FXP1500/1800 front-ends have a backplane-mounted AC input.

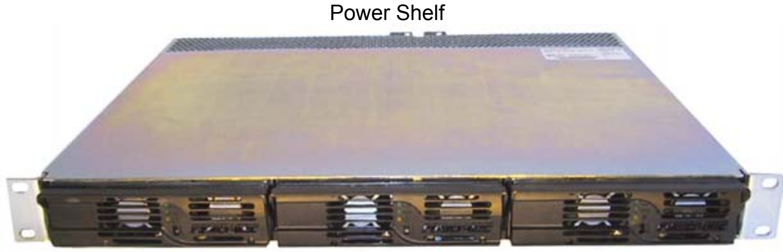
Features

- RoHS compliant for all six substances
- High density front-ends 15.2 to 18.3 W/in^3
- Wide input voltage range 85 to 264 VAC
- 12 V standby voltage, 1A per front-end
- Highly efficient topology reduces operating costs
- I^{2}C interface status and control
- I^{2}C voltage and current limit setting
- Analog output voltage setting
- Overtemperature, output overvoltage, and output overcurrent protection
- ORing circuits for true redundant operation: V_{o1}: ORing FETs; V_{o2}: ORing Diodes
- Status LEDs: AC OK, DC OK, and Fan Fail/Overtemperature Fail

Applications

- Telecommunications
- Data communications
- Servers
- Distributed power

FXR-3
Power Shelf



The FXR-3-48G shelf provides up to 5400 watts in a 19" rack.
(See the Rack section for power shelf details.)

Description

The FXP1500/1800 front-ends are power-factor-corrected (PFC) and provide a 48 VDC (1500 or 1800 watt) output, and can be used in hot-swap redundant systems. Their very small dimensions allow configuration of up to three units in a 1U rack. The FXP front-ends have a rear-mounted AC connector. The highly efficient thermal design with internal-fan cooling permits their use over wide temperature ranges and provides very high reliability.

Status information is provided with front panel LEDs, logic signals, and via an I^{2}C management interface. In addition, the I^{2}C bus can enable the power supply, set high fan speed, adjust the output voltage, and set the output current limit. The FXP1500/1800's meet international safety standards and display the CE-Mark for the European Low Voltage Directive (LVD).

FXR-3-48G power-shelf solutions provide rectification, system management, and power distribution, while maintaining high reliability and offering flexibility for future expansion. The power shelves can be configured with up to three hot-swappable 1500 or 1800-watt AC-DC front-ends.

Model Selection

Model	Input voltage VAC auto selected [1]	Output 1		Output 2		Rated power W	Compatible Shelf [2]
		$V_{o1\ nom}$ VDC	$I_{o1\ max}$ ADC	$V_{o2\ nom}$ VDC	$I_{o2\ max}$ ADC		
FXP1500-48G	105 – 264 85 – 105	48 48	32.2 25.4	12 12	1 1	1512 1212	FXR-3-48G
FXP1800-48G	180 – 264 105 – 180 85 – 105	48 48 48	39.2 32.2 25.4	12 12 12	1 1 1	1812 1512 1212	FXR-3-48G

[1] The available output power is automatically adjusted depending on the input voltage.
[2] 1U standard racks are available from Power-One. See the Rack (Power Shelf) section of this data sheet for configurations and details.

Absolute Maximum Ratings

Stress in excess of the absolute maximum ratings may cause performance degradation, adversely effect long-term reliability, or cause permanent damage to the converter.

Parameter	Conditions/Description	Min	Max	Unit
Input voltage	Continuous Transient, 60 ms max.		264 300	VAC VAC
Operating ambient temperature	$V_{i\ min}$-$V_{i\ max}$, $I_{o\ nom}$, cooling by internal fan @ 100 % load @ 50 % load	 0 0	 50 70	 °C °C
Storage temperature	Non-Operating	-40	85	°C

