

Characteristics:

General Description: The Power Supply System type PSS1250(-HS)-7-48-D is an anodized aluminum 19" Rack unit (4U high) suitable for 4 plug-in Power Supply Modules type PSM1250 and 1 Overview module type PSO1250 for diagnostic functions. Four PSM1250 are divided in two groups and each group is composed by 2 PSM1250 with paralleled outputs and with load sharing circuits which distribute current load equally to each PSM1250 to increase reliability and reduce internal power dissipation. Therefore, each group provides 24Vdc and 50 A output with redundancy. Two groups have their outputs connected in series by internal copper bar, therefore PSS1250(-HS)-7-48-D system provides 48Vdc and 50 A output with redundancy. The system accepts up to two independent AC power sources with nominal voltage range 110 to 240 Vac ($\pm 10\%$). Four configurations of 19" Rack Units are available with or without Hot Swapping: two for wall mounting and two for frontal rack mounting, always into a cabinet. For more information about different configurations see page 2.

Hot Swap Plug-ins: When using rack PSS1250-HS-7-48-D, each PSM1250 power supply module can be placed without disturbing Power Supply operations.

Diagnostic: Rack PSS1250(-HS)-7-48-D, accept a plugin module (PSO1250) dedicated to monitoring all diagnostic functions of each power supply, via a front panel touch screen LCD color display which indicates Input/Output Voltage, Current and Power; Input Line Frequency; Output current sharing percentage related to each group; Internal Temperature; alarm status. RS485 Modbus output provides full diagnostic and status conditions. PSO1250 presence or fault does not affect PSS1250 operation and functional safety application.

Overvoltage protection: each PSM1250 module has got 3 independent overvoltage protections: 1 voltage limiting loop at 30 Vdc and 1+1 crowbars at 30 Vdc. Therefore, PSS1250(-HS)-7-48-D system has 60 Vdc upper limit as maximum overvoltage protection value, considering series connection between overvoltage protections of both PSM1250 module groups.

EMC: Fully compliant with CE marking applicable requirements.
High load fuses breaking capability: In case of short circuit on the load, the Power supply system delivers a very high peak current (about 800 Amp) for a duration of 0.5 ms. This characteristic ensures the instant breakage of the protective fuse or circuit breaker. Because of the very short peak current duration, other equipment connected to the load are not affected by the failure event and continue to operate without interruption.

Functional Safety Management Certification:

G.M. International is certified by TÜV to conform to IEC61508:2010 part 1 clauses 5-6 for safety related systems up to and included SIL3.



Features:

- SIL 3 for NE Load according IEC 61508:2010, (see ISM0528 for more information).
- SIL 2 for ND Load according IEC 61508:2010, (see ISM0528 for more information).
- Systematic capability SIL 3.
- 2 universal AC Input Lines, nominal 110 to 240 Vac ($\pm 10\%$) with 48 to 62 Hz frequency.
- Power factor correction.
- Hot swappable modules.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- TÜV Functional Safety Certification.
- Highly regulated output of 48 Vdc - 50 A, due to 24 Vdc out for each PSM1250 module.
- Under and over voltage alarm monitoring, for each PSM1250 module.
- 3 over voltage redundant protections, for each PSM1250 module.
- For each group, redundant parallel connection of PSM1250 modules with load sharing.
- Reduces Power dissipation (in parallel/redundant configuration of each group) by replacing a Schottky diode with Mosfet Active Ideal Diode.
- 89% efficiency @230 Vac input and 48 Vdc output with full load.
- PSM1250 fan speed control depending on ambient temperature and output power.
- High load fuse breaking capability without interrupting operations.
- 19" Rack unit, 4 U high, anodized aluminium, durable metal enclosure.
- Tropicalization for electronic components.
- Modbus RTU RS-485 diagnostic output.

Image:

PSS1250-HS-7-48-D-W (wall mounting version shown) +
4 x PSM1250 +
1 x PSO1250 +
2 x MCHP228



Technical Data:

Supply:

AC Input voltage: nominal 110 to 240 Vac ($\pm 10\%$), with frequency range 48 to 62 Hz.
Power Factor Correction (full load): 0.95 typ. @230Vac, 0.99 typ. @115Vac, 4 PSMs; 0.98 typ. @230Vac, 0.995 typ. @115Vac, only 2 PSMs: 1st & 5th OR 2nd & 6th.
Efficiency @48Vdc out (full load): $\geq 85\%$ @ 230 Vac, $\geq 82.5\%$ @ 115 Vac, 4 PSMs; $\geq 89\%$ @ 230 Vac, $\geq 86\%$ @ 115 Vac, only 2 PSMs: 1st & 5th OR 2nd & 6th.

Max. internal power dissipation @48Vdc out (full load):
425 W @ 230 Vac, 505 W @ 115 Vac, 4 PSMs;
305 W @ 230 Vac, 395 W @ 115 Vac, only 2 PSMs: 1st & 5th OR 2nd & 6th.

AC input current (sinusoidal at full load) @48Vdc out:
30 A @100Vac, 25.7 A @115 Vac, 13 A @230 Vac, 4 PSMs;
28.4A @100Vac, 24.4 A @115 Vac, 12.1 A @230 Vac, 2 PSMs:1st & 5th OR 2nd & 6th

Inrush current (each PSM): 37Apk @ 264Vac; 32Apk @ 230Vac; 16Apk @ 115Vac.

AC input connection: screw terminal blocks suitable for 4mm² wires on back panel pcb.

Isolation (Test Voltage):

Input to Output isolation: 2500 Vrms (routine test).
Input to Earth-Ground isolation: 1500 Vrms (routine test).
Earth-Ground to Output isolation: 500 Vrms (routine test).
Output or Earth-Ground to Fault contact isolation: 500 Vrms (routine test)

Output:

Output voltage: 48 Vdc (adjustable from 42 to 56 Vdc) for whole system.
Each PSM1250 output is 24 Vdc (adjustable from 21 to 28 Vdc).
Regulation: 0.4 % for a 100 % load change.
Stability: 0.01 % for a 20 % line voltage change.
Ripple: ≤ 250 mVpp.

