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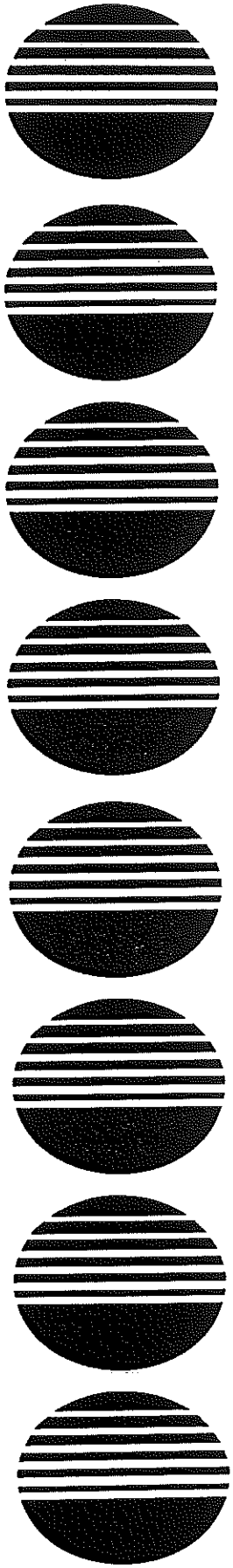
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PRICE: $25.00

TP SERIES
HOT-PLUG N + 1
POWER SYSTEM

Manual No. TP-1095-0

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TP SERIES OPERATING MANUAL

1.0 INTRODUCTION

1.1 This Operating Manual should be read through carefully before installing and operating the TP Series hot-plug power system.

1.2 The TP Series is a switching hot-pluggable power system with N + 1 redundancy. The standard three-module TP power system is shown in Figures 1 and 2. Other configurations are possible as shown in Figure 3; consult the factory on availability.

1.3 The standard system consists of three hot-pluggable power modules in a 3.5-inch high by 19-inch wide chassis. The chassis mounts in a standard 19-inch rack. This manual covers the standard system, although the operating information also applies to the other configurations.

In N + 1 redundant operation this system can provide up to 1200-watts for a single output or up to 1000 watts for a triple or quad output. For non-redundant operation, the power levels are 1800 and 1500-watts respectively. A six-module system, consisting of two stacked three-module systems, can provide up to 3000-watts N + 1 redundant or 3600-watts non-redundant.

1.4 There are 34 standard hot-plug modules in the TP Series. Each module can supply up to 600-watts for a single output or up to 500-watts for a triple or quad output. The modules have built-in output isolation diodes, and each module is individually fan-cooled. High reliability hot-plug connectors are used in the modules and the chassis. For N + 1 redundant or for non-redundant operation, the outputs must be externally connected in parallel by the user; the current share terminals must also be connected together. The system can be supplied with customer-designated backplane connections. Consult the factory on this.

1.5 The TP Series incorporates a number of important features such as active current sharing, N + 1 redundant operation, remote sensing on all outputs, Class A EMI input filter, electronic inrush current limiting and thermal protection. An additional feature is no load operation which permits any output to be operated down to zero load. Options include input autoranging, DC input (42-60VDC) and extra mounting brackets. Control and supervisory signals include high and low margining, output inhibit, power good and DC OK. For a general description of features and an ordering guide, see the Appendix.

