FNP1500/1800
AC-DC Power Supply
FNR-3-12G/FNR-3-48G Power Shelves

The FNP1500/1800 front-ends are power-factor-corrected (PFC) which (depending on model type) provide a 12 VDC or 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 FNP front-ends have a front-mounted AC receptacle. 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^2C management interface. In addition, the I^2C bus can enable the power supply, set high fan speed, adjust the output voltage, and set the output current limit. The FNP1500/1800's meet international safety standards and display the CE-Mark for the European Low Voltage Directive (LVD).

FNR-3-12G and FNR-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.

Key Features & Benefits

- 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^2C interface status and control
- I^2C 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

- Telecom
- Datacom
- Servers
- Distributed power systems

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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		
FNP1500-12G[3]	108 – 264 85 – 105	12 12	129 @ 11.64V 101.8 @ 11.78A	12 12	1 1	1512 1212	FNR-3-12G
FNP1500-48G	105 – 264 85 – 105	48 48	32.2 25.4	12 12	1 1	1512 1212	FNR-3-48G
FNP1800-48G	180 – 264 105 – 180 85 – 105	48 48 48	39.2 32.2 25.4	12 12 12	1 1 1	1812 1512 1212	FNR-3-48G

[1] The available output power is automatically adjusted depending on the input voltage.
[2] 1U standard racks are available from Bel Power Solutions. See the Rack (Power Shelf) section of this data sheet for configurations and details.
[3] Not recommended for new design.

Absolute Maximum Ratings

Stress in excess of the absolute maximum ratings may cause performance degradation, adversely affect 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

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 [1]	90		%
Max Input Current				20	A_{rms}
Input Connector	16A – 20 A / 250 VAC; according to IEC320 C19				

[1] 87% for FNP1500-12

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Output Specifications - FNP1500-12G Model

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

PARAMETER	CONDITIONS / DESCRIPTION	MIN	NOM	MAX	UNITS
Nominal Output Voltage	I_o = 64.5 A		12		VDC
Output Voltage Set Point Accuracy	V_i = 230 VAC, I_{o1} = 65.5 A, T_C = 25 °C (Factory setting)	11.93 -0.42	12	12.05 +0.42	VDC % $V_{o1\ nom}$
Output Voltage Trimming	Adjustable via I²C ($V_{o1\ set}$) Adjustable via Margin pin (R input)	7 6.2	12	13 [1] $V_{o1\ set}$	VDC VDC
Nominal Current Output 1	$I_{o1\ nom}$ @ V_i =108 VAC – 264 VAC, P_o 1.5 kW $I_{o1\ nom}$ @ V_i = 85 VAC – 105 VAC, P_o 1.2 kW		129.0 101.8	129.0	ADC ADC
Current Limit Output 1	$I_{o1\ max}$ @ V_i = 108 VAC – 264 VAC droop hiccup $I_{o1\ max}$ @ V_i = 85 VAC – 105 VAC droop hiccup		147.4 120.2		ADC ADC
Nominal Current Output 2	$I_{o2\ nom}$ @ Vi = 85 VAC – 265 VAC, P_o 12 W		1.0	1.0	ADC
Current Limit Output 2	$I_{o2\ max}$ @ V_i = 85 VAC – 265 VAC		1.5		ADC
Static Line Regulation Output 1	$V_{i\ min}$ - $V_{i\ max}$, 50 % $I_{o\ nom}$, Ta = 25 °C	-0.5		0.5	% $V_{o\ nom}$
Static Load Regulation Output 1 (Droop Characteristic)	V_i = 230 V, 5 - 100 % $I_{o\ nom}$ Full load to no load [0..129 A] at V_o set = 12V dV_{o1} over the setting range [7 to 13V]	 11.64 -0.36	- 5.58 12	 12.36 +0.36	mV/A VDC VDC
Static Load Regulation Output 2 (Droop Characteristic)	Full load to no load @ Vi = 85 VAC – 265 VAC		0.4		VDC
Dynamic Load Regulation	Load change 50% <—>100% $I_{o\ nom}$, dI_o/dt =1A/µs Voltage deviation (droop + over- or undershoot) Max. recovery time to within 1% of $V_{o1\ nom}$	 -2		 2 400	 % $V_{o\ nom}$ µs
Current Share	Difference in current between two units for V_{o1} above 10 % load.		12.9		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 10nf/10µf)	$V_{i\ nom}$, $I_{o\ nom}$, 20 MHz bandwidth V_{o1} V_{o2}			 120 120	 mV_{pp} mV_{pp}
Remote Sense	Total compensation for cable losses			500	mV

