

# PET2000-12-074xH

## AC-DC / HVDC Front-End Power Supply

PET2000-12-074xH is a 2000 Watt, power-factor corrected (PFC) power supply that converts standard AC or DC power into a main output of +12 VDC.

PET2000-12-074xH utilizes full digital control architecture for greater efficiency, control and functionality.

This power supply meets international safety standards and displays the CE-Mark for the European Low Voltage Directive (LVD).



### Key Features & Benefits

- Best-in-class, Meet 80 PLUS "Platinum" Efficiency
- Auto-Selected Input Voltage Ranges: 90...140 VAC, 180 ... 305 VAC, 192 VDC...400 VDC
- AC Input with Power Factor Correction
- 2000 W Continuous Output Power Capability
- Always-On 12 V Standby Output
- Hot-Plug Capable
- Parallel Operation with Active Current Sharing
- Full Digital Controls for Improved Performance
- High Density Design: 42.1 W/in<sup>3</sup>
- Small Form Factor: 73.5 x 40.0 x 265 mm (2.9 x 1.6 x 10.4 in)
- Power Management Bus Communication Protocol for Control, Programming and Monitoring
- Status LED with Fault Signaling
- Approved to latest edition of the following standards: UL/CSA 62368-1, IEC/EN 62368-1

### Applications

- Networking Switches
- Servers & Routers
- Telecommunications



## 1. ORDERING INFORMATION

PET	2000	-	12	-	074	x	H	
Product Family	Power Level	Dash	V1 Output	Dash	Width	Airflow	Input	Inlet <sup>1</sup>
PET Front-Ends	2000 W		12 V		74 mm	N: Normal R: Reverse	H: AC or DC	Saf-D-Grid®

## 2. OVERVIEW

The PET2000-12-074xH AC/DC power supply is a fully DSP controlled, highly efficient front-end power supply. It incorporates resonance-soft-switching technology to reduce component stresses, providing increased system reliability and very high efficiency. With a wide input operational voltage range the PET2000-12-074xH maximizes power availability in demanding server, network, and other high availability applications. The supply is fan cooled and ideally suited for integration with a matching airflow path.

The PFC stage is digitally controlled using a state-of-the-art digital signal processing algorithm to guarantee best efficiency and unity power factor over a wide operating range.

The DC/DC stage uses soft switching resonant techniques in conjunction with synchronous rectification. An active OR-ing device on the output ensures no reverse load current and renders the supply ideally suited for operation in redundant power systems.

The always-on standby output provides power to external power distribution and management controllers. It is protected with an active OR-ing device for maximum reliability.

Status information is provided with a front-panel LED. In addition, the power supply can be controlled and the fan speed set via the I2C bus. The I2C bus allows full monitoring of the supply, including input and output voltage, current, power, and inside temperatures. Cooling is managed by a fan controlled by the DSP controller. The fan speed is adjusted automatically depending on the actual power demand and supply temperature and can be overridden through the I2C bus.

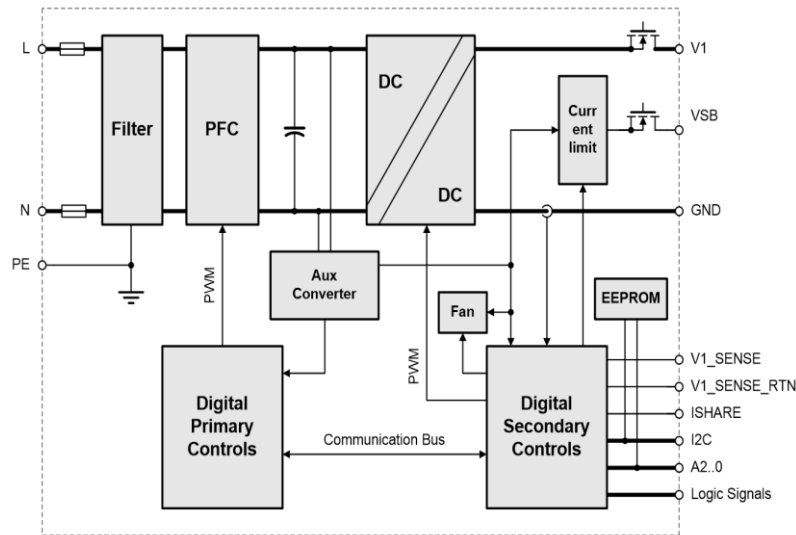


Figure 1. PET2000-12-074xH Block Diagram

## 3. ABSOLUTE MAXIMUM RATINGS

Stresses in excess of the absolute maximum ratings may cause performance degradation, adversely affect long-term reliability and cause permanent damage to the supply.

PARAMETER	CONDITIONS / DESCRIPTION	MIN	MAX	UNITS
$V_i \text{ maxc}$	Maximum Input		305	VAC
			400	VDC

Saf-D-Grid® = Anderson Saf-D-Grid®



tech.support@psbel.com  
belfuse.com/power-solutions

## 4. INPUT

General Condition:  $T_A = 0 \dots 55 \text{ }^\circ\text{C}$ , unless otherwise noted.

PARAMETER		DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
$V_{i\,nom}$	Nominal Input Voltage	Rated Voltage High Line ( $V_{i\,nom\,HL}$ )	200	230	277	VAC
		Rated Voltage Low Line ( $V_{i\,nom\,LL}$ )	100	115	127	VAC
		Rated Voltage DC	192	240/380	400	VDC
$V_i$	Input Voltage Ranges	Normal operating ( $V_{i\,min\,HL}$ to $V_{i\,max\,HL}$ ), High Line	180		305	VAC
		Normal operating ( $V_{i\,min\,LL}$ to $V_{i\,max\,LL}$ ), Low Line	90		140	VAC
$I_{i\,max}$	Maximum Input Current	$V_i$ =100 VAC, $I_I$ = 83 A, $I_{SB}$ = 3 A			13	$A_{RMS}$
		$V_i$ = 200 VAC, $I_I$ =167 A, $I_{SB}$ = 3 A			12	
		$V_i$ = 230 VAC, $I_I$ =167 A, $I_{SB}$ = 3 A			10	
		$V_i$ = 192 VDC, $I_I$ =167 A, $I_{SB}$ = 3 A			12	
$I_{i\,inrush}$	Inrush Current Limitation	$V_{i\,min}$ to $V_{i\,max}$ , $T_{NTC}$ = 25°C, 5 ms			10	A <sub>p</sub>
$f_i$	Input Frequency		47	50/60	63	Hz
$PF$	Power Factor	$V_i$ = 230 VAC, 10% load	0.8	0.880		W/VA
		$V_i$ = 230 VAC, 20% load	0.9	0.950		W/VA
		$V_i$ = 230 VAC, 50% load	0.9	0.997		W/VA
		$V_i$ = 230 VAC, 100% load	0.95	0.999		W/VA
$THD$	Total Harmonic Distortion	TBD			TBD	%
$V_{i\,on}$	Turn-on Input Voltage <sup>2</sup>	Ramping up	87		90	VAC
$V_{i\,off}$	Turn-off Input Voltage <sup>2</sup>	Ramping down	82		87	VAC
$\eta$	Efficiency <sup>3</sup>	$V_i$ = 230 VAC, 10% load	90	91.6		%
		$V_i$ = 230 VAC, 20% load	91	93.8		%
		$V_i$ = 230 VAC, 50% load	94	94.4		%
		$V_i$ = 230 VAC, 100% load	91	92.8		%
$T_{V1\,holdup}$	Hold-up Time $V_i$	$V_i$ = 230 VAC, 50% load, 0°	18			ms
		$V_i$ = 230 VAC, 100% load, 0°	9			ms
$T_{VSB\,holdup}$	Hold-up Time $V_{SB}$	$V_i$ = 90 to 264 VAC, 0 to 100% load	70			ms

### 4.1 INPUT CONNECTOR

PET2000-12-074xH power supply uses the Anderson Saf-D-Grid® connector. The connector has no limitation with respect to both current and temperature.

Below table shows the maximum rated operating conditions for the different input connector options. The applied operating condition must remain within these conditions to allow safety compliant operation.

See also [10.3 MAXIMUM OUTPUT POWER VERSUS INLET TEMPERATURE FOR SAFETY COMPLIANCY](#) for detailed derating curves.

<sup>2</sup> The Front-End is provided with a minimum hysteresis of 3 V during turn-on and turn-off within the ranges

<sup>3</sup> Efficiency measured without fan power per EPA server guidelines



TYPE	INPUT CONNECTOR	REGION	APPLIED RATED MAINS AC VOLTAGE <sup>4</sup>	MAX $I^5$	MAXIMUM DERATED $I_T$ AT MAXIMUM $T_A$
PET2000-12-074NH	Anderson Saf-D-Grid®	All	100 to 127 VAC	83 A	50 A at $T_A = 55^\circ\text{C}$
			200 to 277 VAC	167 A	100 A at $T_A = 55^\circ\text{C}$
			200 to 277 VAC	167 A	100 A at $T_A = 55^\circ\text{C}$
			192 to 400 VDC	167 A	100 A at $T_A = 55^\circ\text{C}$
PET2000-12-074RH	Anderson Saf-D-Grid®	All	100 to 127 VAC	83 A	50 A at $T_A = 70^\circ\text{C}$
			200 to 277 VAC	167 A	100 A at $T_A = 70^\circ\text{C}$
			200 to 277 VAC	167 A	100 A at $T_A = 70^\circ\text{C}$
			192 to 400 VDC	167 A	100 A at $T_A = 70^\circ\text{C}$

## 4.2 INPUT FUSE

Two Time-lag 16 A input fuses (5 x 20 mm) in series with the L-line and N-Line inside the power supply protects against severe defects. The fuse is not accessible from the outside and is therefore not a serviceable part.

## 4.3 INRUSH CURRENT

The AC-DC power supply exhibits an X-capacitance of only 5.7  $\mu\text{F}$ , resulting in a low and short peak current, when the supply is connected to the mains. The internal bulk capacitor will be charged through an NTC which will limit the inrush current.

### NOTE:

Do not repeat plug-in / out operations within a short time, or else the internal in-rush current limiting device (NTC) may not sufficiently cool down and excessive inrush current or component failure(s) may result.

## 4.4 INPUT UNDER-VOLTAGE

If the sinusoidal input voltage stays below the input undervoltage lockout threshold  $V_{i\text{on}}$ , the supply will be inhibited. Once the input voltage returns within the normal operating range, the supply will return to normal operation again.

## 4.5 POWER FACTOR CORRECTION

Power factor correction (PFC) is achieved by controlling the input current waveform synchronously with the input voltage. A fully digital controller is implemented giving outstanding PFC results over a wide input voltage and load ranges. The input current will follow the shape of the input voltage. If for instance the input voltage has a trapezoidal waveform, then the current will also show a trapezoidal waveform.

## 4.6 EFFICIENCY

High efficiency (see [Figure 2](#)) is achieved by using state-of-the-art silicon power devices in conjunction with soft-transition topologies minimizing switching losses and a full digital control scheme. Synchronous rectifiers on the output reduce the losses in the high current output path. The speed of the fan is digitally controlled to keep all components at an optimal operating temperature regardless of the ambient temperature and load conditions.

