

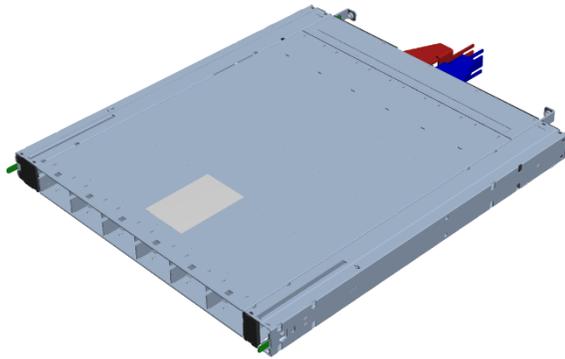
SPSTET4-01

Power Shelf

SPSTET4-01 power-shelf solutions provide rectification, system management, and power distribution, while maintaining high reliability and offering flexibility for future expansion.

The power shelf can be configured with up to six hot-swap capable TET4000-48-069RA AC/DC-DC power supplies that convert 3-phase AC mains power into a main output of 54.5 VDC for powering IT racks, OCP racks and Data centers.

The shelf has an optional slot for Network Attached Controller for providing control functions and monitoring through a 10/100 MB base Ethernet port and can be connected directly to the data center management network.



Key Features & Benefits

- Two 3-Phase inputs, one AC inlet powers 3 power modules.
- Modules are hot-swap capable
- Modules support CAN communication interface for control, programming and monitoring with CAN communication protocol
- Modules implement the following protections: Overtemperature, output overvoltage and output overcurrent
- Overall dimensions: 436.5 x 47 x 710 mm (17.2 x 1.85 x 27.9 in)
- RoHS Compliant

Applications

- IT racks
- OCP racks
- Data centers



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1. ORDERING INFORMATION

| MODEL | INPUT AND OUTPUT CONFIGURATION |
|-------------|---|
| SPSTET4-01 | 3-phase, 200-277 / 346-480 VAC Line to Line input with Neutral line Single output blade for +54.5 V output for OCP Shallow Rack. |
| SPSTET4-01C | 3-phase, 200-277 / 346-480 VAC Line to Line input with Neutral line Single output blade for +54.5 V output for OCP Shallow Rack. Network Attached Controller included |

2. TECHNICAL DATA

| PARAMETER | DESCRIPTION / CONDITION |
|-------------------------|---|
| Input | 3-phase, 200-277 / 346-480 VAC Line to Line input with Neutral ¹ |
| AC Inlet Configuration | 3 power modules are powered from one AC inlet |
| Auxiliary AC Outlet | 3pcs. low power AC outlet providing 230 / 277 VAC output with max. 6A – 10A, Protected by T 10A – F 15 A / 500 VAC Fuse (serviceable) When T _A : +45 °C to +55 °C, Output load current must be derated to 75%. |
| Redundant Configuration | 5+1 configuration |
| Rated Power | 19260 W ² |
| Output Connection | 1 set of output blade for +54.5 VDC output |
| Standby Output | 60 W (Standby output 12 V / 5 A) |
| Communication | CAN Interface / Ethernet – SNMPv3/ HTTPs / USB 2.0 |
| NAC1026-01 | Network Attached Controller: Ethernet – SNMPv3 / HTTP |

3. SAFETY WARNING

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies Bel Power Solutions Inc. from all claims arising from the handling or use of the goods. Persons handling the product(s) must have electronics training and observe good engineering practice standards.

CAUTION: Multiple power source. Disconnect all power cords before servicing.

4. REFERENCE DOCUMENTS

| DOCUMENT NUMBER | DESCRIPTION |
|-----------------|---|
| BCD.00883 | TET4000-48-069RA Datasheet |
| BCA.00231.0 | TET4000-48-069RA CAN Communication Manual |
| BCA.00253.0 | Network Attached Controller Documentation |
| BCA.00254.0 | SPSTET4-0x CAN Communication Manual |
| BCA.00255.0 | SPSTET4-0x HID Communication Manual |
| BCM.00TBD | Installation Instruction SPSTET4-0x |

¹ Power modules are connected Line to Neutral.

² Rated Power is reduced as per current share accuracy characteristic. See TET4000-48-069RA Datasheet.

5. OVERVIEW

The SPSTET4-01 Power Shelf is a 10U height power shelf. It can be configured with up to six hot-swap capable TET4000-48-069RA AC/DC power supplies that convert standard AC mains power into a main output of 54.5 VDC for powering IT racks, OCP racks and Data centers.

