

SPSPFF3-0X

DC-DC Power Shelf

SPSPFF3-0X 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 PFF3000-12-069RD DC-DC power supplies that convert 40 - 72 VDC input power into a main output of 12.5 VDC for powering intermediate bus architectures (IBA) in high performance and reliability servers, routers, and network switches.

The shelf is compatible with the Open Compute rack design.

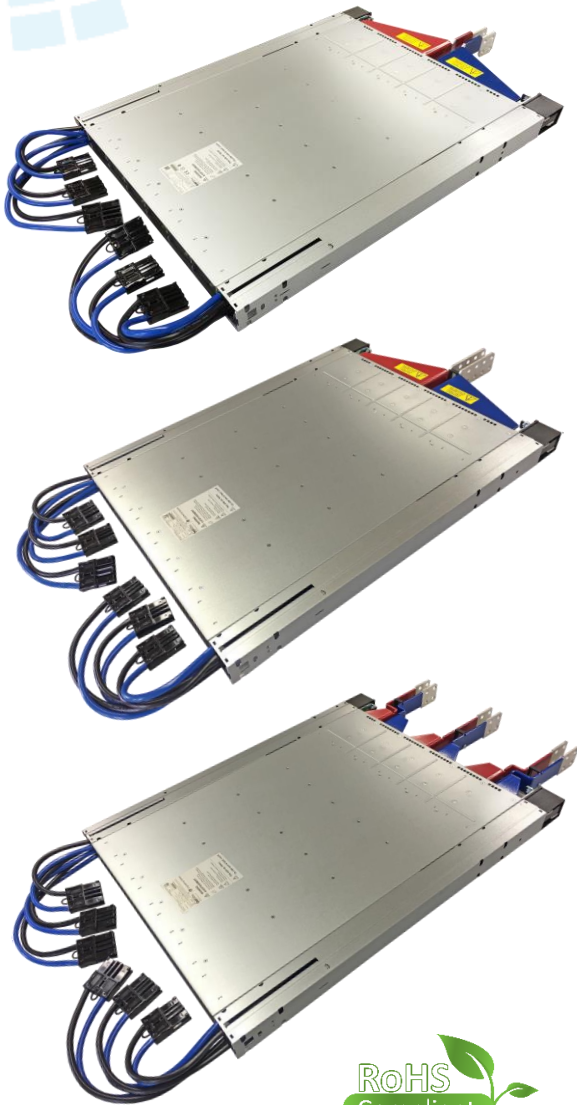
The shelf has an optional slot for Network Attached Controller for providing control functions and monitoring through a 10/100 MB base Ethernet port and can be connected directly to the data center management network.

Key Features & Benefits

- Two separate DC inputs, one DC inlet powers 3 power modules
- Modules are hot-swap capable
- Modules support I²C communication interface for control, programming and monitoring with Power Management Bus protocol
- Modules implement the following protections: Overtemperature, output overvoltage and output overcurrent
- RoHS Compliant
- Available for OCP V1 and V2 bus-bar style connection

Applications

- High Performance Servers
- Routers
- Switches



1. ORDERING INFORMATION

MODEL	INPUT AND OUTPUT CONFIGURATION
SPSPFF3-01	Two -40 to -72 VDC inputs (nominal -53 VDC) 1 set of output blade for +12.5 VDC output, Offset bus bar
SPSPFF3-01C	Two -40 to -72 VDC inputs (nominal -53 VDC) 1 set of output blade for +12.5 VDC output, Offset bus bar Network Attached Controller included
SPSPFF3-02	Two -40 to -72 VDC inputs (nominal -53 VDC) 1 set of output blade for +12.5 VDC output, Straight Bus bar
SPSPFF3-02C	Two -40 to -72 VDC inputs (nominal -53 VDC) 1 set of output blade for +12.5 VDC output, Straight Bus bar Network Attached Controller included
SPSPFF3-03	Two -40 to -72 VDC inputs (nominal -53 VDC) 3 sets of output blades for +12.5 VDC output (each set of blades has max.585 A)
SPSPFF3-03C	Two -40 to -72 VDC inputs (nominal -53 VDC) 3 sets of output blades for +12.5 VDC output (each set of blades has max.585 A) Network Attached Controller included