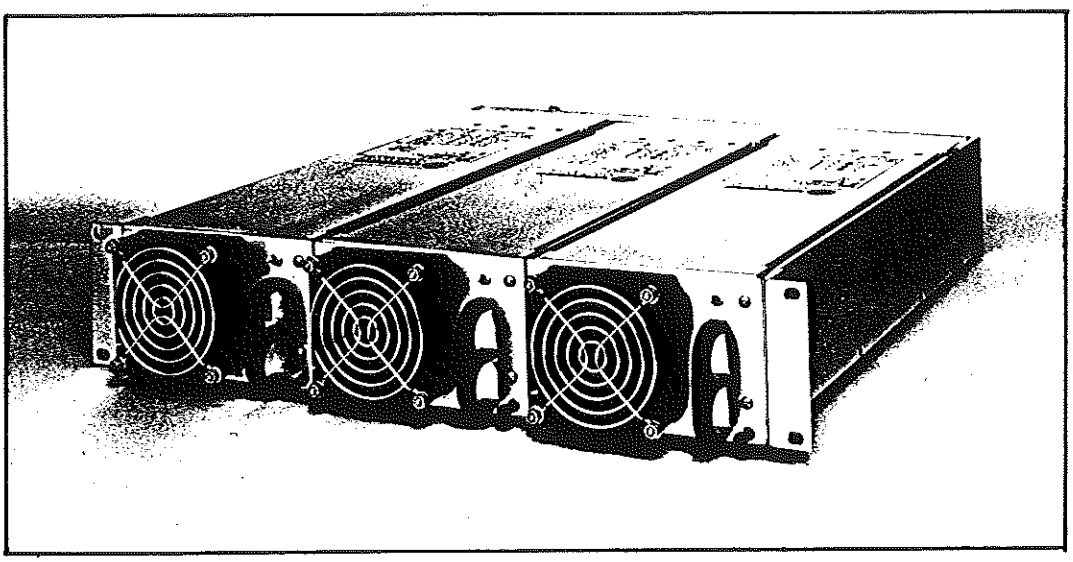


Figure 1. **TP Series Hot-Plug Power System**

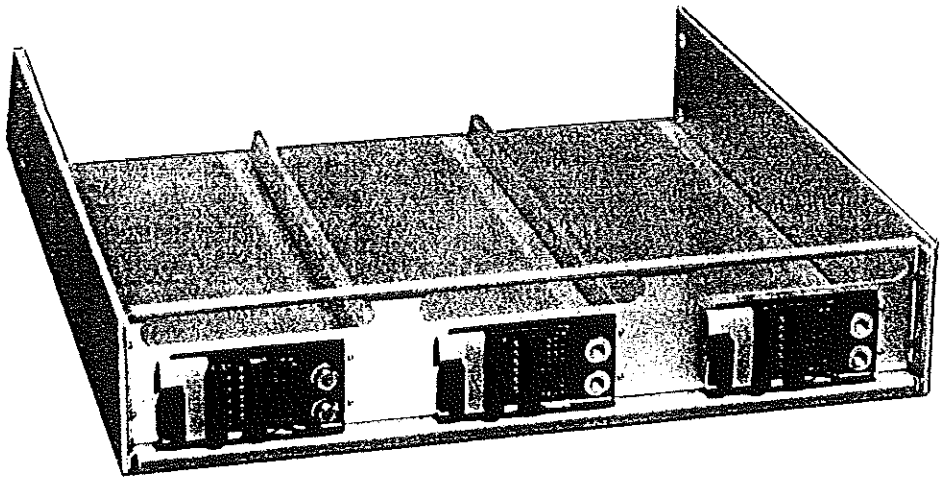


Figure 2. **TP Series Chassis and Backplane**

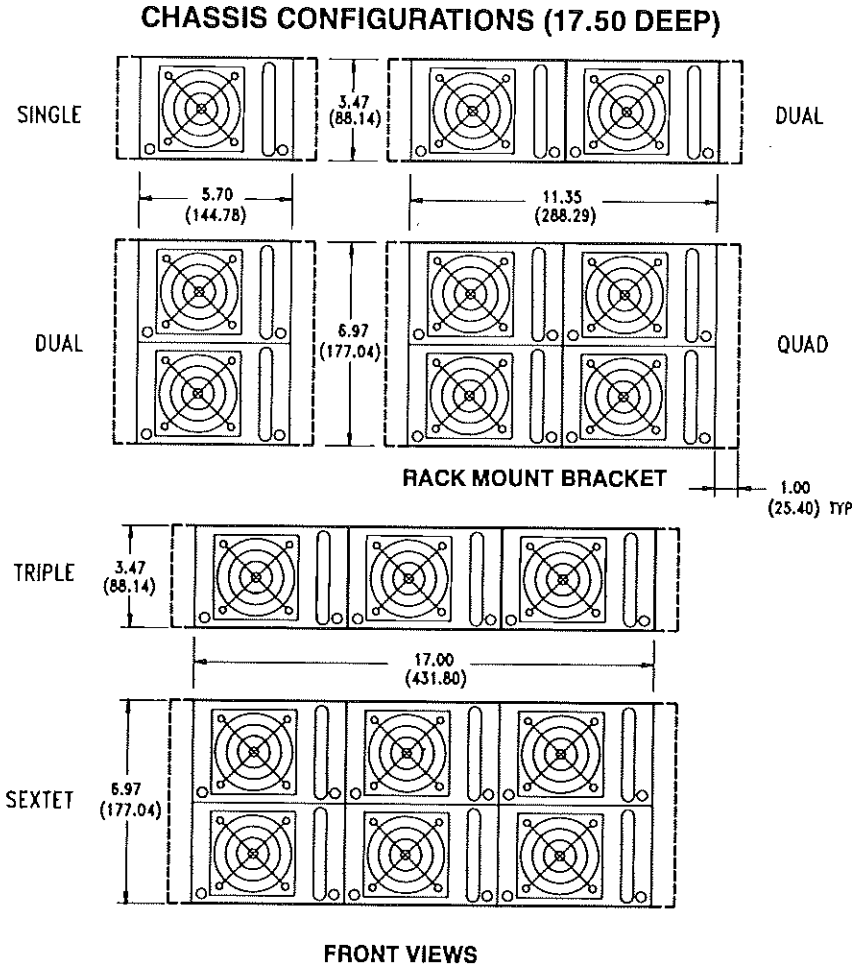


Figure 3. Various Chassis Configurations for TP Series

2.0 SAFETY WARNINGS

2.1 This switching power system has hazardous external and internal voltages. It should be handled, tested and installed only by qualified technical persons who are trained in the use of power supplies and are well aware of the hazards involved.

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

2.3 When operating this power system, the AC input ground terminal must be connected to safety ground to minimize electrical shock hazard and to ensure low EMI (electromagnetic interference).

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

2.5 For units without the autorange option, make sure that the 115/230 VAC selector switches are in the proper positions on all modules for the input voltage used. Operating the power system with the switches in the wrong positions will damage the modules, and this damage is not covered by the warranty.

3.0 WARRANTY POLICY

3.1 All products of UNIPOWER Corporation are warranted for two (2) years from date of shipment against defects in materials 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 the buyer. Freight charges incurred in returning the defective products will be paid

by UNIPOWER. Charges incurred in returning the material will be paid by the buyer. If the buyer fails to fully comply with the foregoing, the buyer shall not be entitled to any allowance or claim with respect to such product. 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.

4.0 UNPACKING AND INSPECTION

4.1 This TP 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. The final acceptance test report is included with each power supply.

4.2 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 materials as evidence of damage for the freight carrier's inspection.

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

4.4 Always save the packing materials for later use in shipping the unit. Never ship the power system without proper packing.

5.0 DESCRIPTION OF OPERATION

5.1 **Outputs.** The TP Series hot-plug power modules are auxiliary output type switching power supplies. The main output has an isolated feedback circuit which is used to regulate the output voltage. This is done by means of pulse-width modulation using MOSFET switches operating at 100kHz. In multi-output models, the auxiliary outputs are derived from additional windings on the high-frequency power transformer. Each winding has an output circuit that rectifies and filters the output; it then regulates it with a magnetic amplifier. The outputs all have their own remote sensing and current sharing capability, and each one is isolated by means of a series isolation diode.

5.2 **N + 1 Redundant Operation.** In this mode, the outputs of the three power modules are all connected in parallel and currents are shared by means of the active current sharing circuit on each output. Two of the three power modules

must be capable of handling the load so that if one of the modules fails, the other two carry the load without any interruption in output power. The isolation diodes prevent a faulty output from affecting another output.

5.3 **AC Input.** The front end of each power module incorporates an input EMI filter to suppress line noise and high frequency transients both from the AC power line and from the power supply to the line. The AC input voltage range can be either switch-selected (standard) or automatically selected by an autoranging circuit (Option A). Electronic inrush-current limiting controls the initial AC input current on power-up.

5.4 **Control and Supervisory Signals.** Each hot-plug power module incorporates a number of control and supervisory signals including remote sense for each output, current share connection for each output, high and low margining for the main output, output inhibit, power good and DC OK signals.

6.0 FRONT AND REAR PANEL DESCRIPTIONS

6.1 Front, side and rear views of the TP Series case are shown in Fig. 4. Each hot-plug power module has its input, outputs and control and supervisory signals brought out separately to the backplane.

6.2 The main output (V1) is at the two terminals of J1. Connections are made by means of no. 1/4-20 screws. The other outputs are at connector P2. AC input connections are made to connector P3. All control and supervisory signal connections are made to the 26-pin connector P1. See Fig. 5.

6.3 Figure 6 is an outline drawing of a single hot-plug power module. The module has a cooling fan on the front panel together with two captive thumbscrews for securing the modules in the chassis. Also on the front panel is a green LED power good indicator. At the rear is the high-reliability hot-plug connector that plugs into the system backplane.

7.0 STANDARD HOT-PLUG POWER MODULES

The following are the standard hot-plug power modules which are available for the TP Series. The output voltages and currents are shown in the table.

STANDARD HOT-PLUG POWER MODULES
(Consult factory for non-standard configurations)

MAX WATTS[1]	MODEL NUMBER	OUTPUT V1	OUTPUT V2	OUTPUT V3	OUTPUT V4
250	TPD1000 TPD2000 TPD3000 TPD4000 TPD5000 TPD7000	2V 65A 5V 50A 12V 21A 15V 17A 24V 11A 48V 5A			
400	TPF1000 TPF9000 TPF2000 TPF3000 TPF4000 TPF5000 TPF7000	2V 100A 3.3V 100A 5V 80A 12V 34A 15V 27A 24V 17A 48V 8.5A			
500	TPG2000 TPG5000 TPG7000	5V 100A 24V 21A 48V 10A			
600	TPH5000 TPH7000	24V 25A 48V 12.5A			
400	TPF2220 TPF2330 TFP2440 TPF2233 TPF2244 TPF2335 TPF2445 TPF2333	5V 60A 5V 60A 5V 60A 5V 60A 5V 60A 5V 60A 5V 60A 5V 60A	5V 10A 12V 8A(12) 15V 7A 12V 8A(12) 15V 7A 12V 8A(12) 15V 7A 12V 8A(12)	5V 10A 12V 8A(12) 15V 7A 12V 8A(12) 15V 7A 12V 8A(12) 15V 7A 12V 8A(12)	 12V 8A(12) 15V 7A 24V 4A(6) 24V 4A(6) 12V 8A(12)
500	TPG2220 TPG2330 TPG2440 TPG2233 TPG2244 TPG2335 TPG2445 TPG2333	5V 75A 5V 75A 5V 75A 5V 75A 5V 75A 5V 75A 5V 75A 5V 75A	5V 10A 12V 8A(12) 15V 7A 5V 10A 5V 10A 12V 8A(12) 15V 7A 12V 8A(12)	5V 10A 12V 8A(12) 15V 7A 12V 8A(12) 15V 7A 12V 8A(12) 15V 7A 12V 8A(12)	 12V 8A(12) 15V 7A 24V 4A(6) 24V 4A(6) 12V 8A(12)

