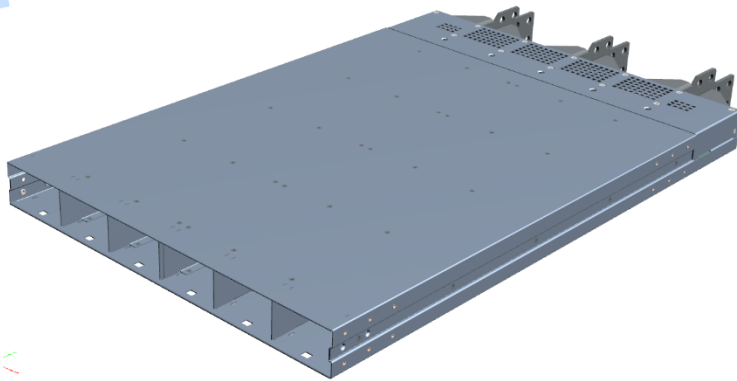


## SPSPFE3-0XG POWER SHELF



**SPSPFE3-0XG** 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 **PFE3000-12-069RA** AC/DC-DC power supplies that convert 3-phase AC mains power into a main output of 12 VDC for powering intermediate bus architectures (IBA) in high performance and reliability servers, routers, and network switches.

The shelf can be mounted to a 19inch or 21inch rack system using adaptor mounting brackets and is compatible with the Open Compute rack design.

### Key Features & Benefits

- Two 3-Phase inputs, one AC inlet powers 3 power modules.
- Modules are hot-swap capable.
- Modules support I2C communication interface for control, programming and monitoring with PMBus™ protocol.
- Modules implement the following protections: Overtemperature, output overvoltage and output overcurrent.
- RoHS Compliant.

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BCD.00575\_001

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# SPSPFE3-0XG Power Shelf

## 1. ORDERING INFORMATION

ITEM NUMBER	INPUT CONFIGURATION
SPSPFE3-02G	3-phase, 400/480 VAC line to line input with Neutral line
SPSPFE3-03G	3-phase, 208 VAC line to line input without Neutral line

## 2. TECHNICAL DATA

SPSPFE3-0XG	
Input	3-phase, 400/480 VAC Line to Line input with Neutral <sup>1</sup> 3-phase, 208 VAC Line to Line input without Neutral <sup>2</sup>
AC Inlet Configuration	3 power modules are powered from one AC inlet
Redundant Configuration	3+3 or 5+1 configuration
Rated Power 1	8700W (3+3 configuration) <sup>3</sup>
Rated Power 2	14400W (5+1 configuration) <sup>3</sup>
Output Connection	3 set of output blades for +12V DC output
Auxiliary Output	60W (Standby output 12V/5A)
Communication	I2C PMBus™, optional Ethernet capability <sup>4</sup>

Notes: <sup>1</sup> Power modules are connected Line to Neutral.

<sup>2</sup> Power modules are connected Line to Line.

<sup>3</sup> Rated Power is reduced as per current share accuracy characteristic. See PFE3000-12-069RA Datasheet.

<sup>4</sup> Contact factory.

## 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.00297	PFE3000-12-069RA Datasheet
BCA.00070	PFE3000-12-069RA PMBus™ Communication Manual
BCM.00177	Installation Instruction PFE3000-12-069RA
BCA.00178	SPSPFE3-0XG Communication Manual
BCM.00339	Installation Instruction SPSPFE3-0XG
PCA9547PW	PCA9547PW Datasheet from NXP

## 5. OVERVIEW

The SPSPFE3-0XG Power Shelf is a 1U height power shelf. It can be configured with up to six hot-swap capable PFE3000-12-069RA AC/DC-DC power supplies that convert standard AC mains power into a main output of 12 VDC for powering intermediate bus architectures (IBA) in high performance and reliability servers, routers, and network switches.

# SPSPFE3-0XG Power Shelf

The I2C communication is routed thru an I2C Multiplexer (NXP PCA9547PW). PSU Modules support I2C communication interface for control, programming and monitoring with PMBus™ protocol.