2. TECHNICAL DATA

PARAMETER	DESCRIPTION / CONDITION
Input	-40 to -72 VDC (nominal -53 VDC)
DC Inlet Configuration	3 power modules are powered from one DC inlet. 2 DC inlets (Input1, Input2)
Redundant Configuration	3+3 or 5+1 configuration
Rated Power 1	8700 W (3+3 configuration) ¹
Rated Power 2	14400 W (5+1 configuration) ¹
Output Connection	SPSPFF3-01: 1 set of output blade for +12.5 VDC output, Offset bus bar SPSPFF3-02: 1 set of output blade for +12.5 VDC output, Straight Bus bar SPSPFF3-03: 3 sets of output blades for +12.5 VDC output (each set of blades has max.585 A)
Standby Output	24 W (Standby output 12 V / 2 A)
Communication	I ² C Power Management Bus
NAC2006-01	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. OVERVIEW

The SPSPFF3-0X Power Shelf is a 10U height power shelf. It can be configured with up to six output hot-swap capable PFF3000-12-069RD DC-DC power supplies that convert -53VDC 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 I²C communication is routed through an I²C Multiplexer (NXP PCA9547PW). PSU Modules support I²C communication interface for control, programming and monitoring with the Power Management Bus protocol.

¹ Rated Power is reduced as per current share accuracy characteristic. See PFF3000-12-069RD Datasheet.

The shelf has a slot for network attached controller (NAC) 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.