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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 I²C or with external resistor)		Adjustable (44.16 to 51.84 VDC)	-8		+8	% $V_{o1\ nom}$
Nominal current output 1	FNP1500-48G	$I_{o1\ nom}$ @ V_i =105 VAC – 264 VAC, P_o 1.5 kW		32.2		ADC
		$I_{o1\ nom}$ @ V_i = 85 VAC – 105 VAC, P_o 1.2 kW		25.4		ADC
	FNP1800-48G	$I_{o1\ nom}$ @ V_i =180 VAC – 264 VAC, P_o 1.8 kW		39.2		ADC
		$I_{o1\ nom}$ @ V_i =105 VAC – 180 VAC, P_o 1.5 kW		32.2	39.2	ADC
		$I_{o1\ nom}$ @ V_i = 85 VAC – 105 VAC, P_o 1.2 kW		25.4		ADC
Current limit output 1	FNP1500-48G	$I_{o1\ max}$ @ V_i = 105 VAC – 264 VAC droop hiccup		36.8		ADC
		$I_{o1\ max}$ @ V_i = 85 VAC – 105 VAC droop hiccup		30		ADC
	FNP1800-48G	$I_{o1\ max}$ @ V_i = 180 VAC – 264 VAC droop hiccup		43.8		ADC
		$I_{o1\ max}$ @ V_i = 105 VAC – 180 VAC droop hiccup		36.8		ADC
		$I_{o1\ max}$ @ V_i = 85 VAC – 105 VAC droop hiccup		30		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)	FNP1500-48G	V_i = 230 V, 5-100 % $I_{o\ nom}$		90.1		mV/A
		V_o: full load (32.2 ADC) to no load	46.54	48	49.44	VDC
	FNP1800-48G	V_i = 230 V, 5-100 % $I_{o\ nom}$		90.1		mV/A
		V_o: full load (32.2 ADC) to no load	45.91	48	49.44	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% <-> 100% $I_{o\ nom}$, dIo/dt =1 A/µs Voltage deviation (droop + over- or undershoot)				% $V_{o\ nom}$
	FNP1500-48G		-5		5	% $V_{o\ nom}$
	FNP1800-48G		-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.				
	FNP1500-48G				3.2	ADC
	FNP1800-48G				3.9	ADC
Start-up time		Time required for output within regulation after initial application of AC-input ($V_{i\ nom}$, $I_{o\ nom}$)			1.5	s
		after removal of inhibit ($V_{i\ nom}$, $I_{o\ nom}$)		100		ms
Output voltage ripple and noise (Filter 10 nF/10 µF)		$V_{i\ nom}$, $I_{o\ nom}$, 20 MHz bandwidth V_{o1}			480	mV_{pp}
		V_{o2}			120	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			122	% $V_{o\ nom}$
	Absolute for 48V models	115		59.5	V
	Absolute for 12V models			16.85	V
Overtemperature protection	Automatic power shutdown at T_C		95		°C

[1] Remove input voltage to reset.

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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)
I²C 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 (I²C)[1]	AC OK & DC OK & no overcurrent & no overtemperature & fans working
DC Current Fail (I²C)[1]	Overcurrent on I_{o1}
AC Fail / Power Down Warning (I²C & 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 (I²C & 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 (I²C & OC)[2]	I²C critical temperature warning: Indicates that the operating temperature has reached [$T_{shut\text{-}down}$ – 10K] I²C & 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 (I²C)[1]	Monitors the voltage V_{o1} at the output connector. Accuracy ± 0.45 V over setting range, temperature and load.
DC Current Monitoring (I²C)[1]	Monitors the output current I_{o1}: Accuracy ± 0.4A over the load range.
DC Voltage Trimming (I²C or external resistor)[1]	Output voltage trimming V_{o1}: ± 8 % of $V_{o\ set}$ Setting accuracy over I²C: ± 50mV at Vo nom, ± 150 mV over setting range
Fan speed control (I²C)[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 (I²C & 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 I²C information is available from the model’s I²C Manual found on the Bel Power Solutions web site.
[2] Provided over the I²C interface and as an open collector signal on the output connector (OC).

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

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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. Bel Power Solutions 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	2121 4242 [1] 500 100			VDC

[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

Output Connector Pinning and Signal Specification

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

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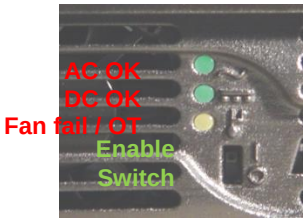
DATA, I^2C data line	S1	I^2C compatible signal referenced to logic GND	5 V or 3.3 V logic	
CLOCK, I^2C clock line	S2	I^2C compatible signal referenced to logic GND	5 V or 3.3 V logic	
V_{o2} + output	S3	Auxiliary power pin, insulated from main output		
V_{o2} – output	S4	Auxiliary ground pin, insulated 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)		dU < 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)		dU < 3 V_{pp} 30 mA
12V model Output margin	R4	Open or connected over resistor to internal ground. Do not connect the margin pins in systems with several units.		3 VDC
48V models	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.		60 VDC
12V model Synch. startup	R5	Open or connected to synch startup circuit, referenced to V_{o1} - at the output connector		12V 3mA
48V models	R5	Open or connected to synch startup circuit, referenced to V_{o1} - at the output connector		12V 2mA
V_{o1} + output **12V** model	P2, P4, P6, P8, P10, P12	Main output + pins		
V_{o1} – output **12V** model	P1, P3, P5, P7, P9, P11	Main output – pins		
V_{o1} + output **48V** models	P2, P4, P6	Main output + pins		
V_{o1} – output **48V** models	P1, P3, P5	Main output – pins		

LED Indicator Functionality

CONDITION	POWER FAIL (AC OK)	OUTPUT GOOD (DC OK)	FAN FAIL AND OVER - TEMPERATURE
Normal Operation	Green	Green	OFF
Power Supply is inhibited	Green	OFF	Amber
Input AC is low	OFF	OFF	Amber
Input AC is low or missing	OFF	OFF	Amber/OFF
Over-temperature	Green	OFF	Amber
Output overload (In regulation)	Green	Green	OFF
Output Overloaded (Out of Regulation)	Green	OFF	OFF
Fan Fault (No overtemperature shutdown)	Green	Green	Amber
Fan Fault (With overtemperature shutdown)	Green	OFF	Amber
Power Supply Failed	OFF	OFF	OFF/ Amber