<sup>4</sup> Nominal grid voltage, does not include typical fluctuations of  $\pm 10\%$ ; e.g. listed range 230-277 VAC allows operation at 230 VAC  $-10\%$  to 277 VAC  $+10\%$ , so 305 VAC actual voltage to account for grid fluctuations

<sup>5</sup> Maximum Input current for PET2000-12-074RH at  $T_A = 40^\circ\text{C}$  and for PET2000-12-074NH at  $T_A = 55^\circ\text{C}$

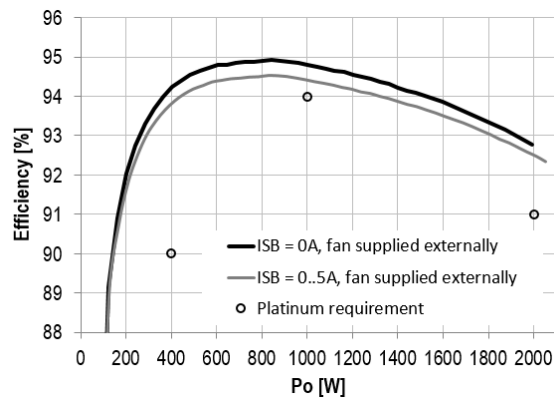


Figure 2. Efficiency vs. Load current (ratio metric loading)

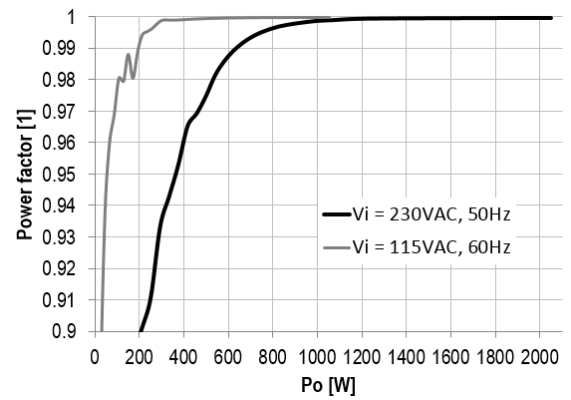


Figure 3. Power factor vs. Load current

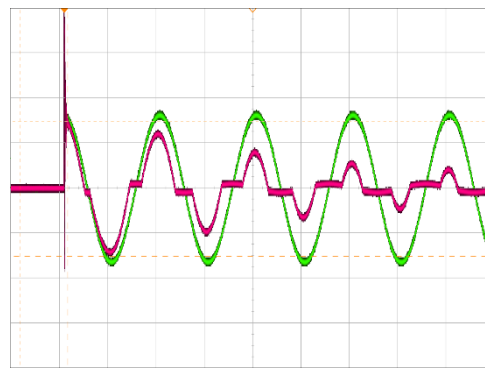


Figure 4. Inrush current,  $V_i = 230\text{Vac}$ ,  $90^\circ$   
CH2:  $V_i$  (200V/div), CH3:  $I_i$  (5A/div)



## 5. OUTPUT

### 5.1 MAIN OUTPUT $V_1$

General Condition:  $T_A = 0 \dots 40^\circ\text{C}$  (PET2000-12-074RH),  $T_A = 0 \dots 55^\circ\text{C}$  (PET2000-12-074NH),  $V_i = 230\text{ VAC}$  unless otherwise noted.

PARAMETER		DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
$V_{1\text{ nom}}$	Nominal Output Voltage			12.0		VDC
$V_{1\text{ set}}$	Output Setpoint Accuracy	$0.5 \cdot I_{1\text{ nom}}, T_A = 25^{\circ}\text{C}$	-0.5		+0.5	% $V_{1\text{ nom}}$
$dV_{1\text{ tot}}$	Static Regulation	$V_{1\text{ min LL}}$ to $V_{1\text{ max HL}}, 0$ to 100% $I_{1\text{ nom}}$	-1		+1	% $V_{1\text{ nom}}$
$P_{1\text{ nom}}$	Nominal Output Power <sup>6</sup>	$V_{1\text{ min HL}}$ to $V_{1\text{ max HL}}$		2000		W
		$V_{1\text{ min LL}}$ to $V_{1\text{ max LL}}$		1000		W
		$V_{1\text{ min DC}}$ to $V_{1\text{ max DC}}$		2000		W
$P_{1\text{ peak}}$	Peak Output Power <sup>6</sup>	$V_{1\text{ min HL}}$ to $V_{1\text{ max HL}}$		2100		W
		$V_{1\text{ min LL}}$ to $V_{1\text{ max LL}}$		1320		W
		$V_{1\text{ min DC}}$ to $V_{1\text{ max DC}}$		2100		W
$I_{1\text{ nom}}$	Output Current	$V_{1\text{ min HL}}$ to $V_{1\text{ max HL}}$	0		167	ADC
$V_{1\text{ min LL}}$ to $V_{1\text{ max LL}}$			0		83	ADC
$I_{1\text{ nom red}}$		$V_{1\text{ min DC}}$ to $V_{1\text{ max DC}}$		0		167
$I_{1\text{ peak}}$	Peak Output Current <sup>7</sup>	$V_{1\text{ min HL}}$ to $V_{1\text{ max HL}}$	0		175	ADC
$I_{1\text{ peak red}}$		$V_{1\text{ min LL}}$ to $V_{1\text{ max LL}}$		0		110
$V_{1\text{ pp}}$	Output Ripple Voltage <sup>8</sup>	$V_{1\text{ min LL}}$ to $V_{1\text{ max HL}}, 0$ to 75% $I_{1\text{ nom}}, C_{\text{ext}} = 0\text{ mF}$			120	mVpp
		$V_{1\text{ min LL}}$ to $V_{1\text{ max HL}}, 75$ to 100% $I_{1\text{ nom}}, C_{\text{ext}} = 0\text{ mF}$			150	mVpp
		$V_{1\text{ min LL}}$ to $V_{1\text{ max HL}}, 0$ to 100% $I_{1\text{ nom}}, C_{\text{ext}} \geq 1\text{ mF/Low ESR}$			120	mVpp
$dV_{1\text{ load}}$	Load Regulation	0 to 100% $I_{1\text{ nom}}$	-83	-110	-138	mV
$dV_{1\text{ line}}$	Line Regulation	$V_{1\text{ min HL}}$ to $V_{1\text{ max HL}}, 0.5 \cdot I_{1\text{ nom}}$	-24	0	24	mV
$dV_{1\text{ temp}}$	Thermal Drift	$0.5 \cdot I_{1\text{ nom}}, T_A = 0 \dots 55^{\circ}\text{C}$		-0.4		mV/°C
$dI_{1\text{ share}}$	Current Sharing	Difference between individual $I_i$ , 1 ... 8 power supplies in parallel	-6		+6	ADC
$V_{\text{ISHARE}}$	Current Share Bus Voltage	$V_{\text{ISHARE}}$ at 167A		8.721		VDC
$V_{\text{ISHARE}}$	Current Share Bus Voltage	$V_{\text{ISHARE}}$ at $I_{1\text{ peak}}$ (180A)		9.4		VDC
$dV_{1\text{ lt}}$	Load Transient Response	$\Delta h = 50\%$ $I_{1\text{ nom}}, I_1 = 5 \dots 100\%$ $I_{1\text{ nom}}, C_{\text{ext}} = 0\text{ mF}$		0.35	0.6	VDC
$dV_{1\text{ lt}}$		$\Delta h = 10\%$ $I_{1\text{ nom}}, I_1 = 0 \dots 10\%$ $I_{1\text{ nom}}, C_{\text{ext}} = 0\text{ mF}$		0.35	0.6	VDC
$t_{\text{rec}}$	Recovery Time	$dh/dt = 1\text{ A}/\mu\text{s}$ , recovery within 1% of $V_{1\text{ nom}}$		0.5	1	ms
$V_{1\text{ dyn}}$	Dynamic Load Regulation	$\Delta h = 60\%$ $I_{1\text{ nom}}, I_1 = 5 \dots 167\text{ A}, f = 50 \dots 5000\text{ Hz}$ , Duty cycle = 10 ... 90%, $C_{\text{ext}} = 2 \dots 30\text{ mF}$	11.4		12.6	V
$t_{V1\text{ rise}}$	Output Voltage Rise Time	$V_1 = 10\text{...}90\%$ $V_{1\text{ nom}}, C_{\text{ext}} < 10\text{ mF}$	1		30	ms
$t_{V1\text{ ovr sh}}$	Output Turn-on Overshoot	0 to 100% $I_{1\text{ nom}}$			0.6	V
$dV_{1\text{ sense}}$	Remote Sense	Compensation for cable drop, 0 to 100% $I_{1\text{ nom}}$			0.25	V
$C_{V1\text{ load}}$	Capacitive Loading		0		30	mF

<sup>6</sup> See also chapter [TEMPERATURE AND FAN CONTROL](#)

<sup>7</sup> Peak combined power for all outputs must not exceed 2100 W; maximum of peak power duration is 20 seconds without asserting the SMBAlert signal

<sup>8</sup> Measured with a 10  $\mu\text{F}$  low ESR capacitor in parallel with a 0.1  $\mu\text{F}$  ceramic capacitor at the point of measurement

## 5.2 STANBY OUTPUT $V_{SB}$

General Condition:  $T_A = 0 \dots 40^\circ\text{C}$  (PET2000-12-074RH),  $T_A = 0 \dots 55^\circ\text{C}$  (PET2000-12-074NH),  $V_i = 230\text{ VAC}$  unless otherwise noted.

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
$V_{SB\text{ nom}}$	Nominal Output Voltage		12.1		VDC
$V_{SB\text{ set}}$	Output Setpoint Accuracy	-1		+1	% $V_{SB\text{ nom}}$
$dV_{SB\text{ tot}}$	Total Regulation	-5		+1	% $V_{SB\text{ nom}}$
$P_{SB\text{ nom}}$	Nominal Output Power		36		W
			60		W
$P_{SB\text{ peak}}$	Peak Output Power <sup>9</sup>		36		W
			60		W
$I_{SB\text{ nom}}$	Output Current	0		3	ADC
				3	ADC
$I_{SB\text{ peak}}$	Peak Output Current <sup>9</sup>	0		3.3	ADC
				3.3	ADC
$V_{SB\text{ pp}}$	Output Ripple Voltage <sup>7</sup>			120	mVpp
$dV_{SB\text{ load}}$	Load Regulation		-240		mV
$dV_{SB\text{ line}}$	Line Regulation	-24	0	24	mV
$dV_{SB\text{ temp}}$	Thermal Drift		-0.5		mV/°C
$dI_{SB\text{ share}}$	Current Sharing	-1		+1	ADC
$V_{SB\text{ dyn}}$	Load Transient Response		0.2	0.3	VDC
$t_{\text{rec}}$	Recovery Time		1	2	ms
$V_{SB\text{ dyn}}$	Dynamic Load Regulation	11.4		12.6	V
$t_{V_{SB}\text{ rise}}$	Output Voltage Rise Time	1	2	5	ms
$t_{V_{SB}\text{ ovr sh}}$	Output Turn-on Overshoot			0.6	V
$C_{V_{SB}\text{ load}}$	Capacitive Loading	0		3100	μF

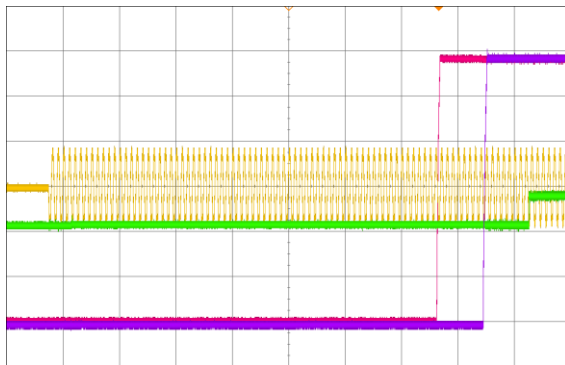


Figure 5. Turn-On AC Line 230VAC, full load (200ms/div)  
CH1:  $V_{in}$  (400V/div) CH2:  $PWOK\_H$  (5V/div)  
CH3:  $V_i$  (2V/div) CH4:  $V_{SB}$  (2V/div)

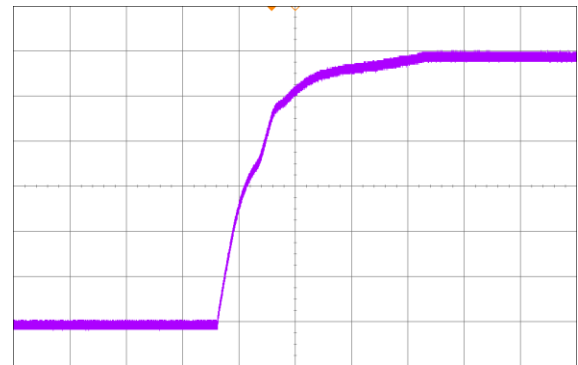


Figure 6. Rise time  $V_i$  at 230VAC, full load (2ms/div)  
CH3:  $V_i$  (2V/div)

