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SMP Series

250, 350 & 450W



Installation Guide

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Input Specifications

The SMP series operate and meet specifications over the worldwide input voltage range of 90 VAC to 264 VAC.

Some important aspects of input wiring include:

- Ensures that the input wiring includes the correct connection between Safety Ground and the Ground input terminal of the power supply.
- Ensures that the input wire gauge for Line and Neutral connections is sufficient to safely carry the maximum input current to the power supply. (The maximum input current usually occurs at 90 VAC at full or peak load). Sola recommends using a wire gauge having 500 circular mils per amp of RMS input current.
- Ensures that the insulation of the input wiring meets appropriate Safety Agency requirements.

Since each model of the SMP Series has an internal line fuse, an additional user provided line fuse may not be necessary. It is up to the user to determine the desirability of a supplemental line fuse.

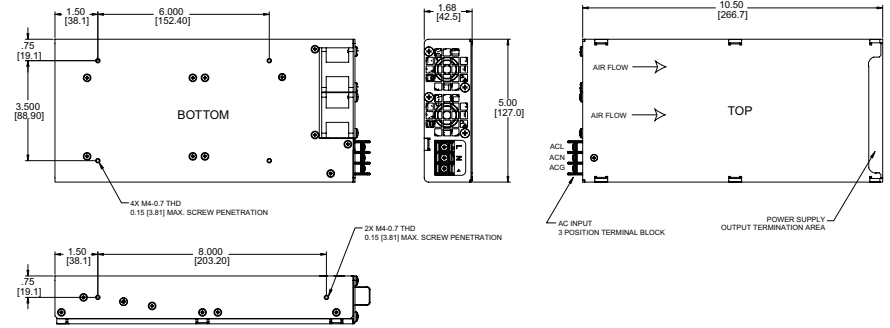
For best EMI performance, the input connector of the power supply should be as close as possible to the AC power entry point of the end system which the SMP power supply is powering. More than about 2" of input wire length between the AC power entry point and the power supply input connector incurs the risk of increasing the conducted EMI spectrum. This is due to antenna effect of the length of the input wires to the power supply. If the power supply input wires are of considerable length, proper use of an appropriate AC Line Filter module almost always results in acceptable conducted EMI performance. Be sure to verify the line leakage current of the filter, since the filter leakage current sums with the power supply's leakage current to give overall line leakage.

Input Specifications

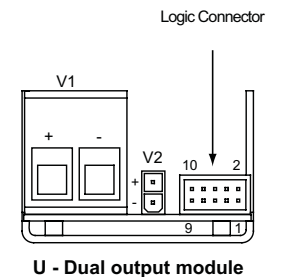
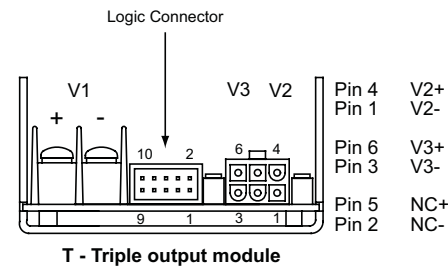
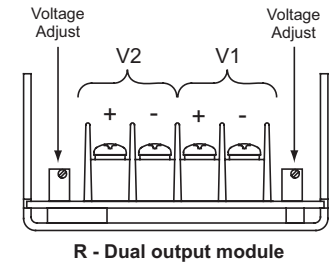
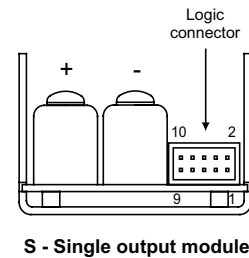
- Input Voltage • 90 to 264 VAC
- Input Frequency • 47 to 63 Hz
- Power Factor • Compliant with EN61000-3-2
- Inrush Current • 20 A peak max