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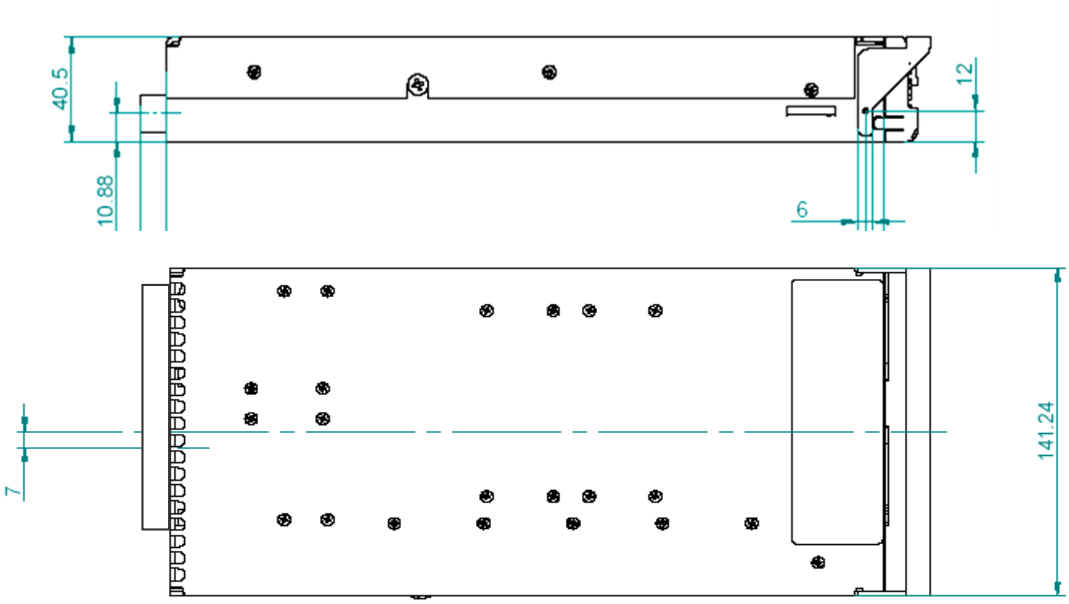
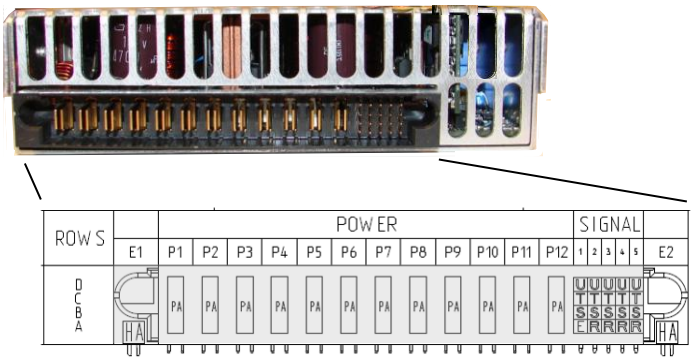
Mechanical Data - FNP1500/1800 12V Models

Mechanical Data (H x W x D): 5.6” (141.2mm) x 1.6” (40.5mm) x 11” (279.4mm)



FNP1500/1800 12V Model Output Connector Descriptions

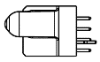
Rear View



Female Connector: FCI (51732-026 LF)

Mates with:

90° output connector type:  Part No. FCI (manufacturer): 51762-11202000AA LF

180° output connector type:  Part No. FCI (manufacturer): 51742-11202000AA LF

Locate information on availability of FCI connectors at http://www.stkcheck.com/evs/fcielectronics/fcisearch.asp
Connector drawings available at: http://portal.fciconnect.com/portal/page/portal/FcicntPublic/DocSrchCustDraw

IEC AC power cord with C19 connector VDE 16A: Interpower Components Ltd. 70009110250
IEC AC power cord with C19 connector UL 20A: Interpower Components Ltd. 70025110250