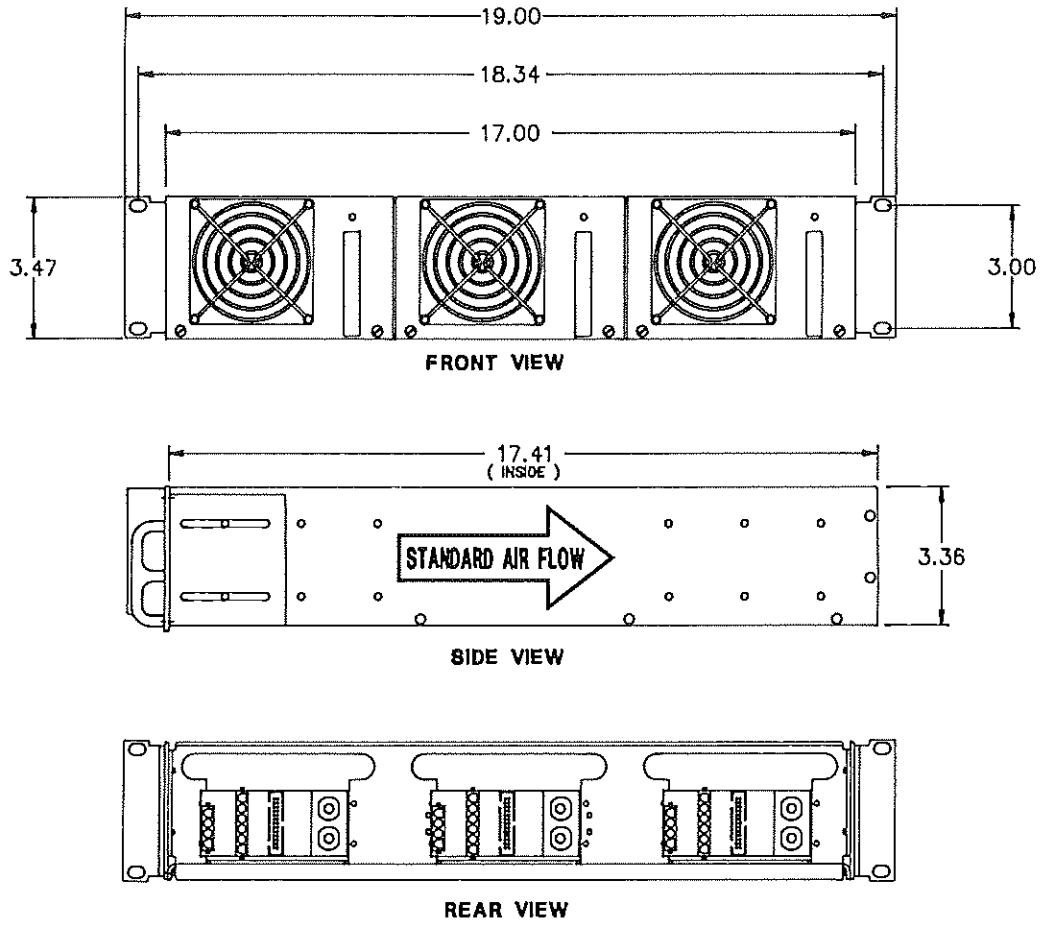


Figure 4. **TP Series Front, Side and Rear Views**

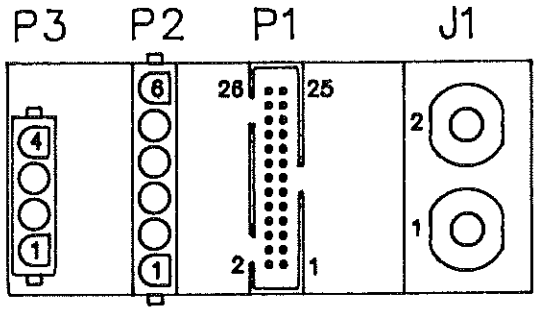


Figure 5. **Backplane Connections for Each Power Module**

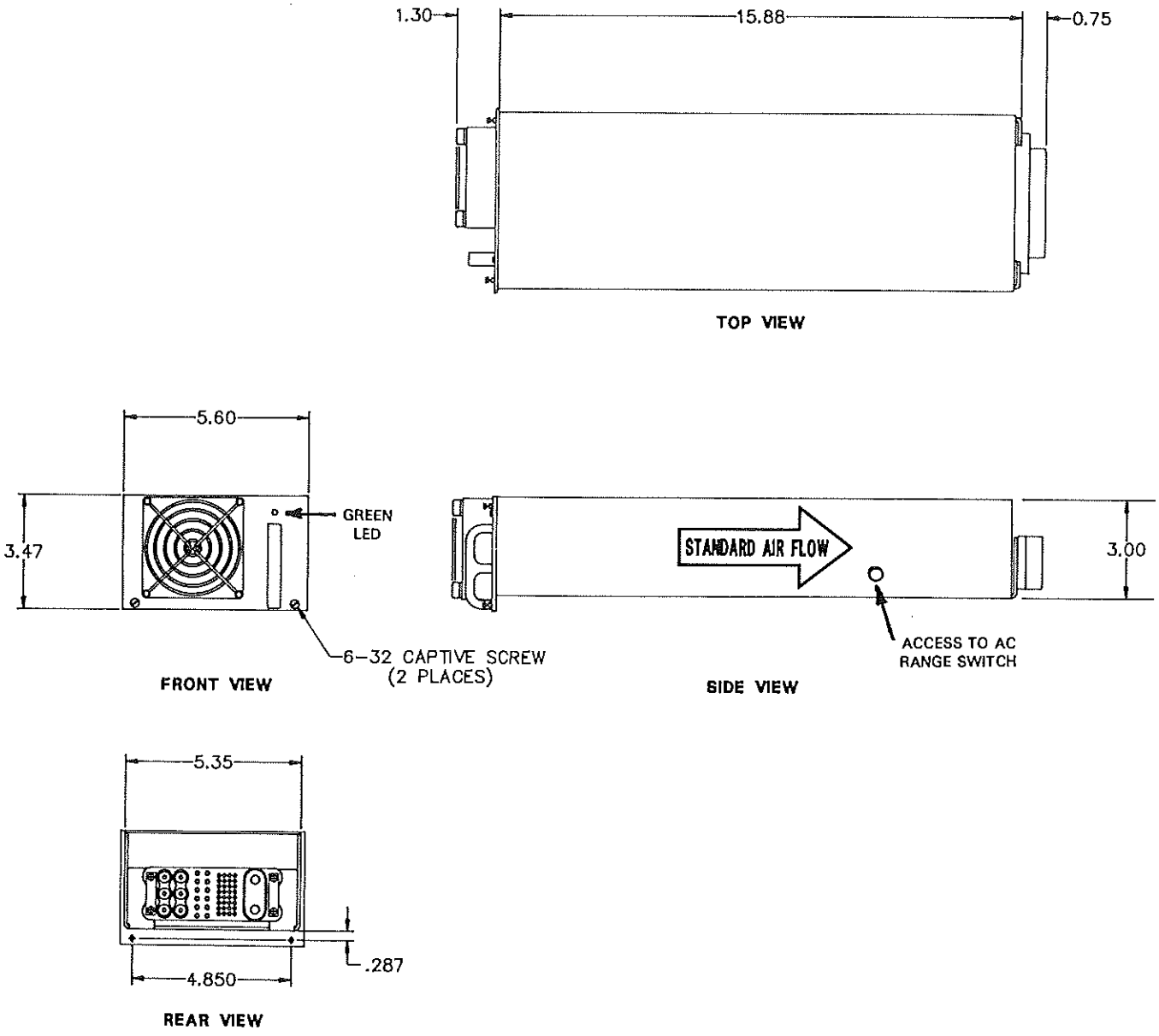


Figure 6. Outline Drawings for TP Series Hot-Plug Power Module

POWER SYSTEM OPTIONS	
A	Worldwide Autorange (115/230VAC)
M	Extra Rack-Mount Brackets
Q	DC Input (42 to 60VDC)

NOTES:
1. Maximum continuous total output power must not exceed the maximum power rating.
2. Add suffix letters to model number for options.
3. ( ) indicates peak current for 30 sec. max.

