SPAFCBK-14G

AC-DC Power Supply

The SPAFCBK-14G is a power-factor-corrected (PFC) power supply that converts 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.

The SPAFCBK-14G meets international safety standards and displays the CE-Mark for the European Low Voltage Directive (LVD).

RoHS Compliant

END OF LIFE

Key Features & Benefits

- Open Compute (OCP) compliant
- Meeting 80 Plus “Platinum” Efficiency
- Wide input voltage range: 90 - 264 VAC
- AC input with power factor correction
- Always-On 10 W standby output (3.3 V/3 A)
- Hot-plug capable
- Active current share
- Small form factor: 321.5 x 54.5 x 40 mm (12.66 x 2.14 x 1.57 in)
- I2C communication interface for control, programming and monitoring with PSMI and Power Management Bus protocol
- Overtemperature, output overvoltage and overcurrent protection

Applications

- High Performance Servers
- Routers
- Switches

1. ORDERING INFORMATION

MODEL	OUTPUT POWER	AC INPUT	DC OUTPUT	AIRFLOW
SPAFCBK-14G	750 W	90 - 264 VAC	12 VDC	N: Normal*

* Rear to front

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	CONDITIONS / DESCRIPTION	MIN	NOM	MAX	UNITS
Input Voltage				300	VAC
	Duration	100			ms
Operating Temperature		-5		55	°C
Storage Temperature	Non-operational	-40		85	°C
Insulation Safety Rating	Input to Case		Basic		
	Input to Output		Reinforced		
	Output to Case		Functional		
Electric Strength Test Voltage (Hi-Pot)	Input to Case	2121			VDC
	Input to Output	2121			VDC
	Output to Case	707			VDC

3. INPUT SPECIFICATIONS

PARAMETER	CONDITIONS / DESCRIPTION		MIN	NOM	MAX	UNIT
Input Operating Range	Universal Input		90	115/230	264	V
Input Frequency			47	50/60	63	Hz
Turn-On Voltage					90	V
Turn-Off Voltage			70		80	V
Input Current	Maximum Current at V_{IN} = 100 V				11	A
	Maximum Current at V_{IN} = 200 V				6	A
Turn-on Delay	AC on		1		3	sec
Enable / Inhibit				150	200	ms
AC Line Inrush Peak Current	@ cold turn-on				35	A
	@ hot turn-on				50	A
Power Factor	Typical, meets EN61000-3-2			0.99		
Efficiency	230 V	Io (100 %)		91		%
		Io (50 %)		94		
		Io (20 %)		90		
Hold Up Time	@ full load, low line		16			ms
	@ 60% load			20		
Startup Time	@ 120 VAC, 60 Hz				3	sec
AC Leakage Current	@ 264 VAC				3.5	mA
Input Fusing	Non-user replaceable fuse in the live line			12.5		A