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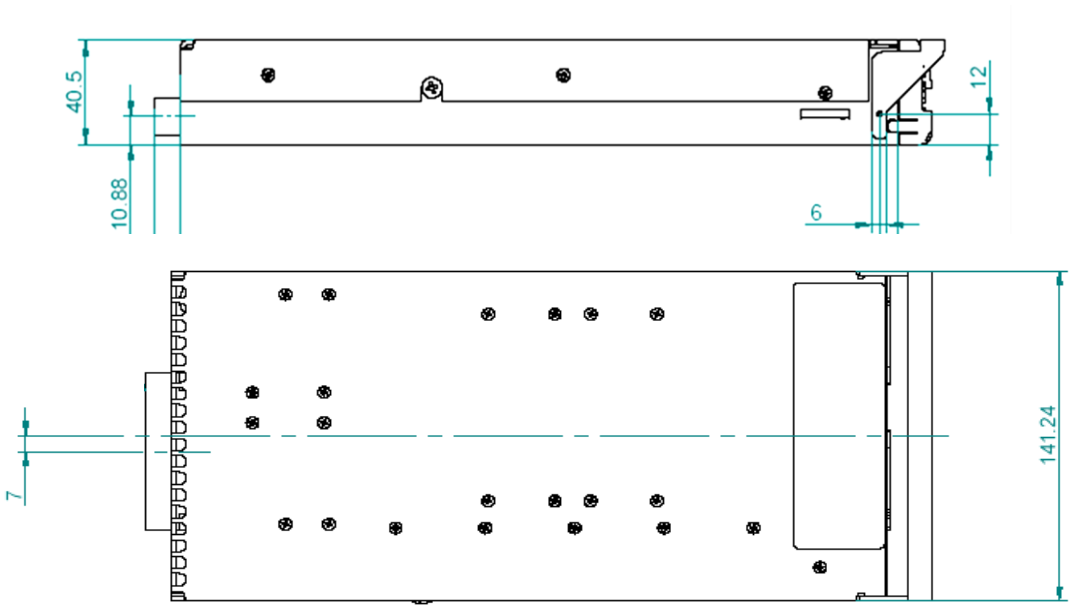
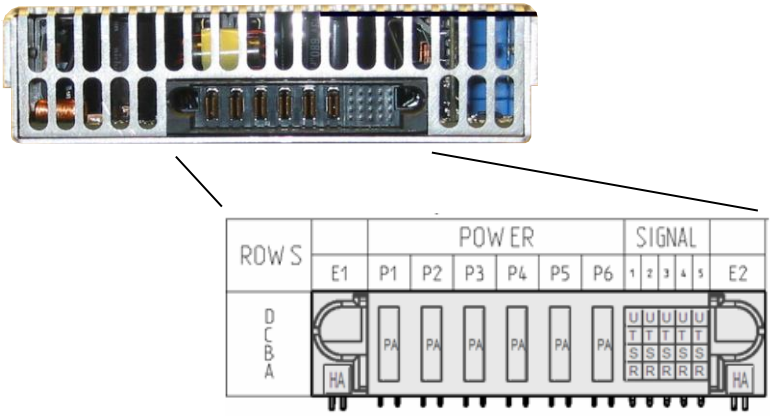
Mechanical Data - FNP1500/1800 48V Models

Mechanical Data (H x W x D): 5.6” (141.2mm) x 1.6” (40.5mm) x 11” (279.4mm)



FNP1500/1800 48V Model Output Connector Descriptions

Rear View



Female Connector: FCI (51732-020 LF)

Mates with:

90° output connector type:  Part No. FCI (manufacturer): 51762-10602000AA LF;
Bel Power Solutions Part No.: ZES258-G

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

Locate information on availability of FCI connectors at http://www.stkcheck.com/evs/fcielectronics/fcisearch.asp
Connector drawings available at: http://portal.fciconnect.com/portal/page/portal/FcicntPublic/DocSrchCustDraw

IEC AC power cord with C19 connector VDE 16A: Interpower Components Ltd. 70009110250
IEC AC power cord with C19 connector UL 20A: Interpower Components Ltd. 70025110250

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Paralleling Front-Ends

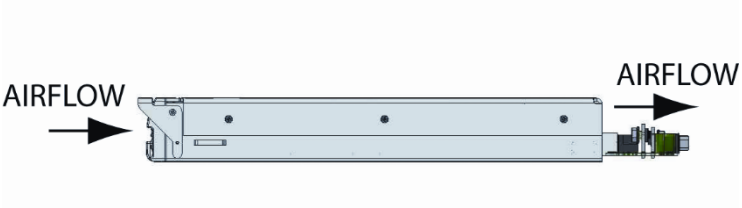
For parallel use in minimal configuration systems, only the inhibit pins must be shorted to logic GND. All other pins can be left open. The power supplies will share the output current automatically (droop current share).

For parallel applications without I²C 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 I²C 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.

Cooling

To achieve best cooling results sufficient airflow through the unit must be ensured. Do not block or obstruct the airflow at the rear of the unit by placing large components directly at the output connector.



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FNR-3-12G and FNR-3-48G Power Shelves