Output current: 50 A nominal (@48Vdc out).
Output power: up to 2400 W nominal (@48Vdc out), max 2600 W nominal (@56Vdc out).
Output Rise Time: 2.5 s.

Dynamic Response: 2 ms for 0-100% load change (overshoot $\pm 1.5\%$ of Vout setting).
Connection: M6 screw terminals on copper bars suitable for lug (at least 6.5 mm hole diameter) with 16mm² wire on back panel pcb.

Hold-up time (AC in) at full load: 40ms (4 PSMs), 20ms (2 PSMs:1st&5th OR 2nd&6th)
Over voltage protection: each PSM1250 output is limited to 30 Vdc plus two redundant crowbars for over voltage protection at 30 Vdc. Therefore, PSS1250(-HS)-7-48-D output is upper limited to 60 Vdc maximum value.

Power good signaling (each PSM1250):

Output good: 19.5 V \leq Vout \leq 29.5 V (see page 4 for more information).
Indication: via LCD screen on PSO1250 and Modbus RTU RS-485 protocol.

Signaling: voltage free SPST normally energized relay (contact closed), de-energize in over/under voltage conditions (contact open).

Contact Rating: 2 A 50 Vac 100 VA, 2 A 24 Vdc 48 W (resistive load).

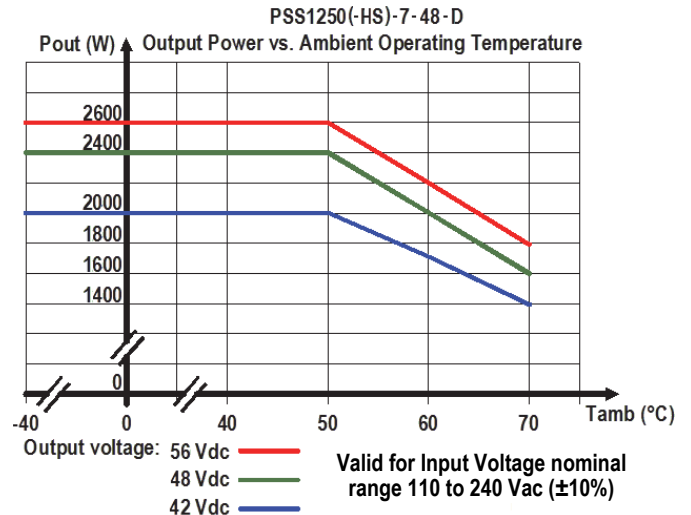
Connection: screw terminal blocks suitable for 1.5 mm² wires on back panel pcb.

Compatibility:

CE mark compliant, conforms to Directive:
2014/30/EU EMC, 2014/35/EU LVD, 2011/65/EU RoHS.

Environmental conditions:

Operating temperature limits: -40 to +70°C de-rated linearly 65-70% load above 50°C



Relative humidity limits: 95 %, up to 55 °C.
Transport, storage temperature limits: - 45 to + 85 °C. **Max altitude:** 2000 m a.s.l.



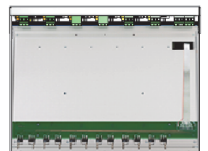




Approvals:

SIL 3 / SIL 2 conform to IEC 61508:2010 Ed. 2.
SIL 3 Functional Safety TÜV Certificate conforms to IEC61508:2010 Ed.2, for Management of Functional Safety.

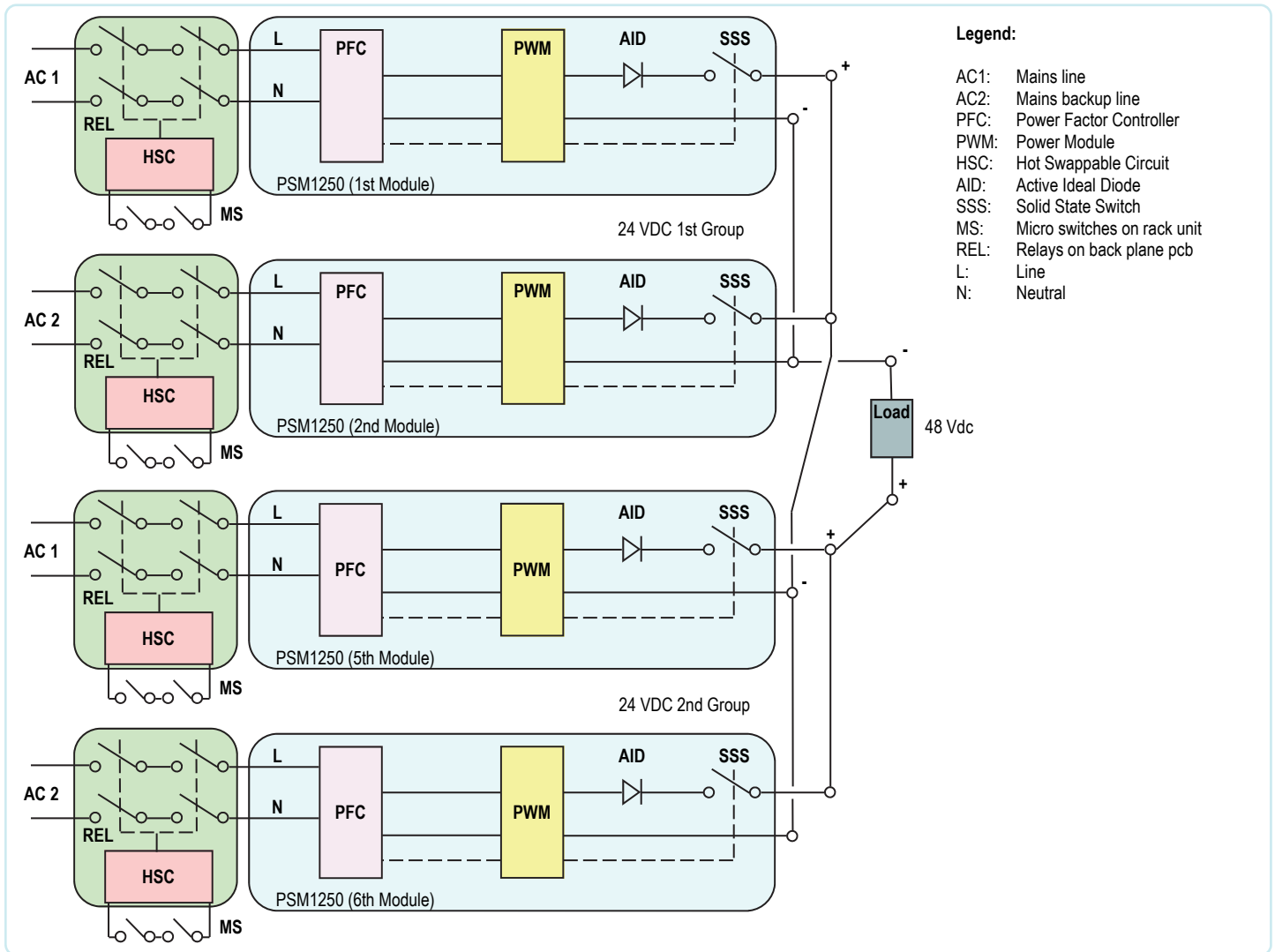
Mechanical:

Mounting: 19" Rack unit for wall mounting or for frontal rack mounting, into a cabinet.
Weight: 19" fully equipped about 20 Kg, with 4 PSM1250 and 1 PSO1250 module.
Location: installation in Safe Area/Non Hazardous Locations.
Protection class: IP 20, Open Type.
Dimensions: see drawings pages 4 to 6.

Ordering Information:

Description	Hot Swapping	Rack Dimension (inches) and Configuration	Ordering Code
 Rack unit and back panel for wall mounting into a cabinet	YES	19" wide 1 output 48 Vdc up to 50 A with redundancy 1 diagnostic module (optional)	PSS1250-HS-7-48-D-W
 Rack unit and back panel for wall mounting into a cabinet	NO		PSS1250-7-48-D-W
 Rack unit and back panel for frontal rack mounting into a cabinet	YES		PSS1250-HS-7-48-D-F
 Rack unit and back panel for frontal rack mounting into a cabinet	NO		PSS1250-7-48-D-F
 Power supply module	-	With 24 Vdc – 50 A output	PSM1250 : needed 4 pieces plugged into 4 slots (1st & 2nd + 5th & 6th)
 Diagnostic module	-	With touch screen LCD color display	PSO1250 : 1 piece (optional) plugged into 7th slot if diagnostic capability is required
 Blank panel	-	To fill a not used rack slot, where a PSM1250 or PSO1250 is not installed	MCHP228: needed 2 pieces plugged into 3rd & 4th slots + 1 piece plugged into 7th slot if PSO1250 is not required

Hot swapping capability



PSS1250 Power Supply System with Hot Swapping (HS) capability is able to provide power and it is fully protected from the Hot Swapping of any power, or diagnostic, module. This protection system operates for both the insertion and disconnection of the modules.

When inserting the module, the mains voltage is only applied when mechanical and electrical module connections are completely and correctly positioned, while before disconnecting the module the external electrical connections have to be at zero voltage level.

To achieve this result, a sophisticated 1002 mechanical and electrical protection circuit, using micro switches (MS), relays (REL) and special hot swapping circuits (HSC), has been designed. All power modules have a mains terminal block for Line-Neutral-Earth/Ground, placed in the back panel pcb that can be used for two independent mains lines (AC1 & AC2). The Line and Neutral are connected to the power module via two couples of 1002 series contact relays, driven from hot swapping circuit according to closed or open state of 1002 series mechanical switches. Two micro switches for each power module are placed in the front part of the 19" Rack unit and are activated (closed) by front panel top screws used to fix the module at rack. For each power module, 4 relays are installed on the back panel pcb, close to the mains terminal blocks, in 1002 architecture for safety purposes.

For further safety, close to the relays, for each position, there is a red LED. Before inserting a power module, the operator must verify that related red LED is OFF.

If the red LED is turned ON, a failure is present on a couple of series relays or HS controller circuit could be damaged and no power module shall be inserted and fixed in that position. The opening of the micro switches, operated by unscrewing at least one of two front panel top screws, initiates the following two actions:

1. Mains line is disconnected from the power module, because hot swapping circuit de-energizes relays, opening their contacts;
2. Voltage on the power module connectors is brought to 0 volts, to avoid any sparking possibility. This is done by a MOSFET solid state switch (SSS) connected in series with the *active ideal diodes (AID)*, which disconnects the output from the DC output bus. The internal voltage in the disconnected power module remains completely isolated from the output connections and therefore, even if an operator shorts the connections with a screw driver or any other tool, this will not generate a spark.

When a power module is inserted and fixed to rack unit by its screws, the MOSFET solid state switch remains open until the power supply starts to operate correctly, then it closes itself applying voltage to the load.

Reasons for using an Ideal Diode-OR Controller circuit, in N+1 redundant power supply applications with high availability systems

High availability systems often employ power supply modules connected in parallel to achieve redundancy and enhance system reliability.

ORing diodes have been a popular means of connecting these supplies at a point of load. The disadvantage of this approach is the forward voltage drop and resulting efficiency loss. This drop reduces the available supply voltage and dissipates significant power.

Replacing Schottky diodes with N-channel MOSFETs reduces power dissipation and eliminates the need for expensive heat sinks or large thermal layouts in high power applications. In the Ideal Diode-OR Controller circuit (*active ideal diode*), the voltage across source and drain is monitored by IN and OUT pins, and GATE pin drives the MOSFETs to control their operation. In effect the MOSFET source and drain serve as the anode and cathode of an ideal diode.

In the event of a power supply failure, for example if the output of a fully loaded supply is suddenly shorted to ground, reverse current temporarily flows through the MOSFETs that are ON. This current is sourced from any load capacitance and from the other supplies. The active ideal diode quickly responds to this condition turning off the MOSFETs in about 0.5µs, thus minimizing disturbance and oscillations to the output bus.