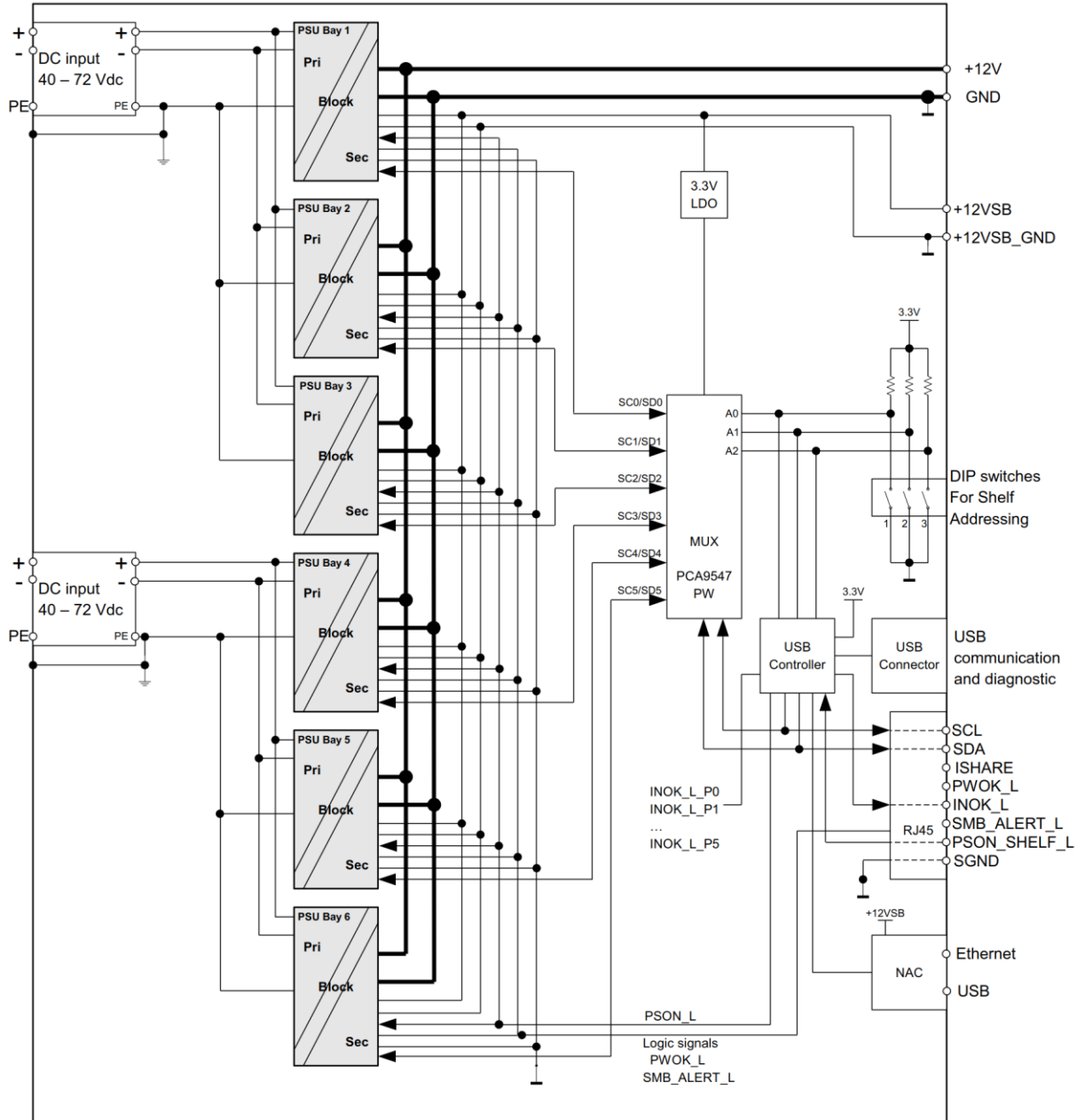


Figure 1. SPSPFF3-0X Block Diagram

5. INPUT SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Input Bus Bar (Input1, Input2)					
DC Nominal Input Voltage			-53		VDC
DC Input Voltage Ranges		-40		-72	VDC
Max Input Current	per Busbar			250	A

6. OUTPUT SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Main Output V1 (Output Bus Bar)					
Nominal Output Voltage			12.5		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, $T_a = 55^\circ\text{C}^2$			7830	W
Nominal Output Power 2	5+1 configuration, $T_a < 45^\circ\text{C}$			14400	W
Derated Output Power 2	5+1 configuration, $T_a = 55^\circ\text{C}^2$			12960	W
Nominal Output Current 1	3+3 configuration, $T_a < 45^\circ\text{C}$			707	ADC
Derated Output Current 1	3+3 configuration, $T_a = 55^\circ\text{C}^2$			636	ADC
Nominal Output Current 2	5+1 configuration, $T_a < 45^\circ\text{C}$			1171	ADC
Derated Output Current 2	5+1 configuration, $T_a = 55^\circ\text{C}^2$			1053	ADC
Standby Output VSB (J23)					
Output Voltage			12		VDC
Voltage Regulation		-5		+5	% Vout nom
Output Power				24	W
Output Current				2	ADC

² Linear derating at $T_a > 45^\circ\text{C}$ is based per module, see PFF3000-12-069RD datasheet

6.1 PROTECTION (PER MODULE)

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Input Fuses (L+N)	Not user accessible, quick-acting (F)		100		A
OV Threshold V_1		13.6	14.2	14.8	VDC
OV Latch Off Time V_1				1	ms
OV Threshold V_{SB}		13.3	13.9	14.5	VDC
OV Latch Off Time V_{SB}				1	ms
Current Limitation on V_1	$T_a < 45^\circ\text{C}$ $T_a = 60^\circ\text{C}$	246 198		260 212	A
Current Limit Blanking Time	Time to latch off when in over current	22	30	35	ms
Current Limit During Short Time Overload V_1	Maximum duration 20ms, per module	292		308	A
Short Circuit Latch Off Time	Measured from $V_1 < 8.0\text{ V}$		1		ms
Current Limitation V_{SB}	Per module	2.5		3.5	A
Current Limit Blanking Time	Time to hit hiccup when in over current			1	ms
Over Temperature On Critical Points	Inlet Ambient Temperature Secondary Sync Mosfet Temperature Secondary OR-ing Mosfet Temperature			60 115 125	$^\circ\text{C}$