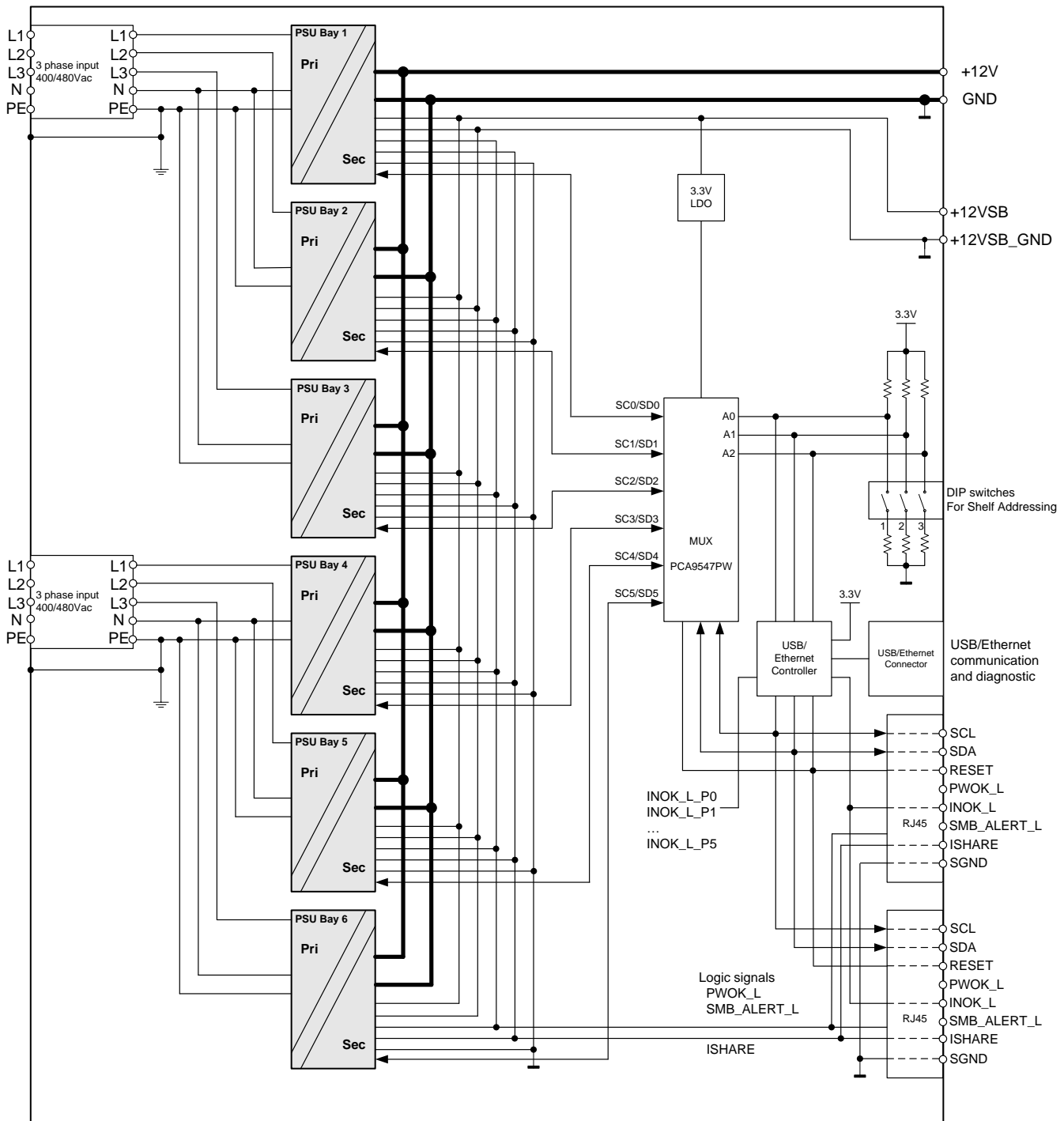


Figure 1 – SPSPFE3-02G Block Diagram

# SPSPFE3-0XG Power Shelf

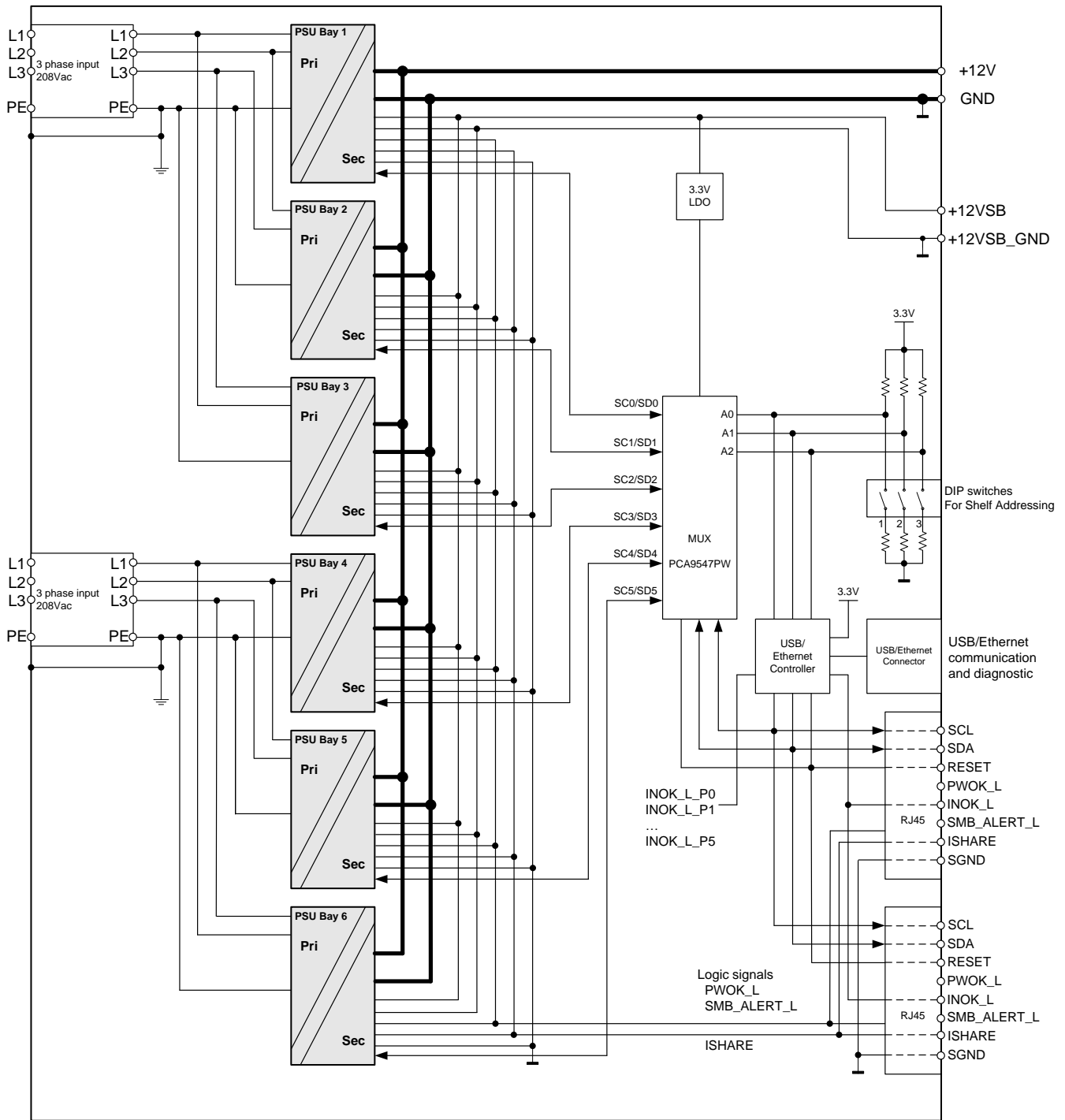


Figure 2 – SPSPFE3-03G Block Diagram

# SPSPFE3-0XG Power Shelf

## 6. INPUT

PARAMETER	DESCRIPTION / CONDITION	SPSPFE3-02G (L1, L2, L3, N, ⊕)			SPSPFE3-03G (L1, L2, L3, ⊕)			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
<b>Input Connector (J106, J107)</b>								
AC Nominal Input Voltage		400 / 480			208			VAC
AC Input Voltage Ranges		346		480	200		240	VAC
Max Input Current	per line			17			30	Arms
Input Frequency		47	50/60	63	47	50/60	63	Hz

## 7. OUTPUT

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
<b>Main Output V<sub>I</sub> (Output Bus bar)</b>					
Nominal Output Voltage			12.3		VDC
Voltage Regulation		-5		+5	% Vout nom
Nominal Output Power 1	3+3 configuration, $T_a < 45^\circ\text{C}$		8700		W
Derated Output Power 1	3+3 configuration, $T_a = 55^\circ\text{C}^5$		6525		W
Nominal Output Power 2	5+1 configuration, $T_a < 45^\circ\text{C}$		14400		W
Derated Output Power 2	5+1 configuration, $T_a = 55^\circ\text{C}^5$		10800		W
Nominal Output Current 1	3+3 configuration, $T_a < 45^\circ\text{C}$		707		ADC
Derated Output Current 1	3+3 configuration, $T_a = 55^\circ\text{C}^5$		530		ADC
Nominal Output Current 2	5+1 configuration, $T_a < 45^\circ\text{C}$		1171		ADC
Derated Output Current 2	5+1 configuration, $T_a = 55^\circ\text{C}^5$		878		ADC