Using Oring diodes to parallel two 24 VDC power supply modules of each group for redundancy, one Schottky diode is used for each module. The voltage drop across the diode can reach about 0.8 V at 50 A, this means about 40 W dissipation for each module. For each group, if two 50 A paralleled modules are used for full 50 + 50 A redundancy, a total power of about 80 W is dissipated for this purpose, but there are two groups of PSM1250 modules, so that total dissipation will be **160 W**. This reduces efficiency, reliability and increases space for heat sinks. Moreover, in case of module failure, diodes take time to recover and consequently they do not preserve the load from transients during the backup operation.

To avoid all these problems G.M. International has introduced, in the new PSS1250 Power Supply System, the use of *active ideal diodes*.

The MOSFETs resistance for *active ideal diodes* is about 1.2 mΩ resulting in 3.6 W dissipation for each power module. For each group, if two 50 A paralleled modules are used for full 50 + 50 A redundancy, a total power of about **2 x 7.2 W = 14.4 W** is dissipated for the purpose resulting in about **ten times less** dissipation compared to Schottky diodes solution. This increases efficiency, reliability, availability and reduces space for heat sinks.

This circuit provides also very smooth voltage switchovers without oscillations with fast turnoff, minimizing reverse current transients.

Output voltage setting - Fault indications - Diagnostic information

For each PSM1250 power module, the output voltage can be set to 24 Vdc + 18%; -14% via a front panel trimmer.

Under voltage threshold is set to 19.5 V, while Over voltage threshold is set to 29.5 V.

A front panel power ON green LED signals mains voltage is applied to the power module and normal DC output voltage is present on DC output screw terminals.

Power module Fault conditions are signaled by opening contact of NE relay (contact closed in normal condition), positioned on back panel pcb "Fault" terminal block.

Faults can be:

- Under voltage $V_{out} < 19.5 V$.
- Over voltage $V_{out} > 29.5 V$.

In absence of under / over voltage fault, the green Power ON LED is ON if output voltage is within 19.5 V - 29.5 V range.

If output voltage goes below 19.5 V, the green Power ON LED blinks and holds this condition as long as output voltage goes over 20 V.

If output voltage goes over 29.5 V, the green Power ON LED is OFF and holds this condition as long as output voltage goes below 29 V.

After under / over voltage fault, coming back to normal condition, the green Power ON LED is ON if output voltage is within 20 V - 29 V range.

Communication with four power modules is achieved via PSO1250 diagnostic module, which incorporates a front panel color touch screen. The diagnostic module is able to query each power modules (using an internal proprietary bus) and read data such as, Input/Output Voltage, Current and Power; Input Line Frequency; Output current sharing percentage related to each group; Internal Temperature; alarm status (under/over out voltage, AC line absence, internal PFC or PWM stage in OFF state, internal high temperature, fans malfunctioning).

This information is available via front panel LCD and externally via Modbus RTU on related wall mounting terminal block. Alarm status of one or more power modules is signalled by opening contact of NE relay (contact closed in normal condition), positioned on back panel pcb "Comm. Fault" terminal block. The diagnostic module **does not interfere** with the Power system functional safety. The power system can perfectly work without the diagnostic module and any failure of the diagnostic module does not affect system performance, reliability and SIL level of Functional Safety applications.

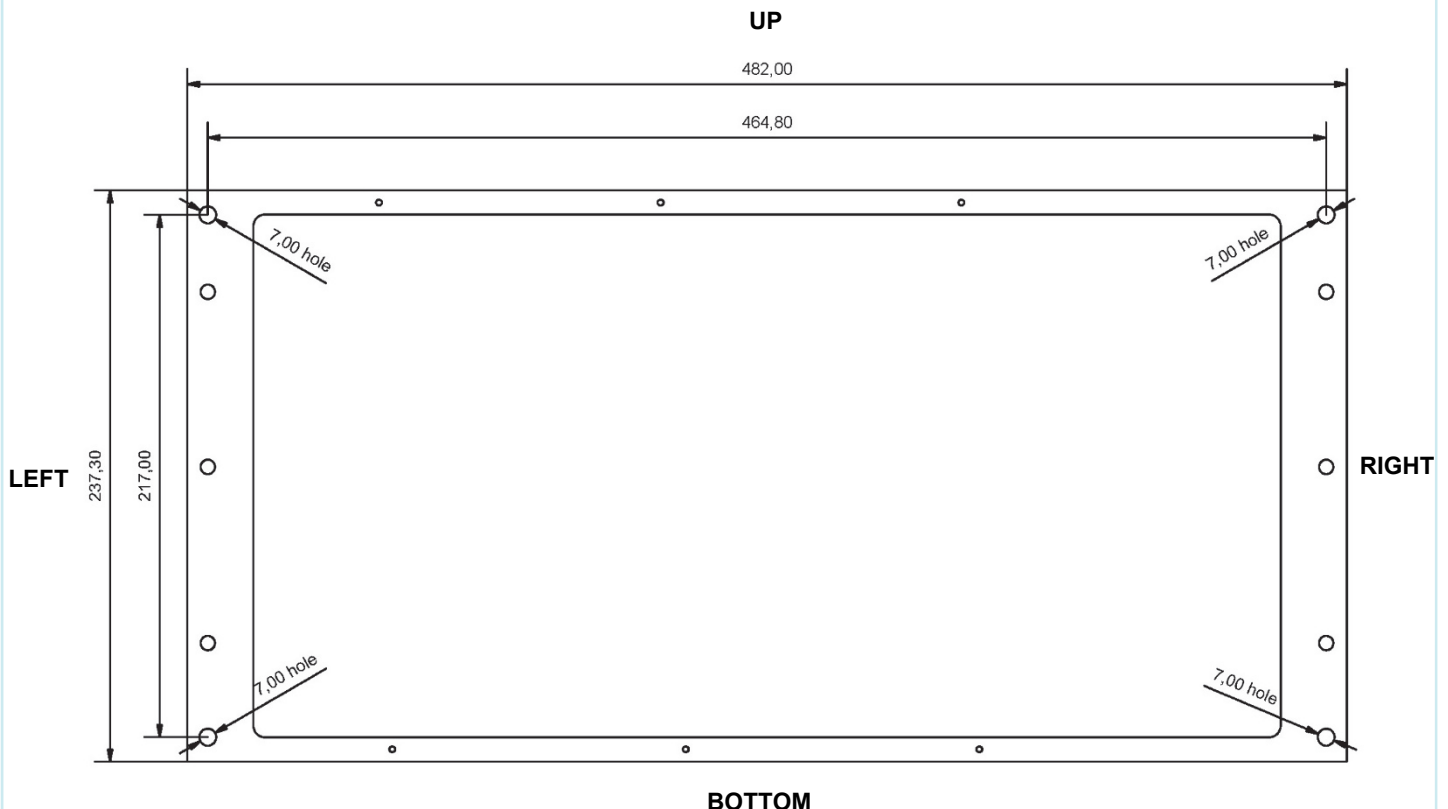
About PSS1250(-HS)-7-48-D fault indication, it's important to connect in series the Fault relay contacts of: the 1st and the 5th PSM1250 modules (which define the 1st 48V generator); the 2nd and the 6th PSM1250 modules (which define the 2nd 48V generator). When a PSM1250 module goes in fault condition which reflect a fault condition on related 48V generator. Both series connections (one for each 48V generator) of Fault relay contacts should be connected to Safety PLC inputs to read status of these contacts and detect possible faults.