The CAN communication is routed through the CAN BUS inside the shelf. PSU Modules support CAN communication interface for control, programming and monitoring with the CAN communication protocol.

The shelf has a slot for network attached controller (NAC) for providing control functions and monitoring through a 10/100 MB base Ethernet port and can be connected directly to the data center management network. It is hot-pluggable and supplied via the 12 V standby provided by the power supplies in the shelf. The controller can be configured through a web interface; the monitoring and control functions are accessed through SNMPv3.

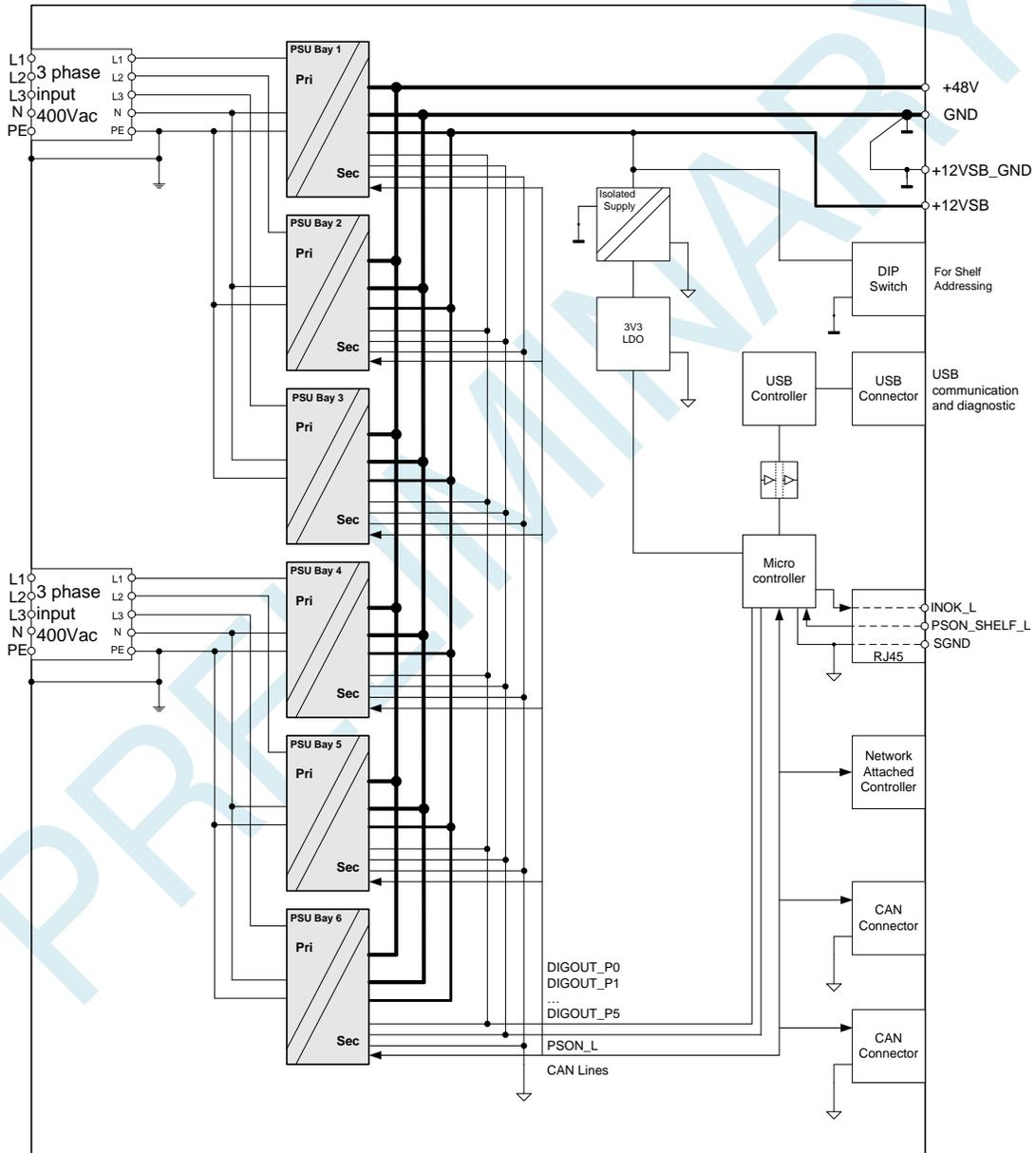


Figure 1. SPSTET4-01 Block Diagram (will be updated for Auxiliary AC Outlet)