6.2 INTERFACE & CONTROL SIGNALS

The PWOK_L is an open collector output of all modules and they are interconnected (wired-OR) within the shelf and this signal is fed to the signal connector. PWOK_L is low when there is at least one module in operation. SMB_ALERT_L is also wired-OR already in the shelf. Sink current must not exceed 4 mA on each of these signals.

The internal INOK_L_Px signal of each individual module is fed to the backplane microcontroller for modules synchronized DC startup. This allows the shelf to start up with load > 3000 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.

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. PSON_SHELF_L is currently bypassed in ON_OFF_CONFIG command.

A pull up resistor of 10k Ω to 3.3 V within the shelf provides the high-level voltage for the PWOK_L, INOK_L and SMB_ALERT_L signals.

The Power Shelf V1 output is capable to be operated in redundant mode by interconnecting the ISHARE on J20. Please consult PBS Technical Representative for details.

RJ45 PIN OUTS (J20)	FUNCTION	DESCRIPTION
1 ³	SCL	I2C clock signal line
2 ³	SDA	I2C data signal line
3	ISHARE	V_1 Current share bus
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-low
7	PSON_SHELF_L	Power Shelf on input: active-low
8	SGND	Signal ground

Table 1. I2C Interface and Signal Connector (RJ45) Pin Out

³ External Pull-up resistor should be 2 – 5k Ω to ensure SMBUS compliant signal rise times

6.3 I2C COMMUNICATION

The PSU Modules are set to a fixed I2C Address (0x20). Power Management Bus communication for the PSU Modules are described in more detail in document BCA.00216. The I2C communication to the PSU Modules are routed through an I2C Multiplexer. The I2C MUX Control Register 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 and backplane controller addresses are configurable via DIP Switches (SW1);

The PSON function of the shelf can also be controlled by a Power Management Bus command sent to the backplane Controller, see document BCA.00178 for further information and the table below.

COMMAND		ACCESS	DATA BYTES	COMMENTS
Code	Name			
0x01	OPERATION	Byte R/W	1	Supported Values: 0x00 = Unit Off 0x80 = Unit On (Default)
0x02	ON_OFF_CONFIG	Byte R/W	1	Supported Values: 0x19 (Default) 0x01, 0x11, 0x15, 0x1D

NOTE: A setting in the ON_OFF_CONFIGURATION register doesn't survive a power cycle. See also the Power Management Bus protocol definition.

6.4 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.

POSITION 1	POSITION 2	POSITION 3	MUX ADDRESS (IN HEX)	Controller ADDRESS (IN HEX)
ON	ON	ON	0xE0	0x50
OFF	ON	ON	0xE2	0x52
ON	OFF	ON	0xE4	0x54
OFF	OFF	ON	0xE6	0x56
ON	ON	OFF	0xE8	0x58
OFF	ON	OFF	0xEA	0x5A
ON	OFF	OFF	0xEC	0x5C
OFF	OFF	OFF	0xEE	0x5E

NOTE: Communication Manual of shelf, see document BCA.00178.

Table 2. DIP Switch Setting (SW1)

6.5 NETWORK ATTACHED CONTROLLER

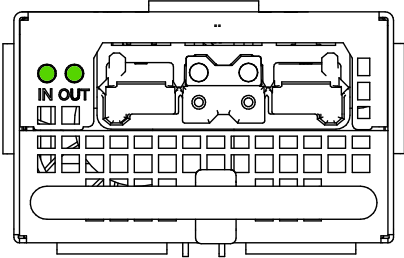
The Network Attached Controller (NAC2006-01) is a shelf level controller providing monitoring and control functions through a 10/100 MB base Ethernet port and can be connected directly to the data center management network. It is hot-pluggable and supplied via the 12 V redundant standby provided by the power supplies in the shelf. The controller can be configured through a web interface; the monitoring and control functions are accessed through SNMP.