8.0 HOT-PLUG POWER MODULE SPECIFICATIONS

The following are specifications for each hot-plug power module:

Typical at Nominal Line, Full Load and 25°C Unless Otherwise Noted

OUTPUT SPECIFICATIONS

Output V Adjust. Range	±5%
Initial Accuracy	±0.5%
Line Regulation	0.5%
Load Regulation	0.5%
Cross Regulation	0.5%
Ripple and Noise	
Main Output	1% or 100mV
Auxil. Outputs	2% or 100mV
Min. Load, Any Output	0 AMP
Hold-Up Time	20 msec, min.
Dynamic Response	500 μsec.
Temp. Coefficient	±0.02%/°C
Overvoltage Prot., All Outputs	Power Shutdown
Remote Sense	All Outputs
Current Sharing Accuracy	10% of Rated Load

INPUT SPECIFICATIONS

Voltage Range	90 to 132 VAC
	180 to 264 VAC
Input Frequency	47 to 63 Hz
Electronic Inrush Current Limiting	40A Peak
Input EMI Filter, Conducted	FCC & VDE Class A
Input Protection	Internal Fuse

GENERAL

Efficiency	65% min.
Switching Frequency	100 kHz
Input to Output Isolation	3,000 VAC

ENVIRONMENTAL SPECIFICATIONS

Operating Temp. Range	0°C to 65°C
Derating, 50°C to 65°C	2.5%/°C
Storage Temp. Range	-40°C to +85°C
Cooling	Internal DC Ball Bearing Fan

PHYSICAL SPECIFICATIONS

Power Module Size	3.47" H x 5.6" W x 17.93" D (88.1 x 142.2 x 455.4 mm)
Chassis Size	3.47" H x 17.0" W x 18.53" D (88.1 x 431.8 x 470.7 mm)

9.0 DESCRIPTION OF FEATURES AND OPTIONS

These descriptions refer to each hot-plug power module.

FEATURE/OPTION	DESCRIPTION
Switch-Selectable AC Input	A slide switch accessible on the side of each module case selects either of the two AC input ranges, 90 to 132VAC or 180 to 264VAC. This is standard for all models.
Isolated Outputs	All DC outputs are floating and isolated from all other outputs. They can be connected as + or - outputs and may be referenced up to ±100V from chassis ground.
Electronic Inrush Current Limiting and Soft Start	This circuit limits the input current to 40 amperes peak when the hot-plug module is first turned on. The output voltage rises to its specified value within 1.0 sec. of turn-on, with 1% max. overshoot.
Safety Agency Approvals	All TP Series power modules are labelled with the appropriate safety agency logos or labels and are recognized to UL 1950, certified to CSA 22.2, and TUV approved to EN 60950. The system chassis is recognized to UL 1950.
EMI Input Filter	The input filter suppresses conducted noise on the AC line. The filter meets FCC level A and VDE 0871 level A requirements for conducted noise.
Thermal Protection	Each hot-plug module latches off when the internal temperature reaches an excessive value. The module must be reset by cycling the AC input off and then on.

FEATURE/OPTION	DESCRIPTION
Output Current Limiting	Current limiting protects each module output and its main converter from overload conditions. Current limiting is set at a minimum of 110% of the rated output current. Auxiliary outputs have their own independent current limiting circuits. Overload protection is continuous, without damage, and recovery is automatic when the overload is removed.
Overvoltage Protection	All outputs are protected from fault conditions in the power supply. OVP operates at 107% to 150% (depending on voltage) of nominal output voltage. The main converter is shut down. The outputs are reset by cycling the AC input off and then on.
Current Sharing	All outputs can share current with other identical outputs. Their current share terminals must be externally connected together. Worse case current sharing error between any two power modules is 10% of rated current. Currents may also be shared between racks.
No Load Operation	All outputs can be operated down to zero load current.
Integral Isolation Diodes	All TP Series power modules have a built-in series isolation diode on each output to prevent a faulty output from affecting another paralleled output.
Autorange (Option A)	With autoranging the AC input circuit automatically switches to the proper input line range for worldwide operation.
Extra Rack-Mount Brackets (Option M)	Two mounting brackets are supplied with the TP Series power system. This option is an extra set (2) of brackets for applications where the user mounts both front and rear panels of the power system.
DC Input (Option Q)	A 42 to 60VDC input option is available. Consult the factory for details.

