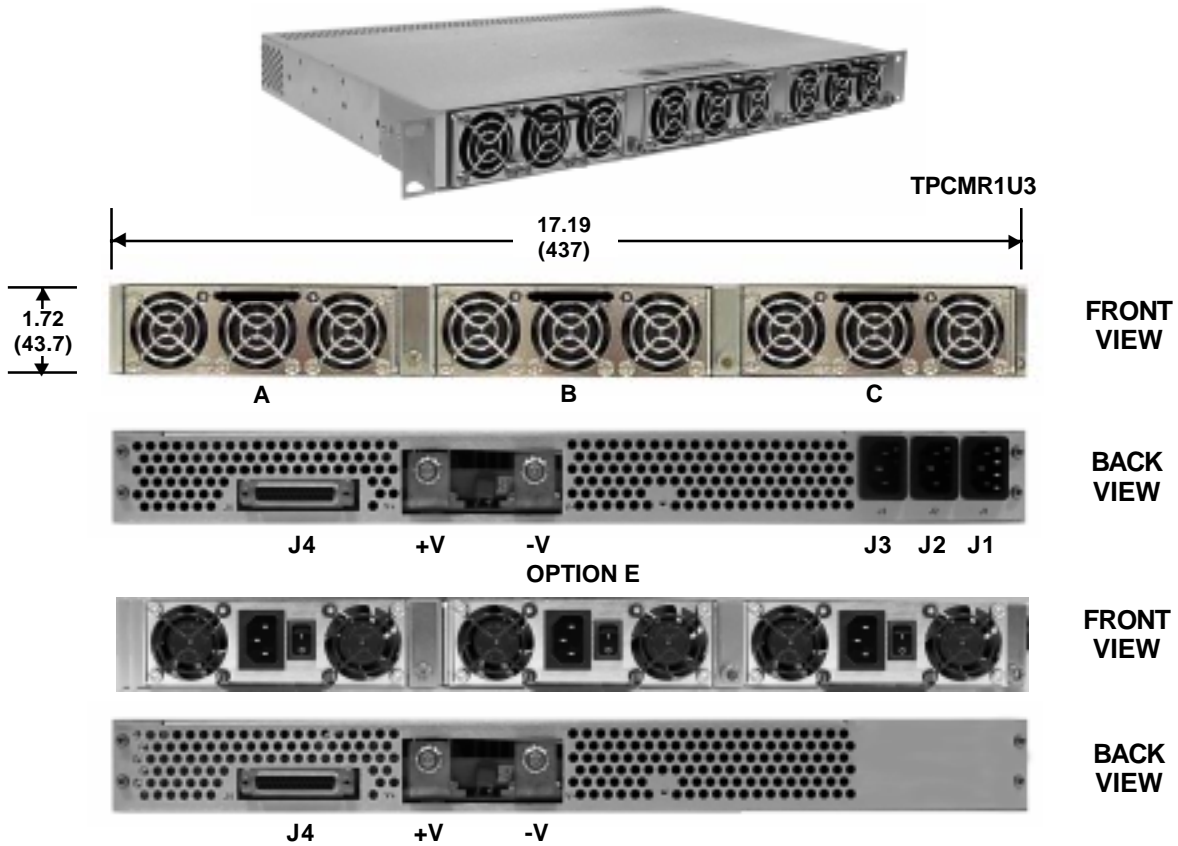
- 13.1 Parallel Connection.** Two or more PowerCassettes can be operated in parallel by connecting their outputs in parallel and connecting their current share terminals, together (pin 18). The PowerCassette racks permit conveniently operating two or three units in parallel in either a 1+1 or 2+1 redundant mode or non-redundant mode.
- 13.2 Redundant Operation.** Connecting two PowerCassettes in parallel, with or without the compatible 19-inch rack, so that the full output load current can be carried by one unit results in 1+1 redundant operation. While operating normally, the load current is shared approximately equally between the two units. Should one PowerCassette fail, the full load is then maintained by the other unit. The failed unit can then be replaced (hot-swap) without affecting the load current. This operation is facilitated by the ORing diode on the output. 1+1 redundancy with quick replacement of a failed unit results in virtually infinite MTBF. 2+1 redundancy works the same way except that the full load is carried by two out of three units.
- 13.3 Non-Redundant Operation.** Higher output load currents can be realized by operating two or three units in the non-redundant mode to achieve up to 1600 watts for two units or 2400 watts for three units. The units are connected in parallel the same as before. In this case if one unit fails, the load will lose power since only part of the load current can now be supplied by the remaining unit(s), which will go into current limit. The failed unit can be quickly replaced, however, without turning the power off (hot-swap) to restore load current.

