PRICE: $25.00

# OPERATING MANUAL
# TMN & TMP SERIES
# BULK POWER FRONT ENDS

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# OPERATING MANUAL

# TMN/TMP SERIES BULK POWER FRONT ENDS

## 1.0 INTRODUCTION

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

The TMN/TMP Series hot-swap modules and rack form a bulk power front end with high-power outputs at 24, 28 or 48VDC. See Figure 1. Each TMN module has a 1000-watt output: 24V at 42A, 28V at 36A or 48V at 21A. Each TMP module has a 1200-watt output: 24V at 50A, 28V at 43A or 48V at 25A.Three modules in a rack produce up to 24V at 150A, 28V at 129A or 48V at 75A. Using the three modules in a 2+1 redundant configuration produces up to 24V at 100A, 28V at 86A or 48V at 50A. The modules have single-wire active load sharing for automatic paralleling of outputs, and output ORing diodes permit hot-swap addition or replacement of modules while the system is operating.

The TMN Series operate worldwide with a 85-264VAC input range at 47-63Hz. The TMP Series operates with a 170-264VAC input range at 47-63Hz. Each module has input power factor correction and a Class B EMI filter. The output voltage is tightly regulated. There is a green AC power good LED and green DC power good LED on the front panel. Each module is self-cooled by an 80mm internal fan.

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

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

## 2.0 FEATURES

The following is a summary of the important features of the TMN/TMP Series modules:

- For Distributed Power Systems
- Tightly Regulated Output Voltage
- 1000 to 1200-Watt Modules
- Output Overload Protected

**Figure 1. TMN/TMP Series Bulk Power Front End.**

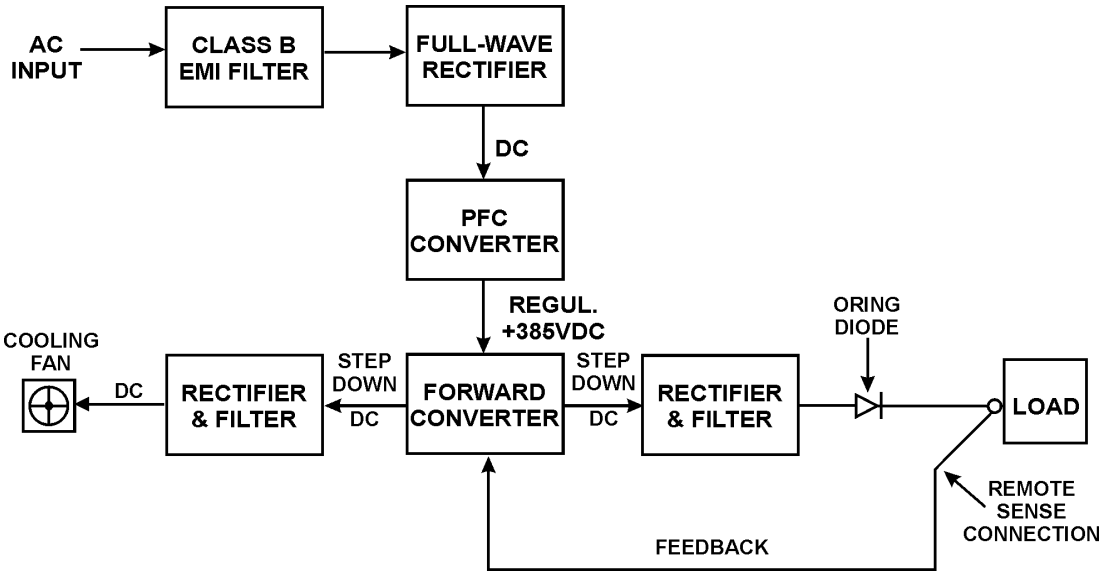



**Figure 2. TMN/TMP Series Module Block Diagram.**

- 24, 28 and 48VDC Versions
- Low Profile: 2U(3.5 inches or 88.9mm) Height
- 19 -Inch Racks
- Rack Capacity Up to 3 Modules
- High Power Density: 6.6 Watts/Cubic Inch
- 85% Efficiency
- 0.99 Power Factor
- Class B EMI Input Filter
- Worldwide Input: 85-264 or 170-264VAC at 47-63Hz
- Up to 2400W Redundant or 3600W Non-Redundant
- Remote Sensing
- Active, Single-Wire Load Sharing
- Integral ORing Diodes
- Hot-Swappable Modules
- LED Operating Indicators
- Control and Monitoring Interface Signals

## 3.0 PRODUCT LINE

### 3.1 Hot-Swap Modules

| MODEL | MAX. WATTS | OUTPUT VOLTAGE | MAX. OUTPUT CURRENT |
|---|---|---|---|
| TMN5000 | 1000 | 24 | 42A |
| TMN6000 | 1000 | 28 | 36A |
| TMN7000 | 1000 | 48 | 21A |
| TMP5000 | 1200 | 24 | 50A |
| TMP6000 | 1200 | 28 | 43A |
| TMP7000 | 1200 | 48 | 25A |

### 3.2 Rack

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

## 4.0 SAFETY WARNINGS

**4.1** These hot-swap modules and racks have hazardous external and internal voltages. They should be handled, tested and installed only by qualified technical persons who are trained in the use of power systems and are well aware of the hazards involved.

