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OPERATING MANUAL
TMF SERIES
HOT-SWAP POWER SYSTEM

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OPERATING MANUAL

TMF SERIES HOT-SWAP POWER SYSTEM

1.0 INTRODUCTION

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

The TMF Series hot-swap modules and rack form a complete power system with high-power outputs at 3.3, 5, 12, 15, 24, 28 and 48VDC. See Figure 1. Each module has up to 400 watts output. Three modules in a rack produce up to 1200 watts. Using the three modules in a 2+1 redundant configuration produces up to 800 watts. The modules have single-wire active load sharing for automatic paralleling of outputs, and output ORing diodes permit hot-swap addition or replacement of modules while the system is operating.

The TMF Series operate worldwide with a 85-264VAC 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 DC power good LED on the front panel and also a green AC power good LED for 24, 28 and 48VDC models. Each module is self-cooled by two 40mm fans.

The TMF Series rack has two copper bus bars for the output and a 15-pin sub-miniature D connector on the back for the control functions: AC power good, DC power good, current share, enable and remote sense. There is also a 5V 100mA auxiliary output for powering external control circuits.

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 TMF Series modules:

- For Distributed Power and Other Systems
- Tightly Regulated Output Voltage
- 400-Watt Modules
- Output Overload Protected
- 3.3 to 48VDC Versions
- Low Profile: 1U(1.72 inches or 43.7mm) Height
- 19-Inch Racks

Figure 1. TMF Series Hot-Swap Power System.

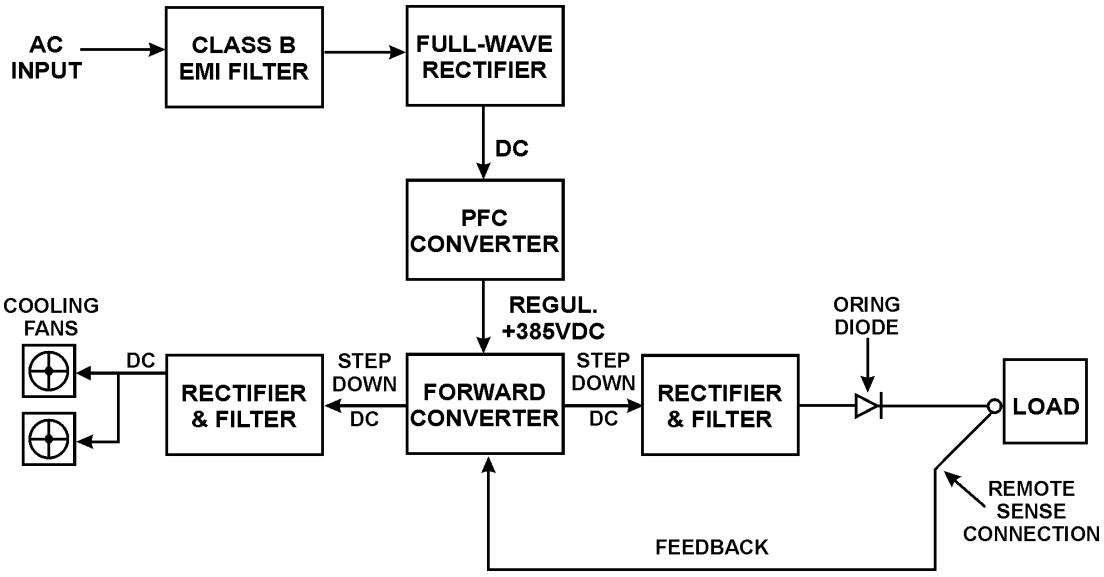


Figure 2. TMF Series Module Block Diagram.

- Rack Capacity Up to 3 Modules
- High Power Density: 4 Watts/Cubic Inch
- Light Weight: 3.2 lbs. per Module
- >75% Efficiency at Full Load
- 0.99 Power Factor
- Class B EMI Input Filter
- Worldwide Input: 85-264 VAC at 47-63Hz
- 800W Redundant or 1200W Non-Redundant
- Remote Sensing
- Active, Single-Wire Load Sharing
- Integral ORing Diodes
- Hot-Swappable Modules
- Front Panel Switch Option
- LED Operating Indicators
- Control and Monitoring Interface Signals