## 14.0 COMPATIBLE 19-INCH RACKS

- 14.1** There are two 19-inch compatible racks. One holds two PowerCassette TPCM units and the other holds three. See Figures 9 and 10. These racks have the following features:
- Standard 19-Inch Racks
  - Only 1U High
  - Hot-Swap Operation
  - Holds Two or Three TPCM Units
  - Class B EMI Input Filter
  - Up to 1600W or 2400W Non-Redundant



**Figure 9. Two-Unit Rack with Connections**

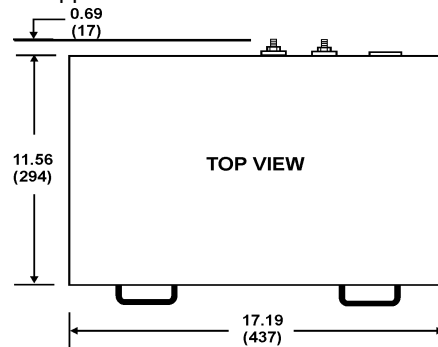


J4 PIN CONNECTIONS			
PIN	FUNCTION	PIN	FUNCTION
1	Inhibit	14	AC Power Fail - A
2	Overtemp. Warning - A*	15	DC Power Good - A*
3	Current Monitor - A*	16	AC Power Fail - B
4	Overtemp. Warning - B*	17	DC Power Good - B*
5	Current Monitor - B*	18	AC Power Fail - C
6	Overtemp. Warning - C*	19	DC Power Good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

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

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

**OUTPUT:** Copper bus bars with no. 1/4-20 studs with nuts.



MAXIMUM RATED OUTPUT			
NON-REDUNDANT		2+1 REDUNDANT	
12VDC @ 150A	1800W	12VDC @ 100A	1200W
24VDC @ 87.5A	2100W	24VDC @ 58.3A	1400W
48VDC @ 50.0A	2400W	48VDC @ 33.3A	1600W

OPTION E*			
12VDC @ 120A	1440W	12VDC @ 80.0A	960W
24VDC @ 70A	1680W	24VDC @ 46.6A	1120W
48VDC @ 40A	1920W	48VDC @ 26.6A	1600W

\* Output currents reduced.

**Figure 10. Three-Unit Rack with Connections**

- Up to 800W or 1600W N+1 Redundant
- Current-Shared Outputs
- IEC60320 AC Inputs
- Front or Rear Access
- I<sup>2</sup>C Serial Data Bus Option
- Optional 23-Inch Mounting (with brackets)
- Module Present Signal

## 14.2 Ordering Guide

RACK MODEL NO.	MAX. NO. MODULES	CONNECTIONS	MAX. POWER
TPCMR1U2	2	All Front Entry	1600W
TPCMR1U3	3	All Rear Entry	2400W
TPCMR1U3-E	3	AC Front Entry DC Rear Entry Signals Rear Entry	1920W

**NOTE:** The E Suffix rack is for Option E PowerCassette front ends (front IEC inputs)

**14.3 Two-Unit Rack.** The two-unit 19-inch rack is shown in Figure 9 together with connectors and pin designations. AC inputs are to two IEC60320 connectors, one for each PowerCassette module. The DC output is at two Anderson connectors. Monitoring and control signals are brought out at a 25-pin sub-miniature D-connector, J3. The maximum rated output figures for two modules in this rack must be observed as shown in the table. Note that the 12V output current is limited by the rack to 75 amperes, less than the total of two modules.

**14.3.1** Input voltage range is 85-264VAC for maximum power in either redundant or non-redundant operation. The Class B EMI input specifications are met.