Back Panel of PSS1250-xx-7-48-D-W (for wall mounting into a cabinet) overall dimensions:

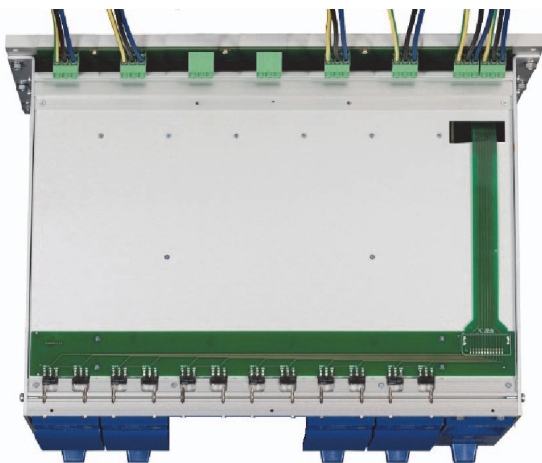
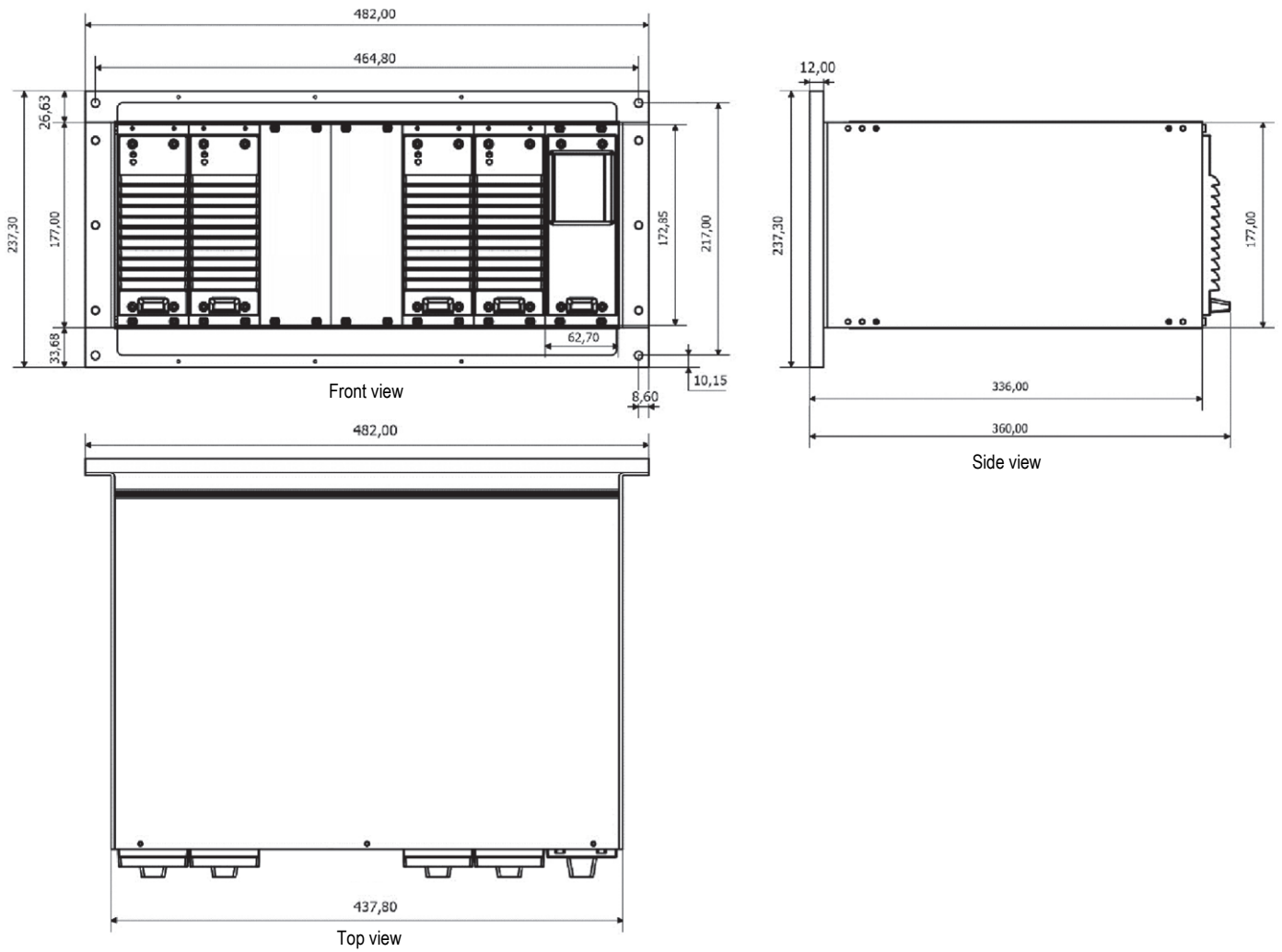
The following drawing with overall dimensions (mm) is only applicable to types: PSS1250-HS-7-48-D-W and PSS1250-7-48-D-W.