6. INPUT SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|-------------------------------------|-------------------------|-----|-----------|-----|------|
| <i>Input Connector (J106, J107)</i> | | | | | |
| AC Nominal Input Voltage | Line to Line input | | 400 / 480 | | VAC |
| AC Input Voltage Ranges | Line to Neutral input | 180 | | 300 | VAC |
| Max Input Current | per line | | | 28 | Arms |
| Input Frequency | | 47 | 50 / 60 | 63 | Hz |

7. OUTPUT SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|--|---|-----|------|-------|------------|
| <i>Main Output V1 (Output Bus Bar)</i> | | | | | |
| Nominal Output Voltage | | | 54.5 | | VDC |
| Voltage Regulation | Programmable PSU module | -12 | | +6.5 | % Vout nom |
| Nominal Output Power | 5+1 configuration, $T_a < 45^\circ\text{C}$ | | | 19200 | W |
| Derated Output Power | 5+1 configuration, $T_a = 55^\circ\text{C}$ | | | 14400 | W |
| Nominal Output Current | 5+1 configuration, $T_a < 45^\circ\text{C}$ | | | 352 | ADC |
| Derated Output Current | 5+1 configuration, $T_a = 55^\circ\text{C}$ | | | 264 | ADC |

| | | | | | |
|---------------------------------|--|----|----|----|------------|
| <i>Standby Output VSB (J23)</i> | | | | | |
| Output Voltage | | | 12 | | VDC |
| Voltage Regulation | | -5 | | +5 | % Vout nom |
| Output Power | | | | 60 | W |
| Output Current | | | | 5 | ADC |

| | | | | | |
|---|---|--|-----------|----|------|
| <i>Auxiliary AC Outlet (J123, J124, and J125)</i> | | | | | |
| AC Output Voltage (J123) | L1 to Neutral | | 230 / 277 | | VAC |
| AC Output Voltage (J124) | L2 to Neutral | | 230 / 277 | | VAC |
| AC Output Voltage (J125) | L3 to Neutral | | 230 / 277 | | VAC |
| AC Output Current (J123) | L3 to Neutral | | | 6 | Arms |
| AC Output Current (J124, J125) | L1, L2 to Neutral | | | 10 | Arms |
| Fuse Protection per Line (F123) | Serviceable (10 A / 500 VAC Time Lag fuse) | | | | |
| Fuse Protection per Line (F124, F125) | Serviceable (15 A / 500 VAC Fast-Acting fuse) | | | | |

Note: When T_a : $+45^\circ\text{C}$ to $+55^\circ\text{C}$, Output load current must be derated to 75%.

7.1 PROTECTION (PER MODULE)

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|--|---|------|------|-----------------|------|
| Input Fuses (L+N) | Not user accessible, fast-acting (F) | | 30 | | A |
| OV Threshold I_1 | Hardware protection | 64 | 67 | 70 | VDC |
| OV Latch Off Time I_1 | | | | 1 | ms |
| Nominal Power Limitation | $V_{in} > 180V_{ac}$, $T_a \leq 45^{\circ}C$, $V_1 \geq 48$ VDC | 4000 | 4100 | | W |
| Nominal Current Limitation | $V_{in} > 180V_{ac}$, $T_a \leq 45^{\circ}C$, $V_1 \geq 48$ VDC | 73 | 76 | | A |
| Power Limit Blanking Time | Time until power limit is reduced to nominal value | | 5 | | ms |
| Power limit during oversubscription V_1 | Maximum duration 5 ms | 4400 | 4500 | | W |
| Current limit during Oversubscription I_1 | Maximum duration 5ms | 83 | 86 | | A |
| Max Short Circuit Current I_1 | $V_1 < 10$ VDC | | | 83 ³ | A |
| Short Circuit Latch Off Time | Time to latch off when in short circuit or output under voltage ($V_1 < 42$ VDC) | | 20 | | ms |
| UV Threshold V_1 | Output under voltage protection | 42.5 | 43 | 43.5 | VDC |
| V_1 Output under voltage protection delay time | $V_1 < V_1_{uv}$ | | 20 | | ms |
| Over Temperature on Critical Points | Inlet Ambient Temperature | | | 60 | °C |
| | PFC Primary Heatsink Temperature | | | 90 | |
| | Secondary Sync Mosfet Temperature | | | 90 | |
| | Secondary OR-ing Mosfet Temperature | | | 100 | |
| UV Threshold V_{SB} | Output under voltage protection standby | 11 | 11.2 | 11.3 | VDC |
| Current Limitation V_{SB} | Standby over current limit | | 5.5 | | A |