**14.3.2** The outputs of the two PowerCassette modules are connected in parallel in the rack.

**14.3.3** The rack depth is 11.56 inches (294mm).

**14.3.4** Module A is on the left and module B on the right as seen from the front of the rack. AC input connector J1 goes to module A and J2 to module B.

- 14.3.5** For details on I<sup>2</sup>C data (J3 pins 9 and 13) see Appendix.
- 14.3.6** The Module Present outputs (J3 pins 20 and 21) are grounded (to -Sense) when the module is plugged in and open when the module is out.
- 14.4 Three-Unit Rack.** The three-unit 19-inch rack is shown in Figure 10 together with connectors and pin designations. The AC input connectors are IEC60320. All connections are at the rear of the rack for the standard model. For option E the AC IEC60320 connectors are on the front of each module. The DC output is at two copper bus bars with no. ¼-20 studs and nuts. Monitoring and control signals are brought out at a 25-pin subminiature D connector, J4. The maximum rated output figures for three modules are shown in the table. Note that the maximum output of a three-module, 12V unit is 150A, or 1800 watts, less than the total capability for the three 650 watt units.
- 14.4.1** All electrical connections are made to the rear of the standard rack. For Option E, the AC inputs are made to the IEC60320 connectors on the front of each Option E module. There is one AC connector for each module. Connector J1 goes to module A, connector J2 to module B and connector J3 to module C.
- 14.4.2** Module A is on the left, module B in the center and module C on the right, as seen from the front of the rack.
- 14.4.3** The outputs of all PowerCassette modules are connected in parallel in the rack.
- 14.4.4** The rack depth is 11.56 inches (294mm).
- 14.4.5** Input voltage range is 85-264VAC for maximum power in either redundant or non-redundant operation.
- 14.4.6** The Module Present outputs (J4 pins 20, 21 and 22) are grounded (to -Sense) when the module is plugged in and open the module is out.
- 14.4.7** For details on I<sup>2</sup>C data (J4 pins 9 and 13) see the Appendix.

## 15.0 DESCRIPTION OF CONTROL AND SUPERVISORY SIGNALS

SIGNAL	PINS	DESCRIPTION
Enable	7	A logic LO or short to Pin 9 enables (turns on) the unit. A logic HI or open inhibits (turns off) the unit. This input is referenced to - Sense, Pin 9. <u>This pin must be activated to a logic LO or short for the PowerCassette to operate.</u>
± Sense	8 & 9	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. The correct polarities must be maintained.
Inhibit	10	A logic LO or short to Pin 9 turns off the output; a logic HI or open at this pin turns on the output. This input is referenced to -Sense, Pin 9.
DC Power Good	14	A logic LO indicates that the unit is operating properly with output voltage in its controllable range. A logic HI indicates output failure. The equivalent circuit is an NPN transistor collector with a 10K ohm resistor to +5V. This signal is referenced to - Sense, Pin 9.
AC Power Fail	15	A logic LO indicates the AC power is present; a logic HI indicates AC power failure. The signal goes HI 4 msec. before the output goes out of regulation and stays HI typically for 15 msec. The equivalent circuit is an NPN transistor collector with a 10K ohm resistor to +5V. This signal is referenced to - Sense, Pin 9.
External Trim	16	This is the connection for the output external trim. The voltage can be adjusted over a ±5% range from nominal using the external circuits shown in Figure 6.
Overtemperature Warning	17	A logic HI at this output indicates an overtemperature condition inside the unit. The HI occurs a few milliseconds before the unit shuts down. This output is referenced to -Sense, Pin 9.
Current Share	18	This analog signal is used to connect to the same pin of another identical PowerCassette to share output currents. Output currents between units 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 9.
Standby Supply	20	This is a +5VDC, ¼A auxiliary output for powering external control or other circuits. The return is the Standby Return, Pin 21. This output is not controlled by the Enable or Inhibit inputs.