4. OUTPUT SPECIFICATIONS

PARAMETER	CONDITIONS / DESCRIPTION	MIN	NOM	MAX	UNIT
Output Voltage V1					
Output Voltage			12		VDC
Output Current			62		ADC
Output Power			750		W
Set Point Accuracy		-1		+1	%
Line Regulation	Output voltage variation as input voltage changes from 85 V to 264 V with 50 % load			±1	%
Load Regulation	Output voltage variation as load changes from 0 to 100 %			±3	%
Total Output Voltage Range		11.64		12.36	V
Transient Response	I_{OUT} changes 50 % of full load starting anywhere from 0 % to 50 % load, at slew rate of 1 A/µs				
Peak Deviation	Di/Dt=1A/us 50% full load change		3	4.2	%
Settling Time	Time until V_{OUT} returns to regulation requirements		0.5		ms
Ripple and Noise	Periodic and Random Deviation PARD ,DC to 200 MHz				
Low Line and Full Load	Differential Mode			120	mVp-p
Worst Case Condition	Differential and Common Mode			120	mVp-p
External Capacitance	Output Capacitance, 12V main output	500		11000	uF
Input Under Voltage		85		90	V
Output Over Voltage	Over voltage Limit, latch off	13.4		14.5	V
Output Current-limit Inception		120		150	%
Over-Temperature Warning and Shutdown				T(shut)-2	°C
Output Voltage V2					
Output Voltage			3.3		VDC
Output Current			3		ADC
Set Point Accuracy			1		%
Total Output Voltage Range		3.14	3.3	3.46	V
Ripple and Noise	Periodic and Random Deviation PARD DC to 200 MHz				
Low Line and Full Load	Differential Mode			45	mVp-p
Worst Case Condition	Differential and Common Mode			45	mVp-p
External Capacitance	3V3 standby	20		1000	uF
Input Under Voltage		80		90	V
Output Over Voltage	Over voltage Limit, latch off	3.6		3.9	V
Output Current-limit Inception		120		150	%
Turn-On / Turn-Off					
Turn-On Delay	Defined as time between after application of AC input (operating range) and Vout rising to 90% of final value.			3	sec
Output Voltage Rise Time	The output rise time is measured from 10% of Vnom to the lower limit of the regulation band.			100	ms
Rate of output rise – dv/dt	The output rise is Monotonic.		100		V/sec
Turn-On Overshoot				5	%
Turn-Off Undershoot					
Turn-on Response Time	Measured with I_{OUT} = 4 A and no external load capacitor Measured with I_{OUT} = 38.5 A and 5000 µF capacitive load	5		400	ms

5. SIGNALING & CONTROL SPECIFICATIONS

The following section defines the input and output signals from the power supply. All digital signals should be compatible with +3.3 volt LVTTL logic levels. All control signal lines share the same return used for +3.3 volt standby (3.3 V_{SB}).

5.1 POWER SUPPLY ENABLE (PS_ON)

The PS_ON signal is required to remotely turn on/off the power supply. PS_ON is an active low, below 0.7 V signal that turns on the 12 VDC power rail. In the low state this input will not source more than 4 mA of current.
The 12 VDC output will be disabled when this input is driven higher than 2.1 V, or open circuited. See PS_ON Signal Characteristics Table.

Signal Type: Input signal to the power supply	Accepts an open collector/drain input from the system. Pull-up to 3.3 V_{SB} located in power supply.	
PS_ON = Low, PS_KILL = Low	ON	
PS_ON = Low, PS_KILL = Low	OFF	
PS_ON = Low, PS_KILL = Open	OFF	
	MIN	**MAX**
Logic level low (power supply ON)	0 V	0.7 V
Logic level high (power supply OFF)	2.1 V	3 V
Output Source current, VPS_ON_L= low		4 mA

Table 1. PS_ON Signal Characteristics

5.2 POWER OK (PW_OK)

PW_OK is a power ok signal and will be pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When 12 VDC main output is < 10.9 V or > 13.2 V, or if any of the outputs fail due to over current protection, over voltage protection, over temperature, or fan failure then this output will be driven LOW. In the event AC mains power is lost, this signal must be driven LOW at least 20mS before the +3.3 V_{SB} output is lost. The output will be an open collector/drain. It will be capable of driving the output below 0.4V with a load of 4 mA. The start of the PW_OK delay time is inhibited as long as any power supply's 12 VDC output is in current limit. See PW_OK Signal Characteristics Table below.

Signal Type: Output signal from the power supply	Open collector/drain output from the power supply. Pull-up to 3.3V located in power supply.	
PW_OK = High	Power OK	
PW_OK = Low	Power Not OK	
	MIN	**MAX**
Logic level low voltage, Isink = 4ma	0 V	0.4 V
Logic level high voltage, Isource = 200µA	2.4 V	3.3 V
Input Sink current, PW_OK = Low		4 mA
Output Source current, PW_OK = High		2 mA
PW_OK delay: (T9) TPW_OK_ON	100 ms	1000 ms
PW_OK rise and fall time (w/o decoupling cap)		100 µs
Power down delay: (T10) TPW_OK_OFF_12V	1 ms	700 ms

Table 2. PW_OK Signal Characteristics

5.3 INPUT VOLTAGE OK (AC_OK)

This signal will be asserted, driven HIGH by the power supply to indicate that the input voltage meets the minimum requirements. After falling outside the input voltage requirements for more than 20 mSec, the signal must be driven Low. The output will be an open collector/drain. It will be capable of driving the output below 0.4 V with a load of 4 mA. See AC_OK Signal Characteristics Table below.