7.2 LOGIC SIGNALS

PSON_SHELF_L signal is an internally pulled-up input signal (3.3 V) to enable / disable the main output V_1 of the Shelf. This active-low pin is also used to clear any latched fault condition, this is similar to the PSON_L on the PSU level. The internal INOK_L_Px signal of each individual module is fed to the backplane microcontroller for modules synchronized AC startup. This allows the shelf to start up with load > 4000 W during AC application. The microcontroller provides an INOK_L output signal. INOK_L is low when there is at least one module supplied with correct input voltage. A pull up resistor of 10k Ω to 3.3 V within the shelf provides the high-level voltage for the INOK_L signal.

| RJ11 PIN OUTS (J15) | FUNCTION | DESCRIPTION |
|---------------------|--------------|----------------------------------|
| 1 | NC | NC |
| 2 | INOK_L | INOK signal: active-low |
| 3 | PSON_SHELF_L | Power shelf on input: active-low |
| 8 | SGND | Signal ground |

Table 1. Signal Connector (RJ11) Pin Out

³ Limit doesn't include effects of main output capacitive discharge

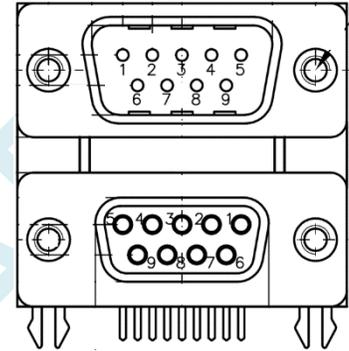
7.3 CAN COMMUNICATION

The PSU Modules are individually set to six fixed different address. CAN communication for the PSU Modules are described in more detail in document BCA.00231. The CAN communication to the PSU Modules are routed through CAN BUS. The PSON function of the shelf can also be controlled by a command similar to PMBus® command sent to the backplane Controller, see document BCA.00254.0 for further information and the table below.

There is a dual port Dsub9 connector for daisy chain operations.

The current share between different shelves is achieved by daisy chain connection of the CAN connectors.

| Dsub 9 PIN OUTS (J13) | FUNCTION | DESCRIPTION |
|-----------------------|------------|------------------|
| 1 | NC | NC |
| 2 | CAN_L | Dominant Low |
| 3 | CAN_GROUND | Ground |
| 4 | NC | NC |
| 5 | CAN_SHIELD | Shield, Optional |
| 6 | CAN_GROUND | Ground, Optional |
| 7 | CAN_H | Dominant High |
| 8 | NC | NC |
| 9 | NC | NC |



Front View

7.4 PSU / SHELF ADDRESSING

The PSU address inside shelf are configurable via DIP Switch (S1);

The Default Shelf Controller Node address is 0x0F.

| POSITION 1 | POSITION 2 | POSITION 3 | PSU Address PSU1, PSU2...PSU6 | | |
|------------|------------|------------|-------------------------------|------|------|
| | | | PSU1 | PSU2 | PSU6 |
| OFF | OFF | OFF | 0x01 | 0x02 | 0x06 |
| OFF | OFF | ON | 0x11 | 0x12 | 0x16 |
| OFF | ON | OFF | 0x21 | 0x22 | 0x26 |
| OFF | ON | ON | 0x31 | 0x32 | 0x36 |
| ON | OFF | OFF | 0x41 | 0x42 | 0x46 |
| ON | OFF | ON | 0x51 | 0x52 | 0x56 |
| ON | ON | OFF | 0x61 | 0x62 | 0x66 |
| ON | ON | ON | 0x71 | 0x72 | 0x76 |

NOTE: SPSTET4-0x CAN Communication Manual, see document BCA.00254.0

Table 2. DIP Switch Setting (S1)

7.5 NETWORK ATTACHED CONTROLLER (optional)

The Network Attached Controller is a shelf level controller providing monitoring and control functions through a 10/100 MB base Ethernet port and can be connected directly to the data center management network. It is hot-pluggable and supplied via the 12 V redundant standby provided by the power supplies in the shelf. The controller can be configured through a web interface; the monitoring and control functions are accessed through SNMP.

See BCA.00253.0 for Network Attached Controller Documentation.