See BCD.00926 for NAC2006-01 Datasheet.

6.6 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
IN: DC Input LED	
DC line within range	Solid Green
DC line UV / OV condition	OFF
Bootload	Blinking green: OFF (1:1)
OUT: DC Output LED	
Normal Operation	Solid Green
PSKILL_IN_L - Left open	
PSON_L - High, PSKILL_L - High	
Power Management Bus Command OPERATION	
DC line UV / OV condition	
V1 or VSB out of regulation	
Over temperature shutdown	
Output over voltage shutdown (V ₁ or V _{SB})	Solid Yellow
Output under voltage shutdown (V ₁ or V _{SB})	
Output over current shutdown (V ₁ or V _{SB})	
Both FANs blocked	
Over temperature warning	Blinking Yellow/Green (2:1)
Minor fan regulation error (> 5 %, < 15 %)	
Or one of the FANs blocked	Blinking Yellow/Green (1:1)
Bootload	Blinking Green (1:1)



6.7 USB CONNECTOR TYPE B (J3)

This is used for Bel Power Diagnostic thru Bel Power Solutions I²C Utility GUI. This connection also provides access to FW boot loading of the PSU Modules.

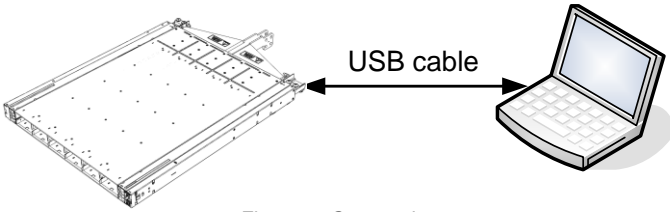


Figure 2. Connection

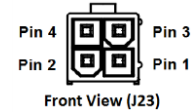


WARNING: The USB interface is NOT galvanically isolated and referenced to the +12V_GND / SGND lines. Preferably, use a battery-operated laptop to avoid earth loop issues. If a desktop computer is being used, there is a risk of generating earth loop currents, therefore the usage of a USB isolator is highly recommended in such a case.

6.8 +12VSB CONNECTOR (J23)

+12VSB output is capable of delivering 2 A. The output is protected by a PTC (16R500GF from Littelfuse).
Mating Part: Molex 39-01-2045

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



7 ELECTROMAGNETIC COMPATIBILITY

PARAMETER	DESCRIPTION / CONDITION	CRITERION
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
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 µs Pulse Modulation, 10 kHz...2 GHz	A
Burst	IEC / EN 61000-4-4, level 3 DC port ±1 kV, 1 minute	A
Surge	IEC / EN 61000-4-5 Line to earth: level 2, ±1 kV Line to line: level 3, ±1 kV	A
RF Conducted Immunity	IEC / EN 61000-4-6, level 3, 10 V _{rms} , CW, 0.1... 80 MHz	A
Acoustical Noise	Sound power statistical declaration (ISO 9296, ISO 7779, IS9295) @ 50% load	60 dBA

8 SAFETY / APPROVALS

PARAMETER	DESCRIPTION / CONDITION	CRITERION
Agency Approvals Pending	Approved to the latest edition of the following standards: <ul style="list-style-type: none"> • IEC60950-1 2nd edition (CB) • EN60950-1 2nd Edition (Nemko) • UL/CSA0950-1 2nd Edition (cCSAus) 	Approved by independent body (see CE Declaration)
Isolation Strength	Input (DCIN+ / DCIN-) to case (PE) Input (DCIN+ / DCIN-) to output Output to case (PE)	Basic Basic Functional
Creepage / Clearance (<i>dc</i>)	Primary (DCIN+ / DCIN-) to protective earth (PE) Primary to secondary	According to safety standard
Electrical Strength Test	Input to case Input to output Output and signals to case	According to safety standard