Signal Type: Output signal from the power supply	Open collector/drain output from the power supply. Pull-up to 3.3V located in power supply.	
AC_OK = High	AC OK	
AC_OK = Low	AC Low (Not OK)	
	MIN	**MAX**
Logic level low voltage, Isink = 4ma	0 V	0.4 V
Logic level high voltage, Isource = 200µA	2.4 V	3.3 V
Input Sink current, AC_OK = Low		4 mA
Output Source current, AC_OK = High		2 mA
AC_OK delay: (T13) TAC_OK_ON		1500 ms
AC_OK rise and fall time (w/o decoupling cap)		100 us
AC_OK delay: (T8) TAC_OK_OFF		20 ms

Table 3. AC_OK Signal Characteristics

5.4 PS_KILL

This pin is used to force the 12 V main output off if the supply is removed from the system. At the system level this pin will be connected to the output return directly. When this input is low the power supply will operate. If the input is floating the 12 V main output will turn off while the 3.3 V_{SB} will remain on. This signal overrides all other on-and-off signals. On the power supply connector, this pin is shorter than the others so it is a last-make and first-break contact. See PS_KILL Signal Characteristics Table below.

Signal Type: Input signal to the power supply	Accepts a ground input from the system. Pull-up to 3.3V located in the power supply.	
PS_KILL = Low, PS_ON = Low	ON	
PS_KILL = Open, PS_ON = Low or Open	OFF	
PS_KILL = Low, PS_ON = Open	OFF	
	MIN	**MAX**
Logic level low (power supply ON)	0 V	1.0 V
Logic level high (power supply OFF)	2.0 V	3.3 V
Source current, VPSKILL = low		4 mA

Table 4. PS_KILL Signal Characteristics

5.5 PRESENT

The PRESENT signal is used to sense the number of power supplies in the system (operational or not).This signal is connected to the power supply's output ground. See PRESENT Signal Characteristics Table below.

Signal Type: Output signal from the power supply	Output from power supply that is connected to ground. Pull-up to 3.3V located in system.	
PRESENT = Low	Present	
PRESENT = High	Not Present	
	MIN	MAX
Logic level low voltage, Isink=4mA	0 V	0.4 V
Logic level high voltage, Isink = 50µA		3.3 V
Sink current, PRESENT = low		4 mA
Sink current, PRESENT = high		50 uA

Table 5. PRESENT Signal Characteristics

5.6 SMBAlert

This signal indicates that the power supply is experiencing a problem that the user should investigate. This may be asserted due to Critical events or Warning events. See PSMI specification for further details.

Signal Type: Output signal from the power supply	Open-drain output from power supply that is connected to ground. Pull-up to 3.3VSB located in system.	
SMBAlert = Low	Not Present	
SMBAlert = High	Present	
	MIN	MAX
Logic level low voltage, Isink = 4mA	0V	0.4V
Logic level high voltage, Isink = 50µA	-	3.3V
Sink current, SMBAlert = low	-	4mA
Sink current, SMBAlert = high	-	50µA

Table 6. SMBAlert Signal Characteristics

5.7 POWER SUPPLY INTERFACE (POWER MANAGEMENT BUS)

The Power Management Bus interface uses a serial SMBus interface for communication between the power supply(s) and the system. Power Management Bus allows the system to access status and power sensors in the power supply. The power sensors monitor both input and output power. The status monitors various critical and non-critical conditions in the power supply. One pin is the Serial Clock (SCL). The second pin is used for Serial Data (SDA). Both pins are bi-directional and are used to form a serial bus.