## 16.0 INSTALLATION

- 16.1 Mounting.** The PowerCassette can either be mounted in the 19-inch rack (model TPCM) and secured by means of the jack screw or it can be mounted (model PCM) on another metal chassis by means of no. 4-40 screws into the four threaded inserts on the bottom of the PowerCassette. It can also be mounted by the two no. 8-32 inserts on either side of the case. Maximum penetration for each is 3/16-inch. Maximum torque on each insert is 6 inch-pounds. See Figure 4.
- 16.2 Input Power Connections.** AC input power connections are made to pins 22, 23 and 24 of the Positronics connector. A three-wire AC line cord should be used with the safety ground connected to pin 22. See Figure 5.
- 16.3 DC Output Connections.** The DC output connections for the PowerCassette are shown in Figure 5. The output uses multiple, paralleled pins on the Positronics connector, namely pins 1 to 6. Pins 1 to 3 are +V Out and pins 4 to 6 are V Return.
- 16.4 Control and Supervisory Signal Connections.** These connections are made to various pins from 7 to 21 on the Positronic connector on the PowerCassette. See Figure 5. Details for these functions are given in Section 15.
- 16.5 Cooling.** The PowerCassette is cooled by three 40mm DC ball bearing fans. For proper cooling, the area in front of the fans and the back of the unit should be kept clear for unimpeded air flow. Option E of the PowerCassette has two fans and a reduction in rated output power as shown in the table of paragraph 3.1. See Figure 3. Reverse air flow models are also available.

## 17.0 MAINTENANCE

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

## 18.0 POWERCASSETTE SETUP AND TESTING

- 18.1** The PowerCassette can be initially tested mounted in a rack or on a test bench. If two units are to be tested in a rack, they should first be individually

tested in Position A (left side) of the rack.

- 18.2** With the input power source turned off, connect input power wires to the PowerCassette mating connector or in case of the rack to the input connector on the A side of the rack. Make sure that the safety ground wire is connected. Do not touch the output terminals when AC input power is present.
- 18.3** Connect a resistive power load across the proper output pins. The load should be 20% to 50% of full load value and can be either a power resistor or electronic load set to the resistive mode. Make sure that the power resistor has adequate heat sinking and cooling.
- 18.4** Connect a color-coded, twisted pair (no. 22 or 24 AWG) from the remote sense pins on the mating connector to the load. **The +Sense pin must go to the positive side of the load and the -Sense pin to the negative side of the load. Also connect the Enable pin, pin 27 of the Positronics mating connector of the PowerCassette, to the - Sense, pin 9. This must be done for the unit to operate.** When using the rack, the Enable pin is automatically connected to - Sense in the rack. The units are then controlled by the Inhibit inputs.
- 18.5 Checking Front Panel LEDs.** With the PowerCassette on the bench or in Position A of the rack, turn on (or plug in) the power source. The AC Power Fail (bottom left) green LED should be on and the DC Power Good (bottom right) green LED should also be on.
- 18.6 Checking the Output Voltage.** Measure the output voltage at its load with a digital voltmeter. The voltage should be within  $\pm 1\%$  of its nominal value.
- 18.7 Checking the Inhibit Input.** Unplug the input power source. Connect a wire from the Inhibit input (pin 10 on the PowerCassette Positronics connector ) to - Sense, pin 9.

Turn the input power source back on. The AC Power Fail green LED should turn on but the DC Power Good green LED should remain off. Check the output voltage with a digital voltmeter. It should read zero volts.

- 18.8 Checking the AC Power Fail and DC Power Good Signals.** Next check the voltage on the AC Power Fail pin (pin 15 on the PowerCassette Positronics connector) with respect to - Sense (pin 9). The voltage should be a logic LO, +0.5V or less. Finally, check the voltage on the DC Power Good pin (pin 14) with respect to - Sense (pin 9). The voltage should be a logic HI,



approximately +5V.

Disconnect the wire from the Inhibit to - Sense. The DC Power Good green LED should turn on. Check the output voltage on the DC Power Good pin as described above. The voltage should be a logic LO, +0.5V or less.

**18.9 Testing the Other Power Cassettes.** For a rack with two or three PowerCassettes, the other PowerCassettes should be plugged into Position A in the rack and tested in the same manner as above in Sections 18.2 to 18.8.