Environmental, Mechanical, & Reliability Specifications

Parameter	Conditions/Description	Min	Nom	Max	Unit
Altitude	Operating Non-Operating			10 k 40 k	ASL Ft. ASL Ft.
Relative humidity, non-condensing	Operating	10		90	% RH
	Storage	5		95	% RH
Temperature coefficient	0 °C to 70 °C (after 15 min warm-up)			0.02	%/K
Shock	IEC/EN 60068-2-27, 11 ms			40	g_{pk}
Sinusoidal vibration	IEC/EN 60068-2-6 2-8 Hz 8-200 Hz 200-500 Hz		 7.5 2 4		 mil g_{pk} g_{pk}
Random vibration	10-2000 Hz		6.15		g_{rms}
MTBF	Calculated per Bellcore (SR-332, Issue 1): GB 25 °C GB 25 °C (FNP1500-12G) Demonstrated	 230 TBD 250			 kh kh kh

Safety Specifications

Maximum electric strength testing is performed in the factory according to EN 550116, IEC/EN 60950, and UL 60950. Input-to-output electric strength tests should not be repeated in the field. Power-One will not honor any warranty claims resulting from electric strength field tests.

Parameter	Conditions/description	Min	Nom	Max	Unit
Agency approvals	UL60950, (UL) CSA 60950 (cUL), EN 60950(TÜV), CE Mark for LVD				
Insulation safety rating	Input to case Input to output Output to case	Basic Reinforced Functional			
Electric strength test voltage	Input to case Input to output Output to case Output 1 to output 2	2.12 4.2 [1] 0.5 0.1			kVDC kVDC kVDC kVDC

[1] Subassemblies are pre-tested with 4.2 kVDC in accordance with EN50116 and IEC/EN60950.

EMC Specifications

Parameter	Description	Criterion
Electrostatic discharge	IEC/EN 61000-4-2, level 4	Performance criterion B
Electromagnetic field	IEC/EN 61000-4-3, level 3	Performance criterion A
Electrical fast transients/burst	IEC/EN 61000-4-4, level 3	Performance criterion B
Surge	IEC/EN 61000-4-5, level 3	Performance criterion B
Voltage dips and interruptions	IEC/EN 61000-4-11	Performance criterion B or better
RF conducted immunity	IEC/EN 61000-4-6	10 VAC, AM 80 %, 1 kHz Performance criterion A
Emissions conducted	CISPR 22/EN 55022/EN 61204	Class B
Emissions radiated	CISPR 22/EN 55022/EN 61204	Class A
Harmonics	IEC/EN 61000-3-2	Class B
Voltage fluctuation and flicker	IEC/EN 61000-3-3	Pass
Voltage sag	SEMI F47-0200 (High Line 230V)	Pass

Input Specifications

Specification is valid for input voltage, load, and temperature ranges, unless otherwise stated.

Parameter	Conditions/description	Min	Nom	Max	Unit
Input voltage		85	230	264	VAC
Input frequency		47	50/60	63	Hz
Turn-on input voltage	Ramping up	79	-	85	VAC
Turn-off input voltage	Ramping down	70	-	78	VAC
Inrush current limitation	115/230 VAC acc. ETS 300 132-1 < 100 ms			50	A_{pk}
Hold-up time	After last AC line peak ,V_i = 230 VAC, $P_{o\ nom}$	20			ms
Power factor	$V_{i\ nom}$, $I_{o\ nom}$	0.95			W/VA
Efficiency	V_i = 230 VAC, $I_{o\ nom}$, T_C = 25 °C	89	90		%
Max input current				20	A_{rms}
Input connector	16A – 20 A / 250 VAC; according to IEC320 C19				

Input Connector Description (FXP1500/1800)

Protection Earth	P1	PE
Phase	P2	L
Neutral	P3	N

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Changing the Shape of Power

Output Specifications, 48Vout Models

Specification is valid for input voltage, load, and temperature ranges, unless otherwise stated.