**4.2** The input terminals are at hazardous voltage potentials. Do not touch this area when power is applied.

**4.3** When operating this power system, the frame ground terminal must be connected to safety ground by means of a three-wire AC power line to minimize electrical shock hazard and to ensure low EMI (electromagnetic interference).

**4.4** The internal voltages are at hazardous potentials. The module covers should not be removed. There are no user-serviceable components in these units. Removing the covers of the modules will void the warranty.

## 5.0 WARRANTY

All products of UNIPOWER Corporation are warranted for two (2) years from date of shipment against defects in material and workmanship. This warranty does not extend to products which have been opened, altered or repaired by persons other than persons authorized by the manufacturer or to products which become defective due to acts of God, negligence or the failure of customer to fully follow instructions with respect to installation, application or maintenance. This warranty is extended directly by the manufacturer to the buyer and is the sole warranty applicable. EXCEPT FOR THE FOREGOING EXPRESS WARRANTY, THE MANUFACTURER MAKES NO WARRANTY, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. As the sole and exclusive remedy under this warranty, the manufacturer, at its option, may repair or replace the non-conforming product or issue credit, provided the manufacturer's inspection establishes the existence of a defect. To exercise this remedy, the buyer must contact the manufacturer's Customer Service Department to obtain a Return Material Authorization number and shipping instructions. Products returned without prior authorization will be returned to buyer. All products returned for repair must be shipped freight prepaid to UNIPOWER. If the buyer fails to fully comply with the foregoing, the buyer agrees that no other remedy (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property or any other incidental or consequential losses) shall be available to the buyer.

## 6.0 UNPACKING AND INSPECTION

**6.1** This TMN/TMP Series Power System was carefully tested, inspected and packaged for shipment from our factory. Upon receipt of the unit it should be carefully unpacked and inspected for any damage in shipment.

**6.2** If there is evidence of damage, do not attempt to test the unit. The freight carrier should be notified immediately and a claim for the cost of the power system should be filed with the carrier for direct reimbursement. Be sure to include the model and serial number of the damaged unit in all correspondence with the freight carrier. Also save the shipping carton and packing material as evidence of damage for the freight carrier's

inspection.

**6.3** UNIPOWER Corporation will cooperate fully in case of any shipping damage investigation.

**6.4** Always save the packing materials for later use in shipping the unit. Never ship the rectifier system without proper packing.

## 7.0 DESCRIPTION OF OPERATION

**7.1 Block Diagram.** A diagram of a TMN/TMP Series Module is shown in Figure 2. The AC input first goes through a Class B EMI filter then to a full-wave rectifier and high-frequency (45kHz) power factor correction (PFC) converter. The output of the PFC converter is a regulated DC voltage at approximately +385V. This voltage is converted down to 24, 28 or 48VDC nominal, depending on the model. This is done by a forward converter operating at 150 kHz. The output of this converter goes through a rectifier, filter and ORing diode to the module output. Feedback from the remote sense terminals back to the forward converter pulse-width modulator regulates the output voltage and keeps it constant.

**7.2 Power Factor Correction.** This high-frequency converter circuit, switching at 45kHz, achieves a power factor of 0.99 by forcing the AC input current into a sinusoidal waveform, in phase with the input voltage. The input current is a smooth sine wave of much lower amplitude than the normal series of high-amplitude, input current pulses that are present in a unit without power factor correction. The result is lower RMS input current for a given output power level.

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

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

## 8.0 FRONT PANEL DESCRIPTION

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

## 9.0 TMN/TMP MODULE SPECIFICATIONS

Specifications for a Single Module. Typical at 115VAC(TMN) and 230VAC(TMP) Line, Full Load and 25°C Unless Otherwise Noted.

### OUTPUT SPECIFICATIONS

| | |
|---|---|
| Total Output Power, Max. | 1000 or 1200 watts |
| Output Voltage | 24, 28 or 48VDC |
| Voltage Adjustment Range | ±10% |
| Total Regulation[1]. | 1.0% |
| Ripple & Noise (Pk-Pk)[2]. | 1% |
| Hold-Up Time [3]. | 20mS |
| Dynamic Response[4]. | 1 msec. |
| Temperature Coefficient. | ±0.02%/°C |
| Minimum Load. | 0A |
| Overload Protection. | Constant Power Limiting |
| Overvoltage Protection | Latched Shutdown |
| Active Current Share | 10% Differential from Rated Current |
| Remote Sense | Up to 0.25V Per Wire |