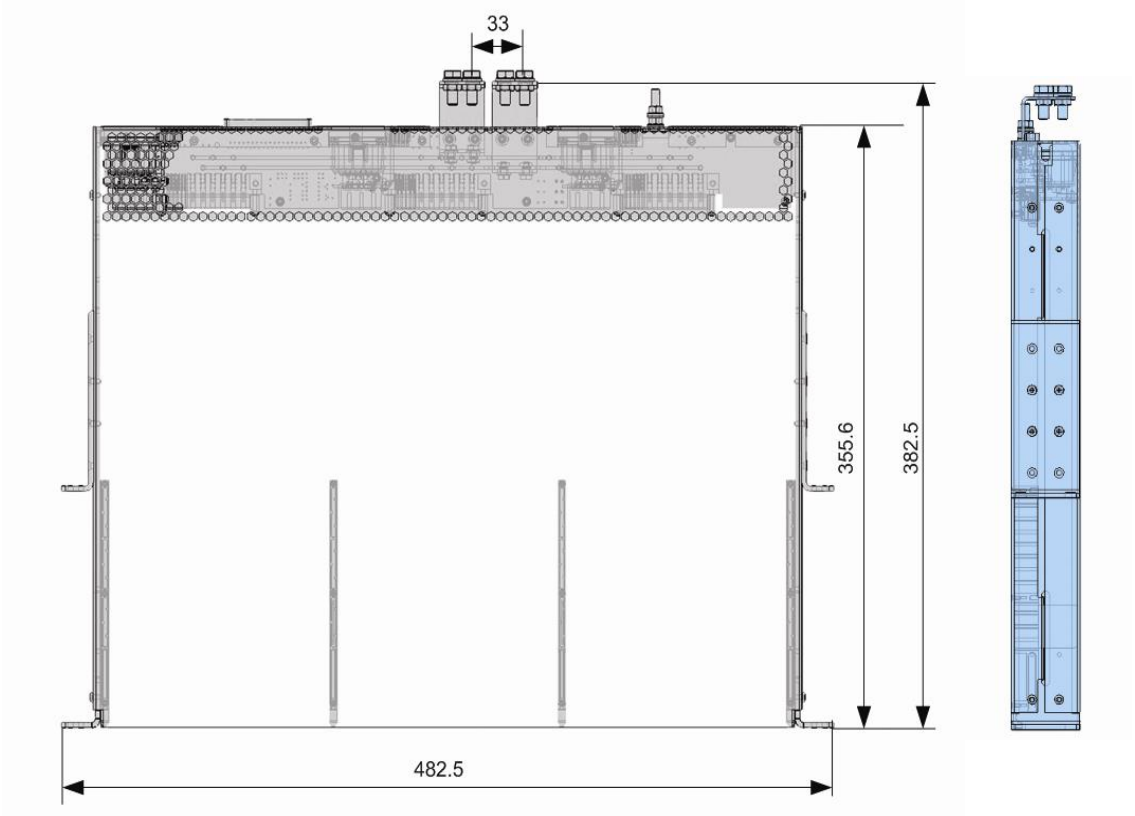
Each rack (power shelf) is 1U high with backplane and designed for up to three front-end models in parallel or in n+1 operation. Each power shelf has:

- 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.

FNR-3-12G and FNR-3-48G Power Shelf Front View

Mechanical Data (FNR-3-12G and FNR-3-48G Power Shelves

Overall Mechanical Dimensions (W x H x D): 17.7” (449.6 mm) x 1.7” (43.1 mm) x 13” (330.2 mm)



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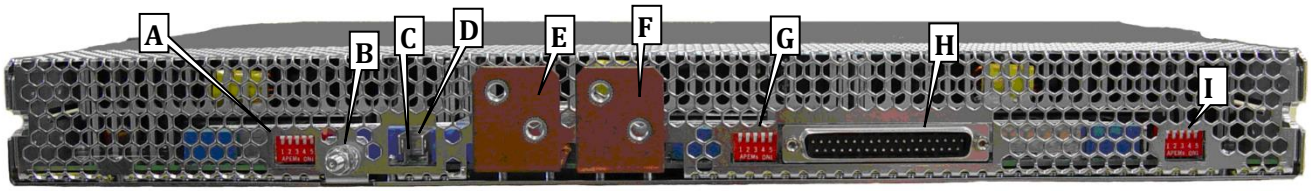
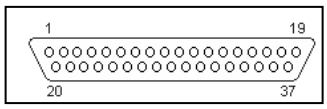
Output Connector Descriptions (FNR-3-12G and FNR-3-48G)



LOCATION	DESCRIPTION
A	5-Bit DIP switch for I^2C addressing of PSU 1
B	Earth connection
C	Earth connection
D	Earth connection
E	Output 1 minus
F	Output 1 plus
G	5-Bit DIP switch for I^2C addressing of PSU 2
H	37-pin SUB-D connector, controlling and auxiliary power (output 2)
I	5-Bit DIP switch for I^2C addressing of PSU 3

SUB-D Output Connector Pinout and Signal Specification



OUTPUT CONNECTOR DESCRIPTION	PIN LOCATION	TYPE	LOW LEVEL HIGH LEVEL	V_{MAX} I_{MAX}
Overtemperature / Fan Fail PSU1	1	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 PSU 1	2	Resistor (1 kΩ) connected to logic GND	Open Pull up	10 V 10 mA
Power Supply Present PSU 2	3	Resistor (1 kΩ) connected to logic GND	Open Pull up	10 V 10 mA
Open	4			
Overtemperature / Fan Fail PSU 3	5	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 PSU 3	6	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 PSU 3	7	Resistor (1 kΩ) connected to logic GND	Open Pull up	10 V 10 mA
DC Fail / Output voltage fault PSU 3	8	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
Overtemperature / Fan Fail PSU 2	9	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
Synch._Start_A	10	Sync_start_A , Active high The signals of several racks can be connected together in such a way that all supplies will be inhibited until the last supply has recovered from its overcurrent condition, referenced to logic GND	<7V off < 9V	15V 10mA
Open	11			