Parameter		Conditions/Description	Min	Nom	Max	Units
Nominal output voltage Vo1		I_o = 16.1 A		48		VDC
Nominal output voltage Vo2		I_o = 0.5 A		12		VDC
Output voltage set point accuracy		V_i = 230 VAC, I_{o1} =16.1 A, T_C = 25 °C (47.8 - 48.2 VDC)	-0.5		+0.5	% $V_{o1\ nom}$
Output voltage trimming (via I^{2}C or with external resistor)		Adjustable (44.16 to 51.84 VDC)	-8		+8	% $V_{o1\ nom}$
Nominal current output 1	FXP1500-48G	$I_{o1\ nom}$ @ V_i =105 VAC – 264 VAC, P_o 1.5 kW $I_{o1\ nom}$ @ V_i = 85 VAC – 105 VAC, P_o 1.2 kW		32.2 25.4		ADC ADC
	FXP1800-48G	$I_{o1\ nom}$ @ V_i =180 VAC – 264 VAC, P_o 1.8 kW $I_{o1\ nom}$ @ V_i =105 VAC – 180 VAC, P_o 1.5 kW $I_{o1\ nom}$ @ V_i = 85 VAC – 105 VAC, P_o 1.2 kW		39.2 32.2 25.4	39.2	ADC ADC ADC
Current limit output 1	FXP1500-48G	$I_{o1\ max}$ @ V_i = 105 VAC – 264 VAC droop hiccup $I_{o1\ max}$ @ V_i = 85 VAC – 105 VAC droop hiccup		36.8 30		ADC ADC
	FXP1800-48G	$I_{o1\ max}$ @ V_i = 180 VAC – 264 VAC droop hiccup $I_{o1\ max}$ @ V_i = 105 VAC – 180 VAC droop hiccup $I_{o1\ max}$ @ V_i = 85 VAC – 105 VAC droop hiccup		43.8 36.8 30		ADC ADC ADC
Nominal current output 2		$I_{o2\ nom}$ @ Vi = 85 VAC – 264 VAC, P_o 12 W		1.0	1.0	ADC
Current limit output 2		$I_{o2\ max}$ @ V_i = 85 VAC – 264 VAC		1.5		ADC
Static line regulation output 1		$V_{i\ min}$ - $V_{i\ max}$, 50 % $I_{o\ nom}$	-0.5		0.5	% $V_{o\ nom}$
Static load regulation output 1 (droop characteristic)	FXP1500-48G	V_i = 230 V, 5-100 % $I_{o\ nom}$ V_o: full load (32.2 ADC) to no load	 46.65	83.5 48	 49.34	mV/A VDC
	FXP1800-48G	V_i = 230 V, 5-100 % $I_{o\ nom}$ V_o: full load (32.2 ADC) to no load	 46.07	83.5 48	 49.34	mV/A VDC
Static load regulation output 2 (droop characteristic)		V_i = 230 V, 5-100 % $I_{o\ nom}$ V_o: full load (32.2 ADC) to no load		0.4		VDC
Dynamic load regulation		Load change 50% $\leftrightarrow$ 100% $I_{o\ nom}$, dI_o/dt =1 A/µs Voltage deviation (droop + over- or undershoot)				% $V_{o\ nom}$
	FXP1500-48G		-5		5	% $V_{o\ nom}$
	FXP1800-48G		-5.7		5.7	% $V_{o\ nom}$
	All models	Max. recovery time to within 1 % of $V_{o1\ nom}$			400	µs
Current Share		Difference in current between two units for V_{o1} above 10 % load.				
	FXP1500-48G				3.2	ADC
	FXP1800-48G				3.9	ADC
Start-up time		Time required for output within regulation after initial application of AC-input ($V_{i\ nom}$, $I_{o\ nom}$) after removal of inhibit ($V_{i\ nom}$, $I_{o\ nom}$)		 100	 1.5	 s ms
Output voltage ripple and noise (Filter 10 nF/10 µF)		$V_{i\ nom}$, $I_{o\ nom}$, 20 MHz bandwidth V_{o1} V_{o2}			 480 120	 mV_{pp} mV_{pp}
Remote sense		Total compensation for cable losses			500	mV

Protection

Parameter	Conditions/Description	Min	Nom	Max	Unit
Input fuse	Not user accessible	25A, fast blow			
Inrush current limitation		With NTCs			
Output		No-load -, short circuit - and overload proof			
Overvoltage protection latching[1]	Tracking Absolute	115		122 59.5	% $V_{o\ nom}$ V
Overtemperature protection	Automatic power shutdown at T_C		95		°C

[1] Remove input voltage to reset.