### INPUT SPECIFICATIONS

| | |
|---|---|
| Input Voltage Range, TMN | 85-264VAC |
| TMP | 170-264VAC |
| Power Factor | 0.99 |
| Input Frequency | 47-63Hz |
| Inrush Limiting, Cold Start | 50A Peak |
| Input Current, Full Load, TMN | 9.9A@120VAC, 5.2A@230VAC |
| TMP | 6.2A@230VAC |
| Input EMI Filter, Conducted | EN55022 Curve B |
| | FCC20780 pt. 15J Curve B |
| Harmonic Distortion | EN61000-3-2 |
| Input Immunity, Conducted | |
| Fast Transients, Line-Line | ±2kV (EN61000-4-4 Level 3) |
| Surges, Line-Line | ±1kV (EN61000-4-5 Level 2) |
| Surges, Line-Ground | ±2kV (EN61000-4-5 Level 3) |
| Input Protection | Internal Fuse, 20A |

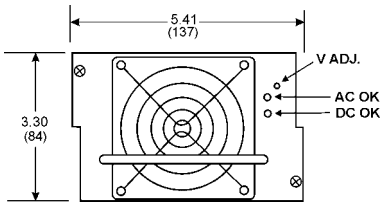



**Figure 3. Front Panel of TMN/TMP Series Module**

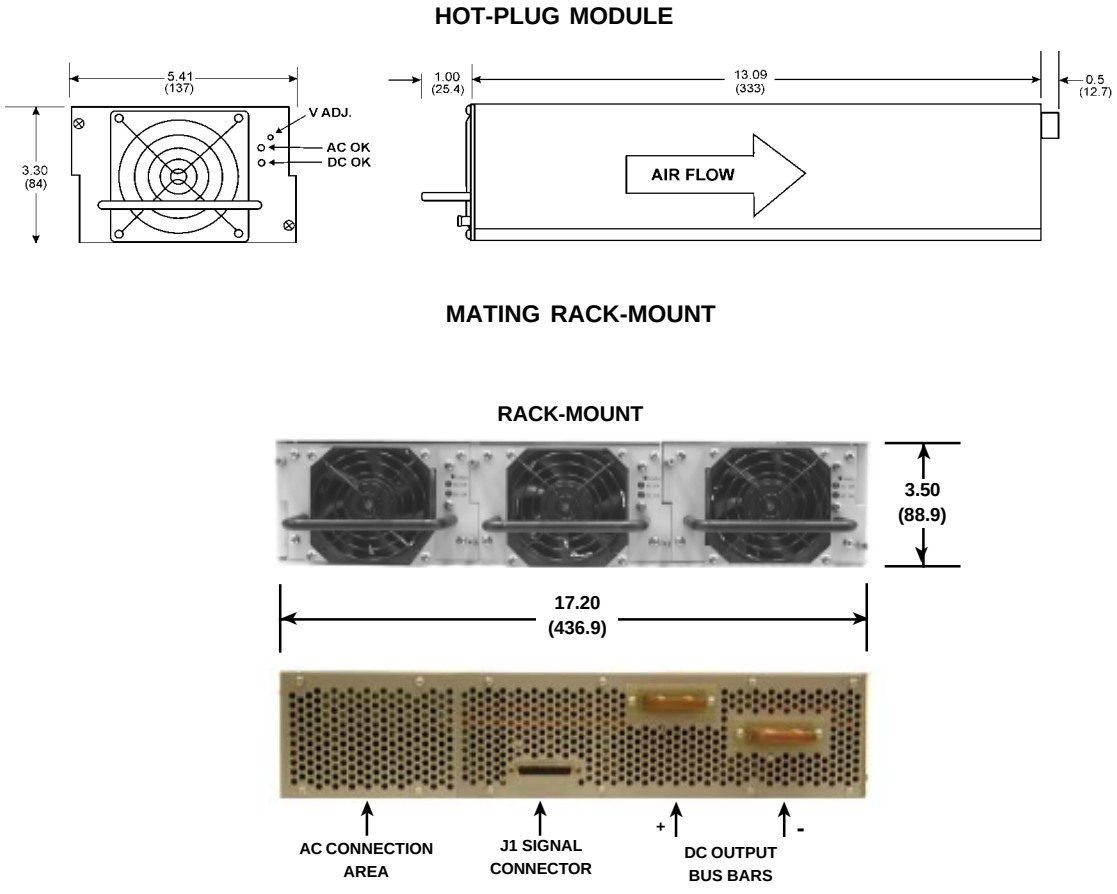



**Figure 4. TMN/TMP Series Mechanical Dimensions**

## GENERAL SPECIFICATIONS

| | |
|---|---|
| Efficiency | 85% at Full Load |
| Switching Frequency | 150kHz Nominal |
| Overtemperature Protection | Power Shutdown |
| Isolation, class I [5], min. | 3000VAC Input-Output |
| | 1500VAC Input-Ground |
| | 50VDC Output-Ground |
| Safety Standards | EN60-950, UL1950, CSA22.2-950 |