Note: <sup>5</sup> Linear derating at  $T_a > 45^\circ\text{C}$ , is based per module, see PFE3000-12-069RA datasheet

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
<b>Standby Output V<sub>SB</sub></b>					
Output Voltage			12		VDC
Voltage Regulation		-5		+5	% Vout nom
Output Power				60	W
Output Current				5	ADC

# SPSPFE3-0XG Power Shelf

## 7.1 Protection (Per Module)

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Input Fuses (L+N)	Not user accessible, quick-acting (F)		25		A
OV Threshold $V_I$		13.6	14.2	14.8	VDC
OV Latch Off Time $V_I$				1	ms
OV Threshold $V_{SB}$		13.3	13.9	14.5	VDC
OV Latch Off Time $V_{SB}$				1	ms
Current limitation	$T_a < 45^\circ\text{C}$ $T_a = 55^\circ\text{C}$	248 186		274 212	A
Current limit blanking time	Time to latch off when in over current	20	22	24	ms
Current limit during short time overload $V_I$	Maximum duration 20ms, per module	292	300	308	A
Max Short Circuit Current $V_I$	$V_I < 3\text{V}$ , per module			350 <sup>6</sup>	A
Short circuit latch off time	Time to latch off when in short circuit		10		ms
Current limitation $V_{SB}$	Per module	6		9	A
Current limit blanking time	Time to hit hiccup when in over current			1	ms
Over temperature on critical points	Inlet Ambient Temperature PFC Primary Heatsink Temperature Secondary Sync Mosfet Temperature Secondary OR-ing Mosfet Temperature			60 80 115 125	$^\circ\text{C}$