3.0 PRODUCT LINE

3.1 Hot-Swap Modules

HOT-PLUG MODULE ORDERING GUIDE

(Other Modules Available, Consult Factory)

Max Watts	Output Voltage	Output Current	PFC	Minimum Load	Total Regulation	MODEL NUMBER
200	3.3V	60.0A	✔	0A	2%	TMF9000
300	5.0V	60.0A	✔	0A	2%	TMF2000
400	12.0V	33.3A	✔	0A	2%	TMF3000
400	15.0V	26.7A	✔	0A	2%	TMF4000
400	24.0V	16.7A	✔	0A	2%	TMF5000
400	28.0V	14.3A	✔	0A	2%	TMF6000
400	48.0V	8.3A	✔	0A	2%	TMF7000

Option S: Front-Panel On/Off Switch. Add “S” as suffix to the module model number. Available only on models with output voltages from 3.3 to 15VDC.

3.2 Racks

MODEL	WIDTH	HEIGHT	NUMBER OF MODULES
TMFR1U	19” (483MM)	1.72” (43.7MM)	3

3.3 System Rack Options

CODE	OPTION
A	**Standard:** 2-position terminal block AC connector plus stud ground connection for 1200W max. output.
B	**Option:** IEC320, C14 AC connector for 800W max. output.
C	**Option:** IEC320, C19 AC connector for 1200W max. output with rear safety cover.
AE	**Option:** 2-position terminal block AC connector plus stud ground connection for 1200W max. output. Also has rear safety cover.
BF	**Option:** IEC320, C14 AC connector for 800W max. output with rear safety cover.

NOTE: Add Option Suffix Code to Rack Model No.

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 TMF 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 rectifier 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 TMF 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 3.3, 5, 12, 15, 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 Fans. Another output from the forward converter is rectified, filtered and used to power the DC ball bearing cooling fans on the module.

7.4 Interface Signals. The module incorporates a number of interface control and supervisory signals which operate off internal circuits and are

brought to the outside. These include remote enable, which enables or inhibits the entire rack, 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 the TMF Series modules is shown in Figures 3(a) and 3(b). On the right side of the panel is the DC Good LED (green). For 24, 28 and 48V models there is also an AC Good LED and an output voltage trim pot. Below these is the engagement latch.

9.0 TMF MODULE SPECIFICATIONS

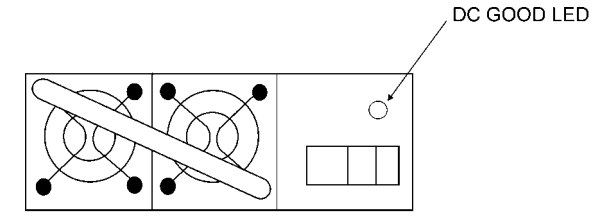
Specifications for a Single Module. Typical at 115/230VAC Line, Full Load and 25°C Unless Otherwise Noted.

OUTPUT SPECIFICATIONS

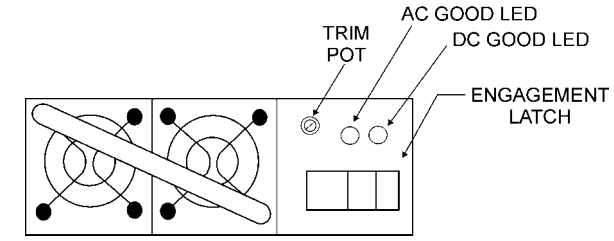
Total Output Power, Max.	400 watts
Output Voltage	3.3, 5, 12, 15, 24, 28 or 48VDC
Total Regulation[1].	<±2.0%
Ripple & Noise (Pk-Pk)[2].	<1% or 50mV
Hold-Up[3].	>15mS
Dynamic Response[4].	300µS
Temperature Coefficient.	±0.02%/°C
Minimum Load.	0A
Overload Protection.	Foldback Current Limiting
Overvoltage Protection	Power Shutdown
Remote Sense	Up to 0.25V Per Wire

INPUT SPECIFICATIONS

Input Voltage Range	85-264VAC Single Phase
Power Factor	0.99
Input Frequency	47-63Hz
Inrush Limiting	30A Peak (Cold Start)
Input Current, Full Load	4.5A, 120VAC
	2.4A, 230VAC
Input EMI Filter, Conducted	EN55022 Curve B
	FCC20780 pt. 15J Curve B
Harmonic Distortion	EN61000-3-2