## ENVIRONMENTAL SPECIFICATIONS

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

## PHYSICAL SPECIFICATIONS

| | |
|---|---|
| Case Material, Module | Aluminum |
| Rack Mount | Steel |
| Finish, Rack Mount | Powder Coat Gray |
| Dimensions, Inches (mm) | |
| Hot-Swap Module | 3.30 H x 4.90 W x 13.09 D |
| | (84 x 124 x 332) |
| 3-Module Rack | 3.5 H x 17.20 W x 19.90D |
| | (89 x 437 x 505) |

**NOTES:**

1. At remote sense point, over full line range and 0-100% load change.
2. 20MHz bandwidth. Measured with 0.1µF ceramic and 10µF tantalum capacitors in parallel across the output.
3. 1000W output power at nominal AC line.
4. <5% deviation recovering to within 1% for 50% load change.
5. Using single-wire current share with remote sense connected.
6. Input-output isolation figure is for isolation components only. 100% production Hipot tested.

## 10.0 DESCRIPTION OF FEATURES & OPTIONS

| FEATURE / OPTION | DESCRIPTION |
|---|---|
| **Power Factor Correction** | The input current is a sine wave in-phase with the input voltage to give a power factor of 0.99. Input current total harmonic distortion meets EN61000-3-2. |
| **Wide Range AC Input** | The AC input range is continuous from 85 to 265VAC (TMN) or 170 to 264VAC (TMP), 47-63Hz, for worldwide operation. |
| **EMI Input Filter** | This filter suppresses conducted noise from the module back onto the AC line. The filter meets FCC20780 part 15J Curve B and EN55022 Curve B. |
| **Inrush Current Limiting** | When the module is turned on from a cold start, the initial input current is limited to a peak value of 50 amperes. |
| **Output Voltage Adjustment Range** | For a 48V unit the adjustment range is 45V to 58V. For a 24V model the adjustment range is 22.5V to 29V. The adjustment is made from the front panel by means of a 12-turn potentiometer or from the input to the remote adjust terminal. |
| **Remote Output Adjust** | This input is used to remotely adjust each module output voltage. An analog voltage from 0 to +5V controls approximately 45-58V output for a 48V module or 22.5-29V output for a 24V module. The analog inputs can also be connected together so that the external control voltage adjusts all the module outputs simultaneously. |
| **Thermal Protection** | If the output power converter overheats, the TMN/TMP module will automatically shut down. The DC Good LED also turns off. After a few minutes the module will cool and automatically start up again. |
| **Current Sharing** | The TMN/TMP modules are automatically connected to current share with each other when they are inserted into the rack. A single-wire connection provides this. The modules current share with an accuracy of 10% of their full load output current for total loads of 50% to 100%. The rack current share pin can be used to current share with another rack of the same output voltage. |
| **ORing Diodes** | This diode in series with each module output protects the parallel-connected modules. If the output of one module fails to a short or to a lower than normal output voltage, the other modules are not affected. Also when hot-swapping modules, the diode prevents a glitch in the output voltage while the output is still rising on the inserted module. |

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

## 11.0 MECHANICAL SPECIFICATIONS

The mechanical dimensions of the TMN/TMP Series modules and rack are shown in Figure 4.

## 12.0 SAFETY AND INDUSTRY STANDARDS

**12.1** The TMN/TMP modules and racks meet the following safety certifications:

| STANDARD | AGENCY |
|---|---|
| UL1950 | UL |
| CSA22.2-950 | CUL |
| EN60-950 | DEMKO |

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

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

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

## 13.0 OPERATING INFORMATION

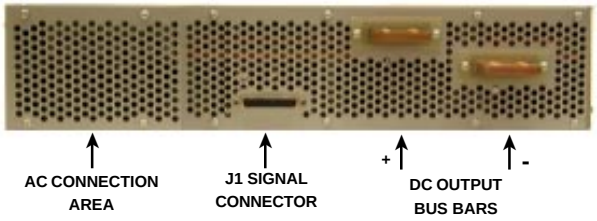
**13.1 Input Voltage.** The TMN/TMP Series modules operate off worldwide AC input voltages within the range of 85 to 264 VAC (TMN) or 170-264VAC (TMP), at 47 to 63 Hz. There is a separate input connection for each module to a terminal block at the rear of the rack mount. For complete details see Section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

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

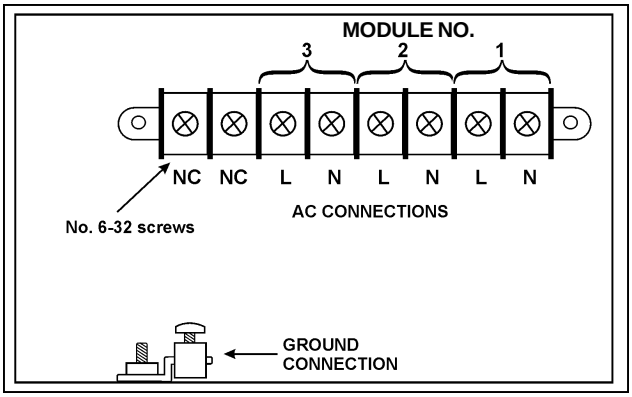
**13.3 Output Voltage.** The output voltage of each module is factory set to 24, 28 or 48 volts, ±1%. The voltages, however, may be adjusted by means of the front panel potentiometer or the voltage adjust input pin.