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7.6 CONTROL LEDs

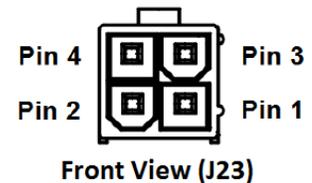
Each PSU front-end module has 2 LEDs to indicate status condition. LED number one is green and indicates AC power is on or off, while LED number two is bi-colored: green and yellow and indicates DC power presence or fault situations.

| OPERATING CONDITION | LED SIGNALING |
|---|-----------------|
| AC LED | |
| AC Line within range | Solid Green |
| AC Line UV condition | Off |
| DC LED⁴ | |
| V_1 or V_{SB} out of regulation | Solid Yellow |
| Over temperature shutdown | |
| Output over voltage shutdown (V_1 or V_{SB}) | |
| Output under voltage shutdown (V_1 or V_{SB}) | |
| Output over current shutdown (V_1 or V_{SB}) | Blinking Yellow |
| Invalid Node Id | |
| Power Supply Turned Off | Blinking Green |
| Normal Operation | Solid Green |
| PSU back-supplied | Blinking Yellow |
| Otherwise | All LEDs off |

7.7 +12VSB CONNECTOR (J23)

+12VSB output is capable of delivering 5 A.

| PIN OUTS (J23) | FUNCTION | DESCRIPTION |
|----------------|----------|---------------|
| 1, 3 | VSB_GND | +12VSB return |
| 2, 4 | VSB | +12VSB output |



7.8 AUXILIARY AC OUTLET

The 3 connectors (J123, J124, and J125) are used to provide AC power to the Network Switch Devices. Each connector is connected to one of the LIVE terminals (L1, L2, and L3) and NEUTRAL from the 3-phase input (J107). These are protected by a 10 A / 500 Vac Time Lag fuse on the LIVE terminal (F123) and 15 A / 500 Vac Fast-Acting fuse on the LIVE terminal (F124 and F125). See Safety Warning when servicing the fuse.

When power shelf is operated at ambient temp of +45 °C to +55 °C, the output load current must be derated to 75%.

⁴ The order of the criteria in the table corresponds to the testing precedence in the controller. LEDs are only available if sufficient input voltage is applied for operation of the internal supply circuits.

8. SAFETY, REGULATORY AND EMC SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | CRITERION |
|---|---|---|
| Agency Approvals Pending | Approved to the latest revisions/amendments of the following standards: UL 62368-1 2nd edition CAN/CSA-C22.2 No. 62368-1 2nd edition IEC 62368-1 2nd edition EN 62368-1 2nd edition | Approved by independent body (see CE Declaration) |
| Insulation | Input (L/N) to case (PE) Input (L/N) to output Output to case (PE) | Basic Reinforced Functional |
| Creepage / Clearance (<i>dc</i>) | Primary (L/N) to protective earth (PE) Primary to secondary | |
| Electrical Strength Test | Input to case Input to output (tested by manufacturer only) | Min. 2121 VDC Min. 4242 VDC |
| Conducted Emission | EN55022 / CISPR 22: 0.15 ... 30 MHz, QP and AVG | Class A |
| Radiated Emission | EN55022 / CISPR 22: 30 MHz ... 1 GHz, QP | Class A |
| Harmonic Emissions (per module) | IEC61000-3-2, $V_{in} = 230$ VAC, 50 Hz, 100% Load (per module) | Class A |
| Acoustical Noise | Sound power statistical declaration (ISO 9296, ISO 7779, IS9295) @ 50% load | TBD dBA |
| AC Flicker | IEC / EN 61000-3-3, $d_{max} < 3.3\%$ | PASS |
| ESD Contact Discharge | IEC / EN 61000-4-2, ± 8 kV, 25+25 discharges per test point (metallic case, LEDs, connector body) | A |
| ESD Air Discharge | IEC / EN 61000-4-2, ± 15 kV, 25+25 discharges per test point (non-metallic user accessible surfaces) | A |
| Radiated Electromagnetic Field | IEC / EN 61000-4-3, 10 V/m, 1 kHz/80% Amplitude Modulation, 1 μ s Pulse Modulation, 10 kHz...2 GHz | A |
| Burst | IEC / EN 61000-4-4, level 3 AC port ± 2 kV, 1 minute DC port ± 1 kV, 1 minute | A |
| Surge | IEC / EN 61000-4-5 Line to earth: level 3, ± 2 kV Line to line: level 2, ± 1 kV | A |
| RF Conducted Immunity | IEC/EN 61000-4-6, Level 3, 10 Vrms, CW, 0.1 ... 80 MHz | A |
| Voltage Dips and Interruptions (per module) | IEC/EN 61000-4-11 (per module) 1: V_i 230 VAC, 100% Load, Dip 100%, Duration 12 ms 2: V_i 230 VAC, 100% Load, Dip 100%, Duration < 150 ms 3: V_i 230 VAC, 100% Load, Dip 100%, Duration > 150 ms | A V1: B, VSB: A B |