Signal Type: Output signal from the power supply	Output from power supply that is connected to ground. Pull-up to 3.3VSB located in system.	
	MIN	MAX
Logic level low voltage, Isink = 4mA	0V	0.4V
Logic level high voltage, Isink = 50µA	-	3.3V
Sink current, SCL and SDA = low	-	4mA
Sink current, SCL and SDA = high	-	50uA

Table 7. SCL and SDA Signal Characteristics

5.8 POWER SUPPLY ADDRESSING

This signal indicates that the power supply address locations will be determined by external settings through the PS_A0 and PS_A1 address signals.

Signal Type: Output signal from the power supply	Accepts a ground input from the system. Pull-up to 3.3V located in the power supply.	
	MIN	MAX
Logic level low voltage, Isink = 4mA	0V	0.4V
Logic level high voltage, Isink = 50µA	-	3.3V
Sink current, PS_A0 and PS_A1 = low	-	4mA
Sink current, PS_A0 and PS_A1 = high	-	50uA

Table 8. PS_A0 and PS_A1 Signal Characteristics

PS_A1	PS_A0	PSU_ID (MCU) Address	EEPROM Address
0	0	B0	A0
0	1	B2	A2
1	0	B4	A4
1	1	B6	A6

Table 9. Address Matrix

5.9 LOAD SHARING CONTROL

The power supplies load share by using a single load share bus signal (ISHARE) connected between the power supplies for the 12V output. If the load sharing is disabled by shorting the load share bus to ground, the power system must continue to operate within regulation limits for loads less than or equal to the maximum specified. The failure of a power supply should not affect the load sharing or output voltages of the other supplies still operating.

5.10 LOAD SHARE SIGNAL CHARACTERISTICS

The load share signal provides both output current information and the load sharing function.
The characteristics of the load share signal are defined below in the following table:

ITEM	DESCRIPTION	MIN	NOM	MAX	UNITS
Vshare; Iout = max	Voltage of load share bus at specified max output current.	-	8	-	V
dVshare/dIout; Iout >1A	Slope of load share bus voltage with changing load.	-	8 / Ioutmax	-	V / A
Ishare sink; Vshare = 8V	Amount of current the load share bus outputs from each power supply sink.	-	-	0.5	mA
I share source; Vshare = 8V	Amount of current the load share bus outputs from each power supply source.	4.0	-	-	mA
Tshare; Iout = max	Delay from output voltages in regulation to load sharing active with maximum load of one power supply and two power supplies in parallel.	-	-	100	mSec