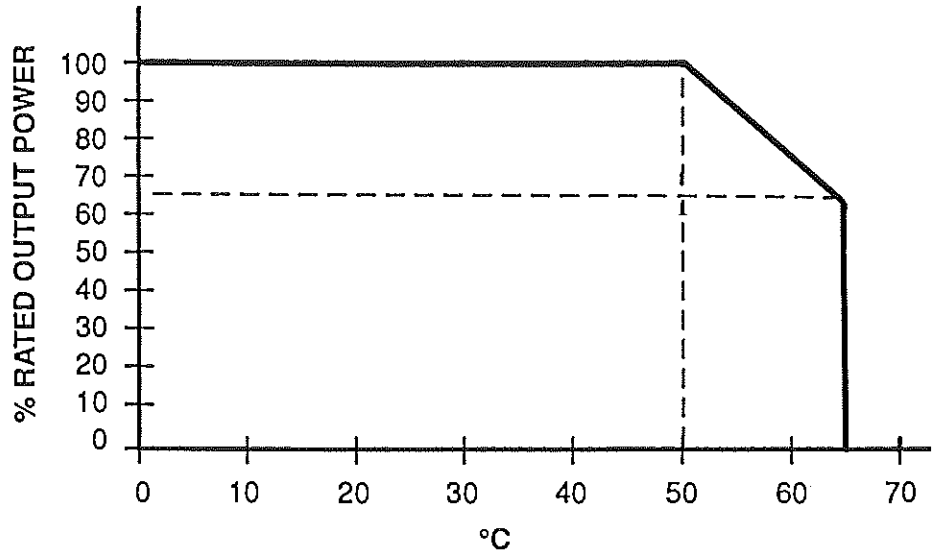


Figure 7. Output Power vs. Ambient Temperature

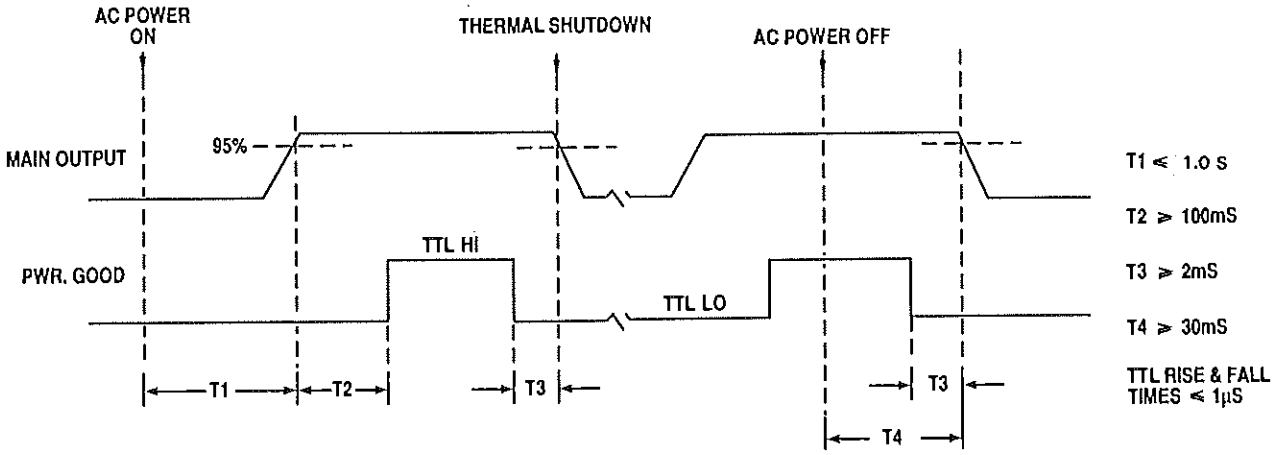


Figure 8. Timing Diagram for Power Good Signal

10.0 OPERATING INFORMATION

10.1 **Input Voltage.** The TP Series Hot-Plug Modules operate on standard 120VAC (90 to 132VAC) or 220-240VAC (180 to 264VAC) input voltages. An autorange option (Option A) is available which automatically sets the power module input for the voltage range used. The connections for line, neutral and ground are made to P3. A switch accessible on the side of each case permits the user to set the AC input range to the desired one. See Fig. 6. **Note that all switches must be set to the proper positions before plugging the units into AC power. Do not change the position of the line select switches while power is applied.** There is also a DC input option (Option Q) permitting 42 to 60VDC input voltage. Further details on this should be obtained from the factory.

10.2 **Outputs.** The main output (V1) power connections are made to J1 which has 1/4-20 threaded holes. See Fig. 5. The top terminal (2) is positive and the bottom one (1) is negative. See Section 14.4 for recommended torque on the screws. Auxiliary output connections V2, V3 and V4 are made to connector P2.

The connecting wires for all outputs should be sized to carry the rated output current plus 30%. Connecting lugs to J1 must be clean and securely connected to the terminals to reduce contact resistance. All outputs should have a 0.1uF ceramic capacitor and 10uF electrolytic capacitor in parallel across each output at the backplane, connection point, or point of load to prevent noise pickup.

10.3 **Output Power.** The TP Series power modules have maximum ratings of 250W, 400W, 500W, or 600W. The ratings of the individual outputs when totalled, however, may exceed these values. See the "Standard Hot-Plug Modules" table in Section 7.0. The continuous output power from all outputs **must not** exceed the output rating of the given hot-plug module.

The maximum continuous output power of the power module may be drawn at up to 50°C ambient temperature. Above 50°C, the output must be derated at 2.5%/°C. See Fig. 7. The maximum operating temperature is 65°C.

10.4 **Remote Sensing.** Remote sense connections for the main output (V1) are made to pins 25 and 26 of P1. For the auxiliary outputs the connections are made to other pins of P1. See the pin connection table for P1 in Section 11.

The remote sense feature is used to regulate the output voltage at the point of load. The + Sense is connected to the + output at the load, and the - Sense is connected to the - output at the load. The sense leads should be a twisted pair to minimize noise pickup. The outputs can compensate for a total voltage drop in the power leads up to 0.5 V, or 0.25 V on each lead. Sense leads can be no. 22 or 24 AWG wire but should not exceed 10 feet (3 meters) in length. If remote sensing is not required, the sense leads should be connected directly to the respective DC output terminals.

10.5 **Control and Supervisory Signals.** All control and supervisory signals are accessible at the 26-pin P1 connector on the back plane of the power system. Some of the pins are for control inputs and others are for warning outputs. The inputs and outputs that are used must have external 0.1uF ceramic capacitors across them to prevent noise pickup. For a description of each function see Section 12 on "Description of Control and Supervisory Signals."

10.6 **Output Voltage Adjustment.** The main output voltage and all auxiliary output voltages are independently adjustable by means of potentiometers on the top of each power module. No output should be continuously operated outside its nominal range of $\pm 5\%$, and the total output power of all outputs must not exceed the maximum rating of each power module.

10.7 **Timing Diagram.** The Power Good signal on pin 19 of P1 is a warning signal for the loss of AC power, main output loss, or thermal shutdown. It is a TTL output signal which is shown in the timing diagram of Fig. 8. As shown, the Power Good signal gives at least a 2 millisecond warning of either a thermal shutdown or loss of AC power. **Note:** On DC input versions (Option Q) of the TP Series, there is no Power Good signal.

10.8 **Green LED.** A green LED is located on the front panel of each power module above the handle. The LED is on when the module is supplying output power and is off when there is loss of AC power, thermal shutdown or other loss of output power.

11.0 INPUT, OUTPUT, AND CONTROL & SUPERVISORY SIGNAL CONNECTIONS

The connections for the input, outputs, and the control and supervisory signals are shown in the following tables:

MAIN OUTPUT, J1

PIN	FUNCTION
1	V1 -
2	V2 +

AUXILIARY OUTPUTS, P2

PIN	FUNCTION
1	V4 -
2	V4 +
3	V3 -
4	V3+
5	V2 -
6	V2 +

AC POWER, P3

PIN	FUNCTION
1	Ground
2	No Connection
3	AC Neutral
4	AC Line

CONTROL & SUPERVISORY SIGNALS, P1

PIN	FUNCTION	PIN	FUNCTION
1	NC	14	V3 - Sense
2	NC	15	V2 + Sense
3	NC	16	V2 - Sense
4	NC	17	V2 Current Share
5	NC	18	Common
6	NC	19	Power Good
7	NC	20	DC OK
8	NC	21	High Margin
9	V4 + Sense	22	Low Margin
10	V4 - Sense	23	Inhibit
11	V3 Current Share	24	V1 Current Share
12	V4 Current Share	25	V1 + Sense
13	V3 + Sense	26	V1 - Sense

NOTE: NC = No Connection

CONNECTORS AND MATES

P1 Conn: AMP104127-5
P1 Mate: AMP102387-6
P2 Conn: AMP641831-1
P2 Mate: AMP640581-1
P3 Conn: AMP350792-1
P3 Mate: AMP350779-1

12.0 DESCRIPTION OF CONTROL AND SUPERVISORY SIGNALS (P1)

SIGNAL	PIN	DESCRIPTION
NC (No Connection)	1 - 8	These pins are not used.
V4 + Sense	9	This remote sense lead should be connected to its corresponding + output at the load point by means of a twisted pair with the - Sense lead. See Section 10.4 for a full description of remote sensing.
V4 - Sense	10	This remote sense lead should be connected to its corresponding - output at the load point by means of a twisted pair with the + Sense lead. See Section 10.4 for a full description of remote sensing.
V3 Current Share/Current Monitor	11	This connection, made between other TP Series power modules with identical outputs, permits current sharing with 10% accuracy. See Section 13.5 to 13.7 for a full description of current sharing. If current sharing is not used, this output may be used as a current monitor. The output voltage is proportional to the main output current. This signal is referenced to the - Sense (pin 26) or common (pin 18).
V4 Current Share/Current Monitor	12	See description for V3 Current Share/Current Monitor (pin 11).
V3 + Sense	13	See description for V4 + Sense (pin 9).
V3 - Sense	14	See description for V4 - Sense (pin 10).
V2 + Sense	15	See description for V4 + Sense (pin 9).
V2 - Sense	16	See description for V4 - Sense (pin 10).
V2 Current Share/Current Monitor	17	See description for V3 Current Share/Current Monitor (pin 11).
Common	18	This is connected internally to the main output (V1) - Sense (pin 26) and is the reference for all control and supervisory signals.