Note: <sup>6</sup> Limit doesn't include effects of main output capacitive discharge

## 7.2 Interface & Control Signals

The PWOK\_L open collector outputs of all modules are interconnected within the shelf and fed to the signal connector. The same applies to SMB\_ALERT\_L module and shelf signals. Sink current must not exceed 4 mA on each of these signals.

The internal INOK\_L signal of individual modules are fed to microcontroller for modules synchronized AC startup. This allows the shelf to start up with load > 3000W during AC application. The microcontroller provide the INOK\_L output signal.

A pull up resistor of 10k $\Omega$  to 3.3V within the shelf provides the high level voltage on PWOK\_L, INOK\_L and SMB\_ALERT\_L signals.

PWOK\_L is low when there is at least one module in operation. INOK\_L is low when there is at least one module supplied with correct input voltage.

ISHARE signal can be used when shelf are configured for redundant operation.

### I2C Interface and Signal Connector (RJ45) Pin Out

RJ45 PIN OUTS	FUNCTION	DESCRIPTION
1 <sup>7</sup>	SCL	I2C clock signal line
2 <sup>7</sup>	SDA	I2C data signal line
3	RESET	Reset pin of I2C Mux
4	PWOK_L	Power OK signal output: active-low
5	INOK_L	Input OK signal: active-low
6	SMB_ALERT_L	SMB Alert signal output: active-high
7	ISHARE	V1 Current share bus
8	SGND	Signal ground

Note: <sup>7</sup> External Pull-up resistor should be 2 – 5k $\Omega$  to ensure SMBUS compliant signal rise times

# SPSPFE3-0XG Power Shelf

## 7.3 I2C Communication

The PSU Modules are set to a fixed I2C Address (0x20). PMBus communication for the PSU Modules are described in more detail in BCA.00070.

The I2C communication to the PSU Modules are routed thru an I2C Multiplexer. The I2C MUX Control Register MUX needs to be configured so that the I2C frames are routed to the correct PSU Module. Refer to the I2C MUX datasheet for additional information.

The I2C MUX Address is configurable (via DIP Switch) to allow parallel configuration of several shelves.

The I2C MUX has a RESET input which can be used to recover from an I2C bus fault. A logic low signal on this pin resets the I2C MUX. If not used, this pin should be left floating.

## 7.4 I2C Addressing (Shelf)

The shelf default MUX address is 0xEE and Controller address is 0x5E.  
When DIP switch (SW1) is in "ON" position means 0, "OFF" Position means 1.

### *DIP Switch Position*

Position	Selected Unit
1	A0
2	A1
3	A2

### *DIP Switch Setting (SW1)*

A0	A1	A2	MUX ADDRESS (IN HEX)
0	0	0	0xE0
1	0	0	0xE2
0	1	0	0xE4
1	1	0	0xE6
0	0	1	0xE8
1	0	1	0xEA
0	1	1	0xEC
1	1	1	0xEE

*Note: Communication Manual of shelf, see document BCA.00178.*

# SPSPFE3-0XG Power Shelf

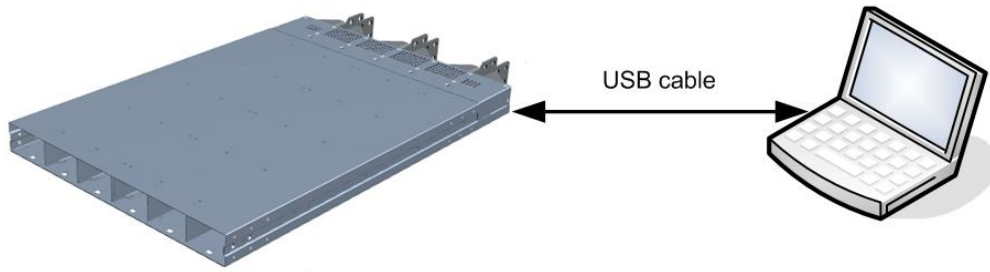
## 7.5 Control LEDs

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.

PARAMETER	DESCRIPTION / CONDITION	LED SIGNALING
<b>AC LED</b>	AC Line within range	Solid Green
	AC Line UV condition	Off
<b>DC LED<sup>8</sup></b>	Normal Operation	Solid Green
	PSON_L High	Blinking Yellow (1:1)
	$V_1$ 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/Green (2:1)
	Over temperature warning	
Minor fan regulation error (>5%, <15%)	Blinking Yellow/Green (1:1)	

Note: <sup>8</sup> The order of the criteria in the table corresponds to the testing precedence in the controller.