Table 10. Load Share Bus Output Characteristics

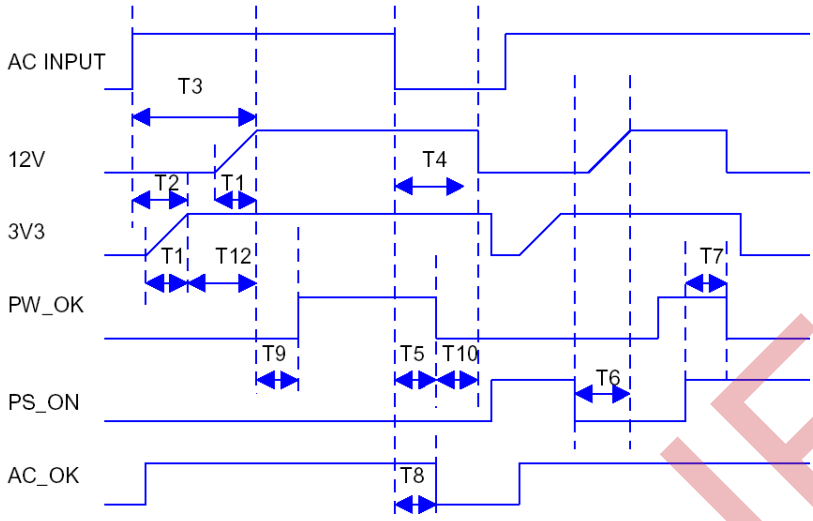


Figure 1. Timing Diagram

PARAMETER	MIN	TYP	MAX	UNITS	CONDITION / COMMENTS
T1 (Tout_rise)	-	-	100	mSec	Output voltage rise time from each main output
T2 (Tsb_on_delay)	-	-	2500	mSec	Delay from AC being applied to 3V3 being within regulation
T3 (Tac_on_delay)	-	-	3000	mSec	Delay from AC being applied to all output voltages being within regulation
T4 (Tvout_holdup)	16	-	-	mSec	Time all output voltages, including 3V3, stay within regulation after loss of AC
T5 (Tpw_ok_holdup)	5	-	-	mSec	Delay from loss of AC to de-assertion of PW_OK
T6 (Tps_on_delay)	-	-	400	mSec	Delay from PS_ON active to output voltages within regulation limits
T7 (Tps_on_pw_ok)	-	-	50	mSec	Delay from PS_ON de-active to PW_OK being de-asserted
T8 (Tac_ok_off)	-	-	20	mSec	Delay from loss of AC input to de-assertion of AC_OK
T9 (Tpw_ok_on)	100	-	1000	mSec	Delay from output voltages within regulation limits to PW_OK asserted at turn on
T10 (Tpw_ok_off_12V)	1	-	700	mSec	Delay from PW_OK de-asserted to 12VDC dropping out of regulation limits
T11 (Tpw_ok_off_3V3)	20	-	-	mSec	Delay from PW_OK de-asserted to 3V3 dropping out of regulation limits
T12 (Tsb_vout)	50	-	1000	mSec	Delay from 3V3 being in regulation to 12VDC being in regulation at AC turn on.
T13 (Tac_ok_on)	-	-	1500	mSec	Delay from AC being applied to assertion of AC_OK

Table 11.Timing Table

6. I²C INTERFACE

The I²C interface should be isolated from primary circuits and be SELV rated. Provision is made to accommodate ground level shift between system I²C ground and the supply's internal signal ground. The I²C circuitry becomes active upon application of AC power at the input, or output to the supply. Inhibiting the output shall not affect the power to the I²C. The signal transition region between 1 and 4 volts shall have no more than 50 mv peak-to-peak ringing. Rise and fall of these signals must be monotonic in the 1 to 4 volt region. Refer to software spec.

It is expected that the vendor supports most of the standard set of commands as per the Power Management Bus specification. However, the following set of "standard" commands MUST be supported at the minimum, either through Power Management Bus access or other methods to retrieve the information related to power efficiency.

Refer to SPAFCBK-14G Power Management Bus Communication manual for more details about the Power Management Bus Commands sets.

COMMAND CODE	COMMAND NAME	TRANSACTION TYPE	COMMENT
0x01	OPERATION	Write	Turns on/off power supply. Command argument determines ON/OFF
0x88	READ_VIN	Read	Read input voltage
0x89	READ_IIN	Read	Read input current
0x8B	READ_VOUT	Read	Read output voltage
0x8C	READ_IOUT	Read	Read output current
0x96	READ_POUT	Read	Read Output Power
0x97	READ_PIN	Read	Read Input Power

Table 12. Power Management Bus Commands

7. EEPROM

A 32K bit EEPROM device (example: AT24C32CY6-YH-T) is used in the power supply for user information storage. The EEPROM address is determined by PS_A0 & PS_A1 settings. (Address Matrix Table).Write protection is enabled in default to prevent unintended write to the EEPROM. In order to write to the EEPROM, first the write protection needs to be disabled by sending the appropriate command to the PSU (Refer to SPAFCBK-14G Power Management Bus Communication Manual for more details).

8. LED INDICATORS

There will be 2 separate LED indicators, one green and one amber to indicate the power supply status. There will be a (slow) blinking green POWER LED (OK) to indicate that AC is applied to the PSU and the Standby Voltage is available. This same LED shall go steady to indicate that all the Power Outputs are available. This same LED or separate one will blink (slow) or be solid ON amber to indicate that the power supply has failed or reached a warning status and therefore a replacement of the unit is/maybe necessary.

The LED are visible on the power supply's exterior face. The LED location meets ESD Requirements.