9. ENVIRONMENTAL SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|---------------------------|--|-----|-----|-------|------|
| Operating Temperature | @ full load, up to 4000 m: | 0 | | +35 | °C |
| | @ full load, up to 1800 m: | 0 | | +45 | |
| | @ 75% load, up to 1800 m: | 0 | | +55 | |
| Non-Operating Temperature | | -40 | | +70 | °C |
| Humidity | Operating: @ at 40 °C, non-condensing | 7 | | 93 | %RH |
| | Non-Operating: non-condensing | 5 | | 95 | |
| Altitude | Operating: | | | 4000 | m |
| | Non-Operating: | | | 13000 | |
| Shock | Operating: 11 ms half-sine shocks in Z axis 10+ve, 10-ve | | 5 | | g |
| | Non-Operating: 11 ms half-sine shocks in Z axis 10+ve, 10-ve | | 30 | | |
| Vibration | Operating: 0.2 g_{rms} random | 5 | | 500 | Hz |
| | Non-Operating: 1 g_{rms} random | 2 | | 200 | |
| Acoustic Noise Emissions | @ normal operation, and 50% load sharing | | | TBD | dBA |
| | Fan speed | | | TBD | |
| Cooling | When equipped with operating PSUs | | | 50 | Pa |

10. MECHANICAL SPECIFICATIONS

| PARAMETER | SPSTET4-01 |
|--------------------------|---|
| Dimensions (W x H x D) | 534.5 x 46.5 x 600 (overall: 436.5 x 47 x 710 mm) |
| Weight (Shelf only) | 9 kg |
| Weight (6 PSU installed) | 25 kg |

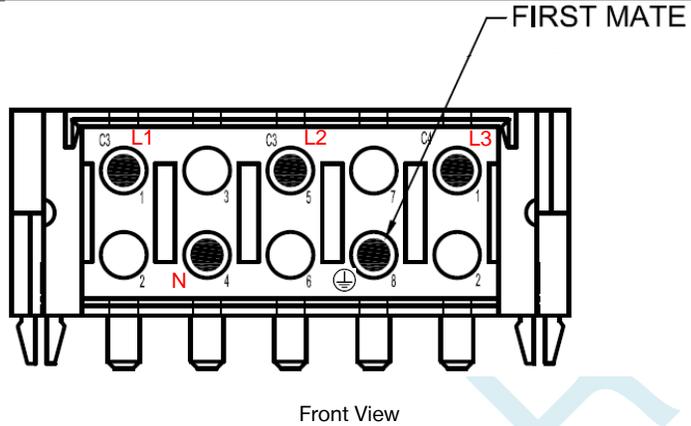
10.1 CONNECTORS

| DESCRIPTION | REFERENCE DESIGNATOR | TYPE | MANUFACTURER | MPN |
|--------------------------|----------------------|------------------------------|----------------------------------|--------------------------------|
| Input Connector | J106, J107 | 3-phase input | Positronic Industries | SP5YYE48M0LN9A1/AA-PA1067 |
| Logic Signal Connector | J15 | RJ11 | Bel Fuse Inc. | SS-6444-NF |
| +12VSB output connector | J23 | | Molex | 39-30-0040 |
| CAN Connector | J13 | Dual port D-SUB 9 | Norcomp | 189-009-413R571 |
| Auxiliary AC Outlet | J123 | Single phase output | Molex | 172043-0302 |
| Auxiliary AC Outlet | J124, J125 | Single phase output | Rong Feng | RF-203P-HP-A-1.0 |
| Auxiliary AC Outlet Fuse | F123 | 5 x 20 mm Time Lag Fuse | Bel Fuse Inc. Eaton | 0ADKC9100-BE BK1-S505H-10-R |
| Auxiliary AC Outlet Fuse | F124, F125 | 6.3 x 32 mm Fast-Acting Fuse | Bel Fuse Inc. Littelfuse Inc. | 0ADEC9150-BE 0505015.MXP |

SHELF

HIGH VOLTAGE CONNECTOR PIN ASSIGNMENT

3-Phase Input Connector
(J106, J107)