9 ENVIRONMENTAL SPECIFICATIONS


PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Operating Temperature	@ full load, up to 4000 m:	0		+40	°C
	@ full load, up to 1800 m:	0		+45	
	@ 90% load, up to 1800 m:	0		+55	
Non-Operating Temperature		-40		+70	°C
Humidity	Operating: @ at 40 °C, non-condensing	7		85	%RH
	Non-Operating: non-condensing	5		93	
Altitude	Operating:			4000	m
	Non-Operating:			13000	
Shock	Operating: 11 ms half-sine shocks in Z axis 10+ve, 10-ve		7		g
	Non-Operating: 11 ms half-sine shocks in Z axis 10+ve, 10-ve		30		
Vibration	Operational: Swept-sine, 5-500-5 Hz		1		g
	Non-Operational: Swept-sine, 5-500-5 Hz		4		
	Non-Operational: Random, 10-500Hz		3.5		
Acoustic Noise Emissions	@ normal operation, and 50% load sharing			70	dBA
Cooling	When equipped with operating PSUs			50	Pa

10 MECHANICAL SPECIFICATIONS

PARAMETER	SPSPFF3-0X
Dimensions (W x H x D)	534.5 x 46.5 x 650 mm (overall: 535 x 47 x 859.5 mm)
Weight (Shelf only)	17 kg
Weight (6 PSU installed)	33 kg

10.1 CONNECTORS

Input:

DESCRIPTION	REFERENCE DESIGNATOR	TYPE	MATING PART MPN	RECOMMENDED CABLING	TORQUE
Input Busbar	Input1 Input2	Busbar with dual hole	Burndy YA26L-2TC38-90 or Equivalent (needs to be UL Listed)	00 AWG / 67 mm ² UL Style UL10070 or Equivalent	11.3 Nm
Protective Earth		2x M6 PEM ⁴	Panduit LCA6-56-L or Equivalent (needs to be UL Listed)	6 AWG / 13 mm ² UL Style UL10070 or Equivalent	4.7 Nm

Output:

DESCRIPTION	REFERENCE DESIGNATOR	TYPE	MANUFACTURER	MPN	MATING PART MPN
USB I2C Connector	J3	USB – B type	Tyco	292304-1	
I2C Interface and Signal Connector	J20	RJ45	FCI Connectors	87180-088LF	
+12VSB output connector	J23		Molex Cvilux	39-30-0040 CP-01404150	39-01-2045

⁴ Mating M6 Screw + Washer are delivered together with the shelf

10.2 SPSPFF3-0X MECHANICAL DATA

NOTE: finished good may look different from images.

