

# SPSTET4-02

## ACDC Power Shelf

SPSTET4-02 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 single phase AC mains power into a main output of 54.5 VDC for powering intermediate bus architectures (IBA) in high performance and reliability servers, routers, and network switches.

The shelf has the option of built-in 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

- 3x single-phase inputs, one AC inlet power up 2 PSU 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
- RoHS Compliant

### Applications

- High Performance Servers
- Routers
- Switches

## 1. ORDERING INFORMATION

MODEL	INPUT AND OUTPUT CONFIGURATION
SPSTET4-02	3x single-phase inputs, 200 – 250 VAC Line to Line/Neutral, single output blade for +54.5 V output.
SPSTET4-02N	3x single-phase inputs, 200 – 250 VAC Line to Line/Neutral, single output blade for +54.5 V output with Network Attached Controller.

## 2. TECHNICAL DATA

PARAMETER	DESCRIPTION / CONDITION
Input	3x Single-phase, 200-250 VAC Line to Line/Neutral.
AC Inlet Configuration	3 pcs Input AC inlet. One AC inlet power up 2 PSU modules
Redundant Configuration	5+1 configuration
Rated Power	19450 W <sup>1</sup>
Output Connection	1 set of output blade for +54.5 VDC output
Standby Output	250 W (Standby output 12 V / 21 A) <sup>2</sup>
Communication	CAN Interface / Ethernet – SNMPv3/ HTTPs / USB 2.0

## 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	SPSTET4-02 CAN Communication Manual
BCA.00255.0	SPSTET4-02 HID Communication Manual
BCM.00473	Installation Instruction SPSTET4-02

## 5. OVERVIEW

The SPSTET4-02 Power Shelf is a 10U height power shelf. It can be configured with up to six hot-swap capable TET4000-48-069RA AC/DC-DC power supplies that convert standard AC mains power into a main output of 54.5 VDC for powering intermediate bus architectures (IBA) in high performance and reliability servers, routers, and network switches.

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 the option of built-in 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 not hot-pluggable and

<sup>1</sup> Rated Power is reduced as per current share accuracy characteristic. See TET4000-48-069RA Datasheet.

<sup>2</sup> 12VSB loading is limited to 60 W for the initial 500 ms after +12VSB has started.



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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.