SIGNAL	PIN	DESCRIPTION
Power Good (Output)	19	The Power Good signal is a warning signal for the loss of AC power, main output power loss or thermal shutdown. A TTL LO (sinks 30mA) occurs at least 2msec. before the main output voltage drops by 5%. See Fig. 8. A TTL HI (sources 10mA) is normal. The signal is referenced to the main output - Sense (pin 26) or common (pin 18). There is no Power Good signal for DC input versions of the TP Series.
DC OK (Output)	20	This output signal indicates that the main output voltage is outside a tolerance limit of ±4% to ±7% of nominal value. A TTL LO (sinks 5mA) indicates the output is within tolerance and a TTL HI (sources 0.2mA) indicates it is out of tolerance. This signal is referenced to the output - Sense (pin 26) or common (pin 18).
HI Margin (Input)	21	The main output voltage can be remotely controlled by a switch closure. Closing a switch between this pin and - Sense (pin 26) or common (pin 18) will put the main output into the HI Margin state in which the output voltage is 5% to 7% higher than its nominal value.
LO Margin (Input)	22	LO Margin operates the same as HI Margin above except that switch closure puts the main output into the LO Margin state in which the output voltage is 5% to 7% lower than its nominal value.
Inhibit (Input)	23	The hot-plug power module can be remotely turned on and off by means of the Inhibit input. A TTL HI (sourcing 0mA) or open circuit turns the power module on, and a TTL LO (sinking 0.25mA) turns it off. The signal is referenced to the main output - Sense (pin 26) or common pin (18).
V1 Current Share/ Current Monitor	24	See description for V3 Current Share/Current Monitor (pin 11).

SIGNAL	PIN	DESCRIPTION
V1 + Sense	25	See description for V4 + Sense (pin 9).
V1 - Sense	26	See description for V4 - Sense (pin 10). This pin is also connected internally to common (pin 18) and is the reference for all control and supervisory signals.

13.0 PARALLEL AND REDUNDANT OPERATION

13.1 The TP Series is designed to operate in three different configurations:

- N + 1 redundant operation
- Non-redundant operation
- Operation as separate power supplies

Each of these modes is detailed below.

13.2 **N + 1 Redundant Operation.** With three hot-plug power modules connected in parallel, N + 1 redundant operation means a 2 + 1 configuration. Two power modules must be able to carry the full load within their maximum output capability. The third module is redundant. During normal operation the load current is shared among the three power modules by means of the active current sharing circuitry which keeps the three output currents in balance. If one of the power modules fails, the load current is automatically picked up by the other two power modules. The failed module can then be replaced while the other two modules continue to power the load. The TP Series can supply up to 1200 watts output power in the N + 1 configuration (two times the maximum rated power for a single module).

Using two stacked, standard TP Series with six hot-plug power modules, N + 2 and N + n redundancy configurations are also possible. An N + 1 configuration provides up to 3000 watts maximum output.

13.3 **Non-Redundant Operation.** In non-redundant operation the three power module outputs are connected in parallel in exactly the same way as for N + 1 redundancy. In this case, however, the full output power of the three power modules is used to power the load. If one of the power modules fails, the outputs of the other two will go into current limit because they cannot carry the full load. The faulty module must then be replaced to restore power to the load. The TP Series can supply up to 1800 watts output power in non-redundant operation (three times the maximum rated power for a single module). The advantage of the TP Series is quick hot-plug replacement of the failed module. Using two

stacked, standard TP Series with six hot-plug power modules, maximum output power up to 3600 watts can be provided.

13.4 **Individual Operation of Power Modules.** The third mode of operation is by operating each of the hot-plug power modules separately to supply power to their individual loads. There is no current sharing between the modules and each of the modules can have different output voltage and current ratings. In this configuration the power modules have the same advantage of quick replacement as in non-redundant operation.

13.5 **Details of Parallel Operation.** In both N + 1 redundant operation and non-redundant operation, the hot-plug power module outputs must all be connected in parallel with current sharing. Paralleled outputs must be identical in both output voltage and current ratings. This means that the three hot-plug power modules must be identical models. All three V1 (main) output terminals are connected together as are the three V2, V3, and V4 (auxiliary) output terminals. For current sharing to operate, the respective current share terminals for each output must be connected together.

13.6 **Current Sharing Accuracy.** The TP Series active current sharing balances output currents between the paralleled power modules. The maximum current imbalance between any two modules is 10% of a module's rated output current. This means that at worst case one module's output current could be 5% high and another's 5% low (of rated output current).

13.7 **Remote Sensing.** For proper operation of the paralleled outputs, all remote sense leads for a given output should be connected to that output's load point. Thus all three sets of V1 sense leads should be connected to the V1 point of load. Each individual set (+ and - lead) should be twisted together to minimize noise pickup. The same applies for V2, V3 and V4 sense leads.

13.8 **Control Signals.** For parallel connection, the control signals should be treated as follows:

<u>High and Low Margin (P1 pins 21 and 22).</u> If this control is used, the pins should be connected together across the paralleled modules, i.e., all three pins 21 together and all three pins 22 together. The margin connections, or switches, then control the V1 output of all three power modules simultaneously. The activating connection is from pin 21 or 22 to the V1 - Sense terminal (pin 26) or common terminal (pin 18).

<u>Inhibit (P1 pin 23).</u> If this function is used, the three pins 23 are also normally connected together across the three paralleled power modules. The inhibit control then turns all three power modules on or off simultaneously. This TTL input is

also referenced to the V1 – Sense terminal (pin 26) or to common (pin 18).

13.9 **Supervisory Signals.** For parallel connection, the supervisory (warning) signals should be treated as follows:

Power Good (P1 pin 19). Generally each power module should be monitored separately. If the AC power input fails, then all of the power modules will signal a problem. If one module has a thermal shutdown or other loss of output power, that module will signal a warning. The pins may be tied together for all three units, however. Then a failure in any of the modules will give an output TTL LO.

DC OK (P1 pin 20). With this signal, each power module should be monitored separately for the main output (V1) within its tolerance band. With parallel connection of the module outputs, this output indicates when a V1 output drops low, signalling a faulty module. This is indicated by a TTL HI.

14.0 INSTALLATION

14.1 **Mounting.** See Fig. 4. The TP Series power system may be mounted by means of the mounting brackets which each have two 0.406 x 0.278 inch mounting holes for mounting in a standard 19-inch rack. One set of brackets (2) is supplied with each TP Series system. Alternatively, the system may be bottom-mounted using the four PEM nuts on the bottom of the chassis. They accept no. 8-32 screws. Maximum torque on the screws is 19 in.-lbs.

14.2 **Cooling.** Each hot-plug power module in the TP Series is cooled by its own internal DC, ball-bearing fan. To insure proper cooling, there must be a minimum clearance of 1 inch (25mm) between the fans and any other surfaces. Normal air flow is from the front (fan-end) to the rear of the system.