**13.4 Output Power.** Maximum output current for a TMP module is 50A at 24 VDC, 43A at 28VDC or 25A at 48VDC, giving a maximum output power of 1200 watts. For a TMN module, maximum output power is 1000 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 6. The maximum operating temperature is 70°C, at which the output current must be derated by 50%.

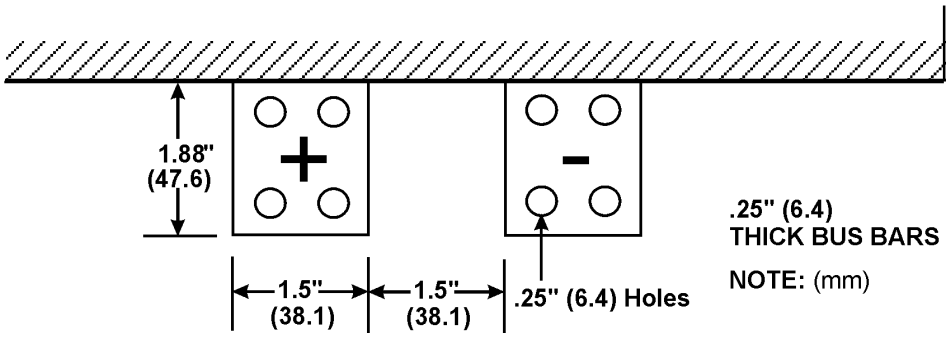
**13.5 Output Overload Protection.** Each module output is protected from damage due to overload or other short circuit condition. This protection is continuous and without damage; recovery is automatic when the overload or short is removed. The current limit characteristic is a constant current above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