<sup>9</sup> In single power supply configuration

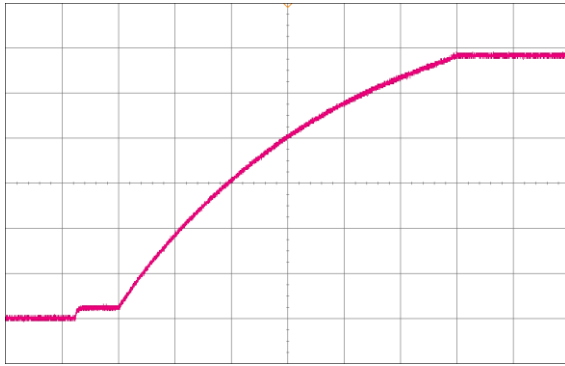


Figure 7. Rise time  $V_{SB}$  at 230VAC, full load (2ms/div)  
CH4:  $V_{SB}$  (2V/div)

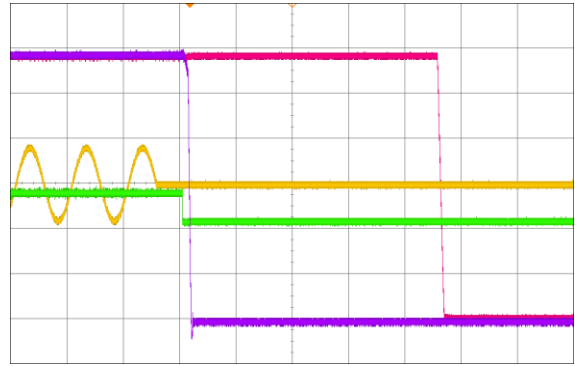


Figure 8. Turn-Off AC Line 230VAC, full load (20ms/div)  
CH1:  $V_{in}$  (400V/div) CH2:  $PWOK\_H$  (5V/div)  
CH3:  $V_I$  (2V/div) CH4:  $V_{SB}$  (2V/div)

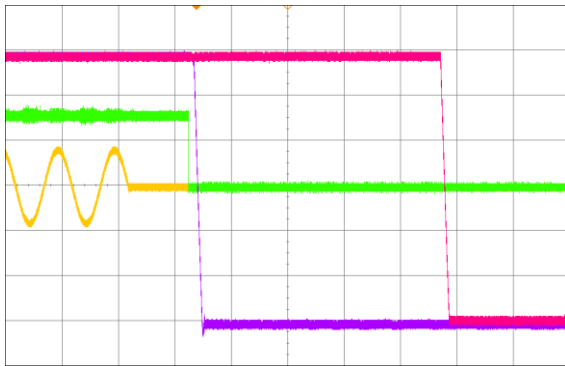


Figure 9. Turn-Off AC Line 230VAC, half load (20 ms/div)  
CH1:  $V_{in}$  (400V/div) CH2:  $PWOK\_H$  (5V/div)  
CH3:  $V_I$  (2V/div) CH4:  $V_{SB}$  (2V/div)

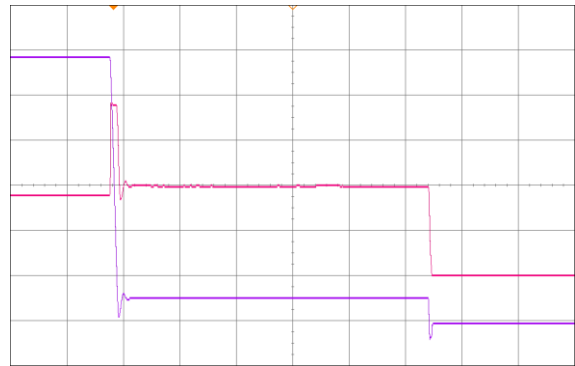


Figure 10. Short circuit on  $V_I$  (10 ms/div)  
CH3:  $V_I$  (2V/div) CH4:  $I_I$  (100A/div)

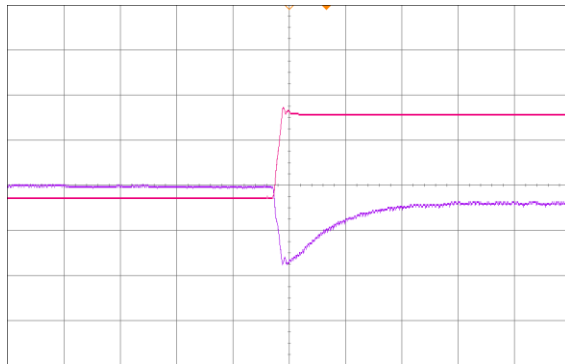


Figure 11. Load transient  $V_I$ , 83 to 167A (500  $\mu$ s/div)  
CH3:  $V_I$  (200mV/div) CH4:  $I_I$  (50A/div)

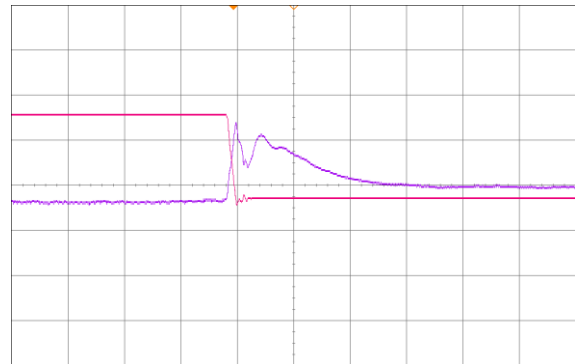


Figure 12. Load transient  $V_I$ , 167 to 83A (500  $\mu$ s/div)  
CH3:  $V_I$  (200mV/div) CH4:  $I_I$  (50A/div)

### 5.3 OUTPUT GROUND / CHASSIS CONNECTION

The output return path serves as power and signal ground. All output voltages and signals are referenced to these pins. To prevent a shift in signal and voltage levels due to ground wiring voltage drop a low impedance ground plane should be used as shown in Figure 13. Alternatively, separated ground signals can be used as shown in

Figure 14. In this case the two ground planes should be connected together at the power supplies ground pins.





**NOTE:**

Within the power supply the output GND pins are connected to the Chassis, which in turn is connected to the Protective Earth terminal on the AC inlet. Therefore, it is not possible to set the potential of the output return (GND) to any other than Protective Earth potential.

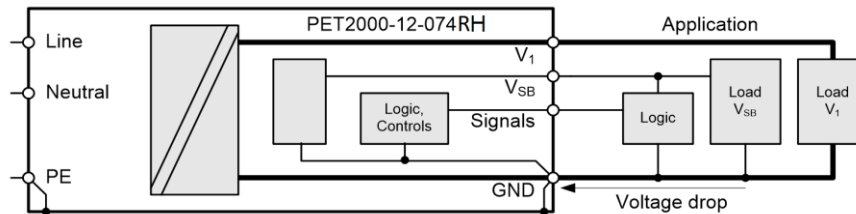


Figure 13. Common low impedance ground plane

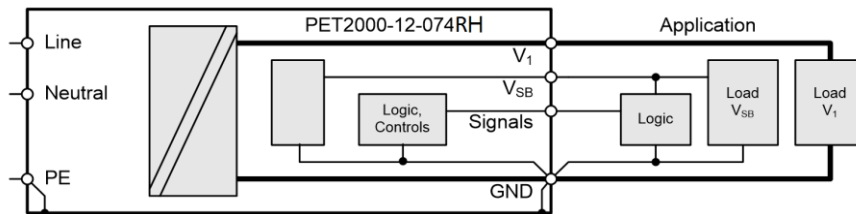


Figure 14. Separated power and signal ground

## 6. PROTECTION

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
$F$	Input fuse (L)	Not use accessible, time-lag (T)			A
$V_1 OV$	OV Threshold $V_1$	13.3	13.9	14.5	VDC
$t_{V1 OV}$	OV Trip Time $V_1$	Over Voltage $V_1$ Protection, Latch-off Type			1 ms
$V_{SB OV}$	OV Threshold $V_{SB}$	13.3	13.9	14.5	VDC
$t_{VSB OV}$	OV Trip Time $V_{SB}$	Over Voltage $V_1$ Protection, Automatic retry each 1s			1 ms
$I_1 OC Slow$	OC Limit $V_1$	Over Current Limitation, Latch-off, $V_1 min HL$ to $V_1 max HL$ , $V_1 min DC$ to $V_1 max DC$			175 ADC
		Over Current Limitation, Latch-off, $V_1 min LL$ to $V_1 max LL$			88 ADC
$t_{V1 OC Slow}$	OC Trip time $V_1$	Over Current Limitation, Latch-off time			20 s
$I_{V1 OC Fast}$	Fast OC Limit $V_1$	Fast Over Current Limit., Latch-off, $V_1 min HL$ to $V_1 max HL$ , $V_1 min DC$ to $V_1 max DC$			180 ADC
		Fast Over Current Limit., Latch-off, $V_1 min LL$ to $V_1 max LL$			115 ADC
$t_{V1 OC Fast}$	Fast OC Trip time $V_1$	Fast Over Current Limitation, Latch-off time			50 55 60 ms
$I_1 SC$	Max Short Circuit Current $V_1$	$V_1 < 3 V$			180 A
$t_{V1 SC}$	Short Circuit Regulation Time	$V_1 < 3 V$ , time until $I_1$ is limited to $< I_1 SC$			2 ms
$I_{SB OC}$	OC Limit $V_{SB}$	Over Current Limitation, Constant-Current Type			5.2 7.5 A
$t_{VSB OC}$	OC Trip time $V_{SB}$	Over Current Limit., time until $I_{SB}$ is limited to $I_{SB OC}$			1 ms
$T_{SD}$	Over Temperature	See chapter 10.2			°C

## 6.1 OVERVOLTAGE PROTECTION

PET2000-12-074xH front-end provides a fixed threshold overvoltage (OV) protection implemented with a HW comparator for both the main and the standby output. Once an OV condition has been triggered on the main output, the supply will shut down and latch the fault condition. The latch can be unlocked by disconnecting the supply from the AC mains or by toggling the PS\_ON\_L input. The standby output will continuously try to restart with a 1 s interval after OV condition has occurred.

## 6.2 UNDERVOLTAGE DETECTION

Both main and standby outputs are monitored. LED and PWOK\_H pin signal if the output voltage exceeds  $\pm 5\%$  of its nominal voltage.

The main output will latch off if the main output voltage  $V_I$  falls below 10 V (typically in an overload condition) for more than 55 ms. The latch can be unlocked by disconnecting the supply from the AC mains or by toggling the PS\_ON\_L input.

If the standby output leaves its regulation bandwidth for more than 2 ms then the main output is disabled to protect the system.

## 6.3 CURRENT LIMITATION

### MAIN OUTPUT

The main output exhibits a substantially rectangular output characteristic controlled by a software feedback loop. If output current exceeds  $I_{V1\ OC\ Fast}$  it will reduce output voltage in order to keep output current at  $I_{V1\ OC\ Fast}$ . If the output voltage drops below  $\sim 10.0$  VDC for more than 55 ms, the output will latch off (standby remains on), see also [Undervoltage Detection](#).

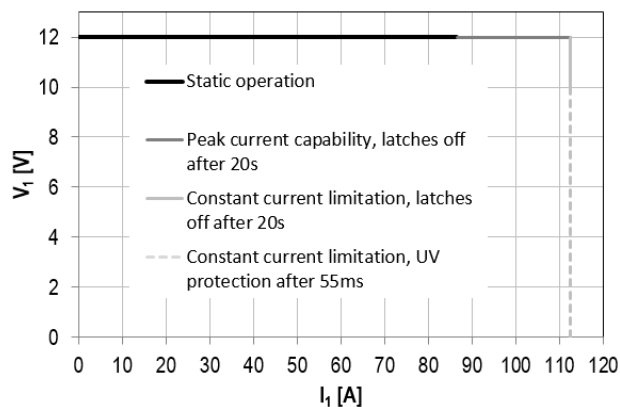


Figure 15. Current Limitation on  $V_I$   
at  $V_I = 90 \dots 140$  VAC

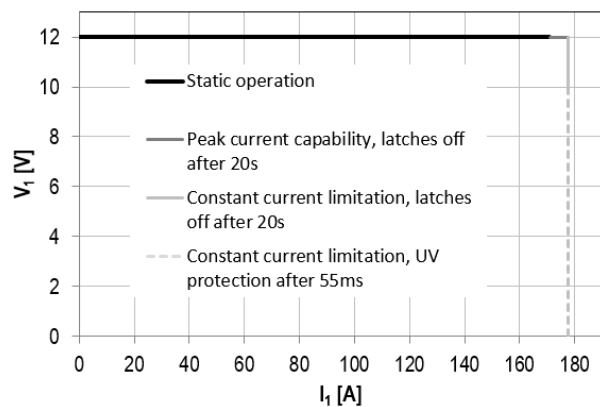


Figure 16. Current Limitation on  $V_I$   
at  $V_I = 180 \dots 305$  VAC

A second SW controlled current limit will latch off the main output if the power supply is operated for long duration in its peak current capability region. This protection trips as soon as the output current exceeds  $I_{I\ OC\ Slow}$  for a duration of more than 20 s. The third current limitation implemented as a fast hardware circuit will immediately switch off the main output if the output current increases beyond the peak current trip point, occurring mainly if a short circuit is applied to the output voltage. The supply will re-start 4 ms later with a soft start, if the short circuit persists ( $V_I < 10.0$  V for  $> 55$  ms) the output will latch off; otherwise it continues to operate.