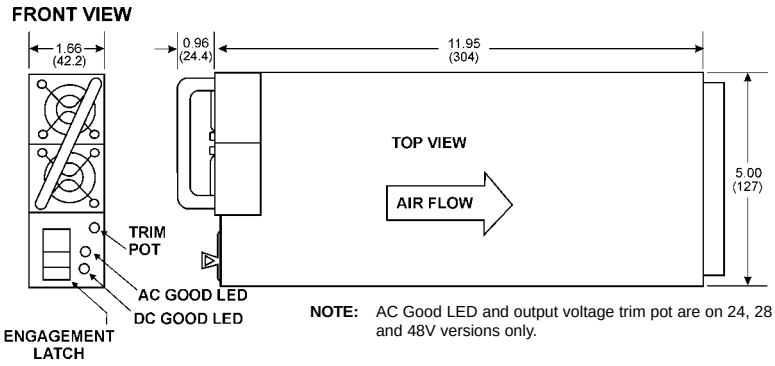
(a) 3.3V to 15V Output Models



(b) 24V to 48V Output Models

Figure 3. Front Panel of TMF Series Modules

HOT-SWAP MODULE



MATING RACK-MOUNT

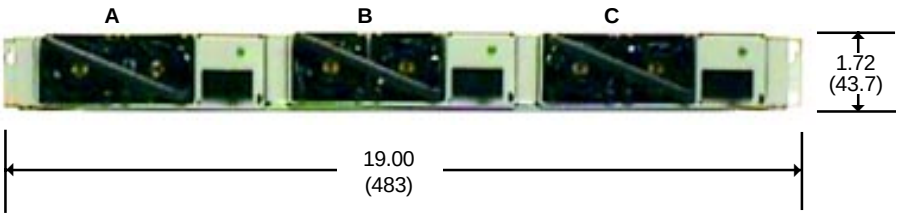


Figure 4. TMF Series Mechanical Dimensions

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, 6.3A

GENERAL SPECIFICATIONS

Efficiency ..... >75% at Full Load
Switching Frequency ..... 150kHz Nominal
Isolation, class I [5]. ..... >3000VAC Input - Output
..... >1500VAC Input - Ground
..... >50VDC Output - Ground
Safety Standards EN60950, 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 ..... Two Ball Bearing Fans

PHYSICAL SPECIFICATIONS

Case Material
- Module ..... Aluminum
- Rack ..... Steel

Rack Finish ..... Powder Coat Gray
Dimensions, Inches (mm)
- Hot-Swap Module ..... 1.66 H x 5.00 W x 11.95 D
..... (42.2 x 127 x 304)
- 3-Module Rack (A & B Options) ..... 1.72 H x 16.88 W x 16.00D
..... (43.7 x 429 x 406)
- 3-Module Rack (C, AE & BF Options) ..... 1.72 H x 16.88 W x 17.44D
..... (43.7 x 429 x 443)

NOTES:

1. No Load to full load, including line regulation and load regulation.
2. Whichever is greater. 20MHz bandwidth. Measured with 0.1µF ceramic and 10µF tantalum capacitors in parallel across the output.
3. 400W output power at nominal AC line.
4. <4% deviation recovering to within 1% for 25% load change.
5. 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 264VAC, 47-63Hz, for worldwide operation.
EMI Input Filter	This filter suppresses conducted noise from the rectifier back onto the AC line. The filter meets FCC20780 part 15J Curve B and EN55022 Curve B.
Inrush Current Limiting	When the rectifier is turned on from a cold start, the initial input current is limited to a peak value of 30 amperes.
Thermal Protection	If the output power converter overheats, the TMF 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.
Output Voltage Adjustment	For the 24, 28 and 48V modules, there is an output voltage adjustment potentiometer on the front panel. The adjustment range is approximately ±5%.
Current Sharing	The TMF 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.
Overvoltage Protection	The output is protected from overvoltage due to fault conditions in the module. Overvoltage protection is set at approximately 20% over the nominal output voltage. The result is a latched shutdown of the module. It is reset by cycling the AC input off for about 10 seconds and then back on.
No Load Operation	The module output can be operated down to zero load while maintaining output regulation.