**(a) Rear Connections to Rack**




**(b) Uncovered AC Input Connection Area**




**(c) Top View of DC Output Bus Bars**

**Figure 5. Rear Rack Input and Output Connections**

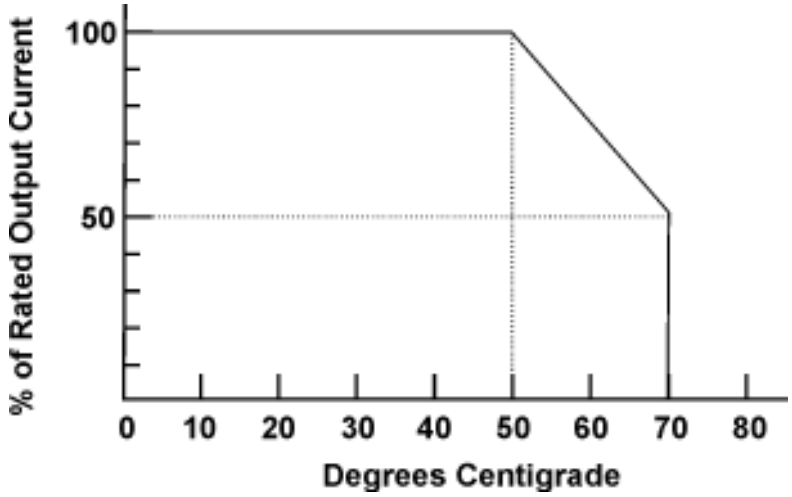



**Figure 6. Rated Output Current vs. Ambient Temperature**

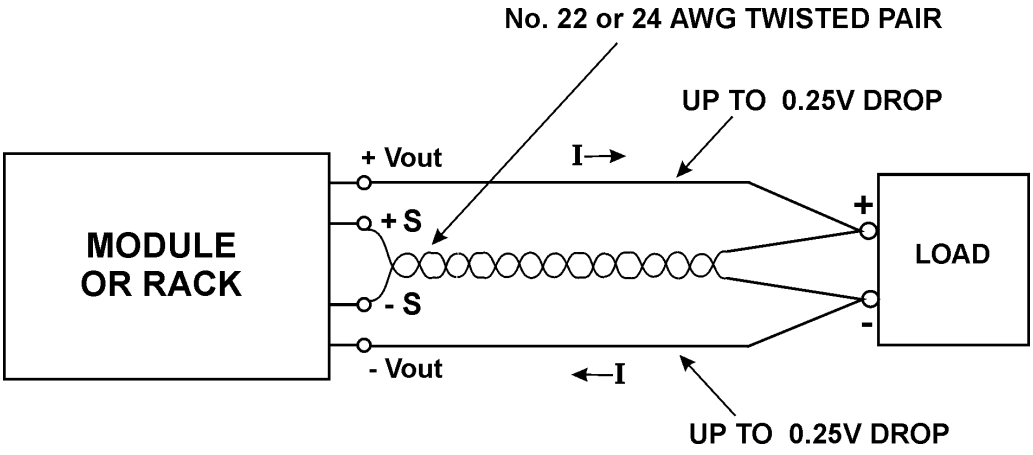



**Figure 7. Remote Sensing Connection**

**13.6 Remote Sensing.** Remote sensing connections are made to pins 11 (+Sense) and 23 (-Sense) of the rack J1 connector. Remote sensing is used to regulate the output voltage at the point of load by compensating for the voltage drop in the wires to the load. The +Sense lead must be connected to the + side of the load and the -Sense to the - side of the load. The sense leads should be a color-coded, twisted pair of AWG no. 22 or 24 copper wire. See Figure 7.

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

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

**13.8 Alarm Signals.** Among the control and supervisory signals are two logic alarms for each module: AC Good and DC Good. They are TTL-compatible signals referenced to Signal Common, J1 Pin 22 on the rack. **AC Good:** A logic HI or open indicates that there is no AC input and the PFC converter stage has failed. **DC Good:** A logic HI or open indicates a DC output failure.

## 14.0 PARALLEL OPERATION

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

**14.1 Redundant Operation.** From Table 14-1, the 19-inch rack mount can be operated in a 2+1 redundant mode. This means, for example, that the full load current must be carried by two modules. While operating normally the current is shared approximately equally among the three modules. If one module fails, however, the output current is then maintained by the two operating modules. The failed unit can be replaced without affecting the output current to the load. N+1 redundancy with quick replacement of

a failed module results in virtually infinite MTBF.

**Table 14-1 Redundant and Non-Redundant Operation**

| MODE | NUMBER OF MODULES | NOM. VOLTS | TMN AMPS MAX. | TMP AMPS MAX. |
|---|---|---|---|---|
| Redundant, 2+1 | 3 | 24 | 84 | 100 |
| Non-Redundant | 3 | 24 | 126 | 150 |
| Redundant, 2+1 | 3 | 28 | 72 | 86 |
| Non-Redundant | 3 | 28 | 108 | 129 |
| Redundant, 2+1 | 3 | 48 | 42 | 50 |
| Non-Redundant | 3 | 48 | 63 | 75 |

**14.2 Non-Redundant Operation.** Higher output current can be achieved by operating the rack in a non-redundant mode as seen in Table 14-1. However, in this case if a module fails, the load will lose power since only part of the required current can be supplied by the remaining modules, and they will go into current limit. The failed module, however, can be quickly replaced to restore the load current.

**14.3 Multiple Parallel Rack Operation.** Multiple racks can also be operated in parallel by interconnecting their current share terminals (J1 Pin 10). The total power can be expanded by several times. In this case N+1 redundant operation is achieved by reserving one module of the total for redundancy. For example, if two full 19-inch racks are employed with a total of six modules, then 5+1 redundancy is achieved and the full load must be able to be carried by the output of five modules. In such applications each set of remote sense wires must be separately connected to the point of load. See Figure 8 for a simplified illustration of two TMN/TMP racks connected in parallel.

## 15.0 RACK CONTROL & SUPERVISORY SIGNAL CONNECTIONS

**15.1** Connections for control and supervisory signals are made at the rack rear to connector J1, a standard 25-pin subminiature D connector (Positronics No. SD25F0S5OOX with FC752OD pins). The mating connector is Positronics SD25M00OOZ with MC7520D pins.

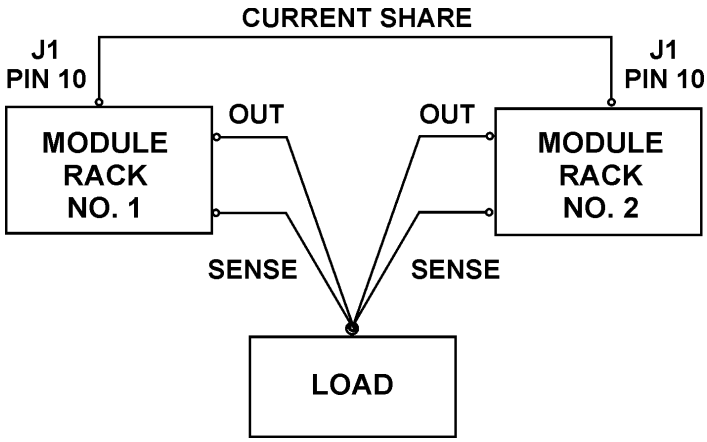
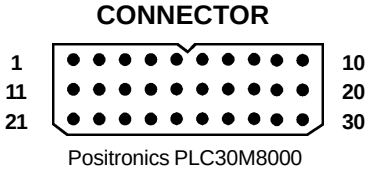



**Figure 8. Parallel Connection of TMN/TMP Racks.**




Positronics PLC30M8000

| MATING CONNECTOR KIT |
|---|
| **Mating Connector:** Positronics PLC30F7000<br>**Order Kit No**.: 775-1427-000<br>$ 40.00 |