Control

Specification is valid for input voltage, load, and temperature ranges, unless otherwise stated.

Parameter	Conditions/Description
Status Indication	LEDs: DC OK (green), AC OK (green); fan fail and overtemperature (amber)
I^2C digital bus	Monitors alarm functions and sets parameters
PS present pin	Contact closure to logic ground (internal pull-down resistor of 1 kΩ)
PS remote shutdown / Inhibit pin	TTL compatible signal, inhibited when open contact, high or at TTL logic “1”. Signal referenced to logic return (LRTN)
Power supply OK (I^2C)[1]	AC OK & DC OK & no overcurrent & no overtemperature & fans working
DC current fail (I^2C)[1]	Overcurrent on I_{o1}
AC fail / Power down warning (I^2C & OC)[2]	Provides a warning that the input power has failed at least 5 ms before the output falls out of regulation (<90% $V_{o1\ set}$). Open collector signal with 20 mA pull-down capability, referenced to logic return (LRTN). AC fail will go high or open during power fail condition and will go low when input is within the operating range. A Power Fail warning will turn off the green AC OK LED.
DC fail / Output voltage fault (I^2C & OC)[2]	Internal undervoltage and overvoltage supervision of V_{o1}. Open collector signal with 20 mA pull-down capability, referenced to logic return (LRTN). DC fail will go high or open if V_{o1} is < 90% or > 110% of $V_{o1\ set}$, measured in front of the ORing FETs. A green LED on the front panel indicates normal operation. The LED will flash if in parallel operation V_{o1} is OK, but the unit is disabled.
Temperature warning (I^2C & OC)[2]	I^2C critical temperature warning: Indicates that the operating temperature has reached [$T_{shut\text{-}down}$ – 10K] I^2C & OC overtemperature warning: Indicates if the unit is in overtemperature shutdown. Open collector signal with 20 mA pull-down capability, referenced to logic return (LRTN). The OC-output will go low 100 ms before an overtemperature condition shuts down the unit. An amber LED on the front panel indicates overtemperature or fan fail.
DC voltage monitoring (I^2C)[1]	Monitors the voltage V_{o1} at the output connector. Accuracy ± 0.45 V over setting range, temperature and load.
DC current monitoring (I^2C)[1]	Monitors the output current I_{o1} : Accuracy ± 0.4A over the load range.
DC voltage trimming (I^2C or external resistor)[1]	Output voltage trimming V_{o1}: ± 8 % of $V_{o\ set}$ Setting accuracy over I^2C: ± 50mV at Vo nom, ± 150 mV over setting range
Fan speed control (I^2C)[1]	Two fan speed levels automatically set depending on the internal temperature. The fan speed can be set to full speed or automatic control.
Fan OK (I^2C & OC)[2]	Indicates if the fans are operating or have failed.
Synch. startup pin	Overcurrent signal which can be used for synchronous startup of units in parallel or to recover from an overload condition. (See application note).

[1] Detailed I^2C information is available from the model's I^2C Manual found on the Power-One web site.

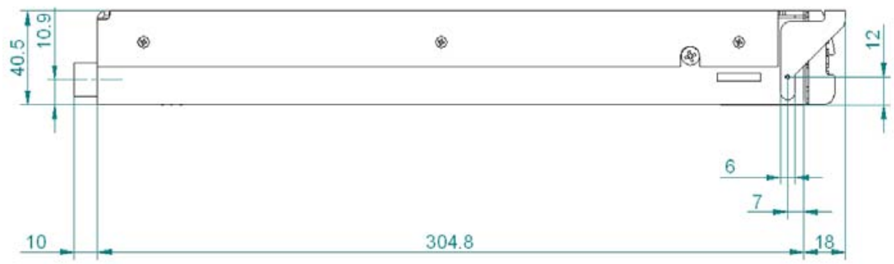
[2] Provided over the I^2C interface and as an open collector signal on the output connector (OC).