14.3 **Input Connections.** AC input connections are made to P3, an AMP350792-1, by means of mating connector AMP350779-1. See Fig. 5. A three-wire AC line and plug must be used for the AC power connection with proper connection made to line, neutral and safety ground terminals. The proper line cord wire size must be used: No. 12 AWG is recommended. The three AC input connections should normally be connected in parallel.

14.4 **Output Connection.** Connections to each of the main outputs (V1) are made at the two terminals of J1. Connections are made by means of no. 1/4-20 screws. The connections must be secure and the wires or lugs must be clean to reduce contact resistance. Recommended torque on the screws is 45 in.-lbs. The wires must be of correct size to carry the rated output current plus 30%. Connections

to the auxiliary outputs V2, V3 and V4 are made to connector P2, an AMP641831-1, by means of mating connector AMP640581-1. The wires must be of correct size to carry the rated output current plus 50%. Normally the outputs of all three hot- plug power modules are connected in parallel.

14.5 **Control and Supervisory Signals.** These connections are made to connector P1, an AMP104127-5 26-pin connector, by means of mating connector AMP102387-6.

15.0 MAINTENANCE

No routine maintenance is required on the TP Series system except for periodic cleaning of dust and dirt around the fan intakes. A small vacuum nozzle should be used for this. The hot-plug power module covers should not be removed; there are no user-serviceable components in the unit.

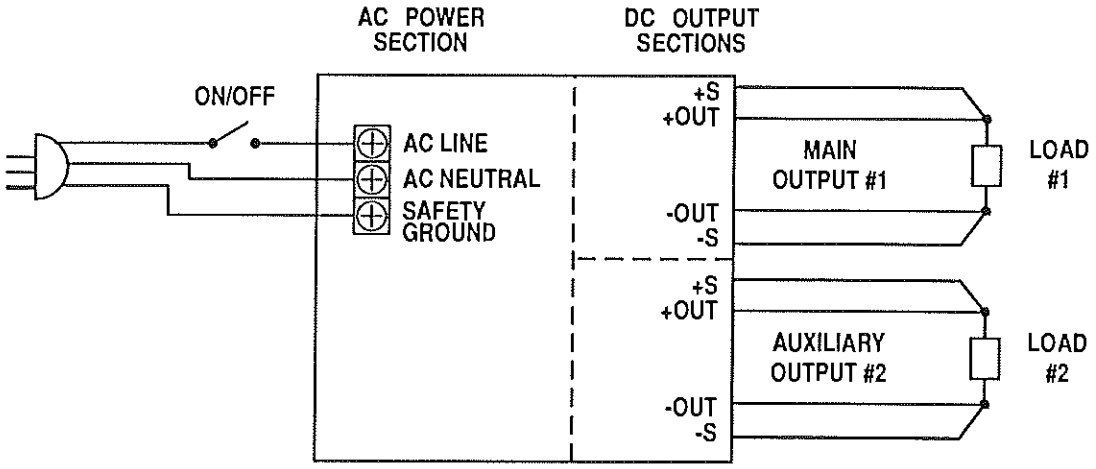
16.0 POWER SYSTEM SETUP AND TESTING

16.1 Connect a three-wire AC power cord to P3 on the backplane to all three power modules. Line, neutral and safety ground terminals should be connected for proper, safe operation. Do not plug in the AC power cord yet.

16.2 Connect each set of remote sense leads for each hot-plug power module to its respective output with proper polarity. See Fig. 9. The outputs should not be connected in parallel yet. Make sure that the Inhibit input (pin 23 of P1) is open or at a TTL HI. Also make sure that the HI and LO Margin inputs (pins 21 and 22 of P1) are both open.

16.3 Plug the AC power cord into the wall socket and measure each output voltage of each power module with a digital voltmeter to see that it is at the correct value. Each voltage should be within $\pm 1.0\%$ of its nominal value and within $\pm 1.0\%$ of other corresponding outputs. If they are not, adjust them to the correct value by means of the adjustment potentiometers on the top of each power module. Unplug the AC power cord.

16.4 Connect the corresponding outputs of each power module together (in parallel) at the back plane. Connect the corresponding current share terminals together at the back plane. See Fig. 10. Read the instructions in Sections 13.5 through 13.7. Connect loads of 150% of the rated load of a single power module output across each of the outputs. Connect all remote sense leads to their respective load points.



NOTE: Remote sense leads (+S & -S) should be twisted to minimize noise pickup.

Figure 9. Input and Output Connections for Hot-Plug Power Module

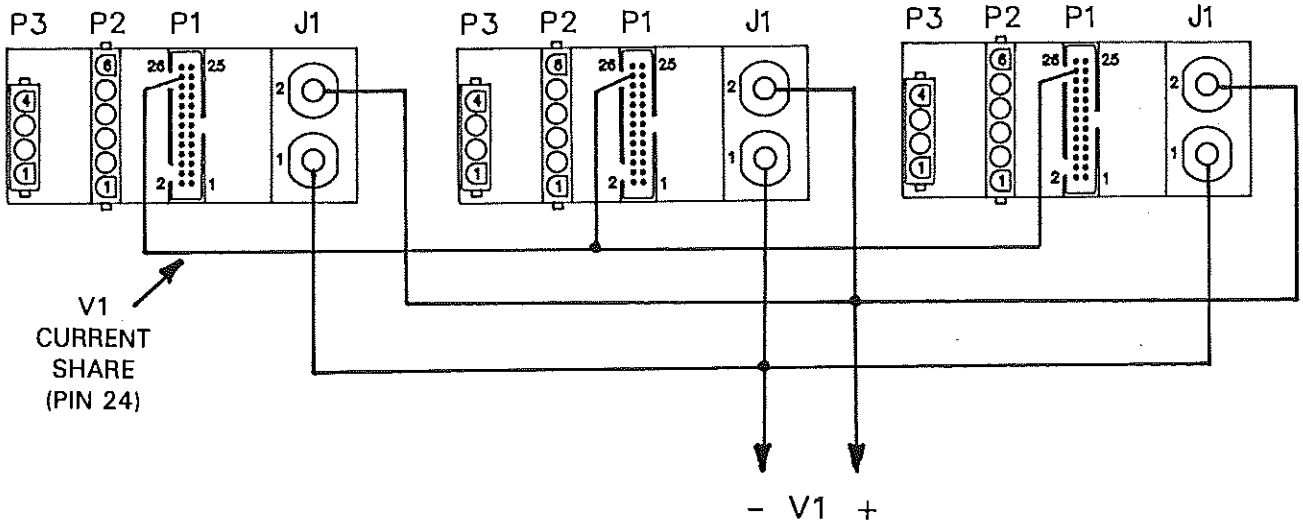


Figure 10. Output Connections for V1 (Main Output) to Current Share

16.5 By means of the Inhibit input (P1, pin 23) of each hot-plug power module, turn off each module in sequence so that the other two remain in operation. This is done by applying a TTL LO or short between pin 23 and pin 18 (common). Each time a power module is turned off, check the output voltage at the load sense points with a digital voltmeter. The voltage for each measurement should remain within $\pm 1.0\%$ of nominal value. This is a check of operation in the N + 1 redundancy mode by simulating a failure of each of the power modules in turn.

16.6 If desired, additional tests may be made to check the other control and supervisory functions by referring to their operation in Section 12.0.

17.0 TROUBLE SHOOTING GUIDE

17.1 If you encounter difficulty and do not get the proper output voltages, go through the following trouble shooting guide.