The latch can be unlocked by disconnecting the supply from the AC mains or by toggling the PS\_ON\_L input.

The main output current limitation thresholds for  $I_{I\ OC\ Slow}$  and  $I_{I\ OC\ Fast}$  depend on the actual input voltage range applied to the power supply. In addition, the threshold for  $I_{I\ OC\ Slow}$  is reduced when ambient temperature exceeds  $55^\circ\text{C}$ , see [Figure 32](#) for PET2000-12-074RH and [Figure 35](#) for PET2000-12-074NH.

### STANDBY OUTPUT

The standby output exhibits a substantially rectangular output characteristic down to 0 V (no hiccup mode / latch off).

The current limitation of the standby output is independent of the AC input voltage.

Running in current limitation causes the output voltage to fall, this will trigger under voltage protection and disables the main output, see also [Undervoltage Detection](#).



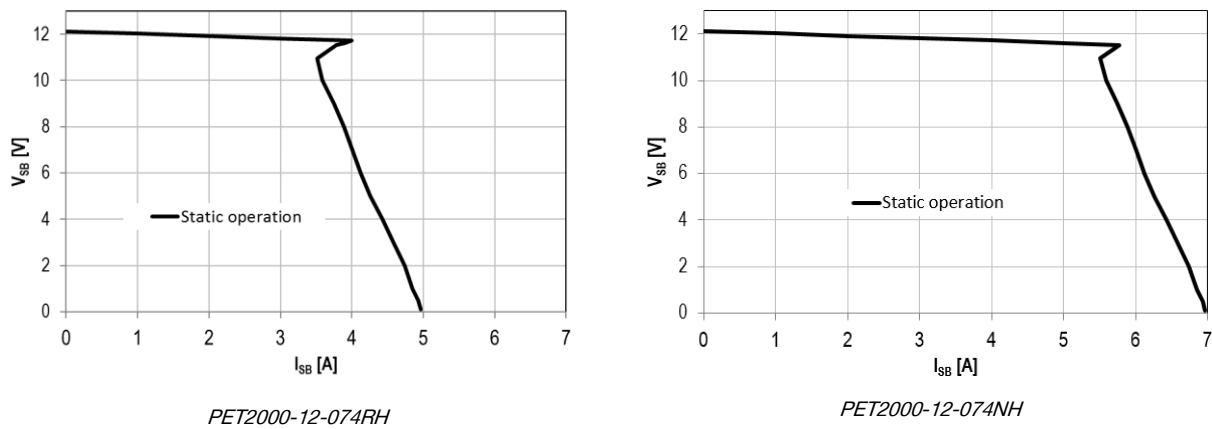


Figure 17. Current Limitation on  $V_{SB}$

## 7. MONITORING

The power supply operating parameters can be accessed through I<sup>2</sup>C interface. For more details refer to chapter [I<sup>2</sup>C / POWER MANAGEMENT BUS COMMUNICATION](#) and document URP.00234 (PET Front-End Power Management Bus Communication Manual).

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
$V_{I\ mon}$	Input RMS Voltage $V_{I\ min\ LL} \leq V_I \leq V_{I\ max\ HL}$	-3		+3	VAC
$I_{I\ mon}$	Input RMS Current $I_I > 6.7\ Arms$	-3		+3	%
	$I_I \leq 6.7\ Arms$	-0.2		+0.2	Arms
$P_{I\ mon}$	True Input Power $P_I > 500\ W$	-4		+4	%
	$50\ W < P_I \leq 500\ W$	-20		+20	W
$V_{I\ mon}$	V1 Voltage	-0.1		+0.1	VDC
$I_{I\ mon}$	V1 Current $I_I > 50\ A$	-1		+1	%
	$5\ A < I_I \leq 50\ A$	-0.5		+0.5	ADC
$P_{I\ mon}$	V1 Output Power $P_I > 1000\ W$	-1		+1	%
	$50\ W < P_I \leq 1000\ W$	-10		+10	W
$V_{SB\ mon}$	VSB Voltage	-0.1		+0.1	VDC
$I_{SB\ mon}$	VSB Current	-0.1		+0.1	ADC
$T_{A\ mon}$	Inlet Temperature $T_{A\ min} \leq T_A \leq T_{A\ max}$	-2		+2	°C



## 8. SIGNALING AND CONTROL

### 8.1 ELECTRICAL CHARACTERISTICS

PARAMETER		DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
PSON_H						
V <sub>IL</sub>	Input Low Level Voltage	PSON_L: Main output enabled	-0.2		0.8	V
V <sub>IH</sub>	Input High Level Voltage	PSON_L: Main output disabled	2		3.5	V
I <sub>IL,H</sub>	Maximum Input Sink or Source Current	V <sub>I</sub> = -0.2 V to +3.5 V	-1		1	mA
R <sub>pull up</sub>	Internal Pull up Resistor to internal 3.3 V			10		kΩ
R <sub>LOW</sub>	Maximum external Pull down Resistance to GND to obtain Low Level				1	kΩ
R <sub>HIGH</sub>	Minimum external Pull down Resistance to GND to obtain High Level		50			kΩ
PWOK_H						
V <sub>OL</sub>	Output Low Level Voltage	V <sub>I</sub> or V <sub>SB</sub> out of regulation, I <sub>sink</sub> < 4 mA	0		0.4	V
V <sub>OH</sub>	Output High Level Voltage	V <sub>I</sub> and V <sub>SB</sub> in regulation, I <sub>source</sub> < 0.5 mA	2.4		3.5	V
R <sub>pull up</sub>	Internal Pull up Resistor to internal 3.3 V			1		kΩ
I <sub>OL</sub>	Maximum Sink Current	V <sub>O</sub> < 0.4 V			4	mA

### 8.2 SENSE INPUTS

The main output has sense lines implemented to compensate for voltage drop on load wires in both positive and negative path. The maximum allowed voltage drop is 200 mV on the positive rail and 50 mV on the GND rail.

With open sense inputs the main output voltage will rise by 270 mV. Therefore, if not used, these inputs should be connected to the power output and GND at the power supply connector. The sense inputs are protected against short circuit. In this case the power supply will shut down.

### 8.3 CURRENT SHARE

The PET front-ends have an active current share scheme implemented for  $V_I$ . All the ISHARE current share pins need to be interconnected in order to activate the sharing function. If a supply has an internal fault or is not turned on, it will disconnect its ISHARE pin from the share bus. This will prevent dragging the output down (or up) in such cases.

The current share function uses an analog bus to transmit and receive current share information. The controller implements a Master/Slave current share function. The power supply providing the largest current among the group is automatically the Master. The other supplies will operate as Slaves and increase their output current to a value close to the Master by slightly increasing their output voltage. The voltage increase is limited to +250 mV.

The standby output uses a passive current share method (droop output voltage characteristic).

### 8.4 PSON\_L INPUT

The PSON\_L is an internally pulled-up (3.3 V) input signal to enable/disable the main output  $V_I$  of the front-end. With low level input the main output is enabled. This active-low pin is also used to clear any latched fault condition. The PSON\_L can be either controlled by an open collector device or by a voltage source.



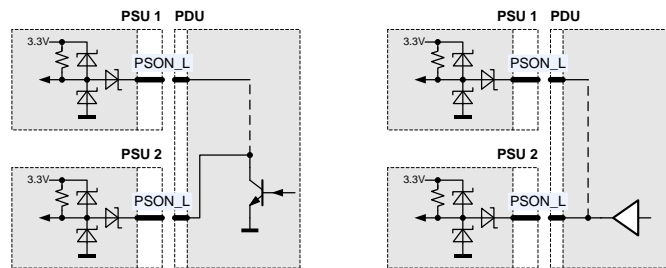


Figure 18. PSON\_L connection

## 8.5 PWOK\_H OUTPUT

The PWOK\_H is an open drain output with an internal pull-up to 3.3 V indicating whether both  $V_{SB}$  and  $V_I$  outputs are within regulation. This pin is active-high.

An external pull down resistor ensures low level when there is no power supply seated. When combining PWOK\_H outputs of several power supplies, circuits as shown in [Figure 19](#) should be used.

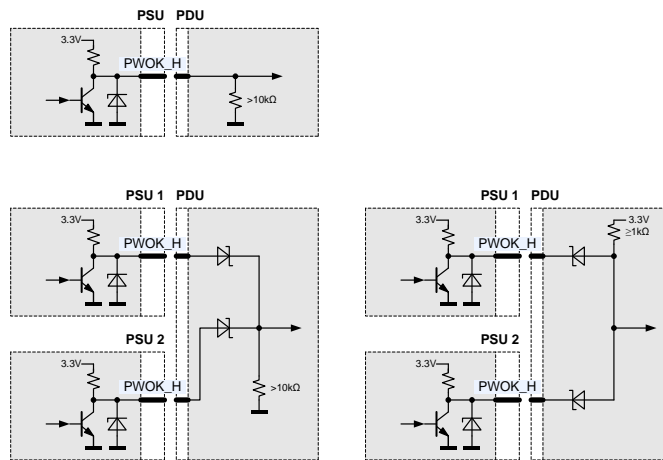


Figure 19. PWOK\_H connection

## 8.6 PRESENT\_L OUTPUT

The PRESENT\_L pin is wired through a 100 Ohms resistor to internal GND within the power supply. This pin does indicate that there is a power supply present in this system slot. An external pull-up resistor has to be added within the application. Current into PRESENT\_L should not exceed 5 mA to guarantee a low level voltage if power supply is seated.