**18.10 Testing the Complete Power Cassette Rack.** With the input power source off or disconnected, insert all PowerCassettes into the rack. Connect a resistive power load of approximately 80% of full load value for a single PowerCassette across the output. Connect a color-coded, twisted pair of remote sense leads to the load, **being careful to connect the correct polarity.**

Turn on or plug in the input power source. Check the voltage across the load with a digital voltmeter. The voltage should be within about  $\pm 1\%$  of its **nominal value. The AC Power Fail and DC Power Good green LEDs should be on for both units.**

While the rack is operating, disengage PowerCassette A (left one) and check the output voltage. It should be very close to the previous value and the DC Power Good green LED should remain on for PowerCassette B (and C) which are now carrying the full power load. Re-insert PowerCassette A and repeat the procedure by disengaging PowerCassette B (then C). The complete rack has now been shown to operate properly in the redundant mode with hot swapping. Disconnect the input power source.

## 19.0 TROUBLESHOOTING GUIDE

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

### 19.2 Table 19-1. PowerCassette and Rack Troubleshooting

SYMPTOM	POSSIBLE CAUSE	ACTION TO TAKE
No output, AC Fail and DC Good LEDs off.	No AC power.	Check connection to AC power source. Check source circuit breakers.
No output, DC Good LED off, AC Fail LED on.	Remote Enable in OFF mode.	Make sure Pin 7 (Enable) is at logic LO or connected to - Sense, Pin 9, of the Positronics connector.
No output, DC Good LED off, AC Fail LED on.	Shorted output.	Check for short and remove.
No output, DC Good LED off, AC Fail LED on.	Overvoltage protection (OVP) has latched.	Reset output by cycling the input power OFF for 10 seconds and then back ON.
No output, DC Good LED off, AC Fail LED on.	Overtemperature protection is activated.	Allow PowerCassette to cool down for about 10 minutes. It will then start up automatically. Check to see if the cooling fans are operating.
No output, DC Good LED off, AC Fail LED on.	Total output load is too large for the PowerCassette capacity.	Reduce loads to proper levels.

**19.3** 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.

## **PowerCassette®: I2C SERIAL BUS INTERFACE FOR PCM/TPCM**

Status Indication of system critical power supply parameters

### **FEATURES**

- Industry Standard Communication Interface
- Inventory Control Information
- Status Indication
- Management of System Load
- Imminent Failure Warning
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**PCM Series**  
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**1U HIGH**  
**1.6" x 5" x 10"**  
(41 x 127 x 254 mm)

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### **DESCRIPTION**

The I2C interface that is incorporated into the PowerCassette includes facilities to monitor various operating parameters within the unit and transmit these to a host computer on demand over an industry standard I2C Serial bus.

Three forms of data are available. These allow the user to monitor the actual status of an individual unit, manage system loading through measurement of the actual load on the output and also control inventory through an inbuilt EEPROM containing specific data about each individual unit.

The implementation of I2C that has been utilized in PowerCassette is a subset of more complete implementations such as IPMI. This data-sheet is intended as a supplement to the data sheet for the PowerCassette family itself and should provide enough information for the system designer to make decisions on how to utilize the available information within his overall system philosophy.

### **I2C DEVICES EMPLOYED**

**PCF8574**  
This device is an 8-bit digital register manufactured by Philips.

**PCF8591**  
This device is a Quad A/D converter manufactured by Philips.

**24C02**  
This device is a 256 byte EEPROM manufactured by ST

**MAX6633**  
This is a 12-bit temperature measurement device manufactured by Maxim.

For detailed information about the operation of these devices please consult the original manufacturers' data-sheets.

## SPECIFICATIONS, PowerCassette®: I2C SERIAL BUS INTERFACE FOR PCM/TPCM

### ELECTRICAL INTERFACE

#### Addressing (GA0, GA1 and GA2)

Three external address lines are employed allowing up to eight PowerCassette modules to be addressed on a single I2C bus.

Module addressing is achieved through hard-wiring the address lines to -Sense or the +5V auxiliary supply via a 100-ohm resistor on the system back-plane. In this way it is the location or position of the module rather than any particular module that is identified by an individual address.