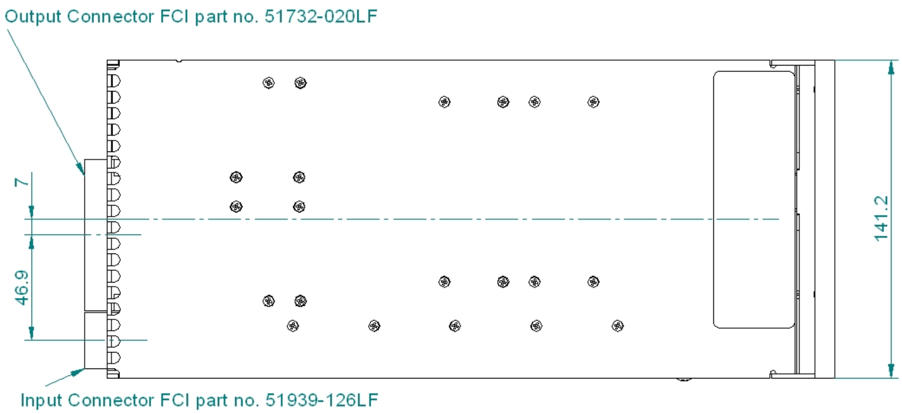
Output Connector Pinning and Signal Specification (48V Models)

Output Connector Description	Pin Location	Type	Low level High level	V max I max
Overtemperature / Fan Fail	U1	OC-output, protected by 16 V Zener diode and a 10 Ω resistor in series, referenced to logic GND	<0.4 V @ 20 mA Pull up	15 V 20 mA
AC Fail / Power down warning	U2	OC-output, protected by 16 V Zener diode and a 10 Ω resistor in series, referenced to logic GND	<0.4 V @ 20 mA Pull up	15 V 20 mA
Power Supply Present	U3	Resistor (1 kΩ) connected to logic GND	Open Pull up	10 V 10 mA
DC Fail / Output voltage fault	U4	OC-output, protected by 16 V Zener diode and a 10 Ω resistor in series, referenced to logic GND	<0.4 V @ 20 mA Pull up	15 V 20 mA
Internal ground	U5	Internal ground (V_{o1}– line before the output filter). Do not connect the internal grounds in systems with several units.		
ADDR0, I^2C address bus	T1	DIP switch or wire to internal ground, Internally pull up to 5V (10 kΩ).	Switch closed Switch open	5V
ADDR1, I^2C address bus	T2	DIP switch or wire to internal ground, Internally pull up to 5V (10 kΩ).	Switch closed Switch open	5V
ADDR2, I^2C address bus	T3	DIP switch or wire to internal ground, Internally pull up to 5V (10 kΩ).	Switch closed Switch open	5V
ADDR3, I^2C address bus	T4	DIP switch or wire to internal ground, Internally pull up to 5V (10 kΩ).	Switch closed Switch open	5V
ADDR4, I^2C address bus	T5	DIP switch or wire to internal ground, Internally pull up to 5V (10 kΩ).	Switch closed Switch open	5V
DATA, I^2C data line	S1	I^2C compatible signal referenced to logic GND	5 V or 3.3 V logic	
CLOCK, I^2C clock line	S2	I^2C compatible signal referenced to logic GND	5 V or 3.3 V logic	
Auxiliary power +12 V	S3	V_{o2}+ output, insulated from main output		
Auxiliary power ground	S4	V_{o2} - output, insulated from main output		
Logic ground	S5	Internally connected over 10 Ω to Auxiliary GND. Wire separately form Auxiliary - and main output GND to minimize noise on signals and I^2C. Leave open if not used.		
Output inhibit	R1	PS active when pulled low (DC-DC stage off when left open) Referenced to logic GND	<0.8 V >2.0 V	10 V 3.5 mA
V sense +	R2	Open or connected to V_{o1}+ at the load (Internally connected to V_{o1}+ over 100 Ω)		dV < 3 V_{pp} 30 mA
V sense -	R3	Open or connected to V_{o1}- at the load (Internally connected to V_{o1}- over 100 Ω)		dV < 3 V_{pp} 30 mA
Output margin	R4	Open or connected to internal ground (+8 % V_{o1}) or V_{sense+} (-8 % V_{o1}) Do not connect the margin pins in systems with several units.		60V
Synch. Startup	R5	Open or connected to synch startup circuit, referenced to V_{o1} - at the output connector		12V 2mA
V_{o1} -	P1, P3, P5	Main output – pins		
V_{o1} +	P2, P4, P6	Main output + pins		