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

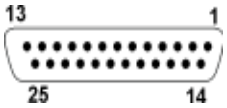
**Figure 9. TMN/TMP Module Connections.**

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

**J1 SIGNAL CONNECTOR**

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

J1




**Standard subminiature D Connector (Positronic SD25F0S5OOX with FC7520D pins)**

## 16.0 TMN/TMP MODULE CONNECTIONS

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

## 17.0 DESCRIPTION OF CONTROL AND SUPERVISORY SIGNALS

| SIGNAL | PIN | DESCRIPTION |
|---|---|---|
| Remote Enable | 1 | A TTL LO (sinking 5mA) or short to Pin 22 enables (turns on) all modules in the rack. This input is referenced to Signal Common, Pin 22. |
| Current Share | 10 | This is an analog control signal made up of the current share signals of all modules connected together. This pin is used to connect to Pin 10 of another identical rack to share output currents. Output currents between racks are shared within an accuracy of 10% of full load current over a 50% to 100% load range. This signal is referenced to -Sense, Pin 23. |
| + Sense<br>- Sense | 11<br>23 | These remote sense leads should be connected as a twisted pair to the respective + and - load points to provide regulation at the point of load. Removal of the sense leads transfers regulation control to the output terminals of the rack via internal 10-ohm sense resistors. |

| SIGNAL | PIN | DESCRIPTION |
|---|---|---|
| Remote Adjust - 1<br>Remote Adjust - 2<br>Remote Adjust - 3 | 24<br>12<br>25 | These are analog voltage inputs to the designated modules by which the output voltage is adjusted. A zero to + 5V input represents approximately 45 to 58V output for a 48V module or 22.5 to 29V for a 24V module. This input should be driven from a source impedance less than 100 ohms and is referenced to -Sense, Pin 23. |
| AC Good - 1<br>AC Good - 2<br>AC Good - 3 | 14<br>16<br>18 | A TTL LO (sinks 2mA) indicates the AC input is present and the PFC converter stage has output. A TTL HI, or open, indicates AC input or PFC converter failure. This signal is referenced to Signal Common, Pin 22. |
| DC Good - 1<br>DC Good - 2<br>DC Good - 3 | 15<br>17<br>19 | A TTL LO (sinks 2mA) indicates that the unit is operating properly with output voltage in its controllable range. A TTL HI, or open, indicates the output is outside the 45-58V range for a 48V module or outside the 22.5-29V range for a 24V module, the unit has failed or is in current limit. This signal is referenced to Signal Common, Pin 22. |
| Signal Common | 22 | This is the reference common for the above logic signals. |

## 18.0 INSTALLATION

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

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

**18.3 DC Output Connections.** The DC output connections are shown in Figure 5(a) and (c). The positive and negative output connections are made to the copper bus bars as shown. The upper left bar is positive, and the lower right one is negative. Each bar has four ¼ - inch holes. Con-

nection to the bus bars should be made by means of ¼ - inch bolts with nuts. The output wires or bus bars should be sized in accordance with the load current and length of conductor.

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

**18.5 Control and Supervisory Signal Connections.** These connections are made to J1, a subminiature D 25-pin connector (Positronics No. SD25F0S5OOX), by means of the mating connector. Details for these connections are given in Sections 15.1 and 15.2.

**18.6 Cooling.** Each TMN/TMP module is cooled by an 80mm, internal DC ball bearing fan. For proper cooling the area in front of the fan and around the air exits should be kept clear for unimpeded air flow.

## 19.0 MAINTENANCE

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

## 20.0 TMN/TMP MODULES AND RACK SETUP AND TESTING

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

**20.2** Connect a three-wire AC power line to module no. 1 on the back of the rack. Be sure to connect the AC safety ground wire to the rack ground terminal. Do not plug the AC line into the 230VAC source yet.

**20.3** Connect a resistive power load across the DC output terminals. This load can be a DC electronic load that is set to the resistive mode or a high-power resistor that has the proper power capacity and cooling. For this test the load should be between about 10% and 50% of the full load rating of the module. For the 24V TMN module the resistor should be between 1.1 and 5.7 ohms; for the 28V TMN module it should be between 1.6 and 7.8 ohms; and for the 48V TMN module it should be between 4.6 and 23 ohms.

For the 24V TMP module the resistor should be between 1 and 4.8 ohms; for the 28V TMP module it should be between 1.3 and 6.5 ohms; and for the 48V TMP module it should be between 3.8 and 19 ohms.

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

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

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

**20.7** **Checking the Remote Enable Input.** Next, disconnect the Remote Enable wire from J1 Pin 1 to Pin 22. The module output should turn off, giving zero volts across the load. The DC Good LED should go off.