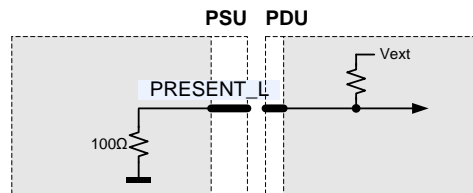


Figure 20. PRESENT\_L connection



## 8.7 SIGNAL TIMING

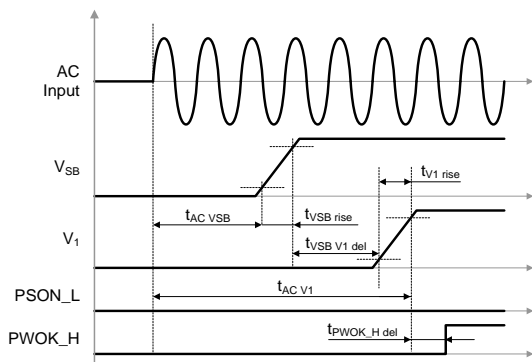


Figure 21. AC turn-on timing

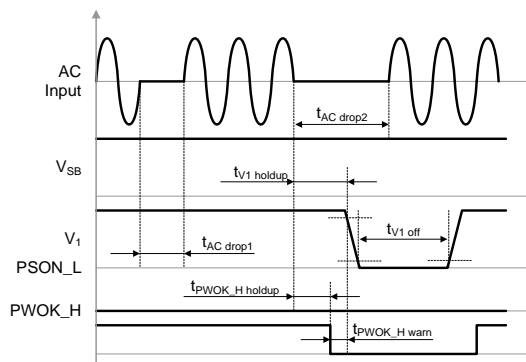


Figure 22. AC short dips

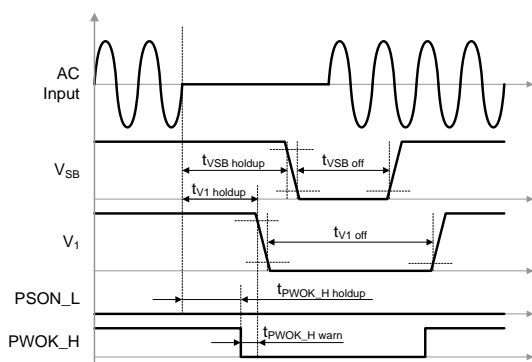


Figure 23. AC long dips

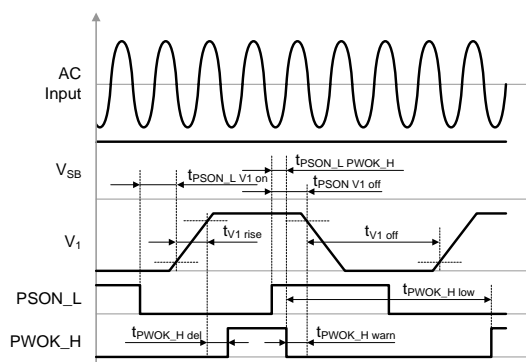


Figure 24. PSon\_L turn-on/off timing

PARAMETER		DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
$t_{AC\ V_{SB}}$	AC Line to 90% $V_{SB}$				1.5	s
$t_{AC\ V_I}$	AC Line to 90% $V_I$	PSON_L = Low		1.5	4 <sup>10</sup>	s
$t_{V_{SB}\ V_I\ del}$	$V_{SB}$ to $V_I$ delay	PSON_L = Low	50	150	1000	ms
$t_{V_I\ rise}$	$V_I$ rise time	See chapter <a href="#">OUTPUT</a>				
$t_{V_{SB}\ rise}$	$V_{SB}$ rise time	See chapter <a href="#">OUTPUT</a>				
$t_{AC\ drop1}$	AC drop without $V_I$ leaving regulation	$0.5 \cdot I_{1\ nom}, I_{SB\ nom}$			17	ms
		$0.7 \cdot I_{1\ nom}, I_{SB\ nom}$			13	ms
		$I_{1\ nom}, I_{SB\ nom}$			5	ms
$t_{AC\ drop2}$	AC drop without $V_{SB}$ leaving regulation	$I_{1\ nom}, I_{SB\ nom}$			70	ms
$t_{V_I\ holdup}$	Loss of AC to $V_I$ leaving regulation	See chapter <a href="#">INPUT</a>				
$t_{V_{SB}\ holdup}$	Loss of AC to $V_{SB}$ leaving regulation	See chapter <a href="#">INPUT</a>				
$t_{PWOK\_H\ del}$	Outputs in regulation to PWOK_H asserted		100	150	200	ms
$t_{PWOK\_H\ warn}$	Warning time from de-assertion of PWOK_H to $V_I$ leaving regulation		0.1			ms
$t_{PWOK\_H\ holdup}$	Loss of AC to PWOK_H de-asserted	$V_{I\ nom\ HL}, I_{1\ nom}, I_{SB\ nom}$	10			ms
$t_{PWOK\_H\ low}$	Time PWOK_H is kept low after being de-asserted		100			ms
$t_{PSON\_L\ V_I\ on}$	Delay PSON_L active to $V_I$ in regulation	$C_{ext} = 0\text{ mF}$	5	10	20	ms
$t_{PSON\_L\ V_I\ off}$	Delay PSON_L de-asserted to $V_I$ disabled		2	3	4	ms
$t_{PSON\_L\ PWOK\_H}$	Delay PSON_L de-asserted to PWOK_H de-asserted			1	2	ms
$t_{V_I\ off}$	Time $V_I$ is kept off after leaving regulation			1		s
$t_{V_{SB}\ off}$	Time $V_{SB}$ is kept off after leaving regulation			1		s

## 8.8 LED INDICATOR

The front-end has one front LED showing the status of the supply. The LED is bi-colored: green and amber and indicates AC and DC power presence and warning or fault conditions. [Table 1](#) lists the different LED status.

OPERATING CONDITION <sup>11</sup>	LED SIGNALING
No AC or AC Line in UV condition, $V_{SB}$ not present from paralleled power supplies	Off
PSON_L High	Blinking Green 1 Hz
No AC or AC Line in UV condition, $V_{SB}$ present from paralleled power supplies	
$V_I$ or $V_{SB}$ out of regulation	
Over temperature shutdown	
Output over voltage shutdown ( $V_I$ or $V_{SB}$ )	Solid Amber
Output over current shutdown ( $V_I$ or $V_{SB}$ )	
Fan error (>15%)	
Over temperature warning	
Minor fan regulation error (>5%, <15%)	Blinking Amber 1 Hz
Firmware boot loading in process	Blinking Green 2 Hz
Outputs $V_I$ and $V_{SB}$ in regulation	Solid Green

Table 1. LED Status

<sup>10</sup> At repeated ON-OFF cycles the start-up times may increase by 1s

<sup>11</sup> The order of the criteria in the table corresponds to the testing precedence in the controller



## 9. I<sup>2</sup>C / POWER MANAGEMENT BUS COMMUNICATION

The PET front-end is a communication Slave device only; it never initiates messages on the I<sup>2</sup>C / SMBus by itself. The communication bus voltage and timing is defined in [Table 2](#) and further characterized through:

- The SDA/SCL IOs use 3.3 V logic levels
- External pull-up resistors on SDA/SCL required for correct signal edges
- Full SMBus clock speed of 100 kbps
- Clock stretching limited to 1 ms
- SCL low time-out of >25 ms with recovery within 10 ms
- Recognizes any time Start/Stop bus conditions

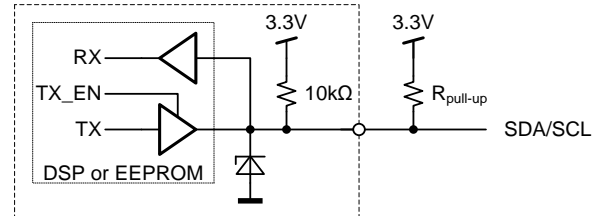


Figure 25. Physical layer of communication interface

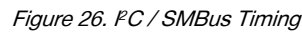
Communication to the DSP or the EEPROM will be possible as long as the input AC voltage is provided. If no AC is present, communication to the unit is possible as long as it is connected to a life  $V_{SB}$  output (provided e.g. by the redundant unit). If only  $V_I$  is provided, communication is not possible.

PARAMETER	DESCRIPTION	CONDITION	MIN	MAX	UNIT
<b>SCL / SDA</b>					
$V_L$	Input low voltage		-0.5	1.0	V
$V_H$	Input high voltage		2.3	3.5	V
$V_{hys}$	Input hysteresis		0.15		V
$V_{OL}$	Output low voltage	3 mA sink current	0	0.4	V
$t_r$	Rise time for SDA and SCL		$20+0.1C_b^1$	300	ns
$t_{of}$	Output fall time $V_{Hmin} \rightarrow V_{Lmax}$	$10 \text{ pF} < C_b^1 < 400 \text{ pF}$	$20+0.1C_b^1$	250	ns
$I_I$	Input current SCL/SDA	$0.1 \text{ VDD} < V_i < 0.9 \text{ VDD}$	-10	10	$\mu\text{A}$
$C_i$	Internal Capacitance for each SCL/SDA			50	pF
$f_{SCL}$	SCL clock frequency		0	100	kHz
$R_{pull-up}$	External pull-up resistor	$f_{SCL} \leq 100 \text{ kHz}$		$1000 \text{ ns} / C_b^1$	$\Omega$
$t_{HDSTA}$	Hold time (repeated) START	$f_{SCL} \leq 100 \text{ kHz}$	4.0		$\mu\text{s}$
$t_{LOW}$	Low period of the SCL clock	$f_{SCL} \leq 100 \text{ kHz}$	4.7		$\mu\text{s}$
$t_{HIGH}$	High period of the SCL clock	$f_{SCL} \leq 100 \text{ kHz}$	4.0		$\mu\text{s}$
$t_{SUSTA}$	Setup time for a repeated START	$f_{SCL} \leq 100 \text{ kHz}$	4.7		$\mu\text{s}$
$t_{HDDAT}$	Data hold time	$f_{SCL} \leq 100 \text{ kHz}$	0	3.45	$\mu\text{s}$
$t_{SUDAT}$	Data setup time	$f_{SCL} \leq 100 \text{ kHz}$	250		ns
$t_{SUSTO}$	Setup time for STOP condition	$f_{SCL} \leq 100 \text{ kHz}$	4.0		$\mu\text{s}$
$t_{BUF}$	Bus free time between STOP and START	$f_{SCL} \leq 100 \text{ kHz}$	5		ms

<sup>1</sup>  $C_b$  = Capacitance of bus line in pF, typically in the range of 10...400 pF

Table 2. I<sup>2</sup>C / SMBus Specification





The address for I<sup>2</sup>C communication can be configured by pulling address input pins A2, A1 and A0 either to GND (Logic Low) or leave them open (Logic High). An internal pull up resistor will cause the A2 / A1 / A0 pin to be in High Level if left open. A fixed addressing offset exists between the Controller and the EEPROM.

Table 3. Address and protocol encoding

The SMBALERT\_L signal indicates that the power supply is experiencing a problem that the system agent should investigate. This is a logical OR of the Shutdown and Warning events. It is asserted (pulled Low) at Shutdown or Warning events such as reaching temperature warning/shutdown threshold of critical component, general failure, over-current, over-voltage, under-voltage or low-speed of a failed fan. This signal may also indicate the power supply is operating in an environment exceeding the specified limits.

The SMBAlert signal is asserted simultaneously with the LED turning to solid amber or blinking amber.

<sup>12</sup> The LSB of the address byte is the R/W bit

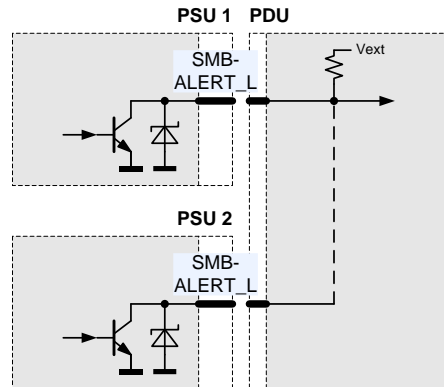


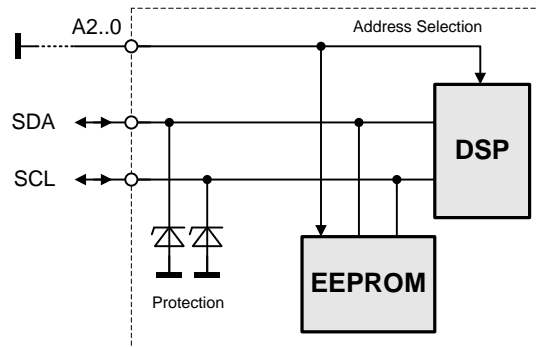
Figure 27. SMBALERT\_L connection

## 9.2 CONTROLLER AND EEPROM ACCESS

The controller and the EEPROM in the power supply share the same I<sup>2</sup>C bus physical layer (see [Figure 28](#)) and can be accessed under different addresses, see ADDRESS SELECTION.

The SDA/SCL lines are connected directly to the controller and EEPROM which are supplied by internal 3.3 V.

The EEPROM provides 256 bytes of user memory. None of the bytes are used for the operation of the power supply.

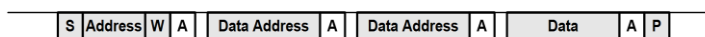
Figure 28. I<sup>2</sup>C Bus to DSP and EEPROM

## 9.3 EEPROM PROTOCOL

The EEPROM follows the industry communication protocols used for this type of device. Even though page write / read commands are defined, it is recommended to use the single byte write / read commands.

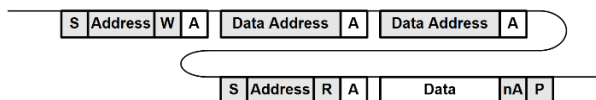
### WRITE

The write command follows the “SMBus 1.1 Write Byte Protocol”. After the device address with the write bit cleared, the Two Byte Data Address is sent followed by the data byte and the STOP condition. A new START condition on the bus should only occur after 5ms of the last STOP condition to allow the EEPROM to write the data into its memory.