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Output inhibit PSU 1-3	12	Active low (DC-DC stage off when pin is open or on high potential) Referenced to logic GND	<0.8 V >2.0 V	10 V 3.5 mA
V sense +	13	Open or connected to V_{o1}+ at the load Internally (PSU) connected to V_{o1}+ over 100 Ω		dU < 3 V_{pp} 30 mA
V sense -	14	Open or connected to V_{o1}- at the load Internally (PSU) connected to V_{o1}- over 100 Ω		dU < 3 V_{pp} 30 mA
Open	15			
NC	16			
NC	17			
NC	18			
NC	19			
AC Fail / Power-down warning PSU 1	20	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
DC Fail / Output voltage fault PSU 1	21	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 PSU 2	22	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
DC Fail / Output voltage fault PSU 2	23	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
DATA, I^2C data line	24	I^2C compatible signal referenced to logic GND	5 V or 3.3 V logic	
CLOCK, I^2C clock line	25	I^2C compatible signal referenced to logic GND	5 V or 3.3 V logic	
Auxiliary power +12 V (Output 2)	26	V_{o2}+ Aux output, insulated from main output		
Auxiliary power ground (Output 2)	27	V_{o2}- Aux output, insulated from main output		
Logic Gnd	28	Internally connected over 10 Ω to V_{o2}-, Auxiliary GND. Wire separately from auxiliary and main output GND to minimize noise and avoid voltage drops on signal- and I^2C return. Leave open if not used.		
Output margin PSU 1	29	Open or connected to V_{sense-} V_{sense-} (+8 % V_{o1}) or V_{sense+} (-8 % V_{o1})		60V
Output margin PSU 2	30	Open or connected to V_{sense-} V_{sense-} (+8 % V_{o1}) or V_{sense+} (-8 % V_{o1})		60V
Output margin PSU 3	31	Open or connected to V_{sense-} V_{sense-} (+8 % V_{o1}) or V_{sense+} (-8 % V_{o1})		60V
NC	32			
NC	33			
NC	34			
NC	35			
NC	36			
NC	37			

Synchronized Start-Up Circuit for Paralleling Operation

Because of hiccup overcurrent protection, when a supply reaches an overcurrent limit, the output voltage will immediately turn OFF and after a delay turn ON again. In parallel use, all power supplies have to start synchronized because of the internal hiccup behavior. Otherwise, the supply which has reached overcurrent first will go to hiccup; this will overload the other supplies, which then will also go to hiccup. When the first supply has recovered from hiccup (hiccup dead time), the others remain in hiccup. This will immediately drive the first one into hiccup once again. This means that without a start-up circuit, a system with several power supplies can never recover from an overload condition or start-up into full load.

The following additional circuit, required to reach synchronized startup, is already implemented inside the FNR-3-12G and FNR-3-48G shelves.

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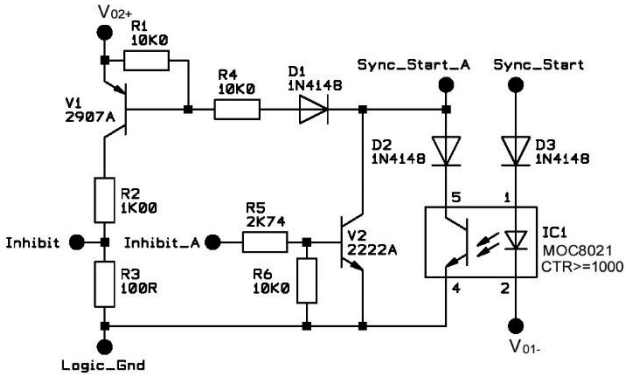
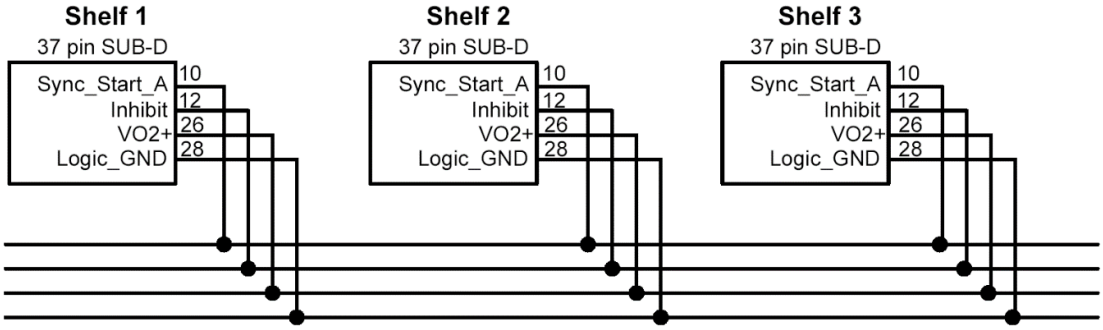


Synch Start-up Connection between Shelves

The following connection between the shelves is required to achieve a parallel operation. The synch-start circuits inside the shelves inhibit all power supplies until the last one has recovered from its overcurrent condition and then synchronize the restart of the outputs.



Synch Start-up Circuit Description

DESCRIPTION	PIN LOCATION, DEFINITION	TYPE	LOW LEVEL HIGH LEVEL	V MAX I MAX
Auxiliary power +12 V (Output 2)	26	V_{o2}+, Aux output, insulated from main output		
Logic ground	28	Logic_GND ,Internally connected over 10 Ω to V_{o2}-, (Auxiliary power ground (Output 2))		
Output inhibit_A PSU 1-3	12	Inhibit_A ,Active low (DC-DC stage off) Referenced to Logic_GND	<0.8 V >2.0 V	10 V 3.5 mA
Synch. Startup 1 PSU 1-3	R5 (at PSU)	The synch_start pin is connected to the overcurrent signal of the PSU1-3. In the case of an overcurrent shutdown, this signal goes high. Referenced to V_{o1}-	<7V off > 9V	15V 10mA
Synch. Startup_A	10	Sync_start_A , Active high		
Rack FNR-3-12G & Rack FNR-3-48G 1-N Pin on the D-Sub connector on the backplane		The signals of several racks can be connected together in such a way that all supplies will be inhibited until the last supply has recovered from its overcurrent condition. Referenced to Logic_GND		

NOTE: The Sync-Start pins can be wired together only if the power supplies are connected with a minimal voltage drop on power ground as achieved on a backplane with massive copper bus bars. If there is a less ideal connection, it is recommended to use an opto-coupler for each unit (IC1, D3, D2).