Power Supply Condition	Green (OK) LED Status	Amber (FAIL) LED Status
No AC power to all power supplies	OFF	OFF
Power Supply Failure (includes over voltage, over current, over temperature and fan failure)	OFF	ON
Power Supply Warning events where the power supply continues to operate (high temperature, high power and slow fan)	OFF	Blinking
AC Present/ 12VSB on (PSU OFF)	Blinking	OFF
Power Supply ON and OK	ON	OFF

Table 13. LED Indicators

9. SAFETY SPECIFICATIONS

Approved to the latest edition of the following standards: UL/CSA60950-1, IEC60950-1 and EN60950-1.

10. ENVIRONMENTAL SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION		MIN	NOM	MAX	UNIT
Temperature	Operating Storage		-5 -40		+55 +85	°C
Humidity	Operating (non-condescending) Storage (non-condescending)		+5		90 95	%RH
Altitude	Operating without derating	up to 40°C up to 55°C	4000 1800			m
Reliability	MTFB (Telcordia)		300			kh

11. ELECTROMAGNETIC COMPATIBILITY

PARAMETER	STANDARD / DESCRIPTION		CRITERIA
Radiated Emissions	EN55022/CISPR 22 and FCC Part 15		Class B > 0 dB margin
Conducted Emissions	EN55022/CISPR 22 and FCC Part 15		Class B > 0 dB margin
Harmonics	EN61000-3-2 (AC Rated Input Current <=16 A per phase) EN61000-3-12 (AC Rated Input Current >16 A and <=75 A per phase)		
Voltage Fluctuations and Flicker	EN61000-3-3 (AC Rated Input Current <=16 A per phase) EN61000-3-11 (AC Rated Input Current >16 A and <=75 A per phase)		
ESD	EN/IEC61000-4-2 (8 kV Contact, 15 kV Air)		Criteria A
Radiated Immunity	IEC61000-4-3 (10 V/m)		Criteria A
EFT	IEC61000-4-4 (5 kHz and 100 kHz repetition rates)	2 kV 0.5 kV	Criteria B Criteria A
Surge	IEC61000-4-5 (4 kV CM, 2 kV DM)		Criteria A
Conducted Immunity	IEC61000-4-6 (10 Vrms)		Criteria A
Power Frequency Magnetic Field	IEC61000-4-8 (30 A/m)		Criteria A
Voltage dips, short interruptions and voltage variations immunity tests	IEC 61000-4-11		
Ring Wave	IEC61000-4-12 (4 kV CM, 2 kV DM)		Criteria A

12. MECHANICAL SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Dimensions	Width		54.5		mm
	Height		40.0		
	Depth		333.5		
M Weight			1.36		kg