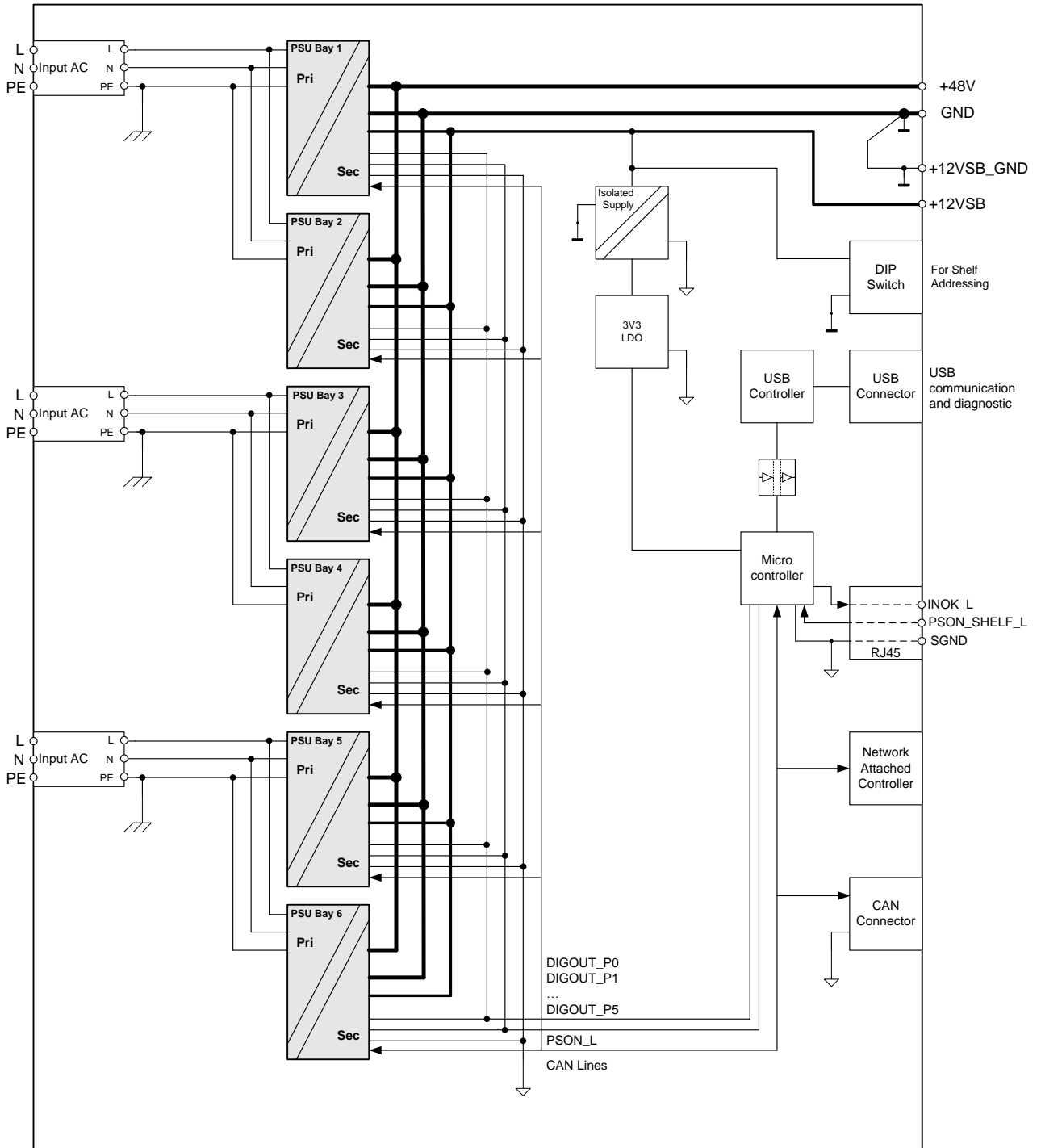


Figure 1. SPSTET4-02 Block Diagram

## 6. INPUT SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
<i>Input Connector (J9, J10, J11)</i>					
AC Nominal Input Voltage	Line to Line input	200	230	250	VAC
AC Input Voltage Ranges	Line to Line input	180		275	VAC
Max Input Current	Per line			34	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 (J12)</i>					
Output Voltage			12		VDC
Voltage Regulation		-5		+5	% Vout nom
Output Power				250	W
Output Current				21	ADC

### 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 $V_1$	Hardware protection	64	67	70	VDC
OV Latch Off Time $t_1$				1	ms
Nominal Power Limitation	$V_{in} > 180\text{Vac}$ , $T_a \leq 45^\circ\text{C}$ , $V_1 \geq 48\text{VDC}$	4000	4100		W
Nominal Current Limitation	$V_{in} > 180\text{Vac}$ , $T_a \leq 45^\circ\text{C}$ , $V_1 \geq 48\text{VDC}$	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 $I_1$	$V_1 < 10\text{VDC}$			83 <sup>3</sup>	A
Short Circuit Latch Off Time	Time to latch off when in short circuit or output under voltage ( $V_1 < 42\text{VDC}$ )		20		ms
UV Threshold $V_1$	Output under voltage protection	42.5	43	43.5	VDC
$V_1$ Output under voltage protection delay time	$V_1 < V_{1\text{UV}}$		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	5.0	5.5		A

<sup>3</sup> Limit doesn't include effects of main output capacitive discharge

**7.2 LOGIC SIGNALS**

PSON\_SHELF\_L signal is an internally pulled-up input signal (3.3 V) to enable / disable the main output V1 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\_LPx 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 10kΩ to 3.3 V within the shelf provides the high level voltage for the INOK\_L signal.

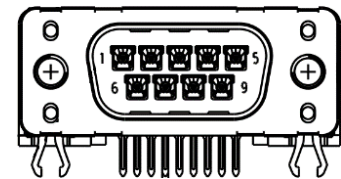
RJ45 PIN OUTS (J15)	FUNCTION	DESCRIPTION
1	NC	NC
2	NC	NC
3	NC	NC
4	NC	NC
5	INOK_L	INOK signal: active-low
6	NC	NC
7	PSON_SHELF_L	Power shelf on input: active-low
8	SGND	Signal ground

Table 1. Signal Connector (RJ45) Pin Out

**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.

Dsub 9 PIN OUTS (J14)	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
ON	ON	ON	0x01	0x02	0x06
OFF	ON	ON	0x11	0x12	0x16
ON	OFF	ON	0x21	0x22	0x26
OFF	OFF	ON	0x31	0x32	0x36
ON	ON	OFF	0x41	0x42	0x46
OFF	ON	OFF	0x51	0x52	0x56
ON	OFF	OFF	0x61	0x62	0x66
OFF	OFF	OFF	0x71	0x72	0x76

**NOTE:** SPSTET4-02 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 not 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.