## 7.6 USB Connector Type B



WARNING:



The USB interface is NOT galvanic isolated and referenced to the +12V\_RTN / SGND lines.

Preferably, use a battery operated laptop to avoid earth loop issue.

If a Desktop Computer is being used, there is a risk of generating earth loop currents, therefore USB Isolators should be used.

## 7.7 +12VSB Connector

+12VSB output is capable of delivering 5A. The output is protected by a PTC (16R900GF from Littelfuse).

PIN OUTS	FUNCTION	DESCRIPTION
1	VSB_GND	+12VSB return
2	VSB	+12VSB output
3	VSB_GND	+12VSB return
4	VSB	+12VSB output



# SPSPFE3-0XG Power Shelf

## 8. SAFETY, REGULATORY AND EMC SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION	CRITERION
Agency Approvals (pending)	Approved to the latest revisions/amendments of the following standards: <b>(pending)</b> UL 60950-1 Second Edition CAN/CSA-C22.2 No. 60950-1-07 Second Edition IEC 60950-1:2005 EN 60950-1:2006	Approved by independent body (see CE Declaration) <b>(pending)</b>
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. 2121Vdc Min. 4242Vdc
Max. Leakage Current	AC input voltage of TBD VAC, line frequency of 50Hz and a temperature of 25°C.	TBD A
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, $V_{in} = 115/230$ VAC, 50 Hz, 100% Load	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: $V_i$ 230Volts, 100% Load, Dip 100%, Duration 12ms 2: $V_i$ 230Volts, 100% Load, Dip 100%, Duration < 150 ms 3: $V_i$ 230Volts, 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:	-5		+35	°C
	@ full load, up to 1800 m:	-5		+45	
	@ 75% load, up to 1800 m:	-5		+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: 11ms half-sine shocks in Z axis 10+ve, 10-ve		5		g
	Non-Operating: 11ms half-sine shocks in Z axis 10+ve, 10-ve		30		
Vibration	Operating: 0.2 g rms random	5		500	Hz
	Non-Operating: 1g rms random	2		200	
Acoustic Noise Emissions	@ normal operation, and 50% load sharing			70	dBA
	Fan speed			7000	
Cooling	When equipped with operating PSUs			50	Pa

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# SPSPFE3-0XG Power Shelf

## 10. MECHANICAL SPECIFICATIONS

PARAMETER	SPSPFE3-0XG
Dimensions (W x H x D)	436 x 46.5x 650 mm (overall : 436.5 x 46.75 x 740.75 mm)
Weight (Shelf only)	12kg
Weight (6 PSU installed)	27kg

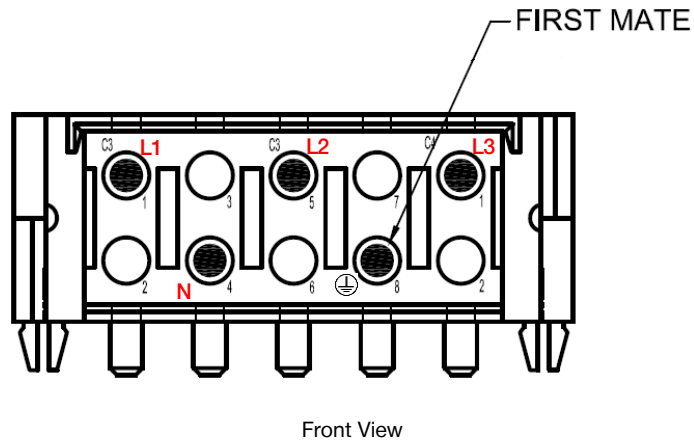
### 10.1 Connectors

SHELF	DESCRIPTION	TYPE	MANUFACTURER	MPN
SPSPFE3-02G	Input Connector	3-phase input (2pcs)	Positronic Industries	SP5YYE48M0LN9A 1/AA-PA1067
	USB I2C Connector	USB – B type	Tyco	292304-1
	I2C Interface and Signal Connector	RJ45 (2pcs)	FCI Connectors	87180-088LF
	+12VSB output connector		Molex	39-30-0040
SPSPFE3-03G	Input Connector	3-phase input (2pcs)	Positronic Industries	SP5YYE48M0LN9A 1/AA-PA1191
	USB I2C Connector	USB – B type	Tyco	292304-1
	I2C Interface and Signal Connector	RJ45 (2pcs)	FCI Connectors	87180-088LF
	+12VSB output connector		Molex	39-30-0040