FEATURE / OPTION	DESCRIPTION
Hot-Swap Connectors	The hot-swap connectors used in both the modules and racks are high-reliability connectors specifically designed for hot swap applications. They have staged pin lengths for safety and optimum operation. The ground (common) pin makes first contact and an interlock pin makes last contact, turning the module on (provided the rack is "enabled").
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 DC Good indicator is a green LED showing that the output voltage is present and within operating range, and the fans are operating. The AC Good indicator (on the 24, 28 and 48V versions) is a green LED showing that AC input is present.
AC Input Options	There are five input versions: An IEC320 connector (options B, C and F) or a two-position terminal block (options A and E) for conduit connection. See Par. 3.3.
Control and Monitoring Signals	For detailed description of Remote Enable, Current Share, Remote Sense and AC & DC Good signals see Section 17, Description of Control and Supervisory Signals.

11.0 MECHANICAL SPECIFICATIONS

The mechanical dimensions of the TMF Series modules and rack are shown in Figure 4.

12.0 SAFETY AND INDUSTRY STANDARDS

12.1 The TMF modules and racks meet the following safety certifications:

STANDARD	AGENCY
UL1950	UL
CSA22.2-950	CUL
EN60950	DEMKO

12.2 The TMF 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; input surges, line-to-ground, meet EN61000-4-5 Level 3.

13.0 OPERATING INFORMATION

13.1 Input Voltage. The TMF Series modules operate off worldwide AC input voltages within the range of 85 to 264 VAC at 47 to 63 Hz. There are five AC input versions of the racks to chose from. For complete details see Paragraph 3.3 and Figure 5.

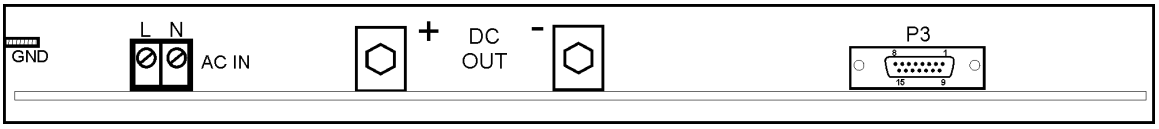
13.2 Output Connection. The output is provided on two copper bus bars. Connection should be made with bolts into the 1/4-20 PEM nuts. For complete details see Section 18.3 and Figure 5. Both positive and negative outputs are floating.

13.3 Output Voltage. The output voltage of each module is factory set to the nominal output voltage, ±1%. For the 24, 28 and 48V modules there is a front-panel potentiometer that can be used to adjust the output voltage over ±5%.

13.4 Output Power. Maximum output power is 200W for the 3.3V output, 300W for the 5V output and 400W for the other output voltages. 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.

13.6 Remote Sensing. Remote sensing connections are made to pins 14 (+Sense) and 13 (-Sense) of the rack P3 connector. Remote sensing is used to regulate the output voltage at the point of load by compensating



(a) Standard AC Input Terminal Block DC Output (Cover Removed) and P3 Signal Connector are shown.

(b) Optional AC Input IEC320, C19 Connector and Rear Cover. IEC320, C14 Connector also available.

Figure 5. Rear Rack Input & Output Connections

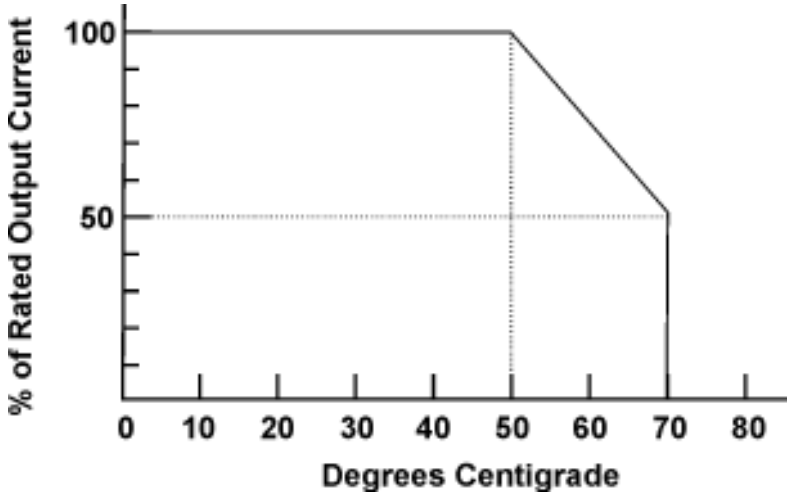


Figure 6. Rated Output Current vs. Ambient Temperature

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 for local sensing at the output terminals. Be careful not to reverse the sense lead connections.