#### Serial Clock (SCLK)

This line is clocked by the processor which controls the I2C serial bus. It should be tied to +5V via a pull-up resistor in the range 3k to 10k.

#### Serial Data (SDA)

This line is a bidirectional data line. It should be tied to +5V via a pull-up resistor in the range 3k to 10k.

#### Interrupt

This line provides an interrupt to the processor in the event of a change of status of the digital register.

#### BUS speed

The I2C interface as used in PowerCassette is designed to run with a serial clock speed 100kHz.

### OPERATION AND FUNCTIONS

#### Digital Functions

Digital status functions are provided by a PCF8574 8-bit I/O port device. When this device is read by the serial bus controller a single 8-bit word provides the following information:

BIT	FUNCTION	GOOD STATE	MEANING
0	Input Power Fail	0	Provides 10ms warning of input supply failure. <sup>1</sup>
1	Output Power Good	0	V is are within specified limits.
2	Temperature Warning	1	Internal temperature exceeds 60C.
3	Fan #1 Good	1	Fan running at >80% nominal speed.
4	Fan #2 Good	1	Fan running at >80% nominal speed.
5	Fan #3 Good	1	Fan running at >80% nominal speed.
6	-	-	-
7	Temperature Alarm	1	Internal temperature exceeds 70C, unit switched off. Also indicates OVP and Inhibit activated.

Note 1: AC input versions only.

#### PCF8574 slave address

BIT	7	6	5	4	3	2	1	0
VALUE	0	1	0	0	A2	A1	A0	R/W

Note: If a zero is written to bit 7 in a data byte, the unit will be inhibited. The default state is enabled.

#### EEPROM Functions

The EEPROM is a 2048 bit (256 byte) device which is preprogrammed at the factory with the following data:

ADDRESS RANGE	DATA
0-15	Model Number
16-31	Manufacturing Part Number
32-47	Serial Number
48-63	Modification Level
64-79	Manufacturer
80-95	Country of Manufacture
96-255	Not used

Note:

Data is organized such that each field of data can be accessed by a page read (16 bytes).

#### EEPROM slave address

BIT	7	6	5	4	3	2	1	0
VALUE	1	0	1	0	A2	A1	A0	R/W

Note: Customers may specify to special order other data which they may require.

#### Analogue Functions

Analogue status functions are provided by two PCF8591 4-channel 8-bit A/D converter devices. When these devices are read by the serial bus controller a single 8-bit word provides the following information:

Device: U1			
A/D	FUNCTION	A/D	FUNCTION
1	V voltage	3	not used
2	V current	4	not used

#### Slave addresses

BIT	7	6	5	4	3	2	1	0	Device
VALUE	1	0	0	1	A2	A1	A0	R/W	U1

The PCF8591 devices initially require a control byte (04 Hex) to be written to the configuration register. This control byte sets the device so that on each successive read the data from the next A/D is read. Note that on each read a conversion is started for a particular channel and the result will be read from the previous channel, thus the first result from a sequence of reads should always be discarded.

#### A/D converter scaling

To obtain a correct voltage or current measurement it is necessary to employ both scaling and offset factors in the controlling software. Note that all voltage measurements are made inside the PSU module, before the 'ORing' diodes, and are typically 0.5V higher than the actual module output voltage. The following calculation should be employed:

Value = (byte read x scaling factor) + offset

Output Voltage	Scaling	Tolerance	Offset	
12V	0.0619	±2%	0	V Voltage (U1 A/D 1)
24V		±2%	0	
48V		±2%	0	
12V	0.262	±10%*	0	V Current (U1 A/D 2)
24V		±10%*	0	
48V		±5%*	0	

\* of full scale

#### Temperature Measurement Functions

The internal temperature of the unit is measured using a MAX6633. This device provides a 12-bit measurement at a resolution of 0.0625°C.

#### MAX6633 slave address

BIT	7	6	5	4	3	2	1	0
VALUE	1	0	0	0	A2	A1	A0	0

Note: The MAX6633 must only be used in the READ mode.