### 7.5.1 LAN PORT: RJ45 (J3)

The LAN should be connected to the RJ45 connector on the front of the NAC. The Ethernet port is galvanically isolated from the PSU output and is connected to a 10Base-T/100Base-TX physical-layer transceiver for transmission and reception of data over standard CAT-5 unshielded twisted pair (UTP) cables. The built-in HP Auto MDI/MDI-X function allows to reliably detect and auto correct straight-through and crossover cable connections. The transceiver will automatically negotiate the and select the highest link-up speed (10/100 Mbps) and duplex (half/full) configuration. Once the interface has received an IP address on the network, the yellow LED on the controller is disabled. On the RJ45 connector only the green LED is active and lights up when there is traffic activity on the network.

### 7.5.2 USB PORT : MINI USB CONNECTOR (J4)

The front USB port is a slave connection and implements an HID interface which can be used in conjunction with the Bel Power Solutions graphical user interface.

### 7.5.3 NAC LEDS

Two LEDs are being provided:

- LED1 green: controller is powered; off: no power available on controller
- LED2 yellow: no IP address assigned; off: IP address assigned

### 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
<b>AC LED</b>	
AC Line within range	Solid Green
AC Line UV condition	Off
<b>DC LED<sup>4</sup></b>	
$V_i$ or $V_{SB}$ out of regulation	
Over temperature shutdown	
Output over voltage shutdown ( $V_i$ or $V_{SB}$ )	Solid Yellow
Output under voltage shutdown ( $V_i$ or $V_{SB}$ )	
Output over current shutdown ( $V_i$ or $V_{SB}$ )	
Invalid Node Id	Blinking Yellow
Power Supply Turned Off	Blinking Green
Normal Operation	Solid Green
PSU back-supplied	Blinking Yellow
Otherwise	All LEDs off

### 7.7 USB CONNECTOR TYPE B (J16)

This is used for Bel Power Diagnostic thru Bel Power Solutions I<sup>2</sup>C Utility GUI. This connection also provides access to FW boot loading of the PSU Modules.

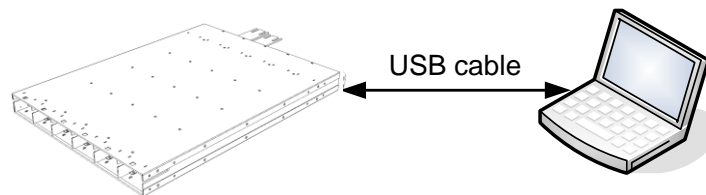
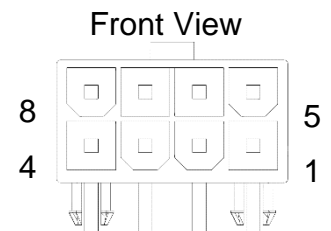


Figure 2. Connection

### 7.8 +12VSB CONNECTOR (J12)

+12VSB output is capable of delivering 21 A.

PIN OUTS (J12)	FUNCTION	DESCRIPTION
3,4,7,8	VSB_GND	+12VSB return
1,2,5,6	VSB	+12VSB output



<sup>4</sup> 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	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	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	60 dBA
AC Flicker	IEC / EN 61000-3-3, $d_{max} < 3.3\%$	PASS
ESD Contact Discharge	IEC / EN 61000-4-2, $\pm 8$ kV, 25+25 discharges per test point (metallic case, LEDs, connector body)	A
ESD Air Discharge	IEC / EN 61000-4-2, $\pm 15$ 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 $\mu$ s Pulse Modulation, 10 kHz...2 GHz	A
Burst	IEC / EN 61000-4-4, level 3 AC port $\pm 2$ kV, 1 minute DC port $\pm 1$ kV, 1 minute	A
Surge	IEC / EN 61000-4-5 Line to earth: level 3, $\pm 2$ kV Line to line: level 2, $\pm 1$ 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	
Cooling	When equipped with operating PSUs			50	Pa



## 10. MECHANICAL SPECIFICATIONS

PARAMETER	SPSTET4-02
Dimensions (W x H x D)	436 x 46.5 x 600 (overall: 436.5 x 47 x 710 mm)
Weight (Shelf only)	8 kg
Weight (6 PSU installed)	25 kg