13.7 Control & Supervisory Signals. All control and supervisory signals are accessible at P3, a 15-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 rectifier module: AC Good and DC Good. They are TTL-compatible signals referenced to Signal Common, P3 Pin 11 on the rack. **AC Good:** A logic HI indicates that there is AC input and the PFC converter stage is operating. **DC Good:** A logic HI indicates a DC output is present and within operating range.

14.0 PARALLEL OPERATION

The TMF 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 shelf can be operated in a 2+1 redundant mode. This means, for example, that the full load current can be carried by two rectifier 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.

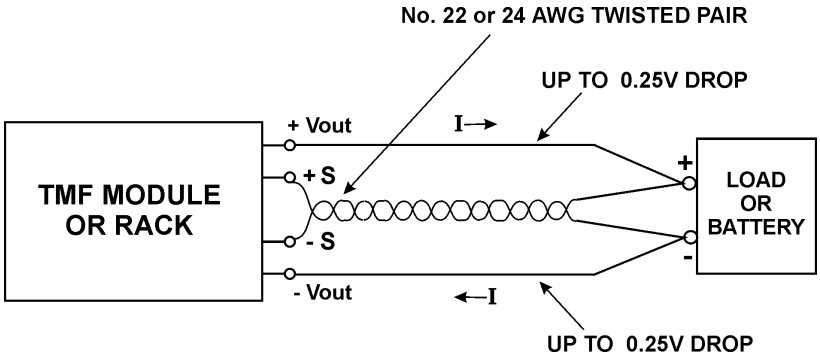


Figure 7. Remote Sensing Connection

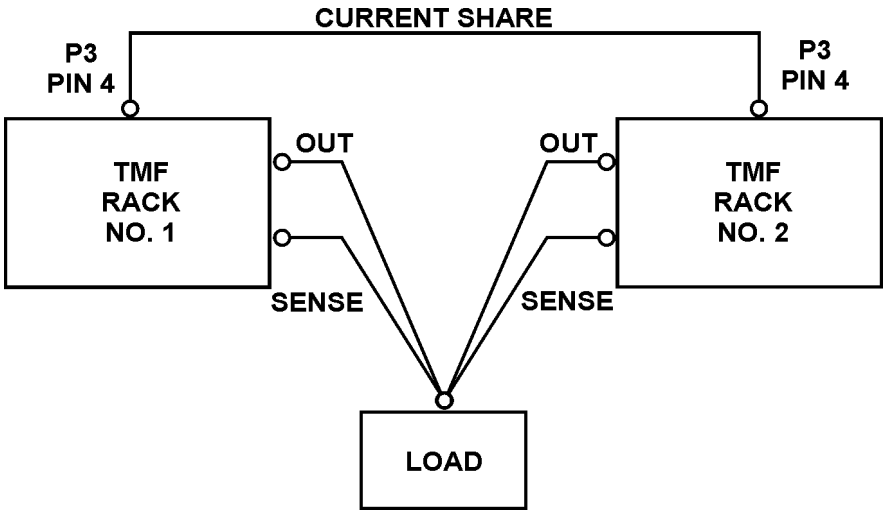


Figure 8. Parallel Connection of TMF Racks.

Table 14-1 Redundant and Non-Redundant Operation

MODE	NUMBER OF MODULES	NOM. VOLTS	OUTPUT WATTS
Redundant, 2+1	3	3.3	400
Non-Redundant	3	3.3	600
Redundant, 2+1	3	5	600
Non-Redundant	3	5	900
Redundant, 2+1	3	12 - 48	800
Non-Redundant	3	12 - 48	1200

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 (P3 Pin 4). 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 TMF racks connected in parallel.

15.0 RACK CONTROL & SUPERVISORY SIGNAL CONNECTIONS

15.1 Connections for control and supervisory signals are made at the back of the rack to connector P3, a standard 15-pin subminiature D connector (AMP AMPLIMATE No. 747845). The mating connector is AMP AMPLIMATE No. 747908-2.