## READ

The read command follows the “SMBus 1.1 Read Byte Protocol”. After the device address with the write bit cleared the two byte data address is sent followed by a repeated start, the device address and the read bit set. The EEPROM will respond with the data byte at the specified location.



## 9.4 POWER MANAGEMENT BUS PROTOCOL

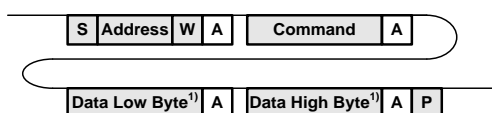
The Power Management Bus is an open standard protocol that defines means of communicating with power conversion and other devices. For more information, please see the System Management Interface Forum web site at: [www.powerSIG.org](http://www.powerSIG.org).

Power Management Bus command codes are not register addresses. They describe a specific command to be executed. PET2000-12-074xH supply supports the following basic command structures:

- Clock stretching limited to 1 ms
- SCL low time-out of >25 ms with recovery within 10 ms
- Recognized any time Start/Stop bus conditions

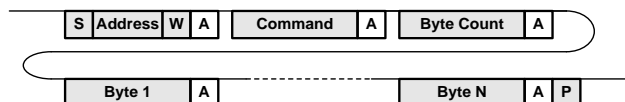
## WRITE

The write protocol is the SMBus 1.1 Write Byte/Word protocol. Note that the write protocol may end after the command byte or after the first data byte (Byte command) or then after sending 2 data bytes (Word command).



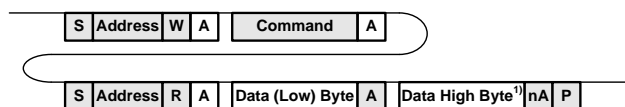
<sup>1)</sup> Optional

In addition, Block write commands are supported with a total maximum length of 255 bytes. See PET2000-12-074xH Power Management Bus Communication Manual URP.00234 for further information.



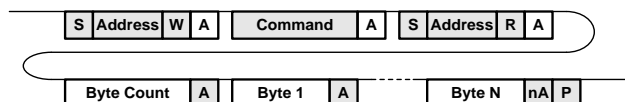
## READ

The read protocol is the SMBus 1.1 Read Byte/Word protocol. Note that the read protocol may request a single byte or word.



<sup>1)</sup> Optional

In addition, Block read commands are supported with a total maximum length of 255 bytes. See PET2000-12-074xH Power Management Bus Communication Manual URP.00234 for further information.



## 9.5 GRAPHICAL USER INTERFACE

Bel Power Solutions provides with its “I<sup>2</sup>C Utility” a Windows® XP/Vista/Win7 compatible graphical user interface allowing the programming and monitoring of the PET2000-12-074xH Front-End.

The utility can be downloaded on: [belfuse.com/power-solutions](http://belfuse.com/power-solutions) and supports both the PSMI and Power Management Bus protocols.

The GUI allows automatic discovery of the units connected to the communication bus and will show them in the navigation tree. In the monitoring view the power supply can be controlled and monitored.

If the GUI is used in conjunction with the YTM.00046 Evaluation Board it is also possible to control the PSON\_L pin of the power supply. Refer to BCG.00809 for YTM.00046 connection and GUI configuration.

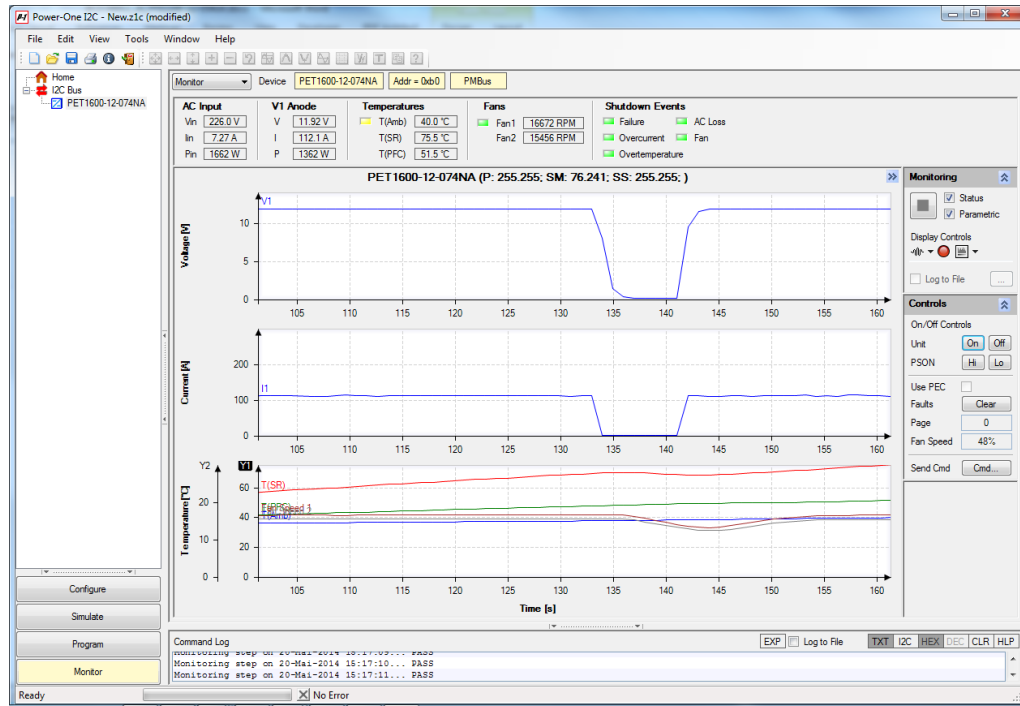


Figure 29. Monitoring dialog of the PC Utility

## 10. TEMPERATURE AND FAN CONTROL

### 10.1 FAN CONTROL

To achieve best cooling results sufficient airflow through the supply must be ensured. Do not block or obstruct the airflow at the rear of the supply by placing large objects directly at the output connector. The PET2000-12-074RH is provided with a front to rear airflow, which means the air enters on the AC-inlet side of the supply and leaves at the DC-output, while the PET2000-12-074NH is provided with a rear to front airflow, which means the air enters through the DC-output of the supply and leaves at the AC-inlet side, as shown in [Figure 30](#).

The PET2000-12-074xH supply has been designed for horizontal operation.



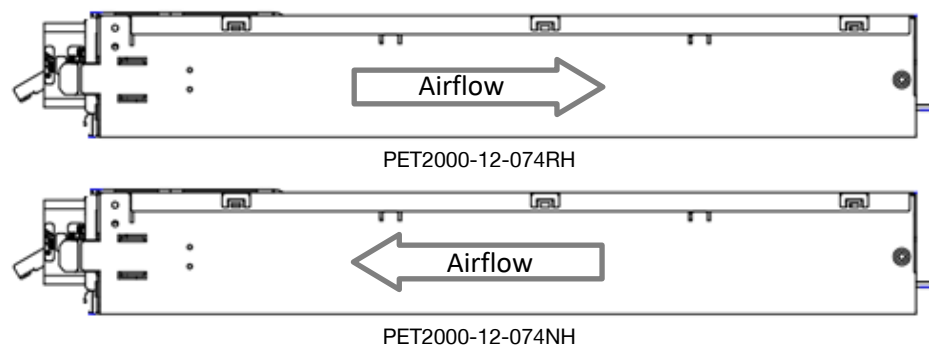


Figure 30. Airflow direction

The fan inside the supply is controlled by a microprocessor. The rpm of the fan is adjusted to ensure optimal supply cooling and is a function of output power. Three different curves are selected based on input voltage and inlet temperature. With standby output loaded the fan speed minimum is limited to ensure enough cooling of circuits providing standby power. Figure 31 illustrates the programmed fan curves.

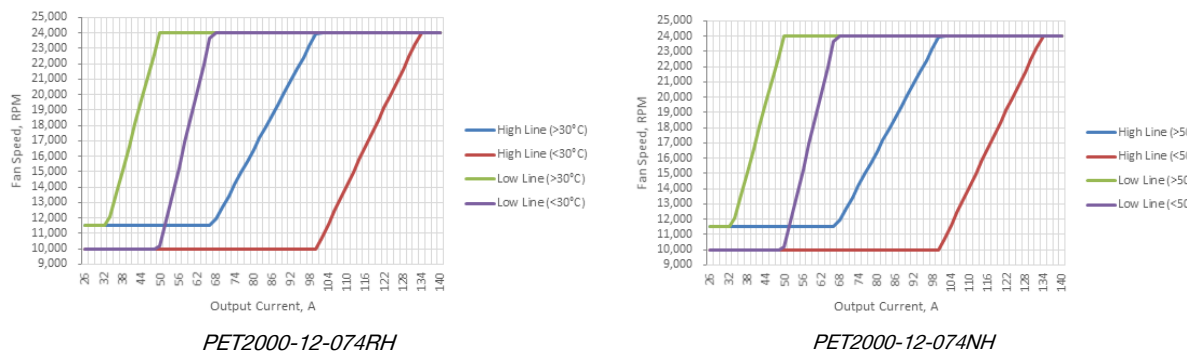


Figure 31. Fan speed vs. main output load

## 10.2 TEMPERATURE MONITOR AND OVER TEMPERATURE PROTECTION

PET2000-12-074xH provides access via I<sup>2</sup>C to the measured temperatures of in total 6 sensors within the power supply, see Table 4. The microprocessor is monitoring these temperatures and if warning threshold of one of these sensors is reached it will set fan to maximum speed. If temperatures continue to rise above shut down threshold the main output  $V_o$  (or  $V_{SB}$  if auxiliary converter is affected) will be disabled. At the same time the warning or fault condition is signaled accordingly through LED, PWOK\_H and SMBALERT\_L.

TEMPERATURE SENSOR	DESCRIPTION / CONDITION	POWER MANAGEMENT BUS REGISTER	WARNING THRESHOLD	SHUTDOWN THRESHOLD
<b>PET2000-12-074RH</b>				
Inlet Air Temperature	Sensor located on control board close to DC end of PSU	8Dh	61°C	63°C
Synchronous Rectifier	Sensor located on secondary side of DC/DC stage	8Eh	105°C	110°C
Primary Heat Sink	Sensor located on primary heat sink	8Fh	96°C	101°C
Output ORing Element	Sensor located close to output	D2h	105°C	110°C
Auxiliary Converter	Sensor located on secondary side on auxiliary rectifier	D3h	95°C	100°C
Outlet Ambient	Sensor located near output connector	D4h	85°C	90°C



PET2000-12-074NH				
Inlet Air Temperature	Sensor located on control board close to DC end of PSU	8Dh	75°C	78°C
Synchronous Rectifier	Sensor located on secondary side of DC/DC stage	8Eh	95°C	100°C
Primary Heat Sink	Sensor located on primary heat sink	8Fh	87°C	92°C
Output ORing Element	Sensor located close to output	D2h	100°C	105°C
Auxiliary Converter	Sensor located on secondary side on auxiliary rectifier	D3h	80°C	85°C
Bridge Rectifier	Sensor located on heat sink for AC rectifier	D4h	86°C	91°C

Table 4. Temperature sensor location and thresholds

### 10.3 MAXIMUM OUTPUT POWER VERSUS INLET TEMPERATURE FOR SAFETY COMPLIANCY

For safety compliant operation the power supply must not exceed specified operating conditions specified herein. These operating conditions ensure the input AC connector is operated within its ratings.