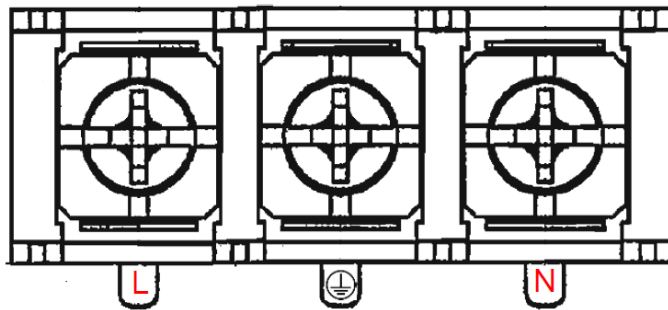
### 10.1 CONNECTORS

DESCRIPTION	REFERENCE DESIGNATOR	TYPE	MANUFACTURER	MPN
Input Connector	J9, J10, J11	Single-phase input	Degson Electronics Co., LTD.	DG88RT-03P-13-00A(H)
USB Connector	J16	USB – B type	Tyco	292304-1
Logic Signal Connector	J15	RJ45	FCI Connectors	87180-088LF
+12VSB output connector	J12		Molex	39-30-0080
CAN Connector	J14	D-SUB 9 Male	Harting	09661227802
NAC Connector	J3	RJ45	Belfuse	08B0-1X1T-06-F
Mini USB Connector	J4	USB MINI-B	Molex	54819-0572

#### SHELF

#### HIGH VOLTAGE CONNECTOR PIN ASSIGNMENT

Single-Phase Input Connector (J9, J10, J11)



Front View

MPN DG88RT-03P-13-00A(H)

**10.2 SPSTET4-02 MECHANICAL DATA:** (Note: finished good may look different from images.)

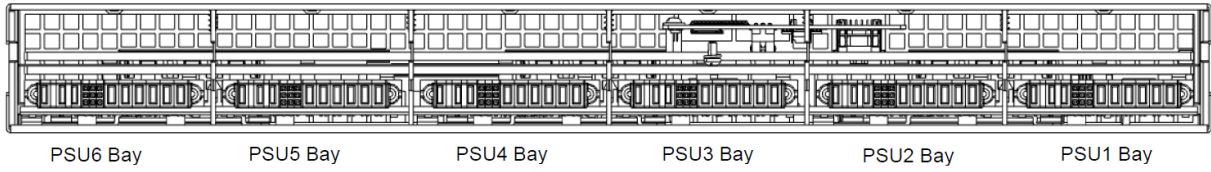


Figure 3. SPSTET4-02 Front View

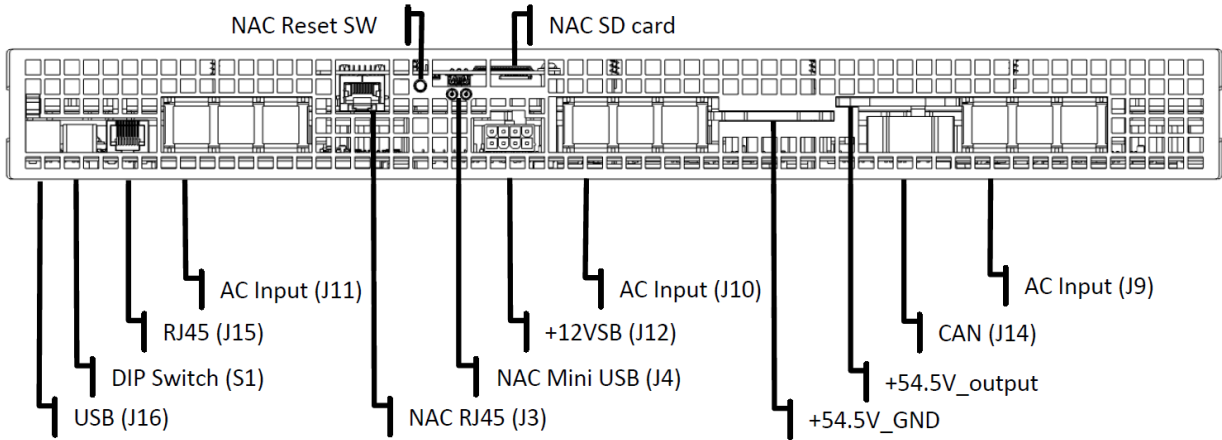


Figure 4. SPSTET4-02 Rear View

Note: NAC is optional, check ordering information section.