15.2 The pin connections to P3 are shown in the table.

RACK MOUNT P3 SIGNAL CONNECTOR

PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION
1	AC Power Good	6	DC Power Good-B	11	Signal Common
2	AC Power Good	7	DC Power Good-A	12	5V, 100mA Aux.
3	AC Power Good	8	Enable-C	13	- Sense
4	Current Share	9	Enable-B	14	+ Sense
5	DC Power Good-C	10	Enable-A	15	Not Used

NOTE: A, B and C refer to the module positions from left to right, viewed from the front of the rack. See Fig. 4.

P3

Standard subminiature D connector AMP AMPLIMATE No. 747845

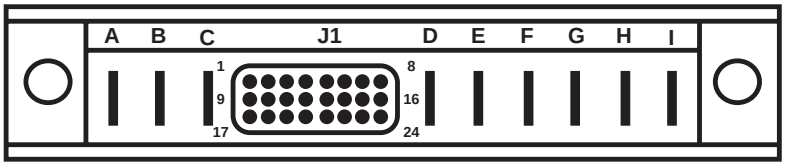
16.0 TMF MODULE CONNECTIONS

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

17.0 DESCRIPTION OF CONTROL AND SUPERVISORY SIGNALS

SIGNAL	PINS	DESCRIPTION
AC Good - C AC Good - B AC Good - A	1 2 3	These are TTL outputs for each corresponding module. A TTL HI indicates the AC input is present and the PFC converter stage has output. A TTL LO (sinking 5mA) indicates AC input or PFC converter failure. This signal is referenced to Signal Common, Pin 11.
Current Share	4	This is an analog control signal made up of the current share signals of all rack modules connected together. This pin is used to connect to Pin 4 of another identical TMF 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 Signal Common, Pin 11.
DC Good - C DC Good - B DC Good - A	5 6 7	These are TTL outputs for each corresponding module. A TTL HI indicates that the module is operating properly with output voltage in its controllable range. A TTL LO (sinking 5mA) indicates output failure or cooling fan failure. This signal is referenced to Signal Common, Pin 11.
Remote Enable	8, 9, 10	A TTL HI or open at each input enables (turns on) the corresponding module in the rack. A TTL LO (sinking 2mA) inhibits (turns off) each module.This input is referenced to Signal Common, Pin 11.
Signal Common	11	This is the reference common for the Remote Enable, AC Good and DC Good signals. It is internally in common with the -Sense, Pin 23.
Auxiliary Supply	12	This is a +5VDC auxiliary output at 100mA for powering external control and supervisory circuits. The return is the Signal Common, Pin 11.
- Sense + Sense	13 14	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.

TMF MODULE CONNECTOR



MODULE
J1 POWER CONNECTIONS

TERMINAL	FUNCTION	TERMINAL	FUNCTION
A	Frame Ground	F	+V Output
B	AC Neutral	G	+V Output
C	AC Line	H	-V Output
D	Not Used	I	-V Output
E	Not Used		

NOTE: J1 connector is an ELCON FLATPAQ™ No. 279-0320-00100.
Mating receptacle is No. 279-0320-00200.

MODULE
CONTROL & SUPERVISORY SIGNALS

PIN	FUNCTION	PIN	FUNCTION
1	Interlock	13	Control Common
2	Remote Adjust	14	- Sense
3	Enable	20	Current Share
4	DC Good	21	5V, 100mA Aux.
9	Control Common	22	+ Sense
12	AC Power Good		

NOTE: All other pins are No Connection.

Figure 9. TMF Series Module Connections

18.0 INSTALLATION

18.1 Mounting. See Figure 4. The TMF 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 the engagement latch on the front panel of each module.

18.2 AC Input Connections. There are five AC input versions of the TMF racks. See Paragraph 3.3. Both IEC320 and terminal block connections are available.

18.3 DC Output Connections. The DC output connections are shown in Figure 5. 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 bar has a ¼ - 20 PEM nut. The output wires 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 P3, a subminiature D 15-pin connector (AMP AMPLIMATE No. 747845), by means of the mating connector. Details for these connections are given in Sections 15.1 and 15.2.

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

19.0 MAINTENANCE

No routine maintenance is required on the TMF 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 TMF MODULES AND RACK SETUP AND TESTING

20.1 The TMF 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 an AC three-wire conduit cable to the proper terminals on the input terminal block or connect a three-wire power line to the IEC320 connector on the back of the rack. Do not plug the AC line into the power socket yet.