Mechanical Data (FXP1500/1800 48V Models)

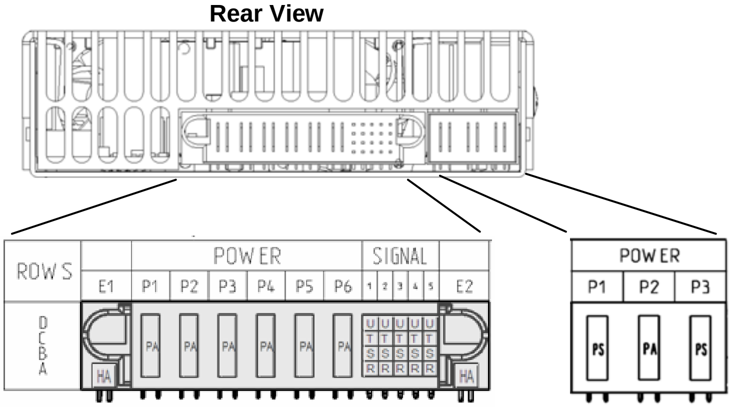
Mechanical Data (H, W, D)	5.6” (141.2mm) x 1.6” (40.5mm) x 12” (304.8mm)





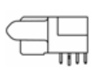
FXP1500/1800 48V Model Output Connector Descriptions

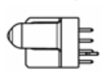
Rear View

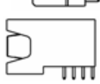


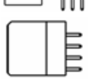
Female Connector: FCI (51732-020 LF) **Input Connector: FCI (51939-126 LF)**

Mates With:

90° output connector type:  Part No. FCI (manufacturer): 51762-10602000AALF; Power-One Part No.: ZES258-G

180°output connector type:  Part No. FCI (manufacturer): 51742-10602000AA LF

90° input connector type:  Part No. FCI (manufacturer): 51915-056 LF

180° input connector type:  Part No. FCI (manufacturer): 51940-099 LF

Paralleling Front-Ends:

For parallel use in minimal configuration systems, only the inhibit pins must be shorted to logic GND. All other pins can be left open. The power supplies will share the output current automatically (droop current share).

For parallel applications without I^2C bus, but the use of all other features, it is recommended to connect all logic GND's on a backplane together, to connect all V_{o2} -, all V_{o2} + and to leave the internal GND's open.
The sense wires can be left open or connected to a common load point, the synch-start pin can be left open or connected to a synch-start circuit, the inhibit pins can be connected together or used individually. All I^2C signals (T1-T5, S1, and S2) can be left open.

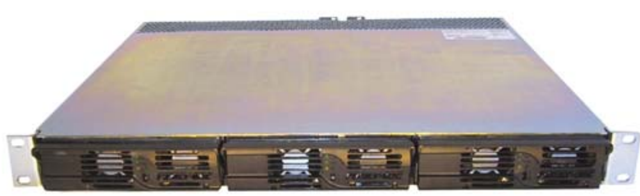
Use of a small foil capacitor > 3µF directly at the power outputs of each unit is recommended in order to prevent voltage drops at the hot plug. For additional information on paralleling see the following Rack (Power Shelf) section.

Racks

(FXR-3-48G Power Shelves)

Each rack (power shelf) is 1U high with backplane and designed for up to three front-end models in parallel or in n+1 operation. Each power shelf has:

- Massive copper bus bars for low-loss current distribution.
- Output terminals with two M4-screws on each power tab.
- Two fast-on contacts for system earthing.
- Address coding over five pole DIP switch on each unit, 37-pin D-Sub connector with I^2C-lines, monitoring signals and support functions.
- Provides a start-up synchronization circuit and EMV filters.



FXR-3-48G Power Shelf Front View

Overall Mechanical Dimensions (FXR-3-48 Power Shelves)

FXR-3 Mechanical Data (W, H, D)	17.7" (449.6 mm) x 1.7" (43.1 mm) x 14" (355.6 mm)