Note: Ethernet connection is under development

#### Shelf SPSPFE3-02G

Input Connector Pin Assignment

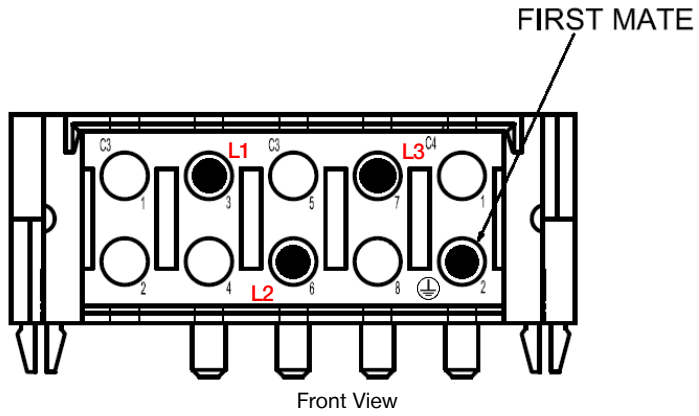


MPN SP5YYE48M0LN9A1/AA-PA1067  
 Mating Part SP5YYE1F0091/AA

# SPSPFE3-0XG Power Shelf

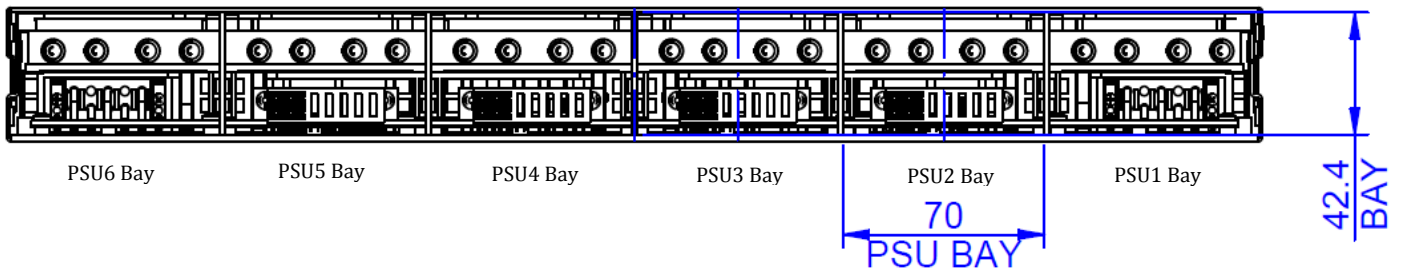
Shelf SPSPFE3-03G

Input Connector Pin Assignment