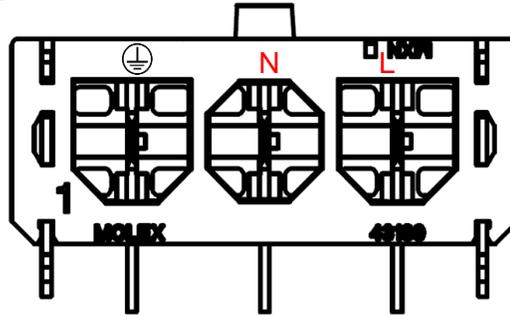


Front View

MPN SP5YYE48M0LN9A1/AA-PA1067

Mating Part SP5YYE1F0091/AA

Auxiliary AC Outlet
(J123)

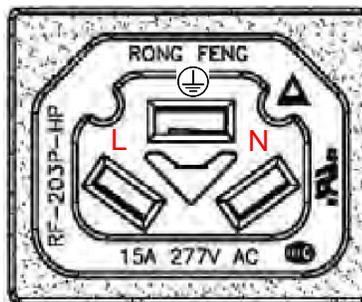


Front View

MPN 172043-0302

Mating Part 172672-2003

Auxiliary AC Outlet
(J124, J125)



Front View

MPN RF-203P-HP-A-1.0

10.2 SPSTET4-01 MECHANICAL DATA: (Note: finished good may look different from images.)

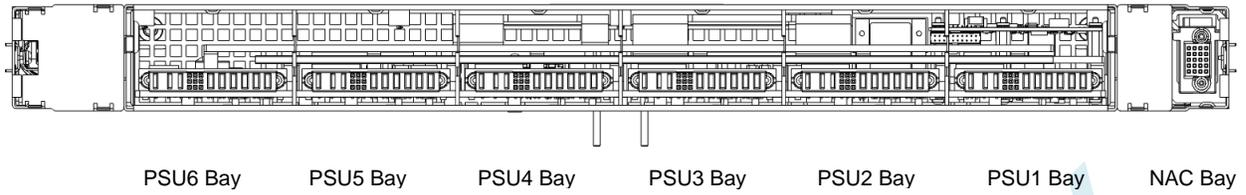


Figure 3. SPSTET4-01 Front View

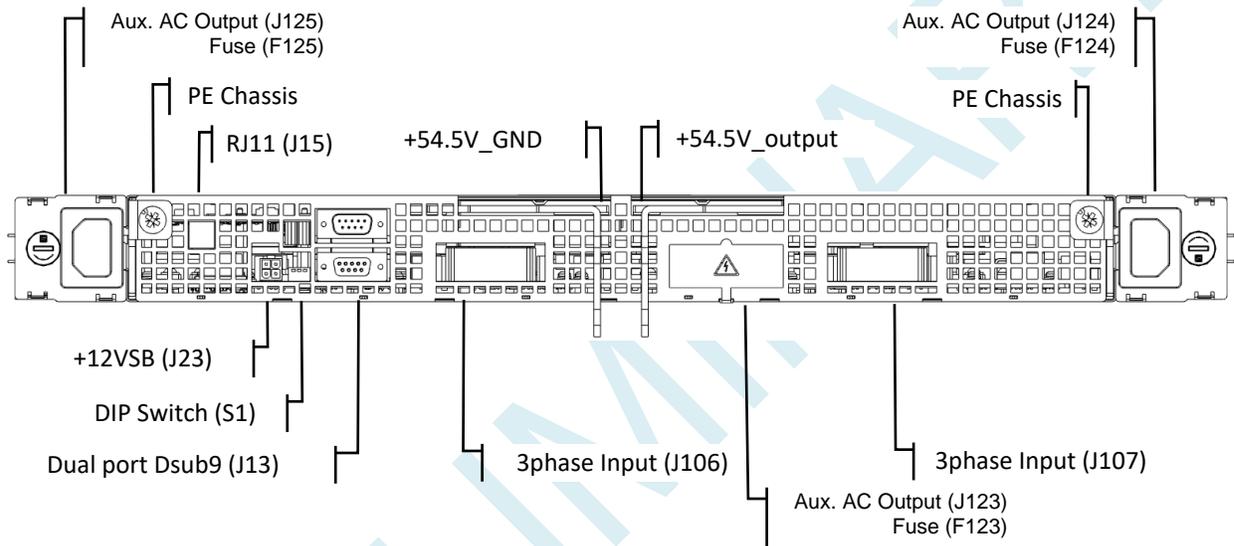


Figure 4. SPSTET4-01 Rear View

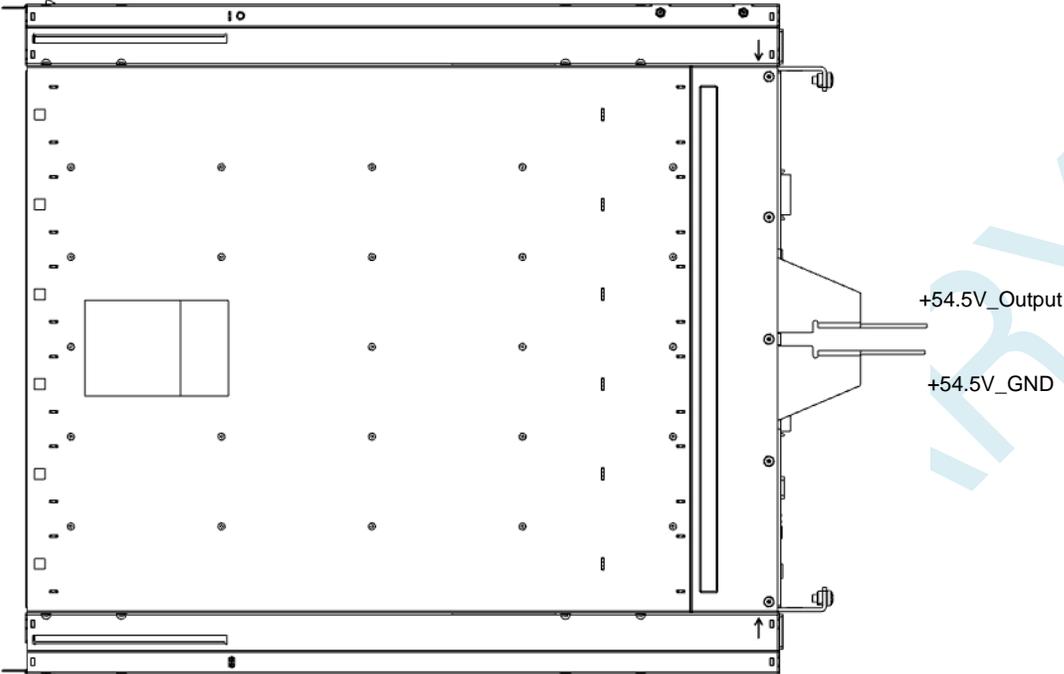


Figure 5. SPSTET4-01 Top View

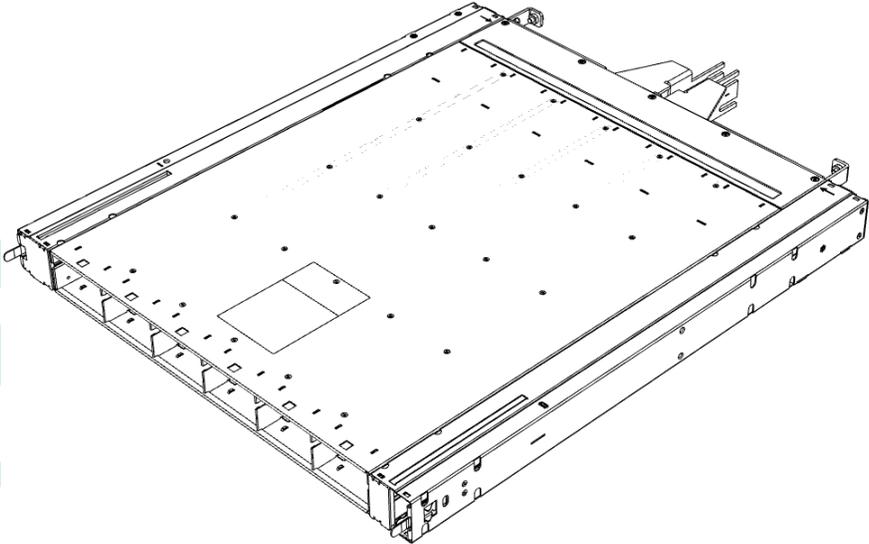


Figure 6. SPSTET4-01 Isometric View

11. ACCESSORIES

| ITEM | DESCRIPTION | ORDERING PN | SOURCE |
|---|--|-------------|--|
|  | I ² C Utility Windows Vista/7/8 compatible GUI to program, control and monitor PFE Front-Ends (and other I ² C units) | N/A | belfuse.com/power-solutions |

12. REVISION HISTORY

| REV | DESCRIPTION | PRODUCT VERSION | DATE | AUTHOR |
|-----|---------------|-----------------|------------|--------|
| 001 | Initial Draft | V001 | 27.05.2018 | GS |

For more information on these products consult: tech.support@psbel.com

NUCLEAR AND MEDICAL APPLICATIONS - Products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.

TECHNICAL REVISIONS - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.



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