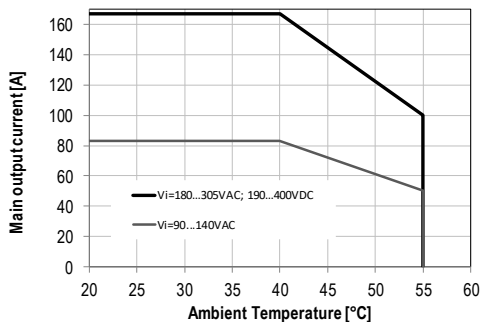
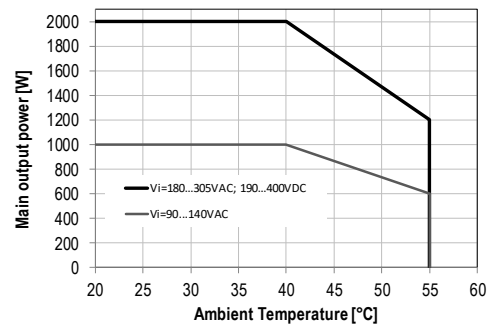
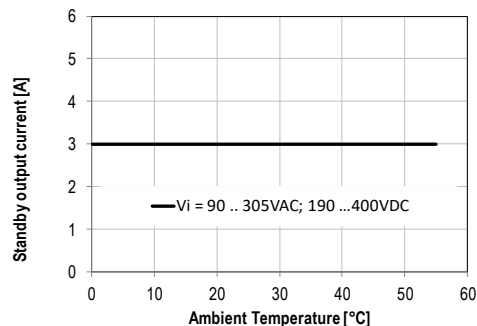
The different input AC connectors and regional usage is not considered in this implementation of current limitation. Therefore, it is under the responsibility of the user to ensure safety compliant operation.

#### 10.3.1 PET2000-12-074RH

Between 0°C and 40°C power supply inlet temperature the maximum allowed output power is only depending on AC input connector type chosen, regional usage and the applied nominal input AC voltage. Above 40°C the maximum output power is further reduced with rising temperature. *Figure 32* to *Figure 34* illustrate these maximum current and power levels.

The mentioned power levels are related to main output power only, in addition the standby output can be operated up to 3 A as shown in *Figure 34*.

Above 55°C the power supply is adjusting the current limit level  $I_{I\ OC\ Slow}$  depending on input voltage range (90...140 VAC, 180-305 VAC or 192...400 VDC) and inlet temperature, as shown in *Figure 32* to protect the power supply from excessive component temperatures.

Figure 32. Maximum  $I_I$  PET2000-12-074RHFigure 33. Maximum  $P_I$  PET2000-12-074RHFigure 34. Maximum  $I_{SB}$

## 10.3.2 PET2000-12-074NH

Between 0°C and 55°C power supply inlet temperature the maximum allowed output power is only depending on AC input connector type chosen, regional usage and the applied nominal input AC voltage. Above 55°C the maximum output power is further reduced with rising temperature. [Figure 35](#) to [Figure 37](#) illustrate these maximum current and power levels.

The mentioned power levels are related to main output power only, in addition the standby output can be operated up to 3 A as shown in [Figure 37](#).

Above 55°C the power supply is adjusting the current limit level  $I_{OC\ slow}$  depending on input voltage range (90...140 VAC, 180-305 VAC or 192...400 VDC) and inlet temperature, as shown in [Figure 35](#).

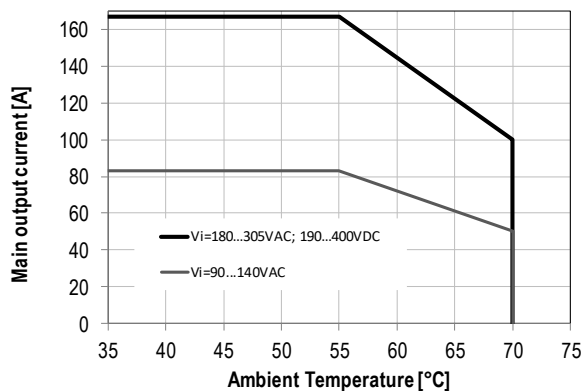


Figure 35. Maximum  $I_1$  PET2000-12-074NH

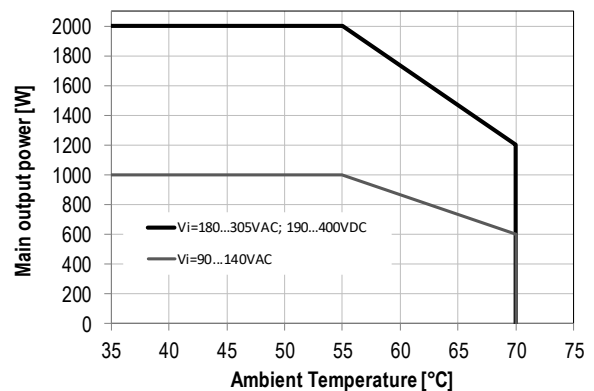


Figure 36. Maximum  $P_1$  PET2000-12-074NH

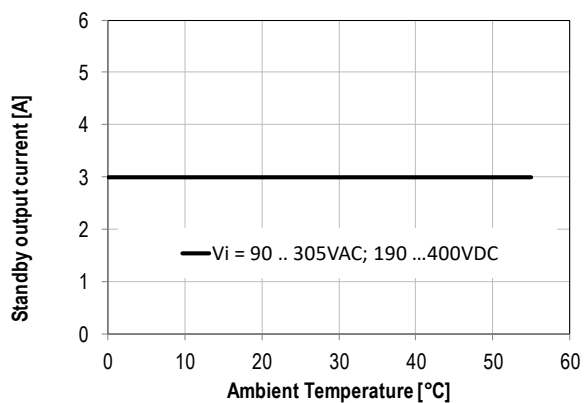


Figure 37. Maximum  $ISB$

## 11. ELECTROMAGNETIC COMPATIBILITY

### 11.1 IMMUNITY

PARAMETER	DESCRIPTION / CONDITION	CRITERION
ESD Contact Discharge	IEC / EN 61000-4-2, $\pm 8$ kV, 25+25 discharges per test point (metallic case, LED, connector body)	A
ESD Air Discharge	IEC / EN 61000-4-2, $\pm 15$ kV, 25+25 discharges per test point (non-metallic user accessible surfaces)	A
Radiated Electromagnetics Filed	IEC / EN 61000-4-3, 10 V/m, 1 kHz/80% Amplitude Modulation, 1 $\mu$ s Pulse Modulation, 10 kHz ... 2 GHz	A
Burst	IEC / EN 61000-4-4, Level 3 AC port $\pm 2$ kV, 1 minute	A
Surge	IEC / EN 61000-4-5, Level 3 Line to Earth: $\pm 2$ kV Line to Line: $\pm 1$ kV	A
RF Conducted Immunity	IEC / EN 61000-4-6, Level 3, 10 Vrms, CW, 0.1 ... 80 MHz	A
Voltage Dips and Interruptions	IEC / EN 61000-4-11 Vi 230VAC / 50 Hz, 90% load, Phase 0°, Dip 100% , duration 10 ms Vi 200VAC / 50 Hz, 70% load, Phase 0°, Dip 30% , duration 500 ms Vi 200VAC / 50 Hz, 100% load, Phase 0°, Dip 20% , duration 10 s	V <sub>r</sub> : A, V <sub>sg</sub> : A V <sub>r</sub> : A, V <sub>sg</sub> : A V <sub>r</sub> : A, V <sub>sg</sub> : A

### 11.2 EMISSION

PARAMETER	DESCRIPTION / CONDITION	CRITERION
Conducted Emission	EN 55022 / CISPR 22: 0.15 ... 30 MHz, QP and AVG, single power supply EN 55022 / CISPR 22: 0.15 ... 30 MHz, QP and AVG, 2 power supplies in a system	Class A 6 dB margin Class A
Radiated Emission	EN 55022 / CISPR 22: 30 MHz ... 1 GHz, QP, single power supply EN 55022 / CISPR 22: 30 MHz ... 1 GHz, QP, 2 power supplies in a system	Class A 6 dB margin Class A
Harmonic Emissions	IEC 61000-3-2, Vi = 115 VAC / 60 Hz & 230 VAC / 50 Hz, 100% Load	Class A
AC Flicker	IEC 61000-3-3, Vi = 230 VAC / 50Hz, 100% Load	Pass
Acoustical Noise	Distance at bystander position, 25°C, 50% Load	65 dBA

## 12. SAFETY / APPROVALS

Maximum electric strength testing is performed in the factory according to IEC/EN 62368-1, and UL/CSA 62368-1. 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	DESCRIPTION / CONDITION	NOTES
Agency Approvals	Approved to latest edition of the following standards: UL 62368-1 CAN/CSA-C22.2 No. 62368-1 EN/IEC 62368-1 NEMKO, EAC, CQC, BSMI,	Approved
Grade of Insulation	Input (L/N) to chassis (PE) Input (L/N) to output Output to chassis	Basic Reinforced None (Direct connection)
Creepage / Clearance	Primary (L/N) to chassis (PE) Primary to secondary	
Electrical Strength Test	Input to chassis Input to output (tested by manufacturer only)	Min. 2500 VDC 5000 VDC





## 13. ENVIRONMENTAL

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
$T_A$ Ambient Temperature	Up to 1'000 m ASL	0		+40 +55*	°C
	Linear derating from 1'000 to 3'048 m ASL			+35 +45*	°C
$T_{A\ ext}$ Extended Temp. Range	Reduced output power <sup>13</sup> , up to 1'000 m ASL			+55 +70*	°C
	Linear derating from 1'000 to 3'048 m ASL			+50 +60*	°C
$T_S$ Storage Temperature	Non-operational	-20		+70	°C
Altitude	Operational, above Sea Level	-		3'048	m
	Non-operational, above Sea Level	-		10'600	m
Shock, operational	Half sine, 11ms, 10 shocks per direction,			1	g peak
Shock, non-operational	6 directions			30	g peak
Vibration, sinusoidal, operational	IEC/EN 60068-2-6, sweep 5 to 500 to 5 Hz,			1	g peak
Vibration, sinusoidal, non-operational	1 octave/min, 5 sweeps per axis			4	g peak
Vibration, random, non-operational	IEC/EN 60068-2-64, 5 to 500 Hz, 1 hour per axis			0.025	g <sup>2</sup> /Hz

\* Max temperature values for PET2000-12-074NH model.

## 14. RELIABILITY

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
$MTBF$ Mean time to failure	$T_A = 25^\circ\text{C}$ , according Telcordia SR-332, issue 3, GB, confidence level = 90%	860			kh

## 15. MECHANICAL

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Dimensions (W x H x D)		73.5	40.0	265	mm
		2.9	1.6	10.4	in
$m$ Weight			1.1		kg