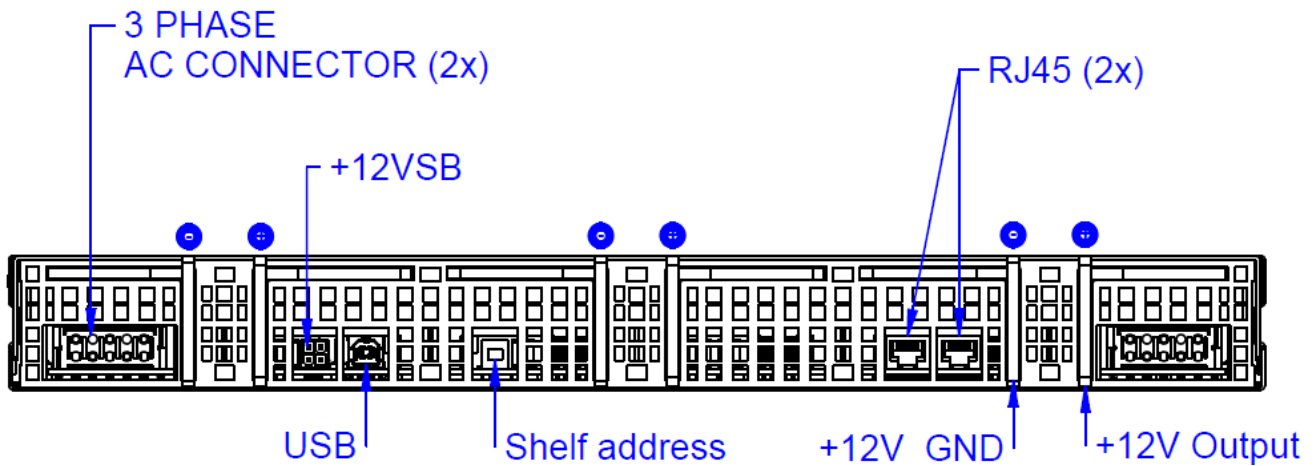


MPN SP5YYE48M0LN9A1/AA-PA1191  
 Mating Part SP5YYE1F0091/AA

SPSPFE3-0XG Front View

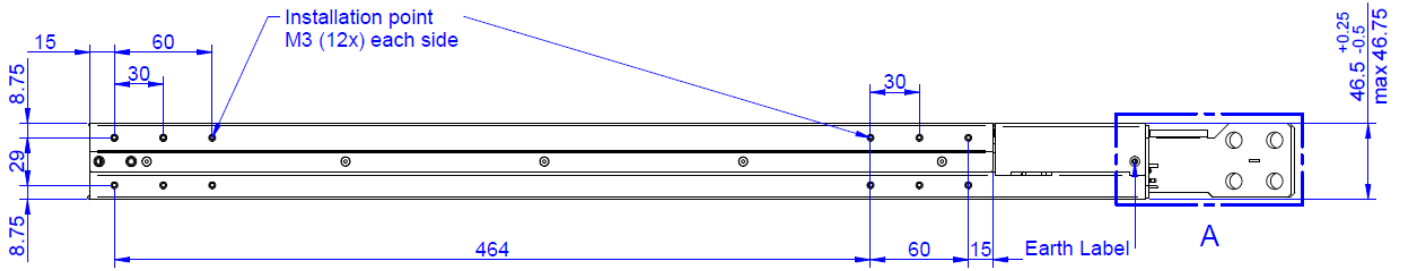


SPSPFE3-0XG Rear View

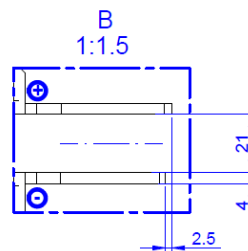
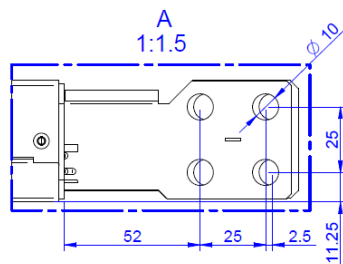
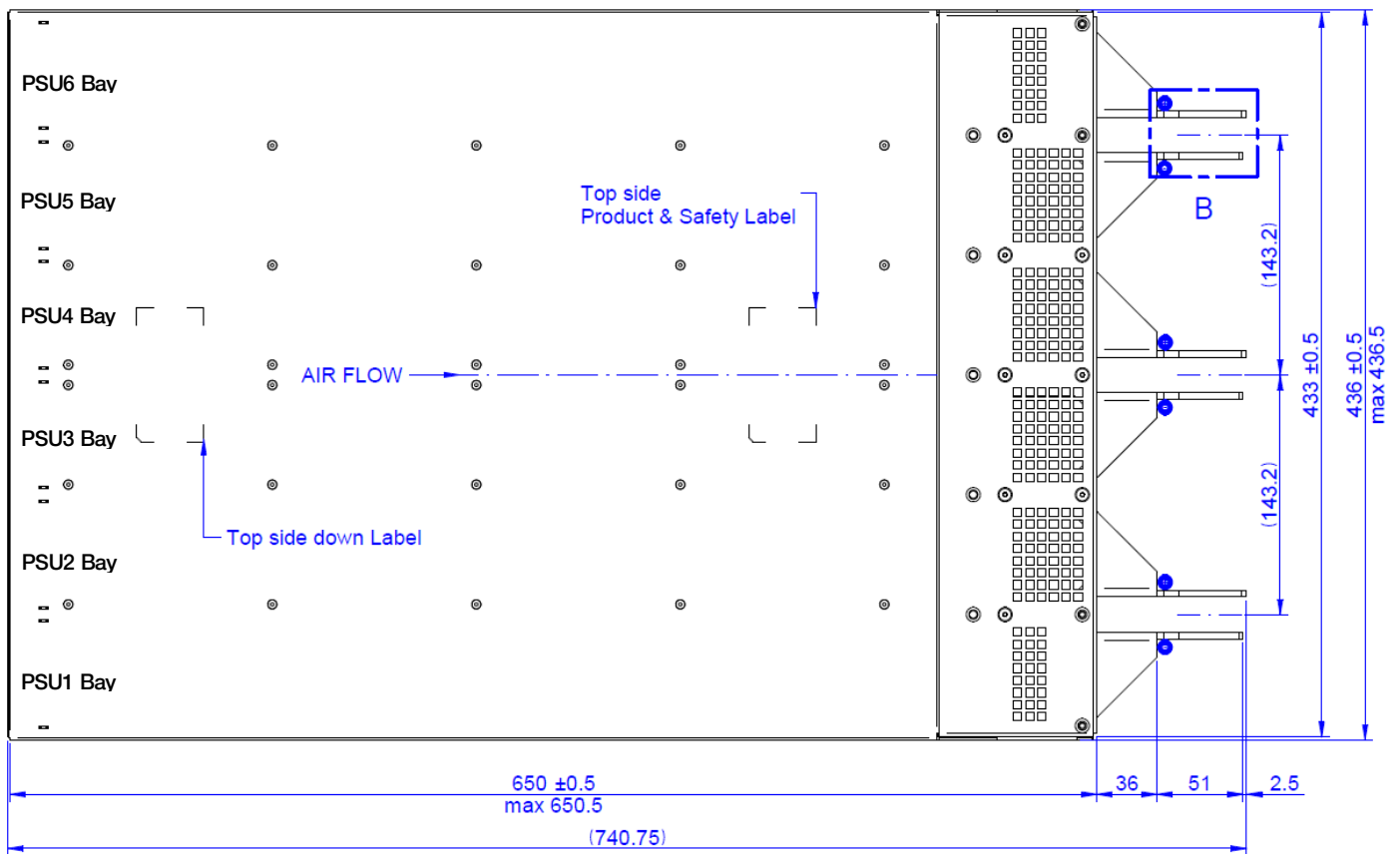