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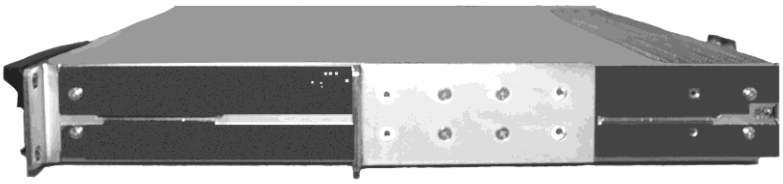
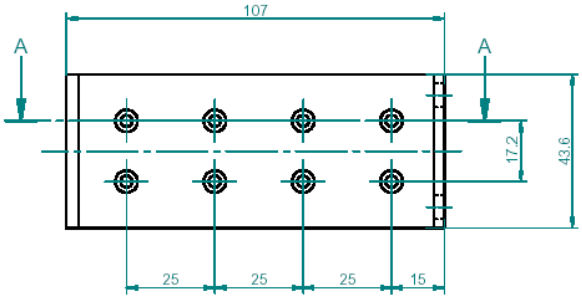
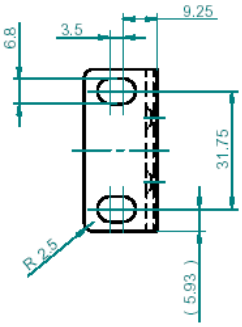
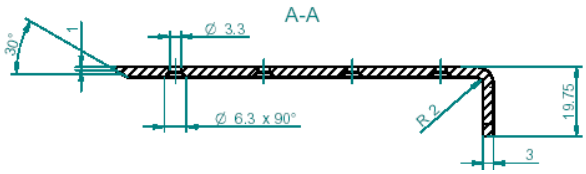
Accessories



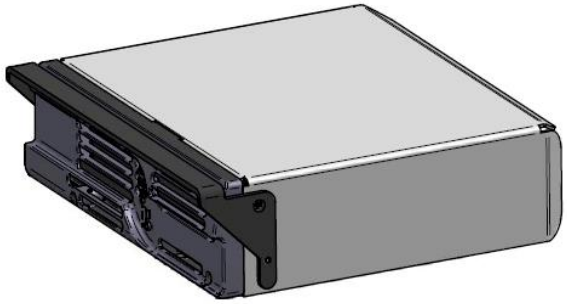
Center Angular Brackets are set in the middle for shelf mounting:

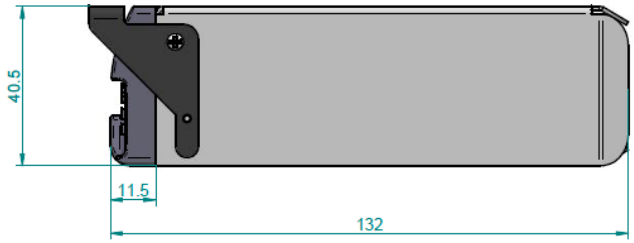


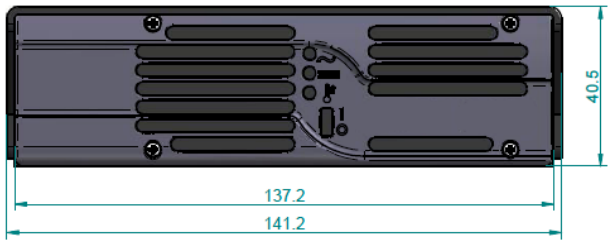




Center Angular Bracket sets can be ordered: Bel Power Solutions part no.: HZZ01222
Note: Each Center Angular Bracket set contains 2 brackets and 8 screws.
Filler for covering empty shelf slots:







Filler can be ordered: Bel Power Solutions part no.: XAK.00043.0

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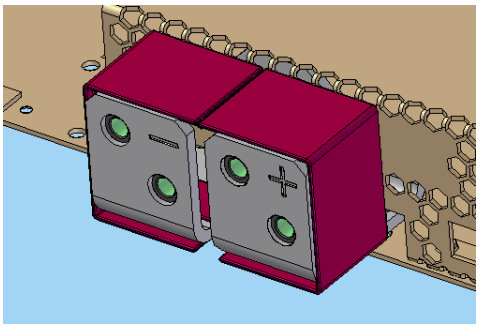
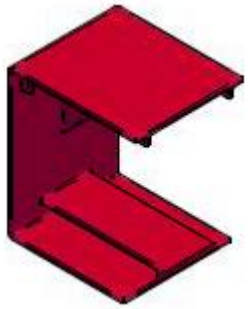
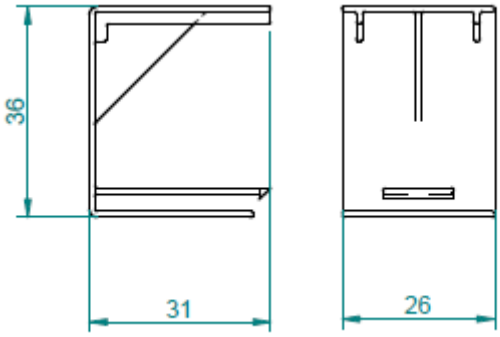
Plastic cover set for the bus bars:





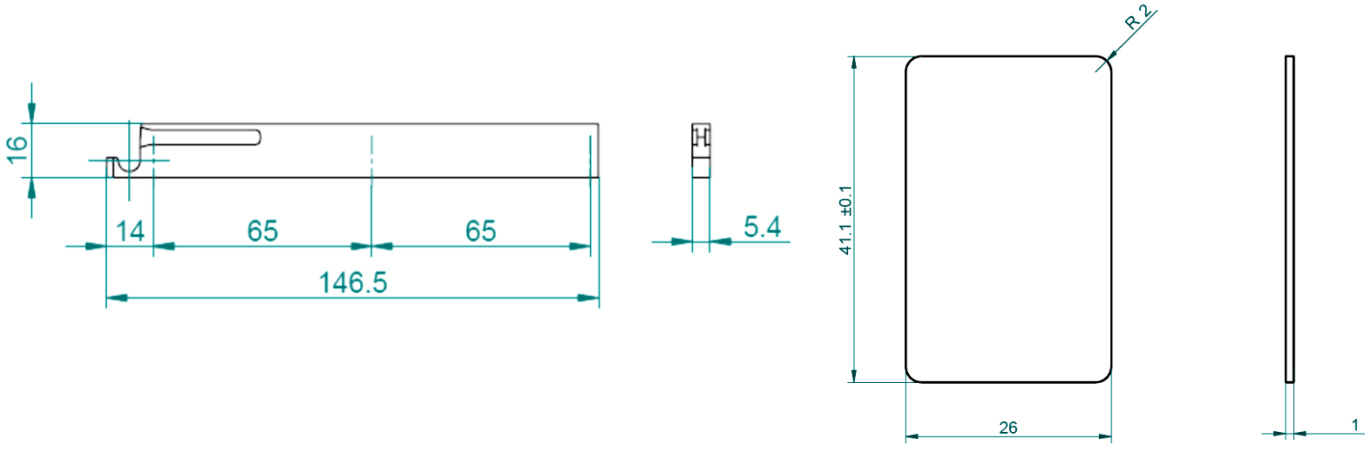


Plastic cover set can be ordered: Bel Power Solutions part no.: XEB.00031.0
Note1: Available upon special request.
Note2: Each plastic cover set contains 2 pieces.

Fulcrum

The handle has been designed to allow easy plug-in and -out in a rack system. The handle (lever) fits into a counter piece (fulcrum) which is fixed to the bottom of the rack. During the plug, the fulcrum holds the unit down and guides it towards the output connector. The Bel Power Solutions part number of the fulcrum and its associated mounting accessories is: HZZ01223.

Individual fulcrum sets can be also ordered: Bel Power Solutions part no.: HZZ01223.
Note: Each HZZ01223 set contain 2 fulcrums, 2 supports, and mounting accessories.



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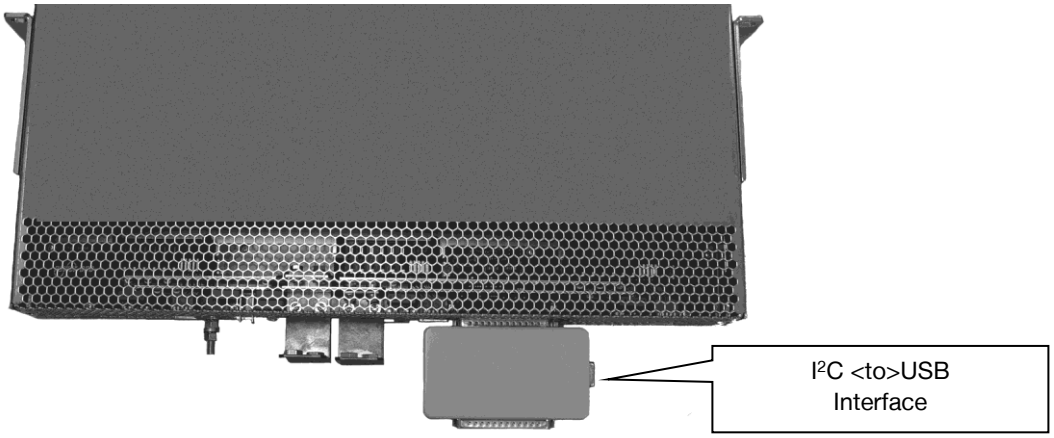
FNP1500/FNP1800

I²C to USB Interface HZZ02002G



I²C Management Software: All FNP front-ends can be controlled via Bel Power Solutions GUI-driven I²C Management software and an I²C-to-USB interface (P/N HZZ02002G). An I²C Programming Manual describes the complete range of parameters that can be programmed to the FNP1500/1800 front-ends. This manual is available by searching on "FNP1500" at www.belpowersolutions.com.

For more information on these products consult: tech.support@psbel.com

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