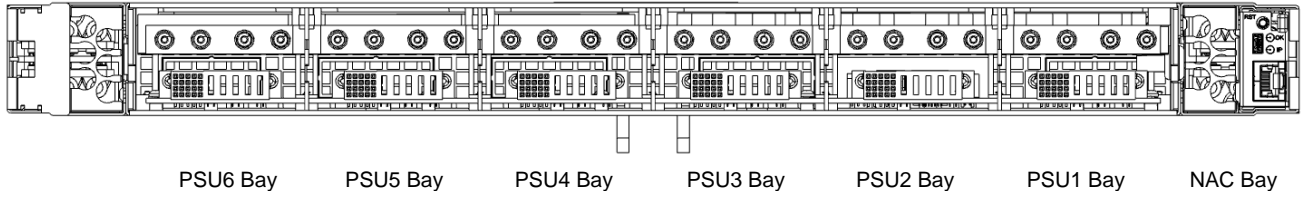


Figure 3. SPSPFF3-01 Front View

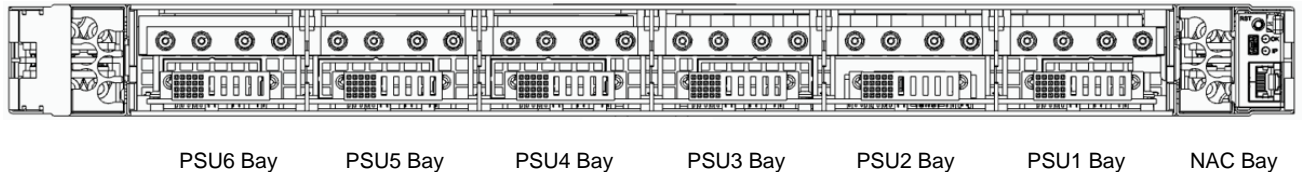


Figure 4. SPSPFF3-02 and SPSPFF3-03 Front View

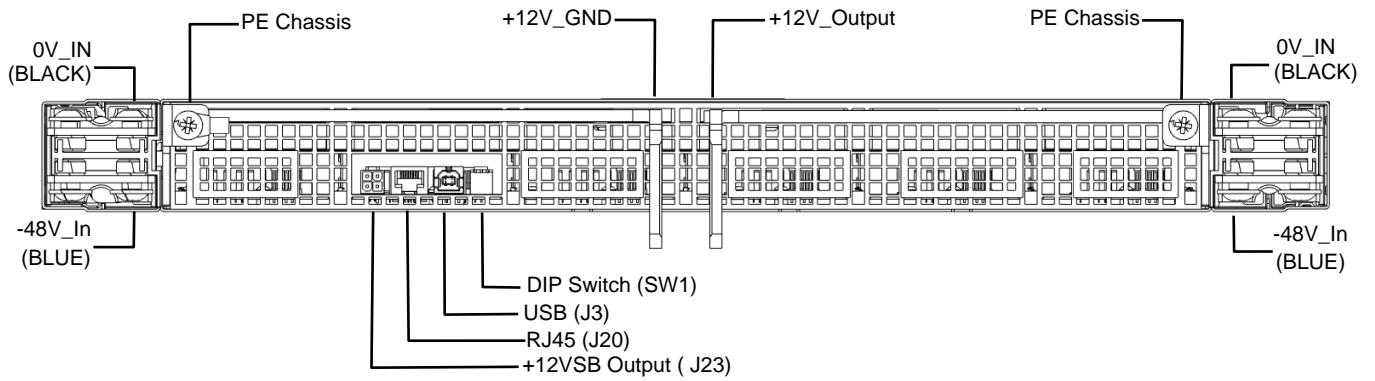


Figure 5. SPSPFF3-01 Rear View

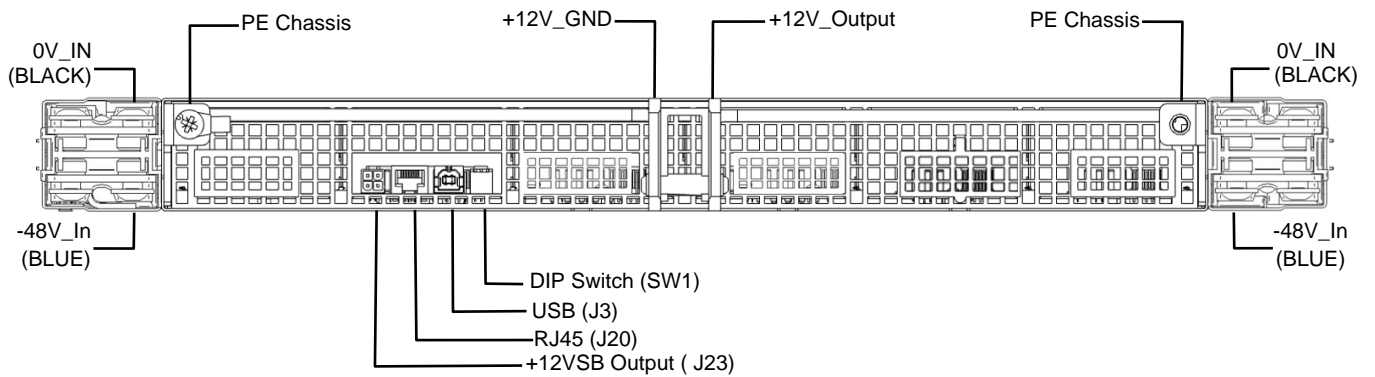


Figure 6. SPSPFF3-02 Rear View

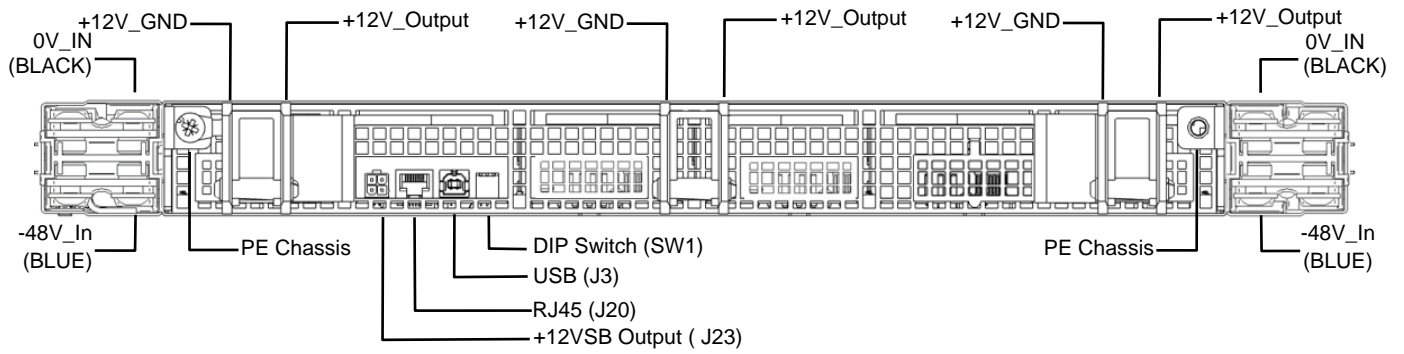


Figure 7. SPSPFF3-03 Rear View



Figure 8. SPSPFF3-01 Isometric View


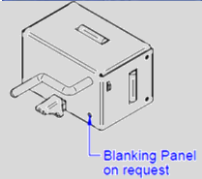


Figure 9. SPSPFF3-02 Isometric View



Figure 10. SPSPFF3-03 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
	Blanking Panel	SPSPFE3BP-01G	belfuse.com/power-solutions

12 REFERENCE DOCUMENTS

DOCUMENT NUMBER	DESCRIPTION
BCM.00448	SPSPFF3-01 Installation Instruction
BCM.00530	SPSPFF3-02 Installation Instruction
BCM.00531	SPSPFF3-03 Installation Instruction
BCA.00178	SPSPFF3-0XG Communication Manual
SPSPFF3-01.FD	SPSPFF3-01 Mechanical Drawing
BCD.00926	NAC2006-01 Datasheet
BCD.00886	PFF3000-12-069RD Datasheet
BCM.00447	PFF3000-12-069RD Installation Instruction
BCA.00216	PFF3000-12-069RD Power Management Bus Communication Manual
PCA9547PW	PCA9547PW Datasheet from NXP
BCA.00280	Bus bar Distribution Drawing for Straight Bus bar output

13 REVISION HISTORY

REV	DESCRIPTION	PRODUCT VERSION	DATE	AUTHOR
001	PRELIMINARY: Initial Draft	V001	03-24-2017	RK
002	Update Input1/ Input2 Update reference document numbers Add mating part information	V001	04-05-2017	RK
003	Update reference document number Update drawings	V001	04-21-2017	RK
004	Update Datasheet part number for NAC2006-01. Power Management Bus™ changed to Power Management Bus; a disclaimer added to the first page:	V005	02-07-2018	VS
AA	Align with PSU specification and release to AA	V201	20-06-2018	RK
AB	Add SPSPPFF3-02 and SPSPPFF3-03 Models and Ishare on J20	V202	04-02-2018	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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