# SPSPFE3-0XG Power Shelf

SPSPFE3-0XG Side View

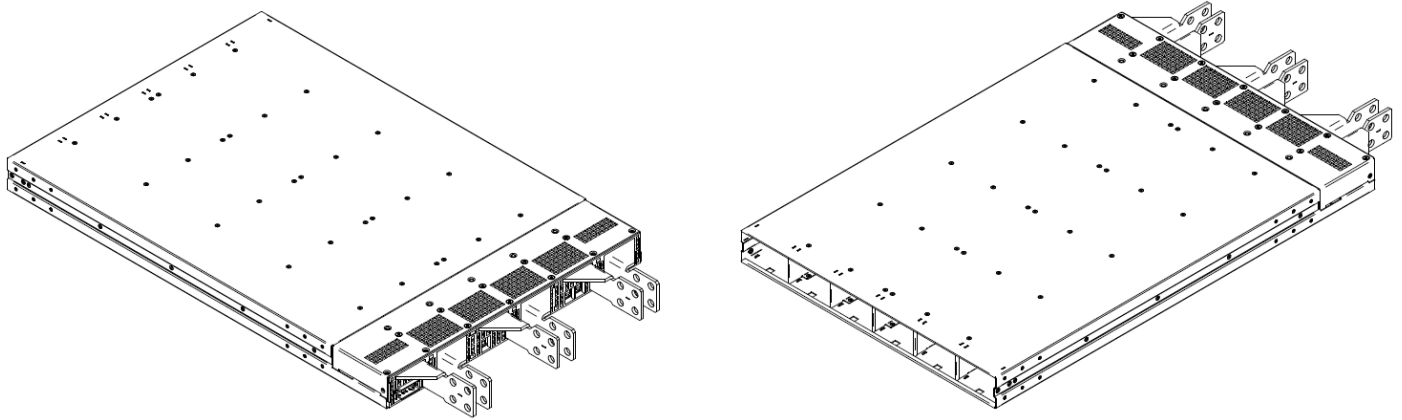


SPSPFE3-0XG Top View

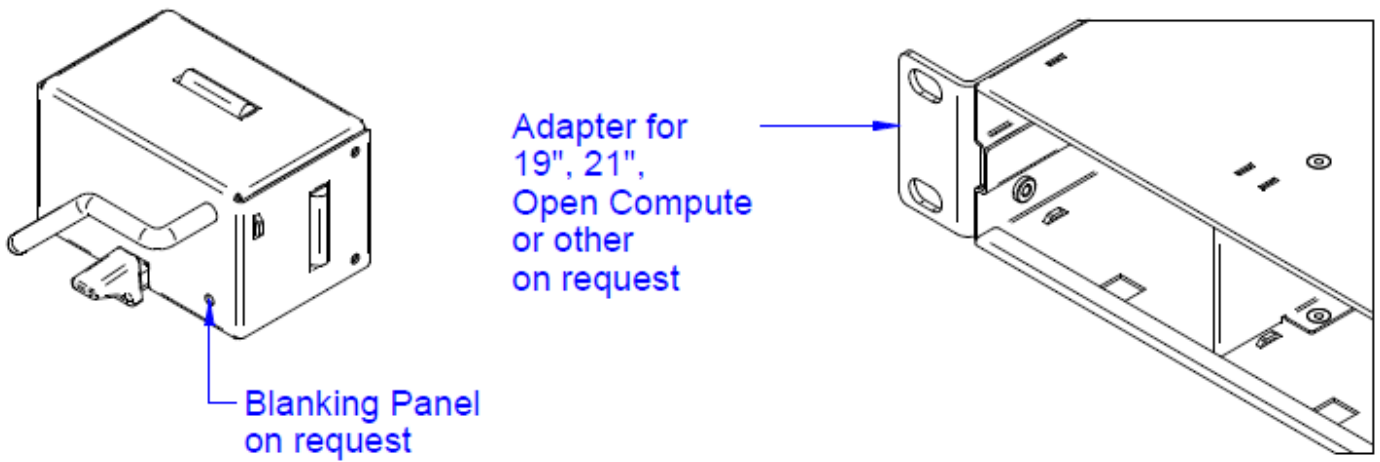


# SPSPFE3-0XG Power Shelf

*SPSPFE3-0XG Isometric View*



*Accessories*



Blanking Panel Item Number: SPSPFE3BP-01G  
Mounting “Ear” Brackets for 19” Rack – SPSPFE3-02GA  
Mounting “Ear” Brackets for 21” Rack – SPSPFE3-02GB

# SPSPFE3-0XG Power Shelf

## 11. REVISION HISTORY

REV	DESCRIPTION	PRODUCT VERSION	DATE	AUTHOR
001	Initial Release of Datasheet	V001 V002	07-20-2015	Uster R&D

For more information on these products consult: [tech.support@psbel.com](mailto:tech.support@psbel.com)

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