HOT-PLUG POWER MODULES OPERATING INDEPENDENTLY

SYMPTOM	POSSIBLE CAUSE	ACTION TO TAKE
No output (all outputs).	No AC input.	Check connection to AC power.
No output (one output).	Shorted output.	Remove short.
No output (all outputs).	Line select switch is on 230VAC. The AC source is 115VAC.	Unplug AC power. Move line select switch to 115VAC. Plug in AC power.
No output (all outputs).	Line select switch is on 115VAC. The AC source is 230VAC.	Unplug AC power. Move line select switch to 230VAC. Plug in AC power. If there is still no output, the power module has been damaged and must be returned to the factory for repair.
No output (all outputs).	Overvoltage protection (OVP) is engaged.	Check Power Good output (pin 19) for a logic LO. Cycle AC input off and then on.
No output (all outputs).	Overtemperature protection is activated.	Check Power Good output (pin 19) for a logic HI. Check to see that fan is operating. Cycle AC input off and then on.

SYMPTOM	POSSIBLE CAUSE	ACTION TO TAKE
No outputs (all outputs).	Output is turned off by Inhibit control.	Check to see if pin 23 is a logic LO. It should be logic HI or open.
Output higher than nominal value (any output).	Remote sense leads not connected.	Connect sense leads as instructed in Section 13.7 and 16.2.
Main output higher or lower than nominal value.	HI or LO Margin is activated.	Check pins 21 and 22 to make sure they are open.
Noisy output voltages.	External pickup in sense leads.	Twist or shield sense leads and re-route away from noise source. Connect capacitors as instructed in Section 10.2.

HOT-PLUG POWER MODULES CONNECTED IN PARALLEL WITH CURRENT SHARING

SYMPTOM	POSSIBLE CAUSE	ACTION TO TAKE
No output (all outputs).	In current sharing operation, one or more sense leads are not connected to the outputs or are connected with wrong polarity. This causes the power supply to shut down.	Connect all sense leads correctly to outputs.
No output (all outputs).	Outputs are held off by Inhibit control.	Check Inhibit control to make sure it is a logic HI or open.
Main output is higher or lower than nominal value.	HI or LO Margin is activated.	Check Margin inputs to make sure they are open circuit.

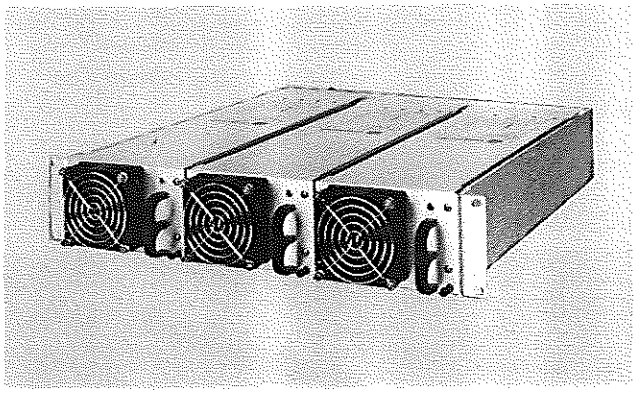
17.2 If none of these actions solves the problem, call the UNIPOWER factory for help and try to resolve the problem over the telephone. If this is not successful, request an RMA (Return Material Authorization) number and return the power system to UNIPOWER. Be sure to pack the unit carefully in the original packing material, if possible. UNIPOWER will fax a form to be filled out and returned with the unit. The unit may then be shipped freight collect to UNIPOWER.

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TP SERIES: HOT PLUG N + 1
1-12 Outputs, Up To 3000 Watts



KEY FEATURES

- P Series Units In A Pluggable Case
- 250 To 600 Watts Per Unit
- 1 To 4 Outputs Per Unit
- Outputs From 2VDC To 48VDC
- N + 1 Redundancy
- Current Share On All Outputs
- Integral Isolation Diodes
- True Hot Plug Replacement
- High Reliability Connectors
- Up To 6 Units Per Chassis
- Standard 19" Rack Mountable
- Standard 3.5" and 7" Panel Height
- LED DC Power Good Indicators
- Each Unit Independently Cooled
- Pluggable Interface Termination

OTHER FEATURES

- Similar To Low Profile P Series

NOTE: All output, input, general and environmental specifications are similar to the P Series. Consult factory for mating connectors.

POWER SYSTEM OPTIONS	
A	Worldwide Autorange (115/230VAC)
M	Extra Rack-Mount Brackets
Q	DC Input (42 to 60VDC)

UL 1950 CSA 22.2, No. 234 TUV EN 60 950

SPECIFICATIONS

All output, input, general and environmental specifications are similar to the P Series.

STANDARD MODEL NUMBERS

At least two model numbers must be specified: One or more for the power supplies and one for the chassis configuration.

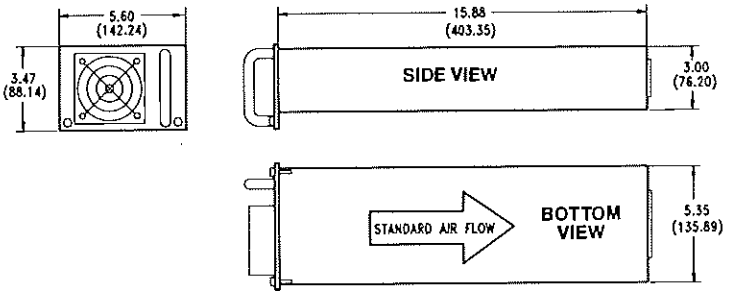
Power Supplies: Any P Series 250 to 600 watt model. Add "T" to the "P" in model number. For example: A PF2330 in a hot plug case is TPF2330.

Chassis Configuration:

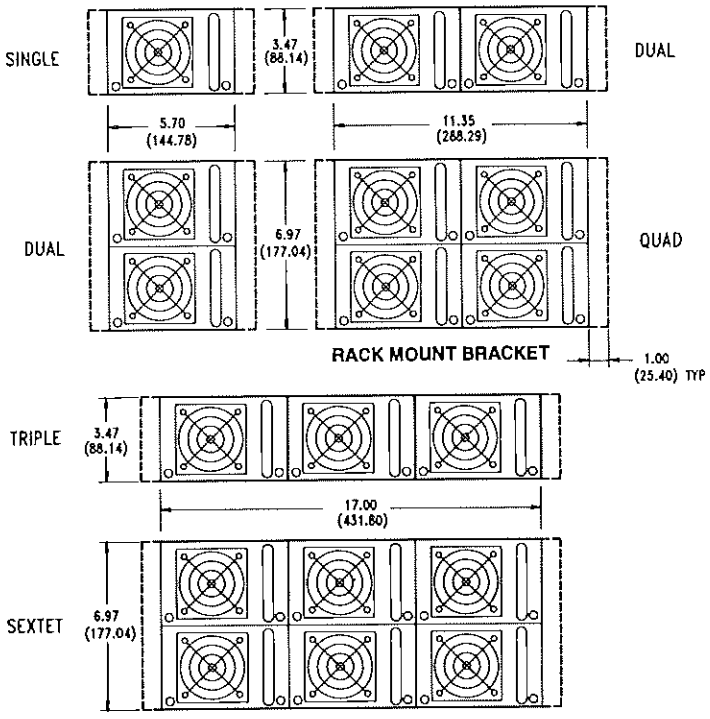
T W X Y Z

- Z — No. of outputs
- Y — No. of slots (1-6)
- X — No. of rows (1 or 2)
- W — Height: 2U (3.5") 4U (7.0")

POWER SUPPLY CASE



CHASSIS CONFIGURATIONS (17.50 DEEP)



FRONT VIEWS

ALL DIMENSIONS IN INCHES (mm). All specifications subject to change without notice.

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