SMP 4 Power Platform



Output Module Connectors

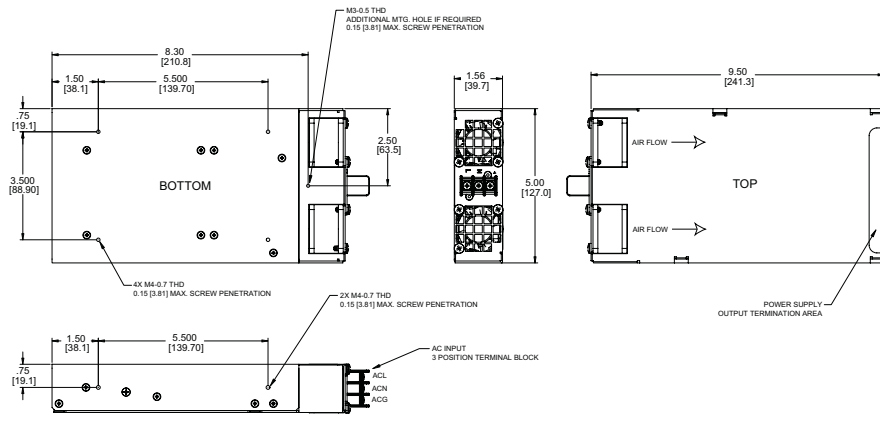


Total Power Rating

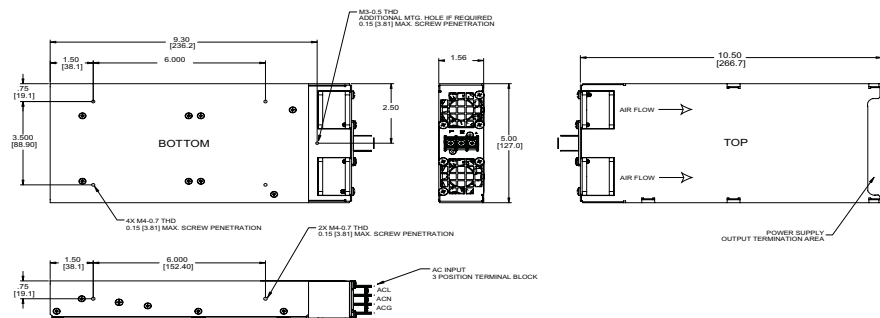
The total power rating of the SMP series is determined by the 'power platform' (chassis). It is possible to configure a power supply with output modules that actually exceed the power rating of the platform. In this case, configuring the same output modules in a larger chassis will enable the full power of the output modules to be realized. This approach maximizes the flexibility of the SMP product line and ensures the greatest level of commonality of components between configurations. A great advantage where multiple power supplies are required in one application or in different products in an end-user product line.

Mechanical Drawings

SMP 2 Power Platform



SMP 3 Power Platform



Output Specifications

Output Voltage Dependent on module selected
Hold Up Time 20 ms min 230 V/50 Hz
Ripple and Noise 50mV or 1% pk-pk, whichever is greater
Line Regulation Typically 0.1%, maximum 0.3%
Load Regulation Single output modules & output 1 of dual & triple output modules = 1% max

Output 2 & 3 of dual & triple output modules = 2% max.
 A 10% load must be applied to output 1 of the high current dual module (U) & triple module (T) to achieve this figure.

Overvoltage Protection 120-130% of nominal output for all single outputs & all main outputs of high current dual (U) & triple output modules.

Overload Protection 140% max of nominal rating
Temp Coefficient 0.03%/°C
Inhibit Inhibits module output voltage with a logic 'low' signal applied

Remote Sense Compensates for up to 0.5 V drop on single output modules & V1 of dual (U) & triple output modules
Power Fail Approx 5 ms
DC OK Detects a drop in output voltage
Aux. Outputs 5V Stand-by and 12V fan output.

High current SMP Series outputs are provided with screw connections to the module buss bars. Lower current modules have plug-in connectors. The manufacturer and part number of the various output plug-in connectors are listed below.

Output Module	Connector	Aux. Output	Mating Connector
S1 - S5 & S11	M4	-	-
S6 - S9	#6	-	-
R	#6	-	-
U	Clamp Type	Molex	Molex
	Terminal	39-01-2025	39-00-0056
T	#6	Molex	Molex
		39-01-2065	39-00-0056
Logic Connector	AMP87631-5		AMP1-87309-4

Application Notes

Cooling

The SMP series of configurable power supplies are designed to operate at rated power over an ambient temperature range of 0-50°C. For most models, operation from 50 to 70°C is possible with de-rating of the output power.