20.3 Connect a resistive power load across the DC output terminals. This load can be a DC electronic load that is set to the resistive mode or a high-power resistor that has the proper power capacity and cooling. For this test the load should be between about 10% and 50% of the full load rating of the module.

20.4 Connect a color-coded, twisted pair (no. 22 or 24 AWG) from the remote sense pins to the load. The +Sense lead (P3 Pin 14) **must go** to the positive side of the load and the - Sense lead (P3 Pin 13) **must go** to the negative side of the load. The Remote Enable input (P3 Pin 10) should be open.

20.5 Insert one of the TMF modules into position A of the rack (leftmost slot). Plug the AC power in and measure the voltage across the load at the remote sense points with a digital voltmeter. The voltage should be at the nominal output voltage of the module, ±1%.

20.6 **Checking the Front Panel LED(s)**. The DC Good green LED should be on. For 24, 28 and 48V module, the AC Good green LED should also be on.

20.7 **Checking the Remote Enable Input.** Next, connect a Remote Enable wire from P3 Pin 10 to Pin 11. The module output should turn off, giving zero volts across the load. The DC Good LED should go off. Disconnect the Remote Enable wire.

20.8 **Checking the AC Good and DC Good Outputs**. Measure the voltage from P3, Pin 3 to Pin 11 and Pin 7 to Pin 11 with a digital voltmeter. Both voltages should be at a TTL HI, or about +5V.

Reconnect the Remote Enable wire from Pin 10 to Pin 11. Measure the output voltage at both P3 Pins 3 and 7 with respect to Signal Common (Pin 11) with a digital voltmeter. Pin 3 should be at a TTL HI, or about +5V. Pin 7 should be at a TTL LO, or less than +0.5V. Disconnect the Remote Enable wire. Unplug the AC input to the TMF rack.

20.9 Checking the Other TMF 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.

20.10 Checking the Complete TMF Rack. Confirm that the output voltages of the individual modules are all accurately set to their nominal values. The voltages between modules should be within ±1% of each other for best performance of the current sharing circuitry. Insert all modules into the shelf. 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. Plug the rack into the AC power source.

Table 20-1 TMF Rack Loads For Test

NO. OF MODULES	OUTPUT VOLTAGE	LOAD CURRENT	LOAD RESISTOR
3	3.3	90-120A	.028 - .037Ω
3	5	90-120A	.042 - .056Ω
3	12	50-66A	.182 - .240Ω
3	15	40-53A	.283 - .375Ω
3	24	25-33A	.736 - .960Ω
3	28	21-28A	1.00 - 1.34Ω
3	48	12-16A	3.00 - 4.00Ω

Check the load voltage with a digital voltmeter. It should be very close to nominal value (±1%). The green DC Good LED should be on.

While the rack is operating, pull Module A out while monitoring the output voltage with a digital voltmeter. It 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.

With all the modules inserted into the rack, check the Enable input for the entire rack. Connect Remote Enable wires from P3, Pins 8, 9 and 10 to Pin 11. The rack output should turn off and the output voltage should go to zero.

Disconnect the Remote Enable wires. This completes the rack setup and testing.