The back panel is fixed to a vertical wall into a cabinet by means of four screws through four 7.00 mm diameter holes shown in the drawing.

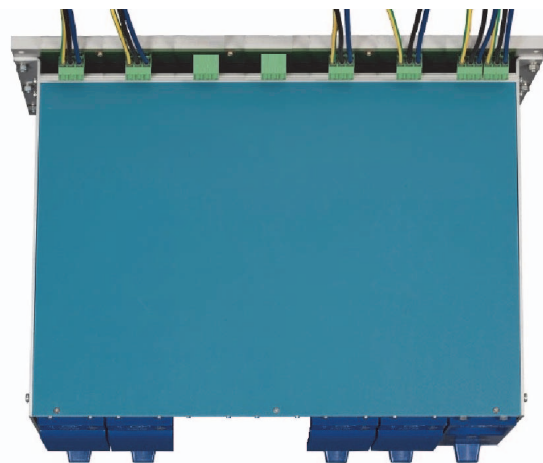
The back panel must only be installed as oriented in the following drawing. On the back panel is fixed the back panel PCB by means of six screws.



PSS1250-HS-7-48-D-W & PSS1250-7-48-D-W (for wall mounting into a cabinet) overall dimensions:

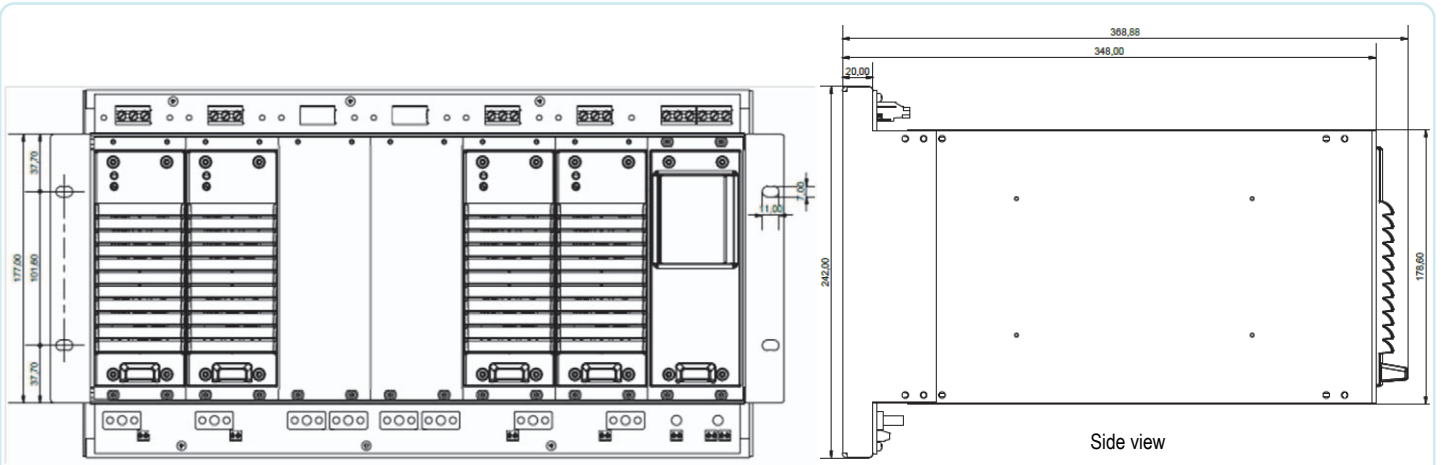


19" Rack Unit type PSS1250-HS-7-48-D-W
Top view without cover



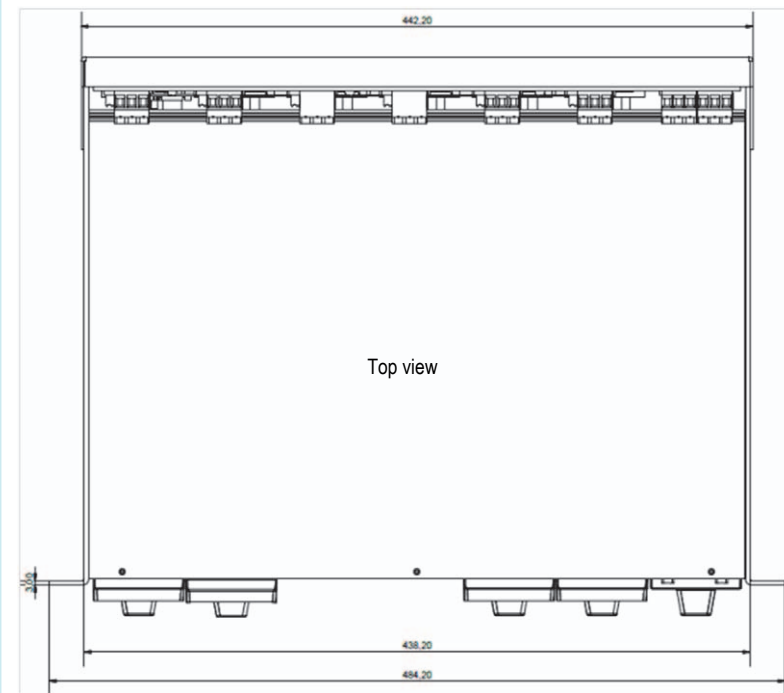
19" Rack Unit type PSS1250-HS-7-48-D-W
Top view with cover

PSS1250-HS-7-48-D-F & PSS1250-7-48-D-F (for frontal rack mounting into a cabinet) overall dimensions:

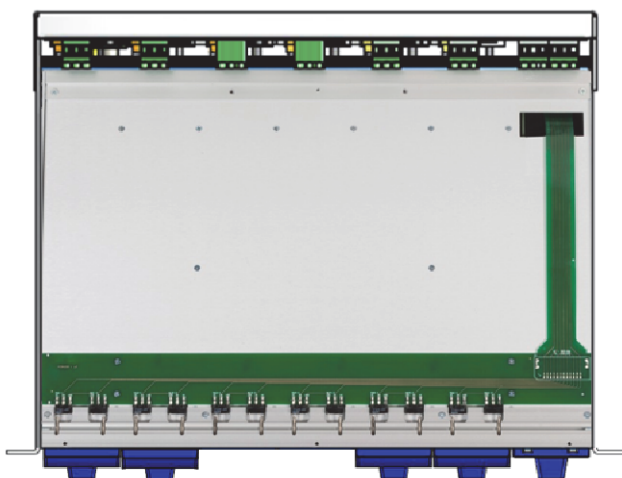
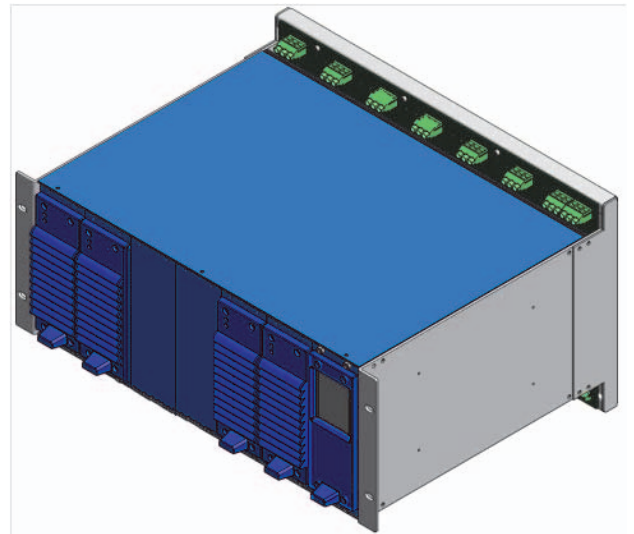


Front view

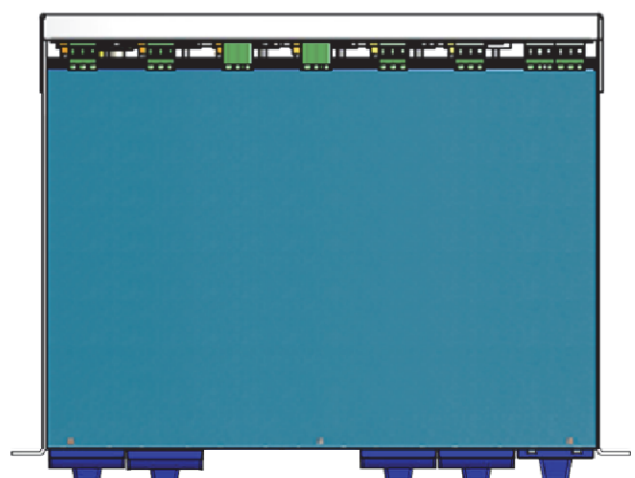
Side view



Top view



19" Rack Unit type PSS1250-HS-7-48-D-F
Top view without cover

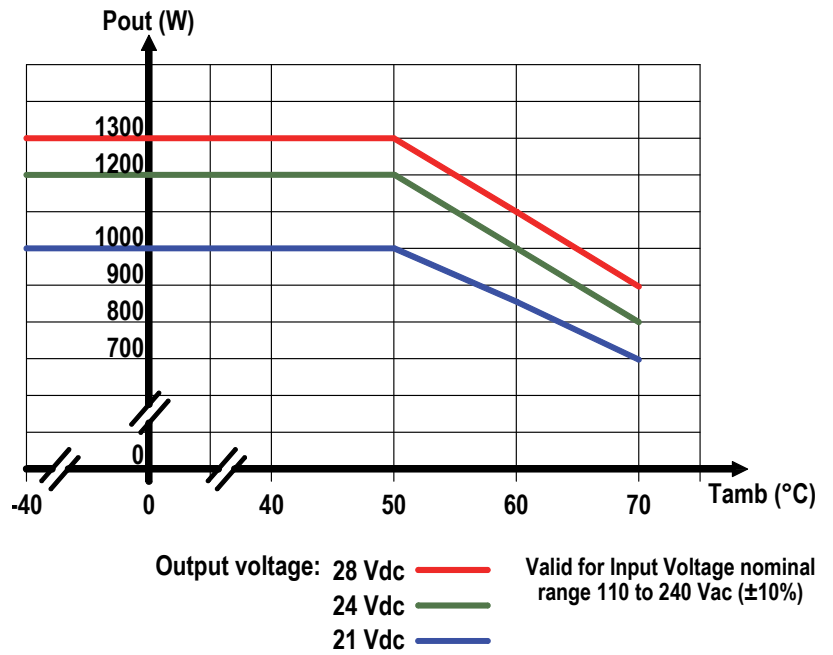


19" Rack Unit type PSS1250-HS-7-48-D-F
Top view with cover



PSM1250
Side view

PSM1250
Maximum Output Power vs. Ambient Operating Temperature



For each group of two PSM1250 with paralleled outputs and load current sharing capability, that is 24 Vdc - 50 A - 1200 W, each PSM1250 operates at 50% load current or 600 W power output up to 70°C operating ambient temperature, with output voltage range 21÷28 Vdc and input voltage nominal range 110÷240 Vac (±10%).



PSM1250
Top view



PSM1250
Front view



PSM1250
Side view without cover



PSO1250
Side view



PSO1250
Side view



PSO1250
Top view



PSO1250
Front view

PSO1250 supply information:

AC Input voltage (each AC terminal block): nominal 110 to 240 Vac ($\pm 10\%$), with frequency range 48 to 62 Hz.

AC input current (sinusoidal): 45 mA @ 100 Vac input voltage, 40 mA @ 115 Vac input voltage, 15 mA @ 230 Vac input voltage.