The SMP 250-450 series is provided with an over-temperature shutdown switch, which shuts down the entire power supply for protection. Auto-recovery occurs when the unit cools to the point where the over-temperature switch resets.

The fans are positioned to direct air through the unit internally along its longitudinal axis from the fan end towards the output connector end. It is important to consider sufficient exit airflow clearance when positioning fan equipped SMP power supplies in the end application. In all cases, the cooling fans direct air into the power supply. The air exits the open end or ends. In general, a clearance, with a cross sectional area larger than the fan cross-section, will be a good start for correct cooling. For SMP 250-450 series, the clearance of the nearest chassis surface from the inlet surface of the fans should be at least one inch with a similar minimum at the outlet end.

Output Connections

Detailed drawings of the Output Module connections are located on page 12.

Separate or Common Return

For each output, the output module provides a separate connection for both supply and return. This offers important advantages for connecting to the load as noted below. It is important to size the output wires correctly with respect to the maximum current being carried. Also, the return wires need to be sized according to the maximum current being conducted in the return wires. This is very important when a return wire carries return current from more than one supply wire (e.g., when a "common return" circuit is employed). Sola recommends that output wires be sized at a minimum of 500 circular mils per amp and provides the capability of separate returns.

Remote Sense

When current flows from the power supply to the load through the output wires, a small voltage drop occurs from IR losses in the wire. (This can be compensated for by use of Remote Sense, as discussed below). However, when there is a rapid change in load current, a corresponding voltage fluctuation occurs because of this IR loss effect. If the common return type of connection between the power supply and loads is being used, fluctuations in load current in one load can cause voltage noise on the voltage of other outputs. Sola recommends that, where feasible, separate returns for each output be provided from the power supply output to the load. This type of connection minimizes voltage fluctuations on one output when another output undergoes rapid load changes.

+Sense pin is not connected to the load, the power supply only regulates the output voltage at the output connector of the module. Any voltage drop across output cables or isolation diodes cannot be detected by the module regulating circuit. However, if the +Sense pin is connected by wire to the actual point of load, the voltage on the Sense wire will be the actual voltage at the load, and the regulating circuit in the module can sense this point for accurate voltage regulation / control at the load itself. The purpose of the +Sense pin is to provide accurate sensing at the + load terminal. (The corresponding purpose of the -Sense pin is described below). If the +Sense pin is not connected, the module operates normally but the voltage regulation is at the module output terminal rather than the point of load. Diagram 6 illustrates use of the +Sense connection to compensate for cable losses and a diode drop so that accurate output regulation is present at the load itself.

- Sense

The -Sense pin is the connection that is used by the low side of the module regulation circuitry to provide precise regulation. If the -Sense pin is connected to the actual point of load, the module regulation circuits will compensate for voltage losses that occur in the return cable of the module output. Sola strongly recommends using separate returns where multiple outputs are used or where modules are paralleled for increased current. This becomes especially important when the Sense lines are connected. If the - Sense lines are connected to the load where multiple outputs share a common return cable, regulation will be adversely affected. This can become a severe problem when load dynamics are present.

Connections

The Logic and Control functions use very low current for operation. Thus, large wire size is not necessary. When wiring the mating connector for the module logic connector, use the wire size intended for the contacts recommended by the connector manufacturer. On many modules, there are multiple pins for the +Sense and -Sense functions. This is merely for ease of multiple connections, when necessary. All +Sense pins are wired together internally, and all -Sense pins are wired together internally.

Output Connection in Series

Any outputs can be connected in series to obtain the voltage required, The maximum current will be limited to the rating of the lowest output. EG. If a 29 Volt output is required, connecting the outputs of V1 (5V@8A) and V2 (24V@3A) in series will result in 29V output at max. 3A.