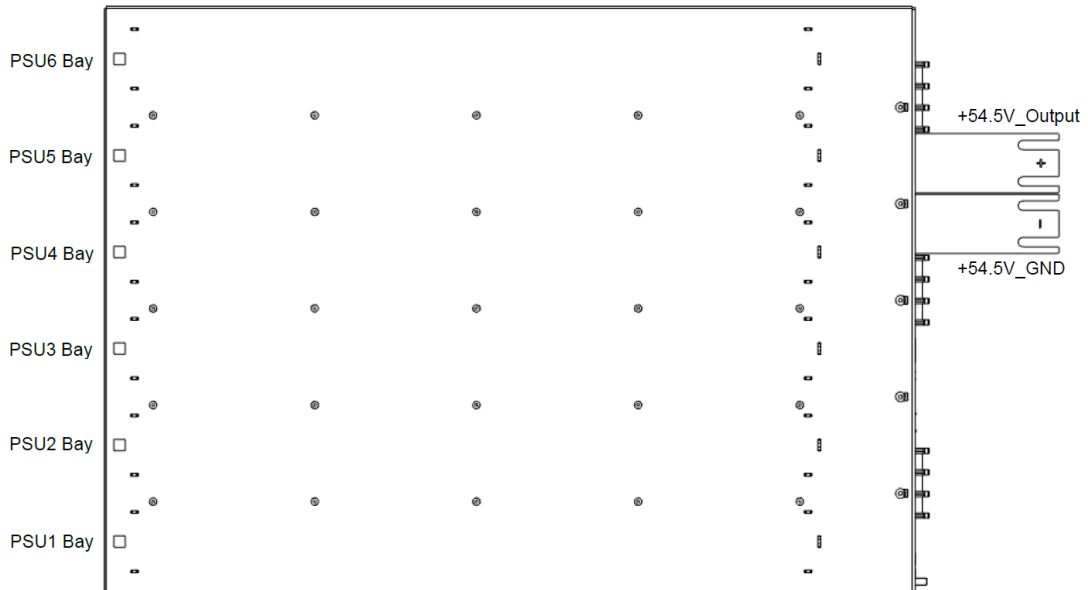


Figure 5. SPSTET4-02 Top View

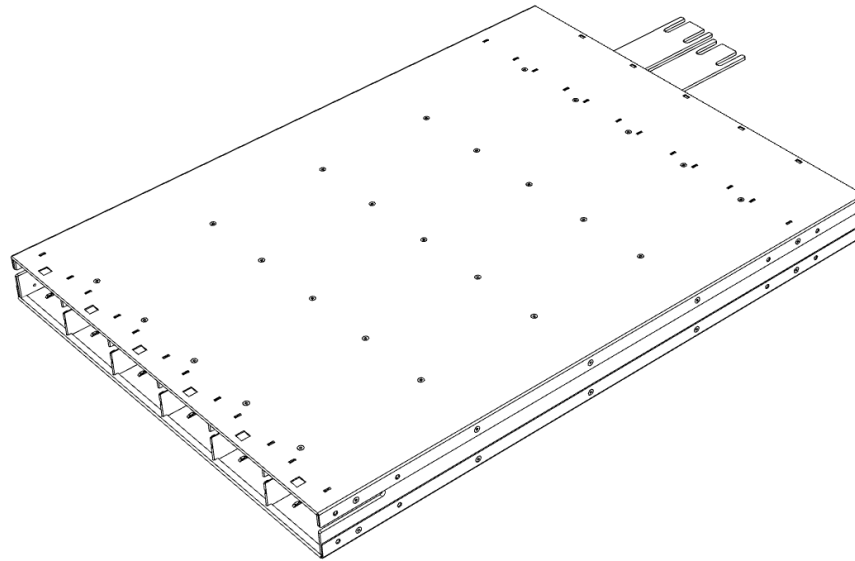



Figure 6. SPSTET4-02 Isometric View

11. ACCESSORIES

ITEM	DESCRIPTION	ORDERING PN	SOURCE
	<p>I<sup>2</sup>C Utility Windows Vista/7/8 compatible GUI to program, control and monitor PFE Front-Ends (and other I<sup>2</sup>C units)</p>	<p>N/A</p>	<p><a href="http://belfuse.com/power-solutions">belfuse.com/power-solutions</a></p>

## 12. REVISION HISTORY

REV	DESCRIPTION	PRODUCT VERSION	DATE	AUTHOR
001	PRELIMINARY: Initial Draft	V001	12.07.2017	GS
002	Update on V1 output regulation. Mechanical Update.	V001	28.09.2017	GS
003	PSU/Shelf addressing table added.	V001 V002 V003	24.01.2018	GS
004	Update Ordering Information.	V004	14.03.2018	GS
005	Change Max. Input Nominal Voltage. Removed Pending on Safety Agency Approvals.	V005	04.09.2018	GS
A	Release Datasheet to A	V005	15.05.2020	GS

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**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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