### 15.1 OUTLINE PET2000-12-074RH, PET2000-12-074NH

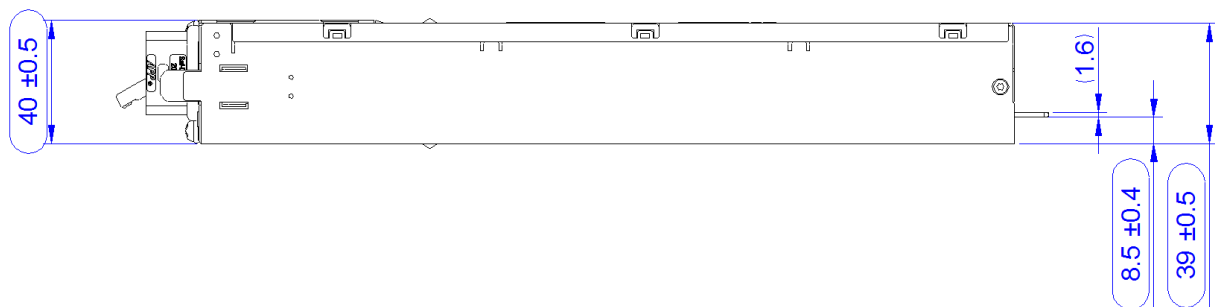


Figure 38. Side view

<sup>13</sup> See chapter 10.3

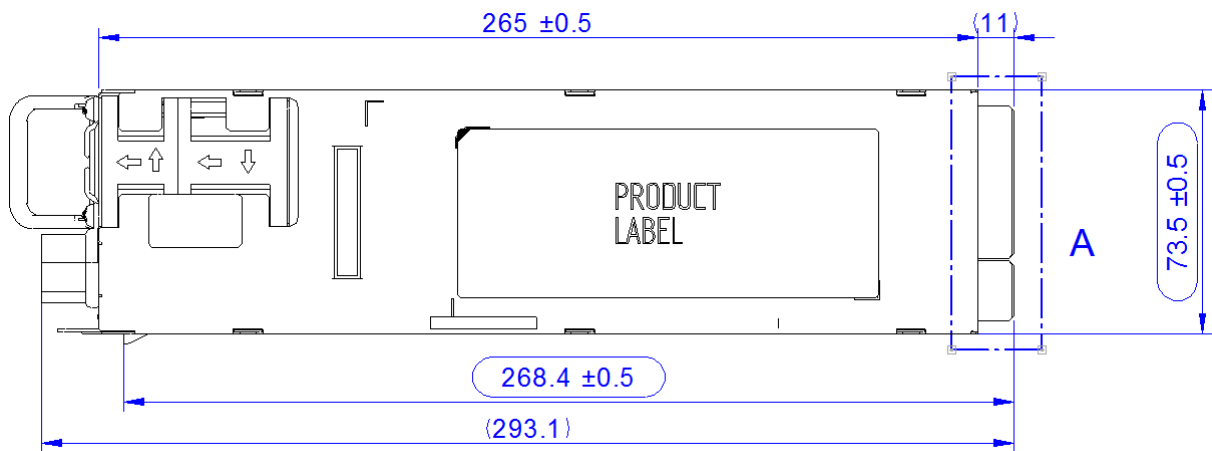


Figure 39. Top view

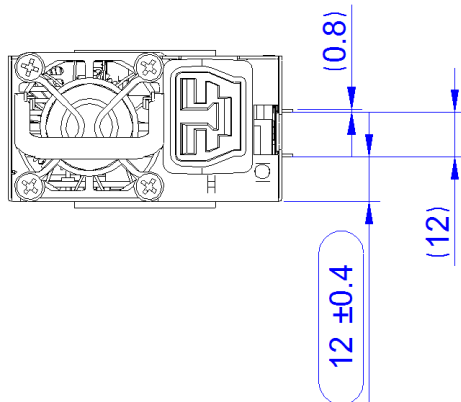


Figure 40. Front view

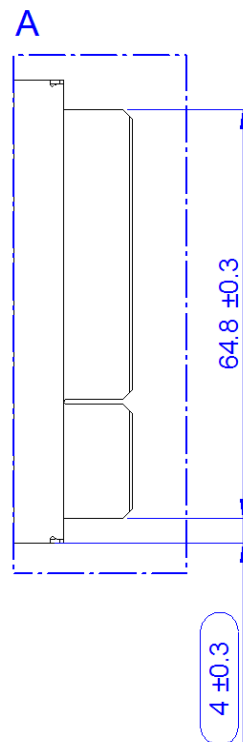


Figure 41. Rear view

## 15.3 OPTION OF ADDING KEYING SCREW

A thread added to the side of the PET2000-12-074xH allows the user to add a screw to prevent the PET2000-12-074xH from being inserted into systems using other card edge connector types with the same power supply width and height. In such case, systems using PET2000-12-074xH must have a slot of  $\varnothing 6$  mm x 14 mm implemented to allow PET2000-12-074xH to be inserted. The maximum size of the screw head is  $\varnothing 6$  mm and height 2.12 mm.

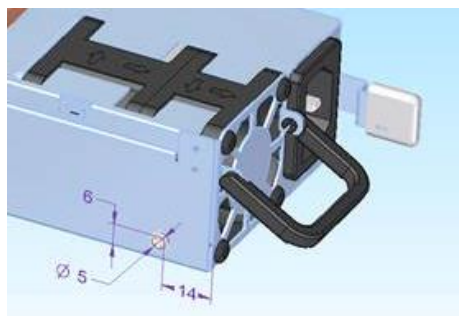


Figure 42. Polarizing screw

## 15.4 OUTPUT CONNECTOR PIN LOCATIONS

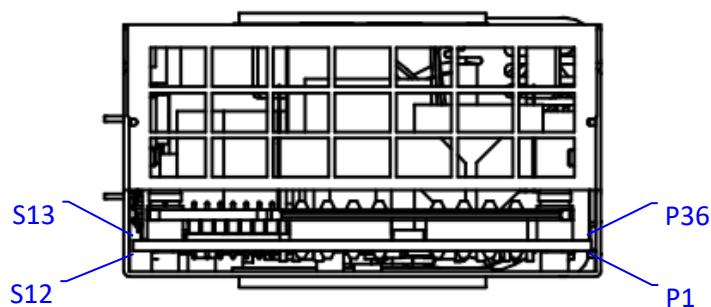


Figure 43. Rear view

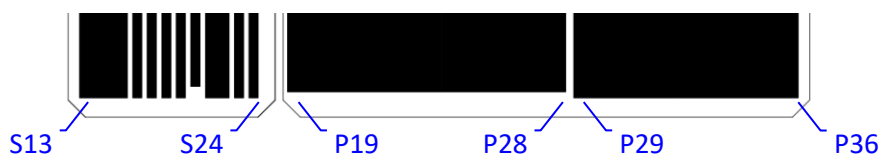


Figure 44. Card edge PCB top view

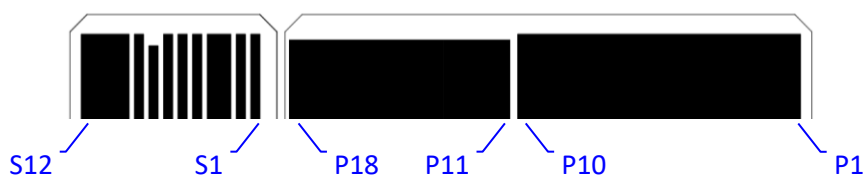


Figure 45. Card edge PCB bottom view

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
AC inlet	PET2000-12-074NH: Anderson Saf-D-Grid®, P/N 2006G1 PET2000-12-074NH Anderson Saf-D-Grid®, P/N 2006G1				
AC cord requirement	Wire size	16			AWG
Output connector	36 Power- + 24 Signal-Pins PCB card edge				
Mating output connector	Manufacturer: FCI Electronics				
	Manufacturer P/N: 10130248-005LF (see <a href="#">Figure 48</a> for option x)				
	Bel Power Solutions P/N: ZES.00678				

[illegible]

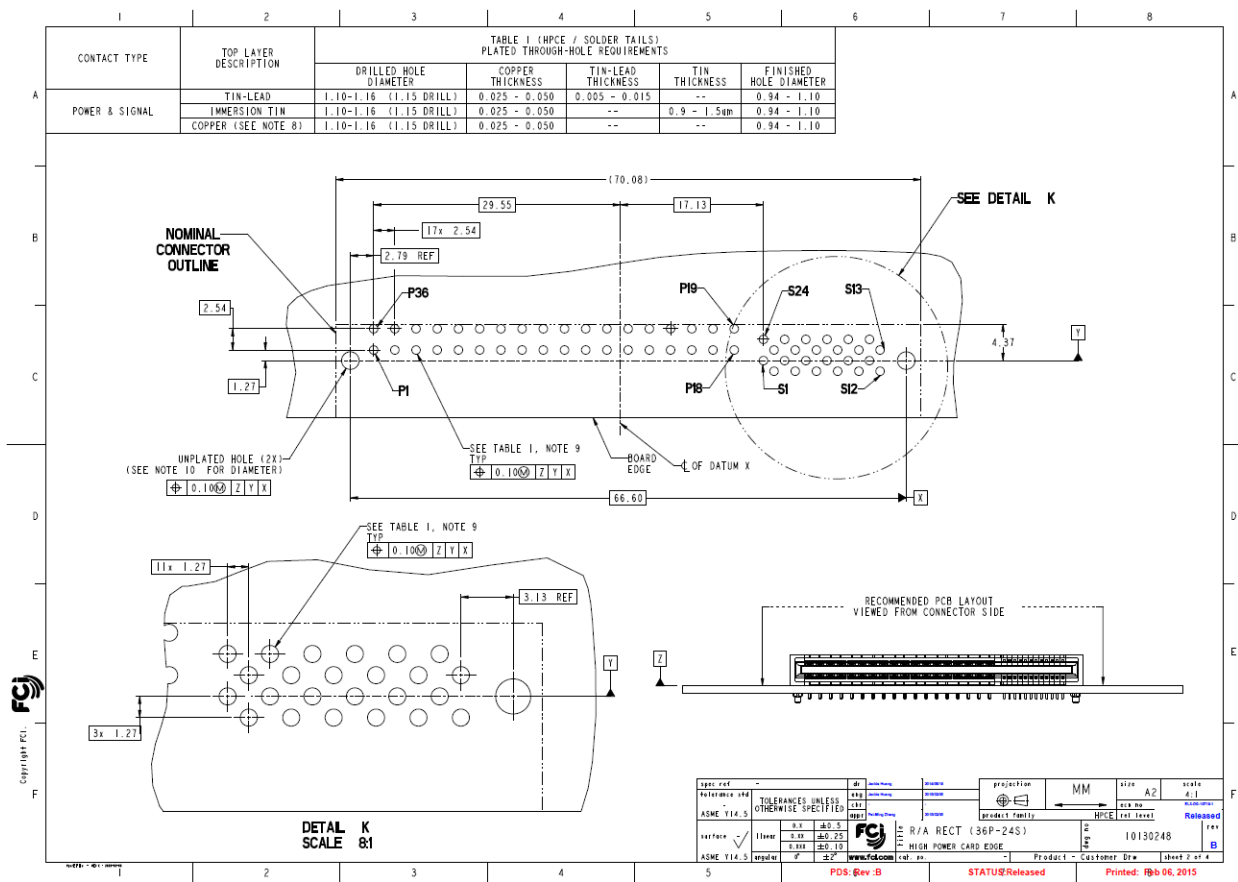


Figure 47. Mating connector drawing page 2



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## 16.2 MATING OUTPUT CONNECTOR SPECIFICATION


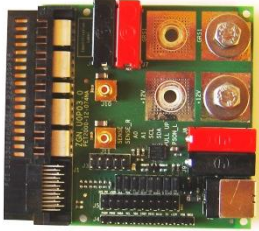
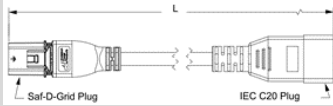
PIN	SIGNAL NAME	DESCRIPTION	Mating Sequence <sup>14</sup>
P1 ~ P10	GND	Power and signal ground (return)	1
P29 ~ P36	GND		
P11 ~ P18	V1	+12 VDC main output	2
P19 ~ P28	V1		
S1	A0	I <sup>2</sup> C address selection input	2
S2	A1		2
S3, S4	VSB	+12 V Standby positive output (as pins S3, S4)	2
S5	HOTSTANDBYEN_H	Not used	2
S6	ISHARE	Analog current share bus	2
S7	Reserved	For future use, do not connect	2
S8	PRESENT_L	Power supply seated, active-low	3
S9	A2	I <sup>2</sup> C address selection input	2
S10 ~ S15	GND	Power and signal ground (return)	2
S16	PWOK_H	Power OK signal output, active-high	2
S17	V1_SENSE	Main output positive sense	2
S18	V1_SENSE_R	Main output negative sense	2
S19	SMB_ALERT_L	SMB Alert signal output, active-low	2
S20	PSON_L	Power supply on input, active-low	3
S21, S22	VSB	+12 V Standby positive output (as pins S3, S4)	2
S23	SCL	I <sup>2</sup> C clock signal line	2
S24	SDA	I <sup>2</sup> C data signal line	2

Table 5. Output connector pin assignment

<sup>14</sup> 1 = First, 3 = Last, given by different card edge finger pin lengths and mating connector pin arrangement



## 17. ACCESSORIES

ITEM	DESCRIPTION	ORDERING PART NUMBER	SOURCE
	<b>I<sup>2</sup>C Utility</b> Windows XP/Vista/7 compatible GUI to program, control and monitor Front-End power supplies (and other I <sup>2</sup> C units)	ZS-00130	<a href="http://belfuse.com/power-solutions">belfuse.com/power-solutions</a>
	<b>Evaluation Board</b> Connector board to operate PET2000-12-074xH. Includes an on-board USB to I <sup>2</sup> C converter (use I <sup>2</sup> C Utility as desktop software).	YTM.00046	<a href="http://belfuse.com/power-solutions">belfuse.com/power-solutions</a>
	<b>AC cable for PET2000 Series</b> Anderson Saf-D-Grid® receptacle to IEC 60320-C20 plug, 14 AWG, 2 m, Anderson P/N 2052KH2	TBD	

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