Output Voltage Adjustment

All SMP series outputs are adjustable using a 'trim pot'. Any output can be adjusted within a 10% range. The auxiliary outputs (V2 and V3) of the U (slim-line dual) and T (tripe) output modules are continuously adjustable from 5 to 15 volts.

power operation remains after Power Fail signal assertion. This pin can be left open without adverse affect on operation of the module. The Power Fail signal is generated from a circuit which monitors the voltage present on the input energy storage buss (which is the output of the power factor correction circuit). When the buss decreases by $\pm 15\%$, the Power Fail circuit is activated.

Power Valid (DC OK)

The Power Valid feature is a TTL compatible output status signal, which indicates that the output voltage of the module is within regulation. The circuit is Open Collector, and requires a pull-up resistor on the system side. Nominal value for the pull-up would be 330 ohms to +5 volts. The signal is active Low. It is important to know that the DC OK signal is automatically de-asserted when the power supply starts up. It takes a finite amount of time (several milliseconds) for the out-put voltage to ramp up from zero to the nominal regulated value. During this time, the DC OK signal is de-asserted (Hi). If, for any reason during normal operation (for example, excessive overload forcing the module into fold-back protection), the output voltage drops to a value out of the regulation band, the DC OK signal will de-assert. This pin can be left open without adverse affect on proper operation of the module.

Inhibit

The Inhibit feature is a control function, which allows the user to electronically switch the module output off. This pin is TTL compatible. A logic 'Low' applied to this pin will cause the module to shut off. Release of the 'Low' causing the pin to go 'High' (or float) will allow normal operation of the module. Inhibiting the module will cause the Power Valid signal to assert, since the output will drop to near zero. However, activating the Inhibit pin of any one module will have no affect on any other module. Also, the module Inhibit pin will not cause "global" shutting down of the entire power supply. Leaving the Inhibit pin open will allow the module to operate normally.

Current Share

The current share pin is a control pin which will activate a force-current-share circuit within the module. This circuit electronically forces all modules with current share pins tied together to share output current equally. Up to three modules can be connected this way for equal sharing. Accuracy of sharing depends, to some extent, on whether or not the -Sense pins of the modules are used since the Current Share function is referenced to the -Sense potential. For optimum current share accuracy, Sola recommends either using the share pins in their intended manner to control the voltage at the point of load, or just connecting the -Sense pins between the two shared modules.

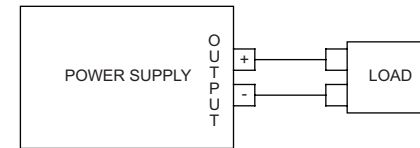
+ Sense

The + Sense pin is a connection that is used by the module control circuits for precise regulation. Technically, the output voltage of the power supply is regulated with respect to the Sense pins. The +Sense pin is connected to the module control circuit, which determines if the output voltage is correct. If the

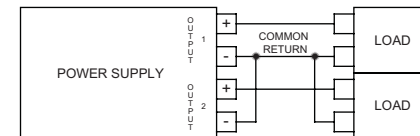
Connection to Load

Some broad principles of connecting the power supply to the load are illustrated in diagrams 1,2 & 3.

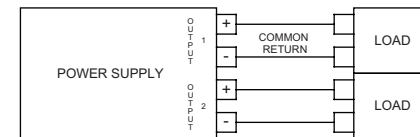
- **Diagram 1** illustrates connecting a single output power supply (single module) to the load.



- **Diagram 2** illustrates connecting a two-output power supply using the common return circuit architecture.



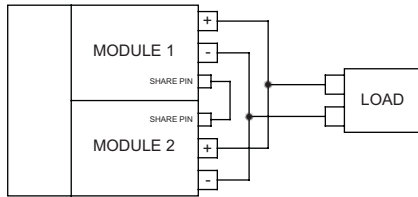
- **Diagram 3** illustrates connecting a two-output power supply using three commended separate return circuit architecture.