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

**20.9** **Checking the Remote Adjust Input.** Connect a variable external power supply as shown in Figure 11. With the output voltage set to zero, check the output voltage of the module with a digital voltmeter. For a 48V unit it should be approximately 45V and for a 24V unit it should be approximately 22.5V. Next, adjust the supply output to +5V and check the output voltage of the module. For a 48V unit it should be approximately 58V and for a 24V it should be approximately 29V. Unplug the external 5V supply and unplug the AC inputs to the rack.

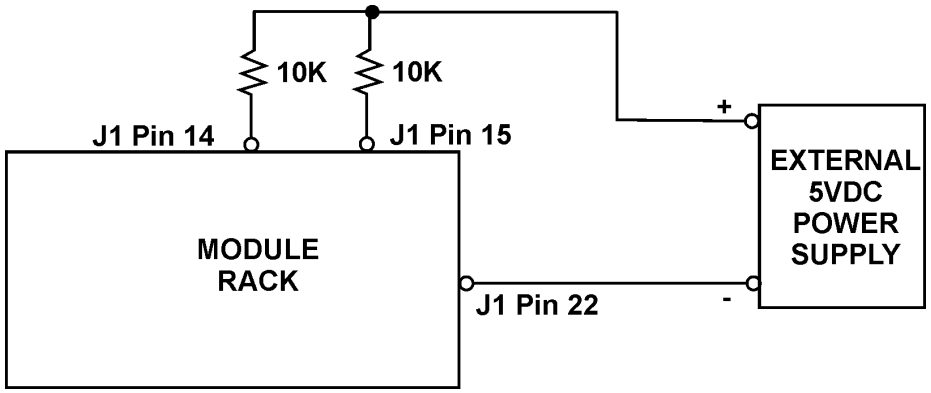



**Figure 10. Checking AC Good and DC Good Outputs**

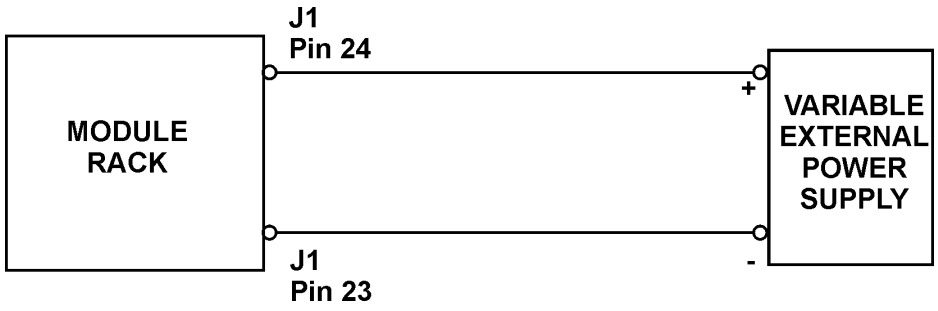



**Figure 11. Checking Remote Adjust Input**

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

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

**Table 20-1 TMN/TMP Rack Loads for Test**

| MODEL | NO. OF MODULES | OUTPUT VOLTAGE | LOAD CURRENT | LOAD RESISTOR |
|---|---|---|---|---|
| TMN | 3 | 48 | 31.5-42A | 1.14 - 1.52Ω |
| TMN | 3 | 28 | 54-72A | 0.39 - 0.52Ω |
| TMN | 3 | 24 | 63-84A | 0.29 - 0.38Ω |
| TMP | 3 | 48 | 37.5-50A | 0.96 - 1.28Ω |
| TMP | 3 | 28 | 64.5-86A | 0.33 - 0.43Ω |
| TMP | 3 | 24 | 75-100A | 0.24 - 0.32Ω |

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

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

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

**20.13** With all the modules inserted into the rack, check the Enable input for the entire rack. Disconnect the Remote Enable wire from J1 Pin 1 to Pin 22. The rack output should turn off and the output voltage should go to zero.

Reconnect the Remote Enable wire. This completes the rack setup and testing.

## 21.0 TROUBLESHOOTING GUIDE

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

### 21.2 Table 21-1. TMN/TMP Module and Rack Troubleshooting

| SYMPTOM | POSSIBLE CAUSE | ACTION TO TAKE |
|---|---|---|
| No output, AC Good and DC Good LEDs off. | No input power. | Check connection to AC source. Check AC source circuit breakers. |
| No output, DC Good LED off, AC Good LED on. | Remote Enable in OFF mode. | Make sure J1 Pin1 (Remote Enable) is connected to Pin 22 (Signal Common). |
| No output, DC Good LED off, AC Good LED on. | Shorted output. | Check for short and remove. |
| No output, DC Good LED off, AC Good LED on. | Overvoltage protection (OVP) has latched. | Reset output by cycling the AC input OFF for 20 seconds and then back ON. |
| No output, DC Good LED off, AC Good LED on. | Overtemperature protection is activated on one or more modules. | Allow modules to cool down for about 10 minutes. They will then start up automatically. Check to see if the cooling fans are operating. |
| No output, DC Good LED off, AC Good LED on. | Output load is too great for the number of modules. | Reduce load to proper level. |

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