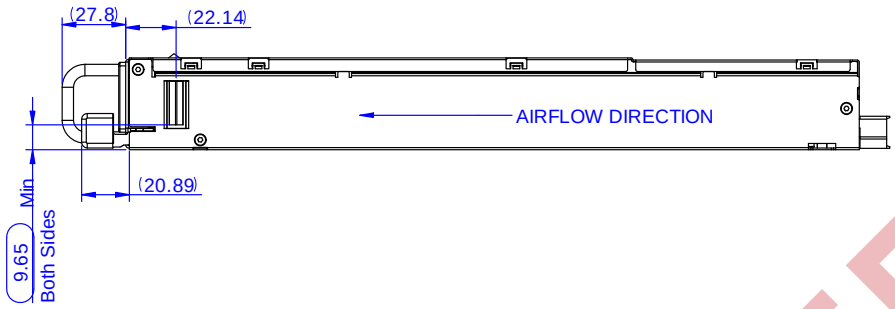


Figure 2. Side View 1

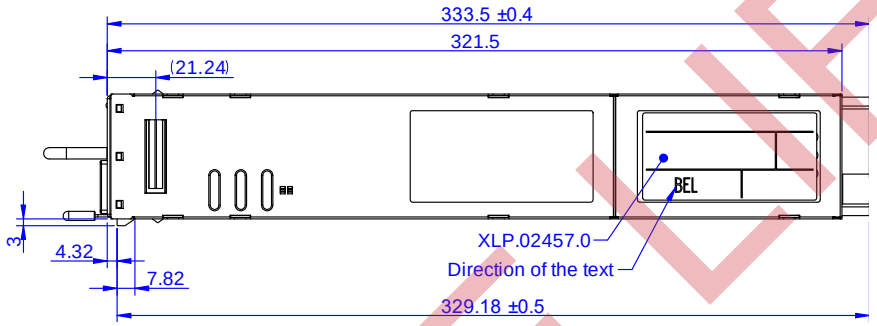


Figure 3. Top View

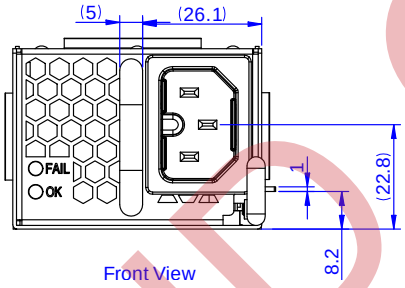


Figure 4. Front View

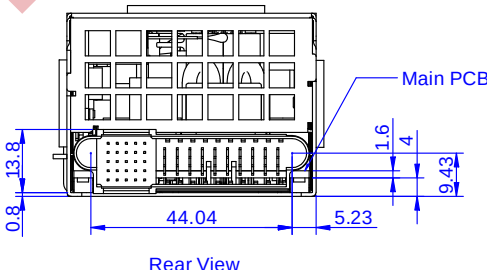
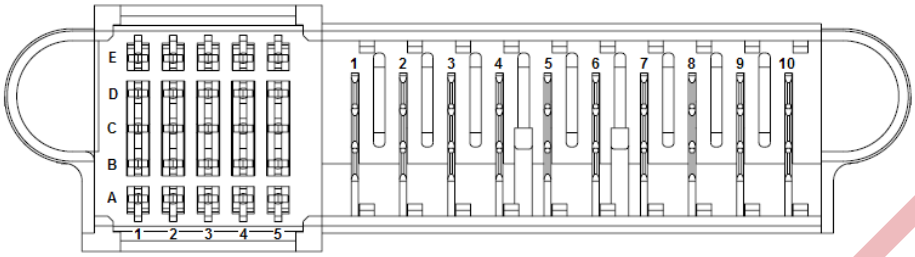


Figure 5. Rear View

13. CONNECTIONS

13.1 OUTPUT CONNECTOR

The output connector is “Hot-pluggable” and interface with DC Power Distribution Board. The output connector shall ensure that the ground signal is connected first, then the power and interface Signals except for a final control signal, such as PSKILL and PRESENT/L which shall be connected last.
All connectors shall be capable of 100 insertions.
Manufacturer shall ensure that Safety Agency performs additional test, as applicable, to accept connector as suitable for “current interruption”
Applications as defined in UL1977. Minimum of 100 “hot” make and break Cycles.



Unit: Tyco Electronics P/N 1926736-2 or FCI 10122460-002LF
Counter part: : Tyco Electronics P/N 2-1926739-5 or FCI 10108888-R10253SLF (Bel Power Solutions P/N: ZES.00672)

	PIN	SIGNAL NAME	LEVEL	COMMENTS
P1- top	6,7,8,9,10	+12V		Power contacts
P2- top	1,2,3,4,5	Ground		Power contacts
	A1	VSB		
	B1	VSB		
	C1	VSB		
	D1	VSB		
	E1	VSB		
	A2	SGND		Signal ground
	B2	SGND		Signal ground
	C2	reserved		
	D2	Reserved		
	E2	Reserved		
	A3	PSKILL		Short pin
	B3	Reserved		
	C3	SDA		
	D3	V1_SENSE_rtn		
	E3	V1_SENSE		
	A4	SCL		
	B4	PSON		
	C4	ALERT		
	D4	ISHARE		12 V current share signal
	E4	ACOK		
	A5	A0		Address 0
	B5	reserved		
	C5	PWOK		
	D5	A1		Address 1
	E5	PRESENT_L		

Table 14. Pin Description

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.