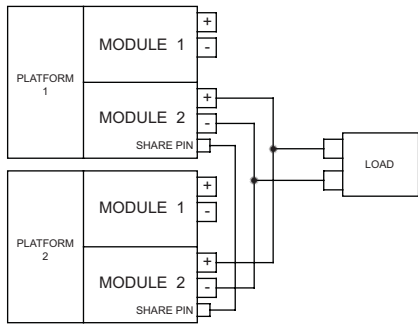
Connecting Output Modules in Parallel

Increased current at any output voltage can be obtained by paralleling the SMP Series output modules. Single output modules can easily be paralleled with another identical single output module for double the output current of the individual modules. All single output modules can be paralleled in this manner. Also, the main outputs of multiple output modules can be paralleled. However, it is important to remember that paralleling can only be done between output modules with the same part number (e.g. a U module can only be paralleled with another U module). Paralleling can be done either with two identical modules in the same power platform, or with identical modules in another power platform. Up to three identical output modules can be connected in parallel.

- **Diagram 4** illustrates the paralleling of two modules in the same platform.



- **Diagram 5** illustrates the paralleling of two modules in different platforms.

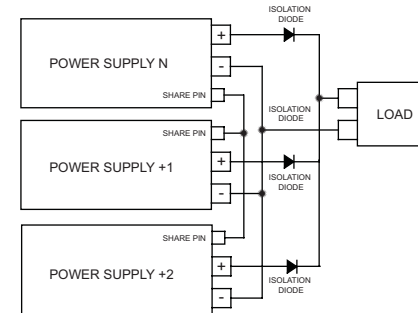


Usually in a parallel configuration, it is desirable that the paralleled modules share the output current equally. SMP Series modules have provision for forced active sharing using the popular and easy to use “single wire” method of current sharing. All single output modules have active share capability and the main outputs of all multiple output modules have the active sharing feature. Use of the “share” logic function to implement forced sharing is described in the section on logic functions in the paragraph below.

Redundant Parallel Configurations

Redundant connection of SMP power supplies is performed by connecting two modules in parallel so that if one module or power supply should fail for any reason, the remaining good module can continue to supply power to the load. Redundant applications are usually described in terms of “N+1”. This means that the total current necessary to power the load is obtained from a number equal to N. The “+1” indicates that one more module than necessary is also present in parallel connection. If one of the N modules fails, the additional current available from the +1 extra module will be sufficient to power the load. For example, if a load needs 100 watts of power, but a redundant configuration is implemented, N will be one 100 watt module, and the +1 will be another (identical) 100 watt module. If one module fails, the remaining 100 watt module will be sufficient to power the 100 watt load. Another example would be a 400 watt load powered by three 200 watt power supplies, in an N + 1 configuration where N = 2. In this case, N = 2, (2 X 200 watts = 400 watts) therefore, two of the three units are sufficient to power the 400 watt load. If any one should fail, the remaining two can power the load at full power.

In truly redundant applications, the output load or power buss must be isolated from any failed power supply to prevent system failure. This is usually done by means of a series isolation diode. If a power supply fails in such a manner that its output is shorted (extremely unlikely with SMP power supplies), the isolation diode prevents the outputs of the remaining units from being pulled down by the shorted unit. However, the isolation diode imposes approximately a 0.5 volt drop in the voltage to the load. The SMP power supplies have a Remote Sense compensation feature (described below) which can compensate for this diode drop on single output modules, and the main output of multiple output modules. The diagram below illustrates an N + 1 parallel redundant configuration where three 200 watt modules power a 400 watt load. In this case N = 2.



Logic and Control Signals

The single output modules and many versions of the multiple output modules of the SMP Series have logic and control functions which are brought out through a 10 pin connector to interface with the user system. The following descriptions provide user information regarding these features.

Logic Connector Pin Assignment

10	2	1	+ Sense
		2	- Sense
		3	+ Sense
		4	Current Share
		5	Not Used
		6	Inhibit (Active Low)
		7	- Sense
		8	Power Valid
		9	Not Used
		10	Power Fail

Power Fail

The Power Fail feature is a TTL compatible output status signal, which indicates that the AC input power to the power supply is inadequate to support full load (“Brownout”), or has failed completely. This signal is Active Low to indicate input power failure. The circuit is Open Collector and requires a pull-up resistor on the system side. Nominal value for the pull-up would be 330 ohms to +5 volts. Typically, this signal is asserted in time so that about 5 milliseconds of full