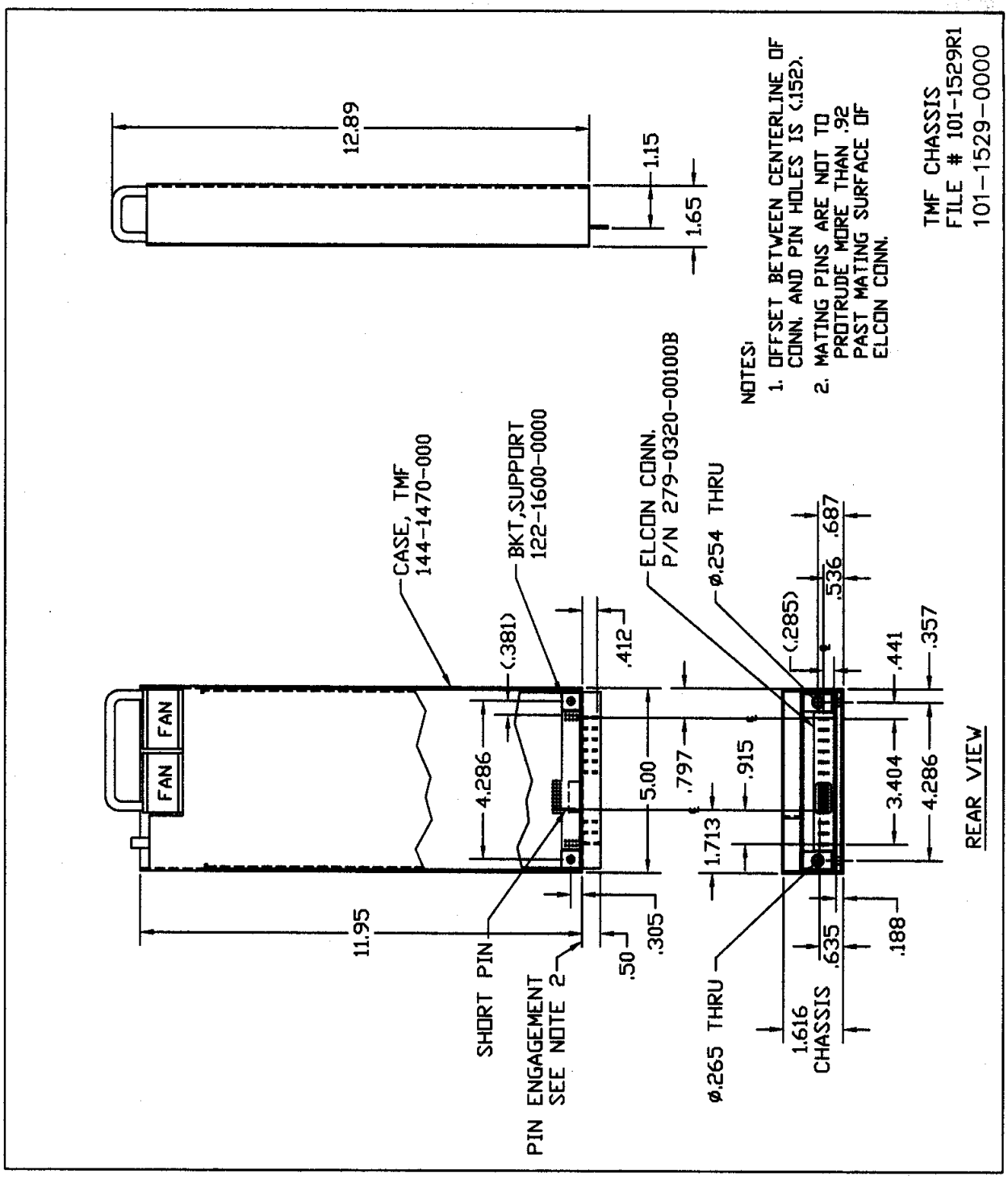
21.0 TROUBLESHOOTING GUIDE

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. TMF Module and Rack Troubleshooting

SYMPTOM	POSSIBLE CAUSE	ACTION TO TAKE
No output, DC Good LED off.	No input power.	Check connection to AC source. Check AC source circuit breakers.
No output, DC Good LED off.	Remote Enable in OFF mode.	Make sure P3 Pins 8, 9 and 10 (Remote Enable) are open or at TTL HI.
No output, DC Good LED off.	Shorted output.	Check for short and remove.
No output, DC Good LED off.	Overvoltage protection (OVP) has latched.	Reset output by cycling the AC input OFF for 10 seconds and then back ON.
No output, DC Good LED off.	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.	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.


TMF CHASSIS
FILE # 101-1529R1
101-1529-0000
NOTES:
1. OFFSET BETWEEN CENTERLINE OF CONN. AND PIN HOLES IS (.152).
2. MATING PINS ARE NOT TO PROTRUDE MORE THAN .92 PAST MATING SURFACE OF ELCON CONN.
CASE, TMF 144-1470-000
BKT,SUPPORT 122-1600-0000
ELCON CONN. P/N 279-0320-00100B
Ø.254 THRU
FAN
FAN
12.89
1.15
1.65
(.381)
.412
4.286
5.00
.797
.915
1.713
(.285)
.536
.687
.441
.357
3.404
4.286
11.95
.305
.50
.635
.188
1.616
CHASSIS
Ø.265 THRU
SHORT PIN
PIN ENGAGEMENT SEE NOTE 2
REAR VIEW