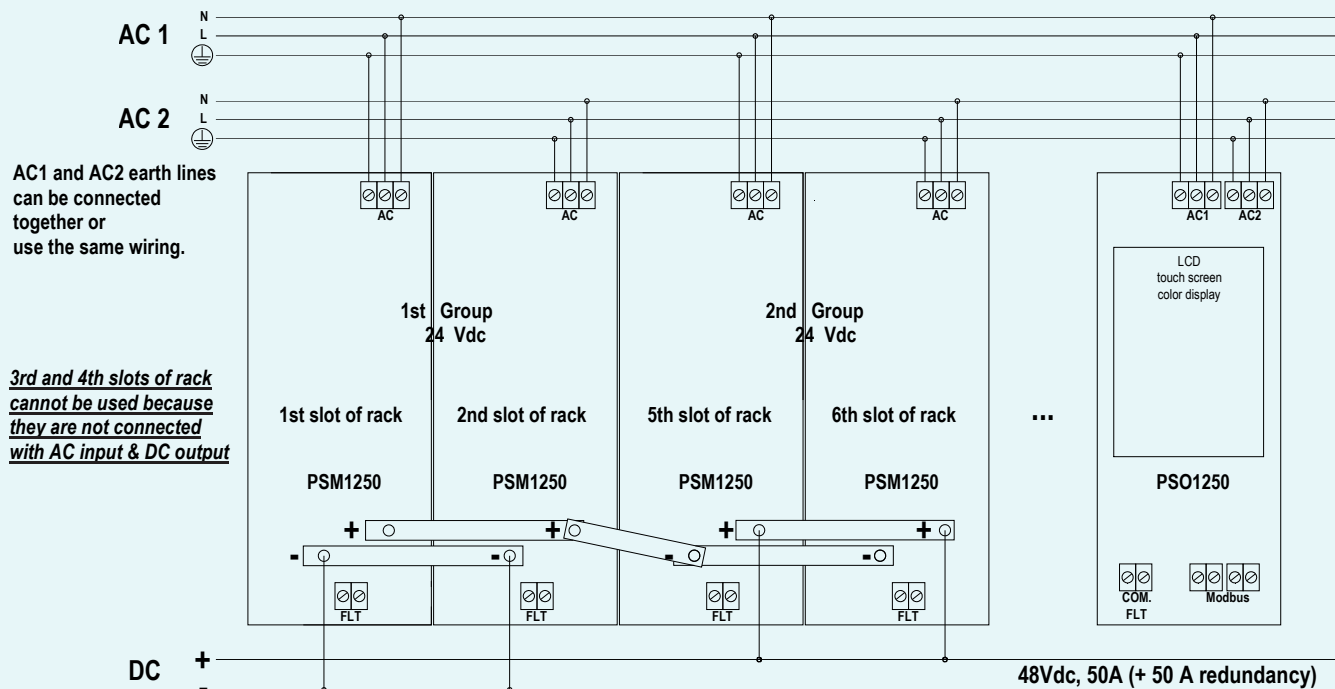
Inrush current: 1.6 A peak @ 264 Vac; 1.4 A peak @ 230 Vac; 0.7 A peak @ 115 Vac.

Function Diagram Dual AC Supply wiring architecture for PSS1250-HS-7-48-D or PSS1250-7-48-D:

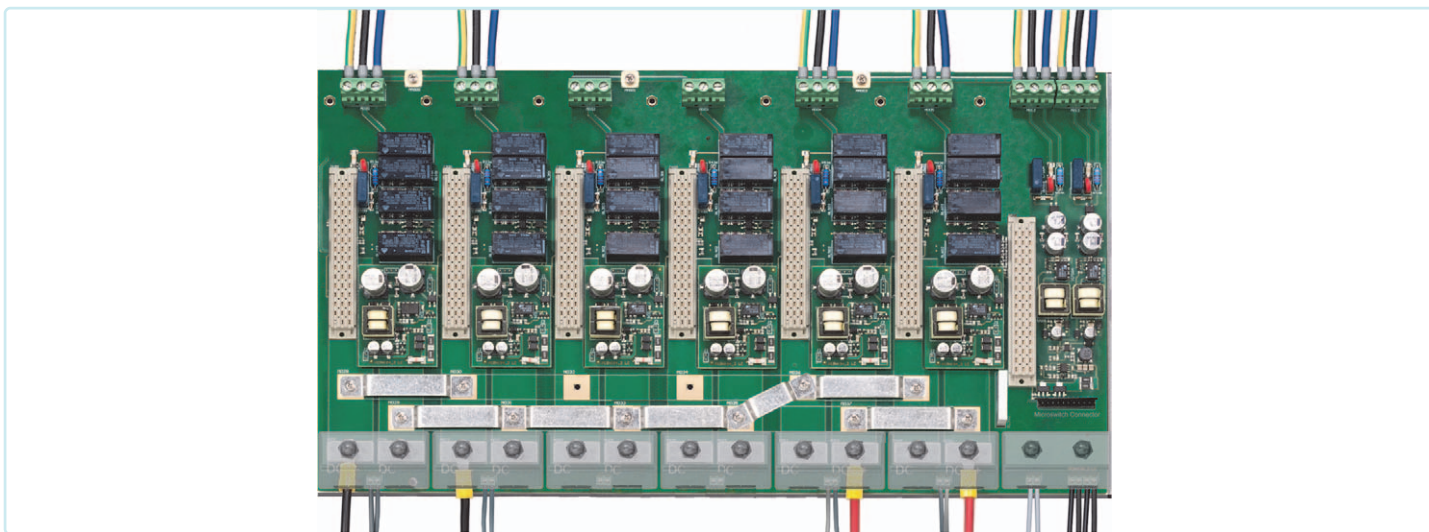
SAFE AREA,
NON HAZARDOUS LOCATIONS

PSS1250-HS-7-48-D or PSS1250-7-48-D, dual AC supply, 1 redundant 48 Vdc - 50 A Output, PSO1250 overview module

Series of two groups, each with two paralleled PSM1250 modules, to provide full redundancy on AC lines (AC1 and AC2) and one 48 Vdc - 50 A redundant output.



Back Panel PCB of PSS1250-HS-7-48-D with Hot Swapping circuits:



Back Panel PCB of PSS1250-7-48-D without Hot Swapping circuits:

