

## 1.5kW FAN COOLED

The HPA1K5 series offers users both output voltage and output current programming, via voltage, I<sup>2</sup>C PMBus, RS485 and CANopen in a very high efficiency, high power density 1.5kW chassis mount package. Options are available for RS232 or UART.

Measuring just 279.4 x 106.6 x 41.6mm, the HPA1K5 also features active current sharing, remote on/off, remote sense and a power OK signal. The 5V/2A standby output is available whenever the mains supply is present.

### Features

- Programmable output voltage (0-105%)
- Programmable output current (0-110%)
- High efficiency - up to 93%
- ITE and medical approvals
- Parallel operation
- Analog and digital interfaces
- Multiple digital protocols - PMBus, CANopen, MODBUS and SCPI
- Fully featured signals and controls
- Graphical user interface (GUI)
- 5V/2A standby supply
- 3 year warranty

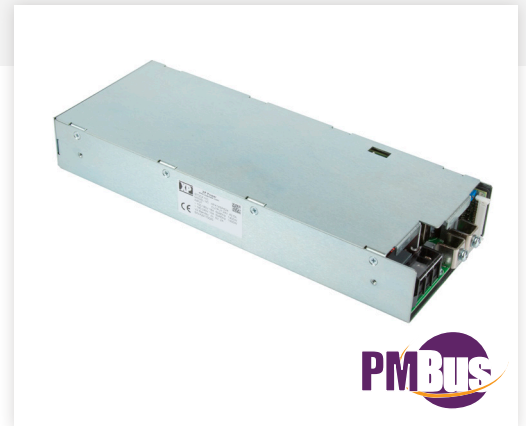
### Models & Ratings

Model Number <sup>(1)</sup>	Max Output Power	Output Voltage V1			Output Current		Efficiency <sup>(2)</sup>
		Minimum	Nominal	Maximum	Minimum	Maximum	
HPA1K5PS24	1500W	0VDC	24VDC	25.2VDC	0.0A	62.50A	91%
HPA1K5PS36	1500W	0VDC	36VDC	37.8VDC	0.0A	41.70A	92%
HPA1K5PS48	1500W	0VDC	48VDC	50.4VDC	0.0A	31.25A	93%
HPA1K5PS60	1500W	0VDC	60VDC	63.0VDC	0.0A	25.00A	92%

#### Notes:

- Standard models include PMBus, CANopen and RS485 interfaces. RS485 default is full duplex. RS485 half duplex can be configured via I<sup>2</sup>C or factory configured on request. To replace RS485 with RS232 or UART, contact sales.
- Measured with 230VAC input and full load.
- USB interface available to enable RS485 and RS232 communication with GUI. Part number XP PS MANAGER INT.

### AC-DC POWER SUPPLIES



### Applications



Healthcare



Industrial  
Electronics



Semiconductor  
Manufacturing



Technology

### Dimensions

279.4 x 106.6 x 41.6mm (11.0" x 4.20" x 1.64")

## Input

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Input Voltage (see application notes)	180		264	VAC	1500W
	100		180		1400W max
	90		100		1200W max
Input Frequency	47		63	Hz	
Power Factor		0.96			Complies with EN61000-3-2 for Class A
Input Current			16	A	100VAC, 1400W
Inrush Current			40	A	264VAC, 25°C cold start
Earth Leakage Current			450	µA	264VAC, 60Hz
Input Protection	F20A / 250V fuse fitted in line and neutral				

## Output

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Output Voltage	0		63	VDC	See Models and Ratings table
Output Set Tolerance		±0.5		%	Nominal voltage irrespective of set voltage
+5V Standby Tolerance		±3		%	5V/2A Standby
Output Voltage Program	0		105	%	Of nominal, slew rate <40ms 10-105% & 105-10%. Max frequency of voltage program is 0.5 Hz 0-5% load, 0.67Hz 5-10% load, 1Hz 10-20% load, 3 Hz 20-100% load
Output Voltage Adjust	±10			%	Of set output via potentiometer 105% of nominal max.
Output Current Program	0		110	%	Of nominal
Minimum Load	0			A	No minimum load required
Start Up Delay		1.3	2	s	Under all load and line conditions
Start Up Rise Time			40	ms	
Hold Up Time	10	14		ms	230VAC at 1500W and 25°C
	10	17			100VAC at 1400W and 25°C
Line Regulation			±0.5	%	Of nominal voltage
			±0.5		5V Standby
Load Regulation			1	%	0-100% or 100-0% load
			2		5V Standby
Transient Response			3	%	Deviation with a 50-75-50% load change. Output returns to within 1% in less than 500µs
Ripple & Noise			1/2.5	%	Of nominal voltage/5V Standby. Measured with 20MHz bandwidth limited oscilloscope 0-50°C
Overshoot			5	%	Turn on & turn off
Overvoltage Protection	110		120	%	Of nominal voltage, latching. Cycle AC to reset. No protection for 5V Standby
Overtemperature Protection	Auto resetting thermal protection				
Overload Protection			±3	% of max load	Set current limit point. Constant current characteristics. Max current limit is 108/112% ±3% (24V/48V models) of maximum rated current. For low line (80-115VAC), constant power characteristic set at 1.4kW until current limit point is reached. 5V Standby: <5A max
Temperature Coefficient			0.03	%/°C	Of max load
Short Circuit Protection	Constant current characteristics. 5V Standby: Foldback characteristic < 5A max				
Remote Sense	Compensates for 1% max of nominal voltage per lead, 2% of total nominal voltage drop.				

## General

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency		92		%	230VAC, 1500W, 5V Standby at full load
Isolation: Input to Output	4000			VAC	2 x MOPP
Input to Ground	1500			VAC	1 x MOPP
Output to Ground	500			VDC	
Switching Frequency	60	65	70	kHz	Fixed frequency PFC
	40		250	kHz	Variable frequency main converter
Power Density			19.8	W/in <sup>3</sup>	
Signals and Controls	V Program, I Program, AC OK, DC OK, Fan Fail/Temperature Warning, Sync, PMBus, Inhibit, Current Share				
MTBF		580		khrs	Telecordia 332, +25°C
Weight		1.9 (4.2)		kg (lb)	

## Environmental

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating Temperature	-20		+70	°C	Derate linearly from 50°C to 50% rated power at +70°C
Storage Temperature	-40		+85	°C	
Cooling	Force-cooled with intelligent fan speed control				
Humidity	5		95	%RH	Non-condensing
Operating Altitude			4000	m	Medical
			5000		IT
Shock	±3 x 30g shocks in each plane, total 18 shocks. 30g = 11ms (±0.5ms) half sine. Conforms to EN60068-2-27 & EN60068-2-47				
Vibration	Single axis 10-500Hz at 2g sweep and endurance at resonance in all 3 planes. Conforms to EN60068-2-6				
Acoustic Noise	<70dB L <sub>pa</sub> measured at 1m on axis of the fans				

## Signals & Controls

	Function
V Program <sup>(1)(2)</sup>	0V to 5V signal will program Vout from 0-105%. VProg accuracy ±3% of nominal output voltage. When left open, supply will go into its default operating mode
I Program <sup>(1)(2)</sup>	0V to 5V signal will program the current limit from 0-110%. When this signal is left open, supply will go into its default operating mode. IProg accuracy ±3% of maximum rating
AC OK	LOW = Input Voltage is within operating range, HIGH = Input Voltage is outside of operating range or there is a loss of phase. Uncommitted opto-transistor, 2ms warning time
DC OK	When the supply is used as a variable output supply, this signal is disabled. When the supply is programmed as a fixed output supply, LOW = Vout > 95% of Vnominal. This level is programmable by the user through the PMBus. Uncommitted opto-transistor
Fan Fail/Temp Warning	High = Fan FAIL and/or overtemperature, Low = Fan OK and temperature OK (3.3V Logic), unit switches off 10 s after Fan Fail/Temp Warning alarm, auto recovery. XP Power GUI available for download, contact sales
Sync.	Connect parallel units to synchronise output turn on
PMBus, CANopen and RS485 Optional: RS485 can be replaced with RS232 or UART	The interface specification is detailed in a separate document "HPA1K5 Communication, Control and Status Specification". XP GUI available for download, contact sales. Vout monitor accuracy is ±1% of nominal voltage, Vout setting accuracy is ±1% of nominal voltage, Iout monitor accuracy is ±3% of full load, Iout setting accuracy is ±3% of full load
Current Share	Connecting pin 23 on one unit to pin 23 on a like voltage unit will force the current to be shared. Up to 5 units can be paralleled. Current share accuracy ±3% of full system load
Inhibit	Uncommitted opto diode. See Signals & Controls

(1) In analog mode, the default Vout and Iout settings are 0% when open circuit.

(2) To activate analog mode, PMBus\_EN (pin 24) must be pulled down to SGND. Default when open is digital programming.

## EMC: Emissions

Phenomenon	Standard	Test Level	Notes & Conditions
Conducted	EN55011/EN55032	Class B	Class A <80% nominal output voltage
Radiated	EN55011/EN55032	Class A	
Harmonic Currents	EN61000-3-2	Class A	
Voltage Flicker	EN61000-3-3		

## EMC: Immunity

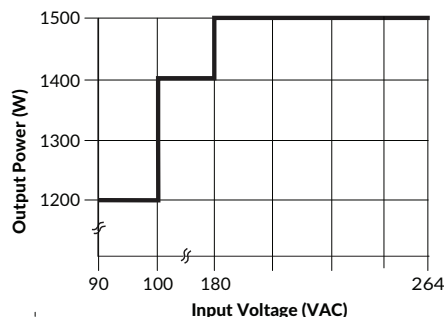
Phenomenon	Standard	Test Level	Criteria	Notes & Conditions
ESD Immunity	EN61000-4-2	4	A	±8kV contact / ±15kV air discharge
Radiated Immunity	EN61000-4-3	3	A	
EFT/Burst	EN61000-4-4	3	A	
Surge	EN61000-4-5	Installation class 3	A	
Conducted	EN61000-4-6	3	A	
Magnetic Field	EN61000-4-8	4	A	
Dips and Interruptions	EN61000-4-11 (100VAC)	Dip 100%, 8.4ms	A	
		Dip 100%, 16.7ms	B	Criteria A derate to 1100W
		Dip 60%, 200ms	B	Criteria A derate to 315W
		Dip 30%, 500ms	A	
		Dip 20%, 5000ms	B	
		Int 100%, 5000ms	B	
	EN61000-4-11 (240VAC)	Dip 100%, 10ms	A	Criteria B >1440W
		Dip 100%, 20ms	B	Criteria A derate to 1000W
		Dip 60%, 200ms	B	Criteria A derate to 1300W
		Dip 30%, 500ms	A	
		Dip 20%, 5000ms	A	
		Int 100%, 5000ms	B	
	EN60601-1-2 (100VAC)	Dip 100%, 10ms	A	Criteria B derate to >1200W
		Dip 100%, 20ms	B	Criteria A derate to 1000W
		Dip 60%, 100ms	B	Criteria A derate to 325W
		Dip 30% , 500ms	A	
		Int 100%, 5000ms	B	
	EN60601-1-2 (240VAC)	Dip 100%, 10ms	A	
		Dip 100%, 20ms	B	Criteria A derate to 1000W
		Dip 60% ), 100ms	A	
		Dip 30%, 500ms	A	
		Int 100%, 5000ms	B	
	SEMI F47 (100/200VAC)	Dip 22% (88/176VAC), 1000ms	A/A	
		Dip 33% (67/134VAC), 500ms	B/A	Criteria A derate to 960W
		Dip 55% (48/90VAC), 200ms	B/A	Criteria A derate to 325W

## Safety Approvals

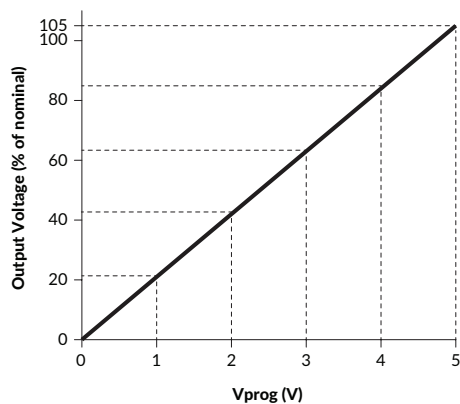
Certification	Safety Standard	Notes & Conditions
CB Report	IEC62368-1 Ed 2	Information Technology
	IEC60601-1 Ed 3 Including Risk Management	Medical
UL	UL62368-1, CSA 22.2 No.62368-1, UL60950-1	Information Technology
	ANSI/AAMI ES60601-1:2005 & CSA C22.2, No.60601-1:08	Medical
EN	EN62368-1	Information Technology
	EN60601-1/2006	Medical
CE	Meets all applicable directives	
UKCA	Meets all applicable legislation	
Equipment Protection Class	Class I	See safety agency conditions of acceptability for details
Isolation	Means of Protection	Notes & Conditions
Primary to Secondary	2 x MOPP (Means of Patient Protection)	IEC60601-1 Ed 3
Primary to Earth	1 x MOPP (Means of Patient Protection)	
Secondary to Earth	N/A	

## Applications Notes

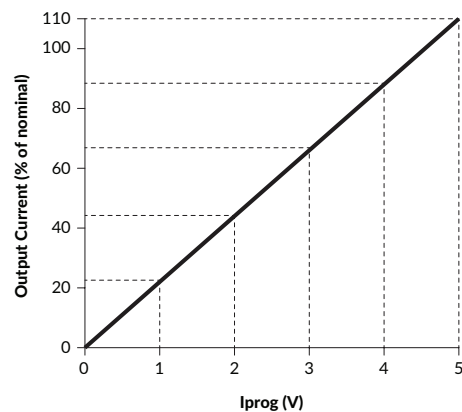
### Input Derating



### Output Voltage Programming

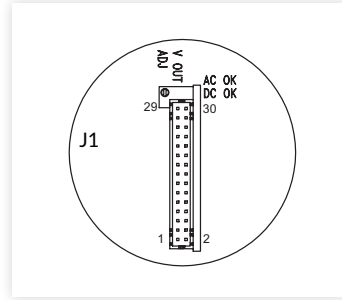


### Output Current Programming



## Signals & Controls

### Signal Connections



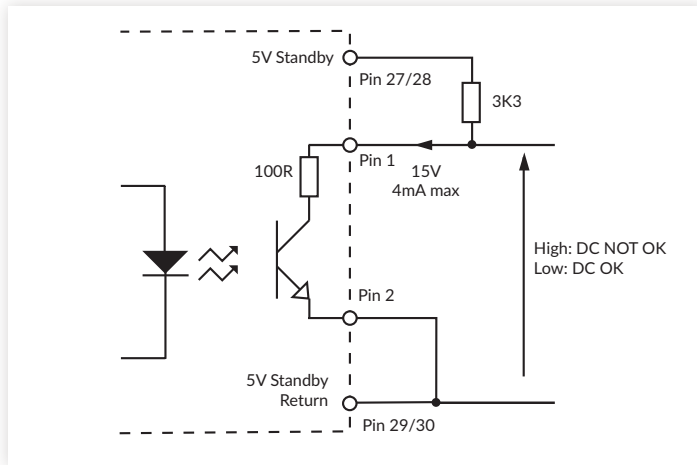
J1 Signal Connector Connections			
Pin	Function	Opto-isolator	Description
1	DCOK	Collector	See circuit diagram on page 7. Uncommitted opto-isolator. Circuit conducting means Vout is within range.
2	DCOK Return	Emitter	
3	Remote Inhibit	Anode	See circuit diagram on page 7. Uncommitted opto-diode. Diode conducting means output OFF.
4	Remote Inhibit Return	Cathode	
5	A0		I <sup>2</sup> C Device Address Bit (Internal 10kΩ pull-up to 3.3V)
6	A1		I <sup>2</sup> C Device Address Bit (Internal 10kΩ pull-up to 3.3V)
7	A2		I <sup>2</sup> C Device Address Bit (Internal 10kΩ pull-up to 3.3V)
8	CANH		CAN Bus Communication using CANopen protocol
9	RS485_Y		RS485 Differential Serial Bus Communication
10	CANL		CAN Bus Communication using CANopen protocol
11	RS485_Z		RS485 Differential Serial Bus Communication
12	SGND		Signal Return
13	UART_RX / RS232_RX/RS485_A		RS485 Differential Serial Bus Communication or RS232 Serial Bus Communication or UART
14	I <sup>2</sup> C SDA		I <sup>2</sup> C (Internal 10kΩ pull-up to 3.3V)
15	UART_TX / RS232_TX/RS485_B		RS485 Differential Serial Bus Communication or RS232 Serial Bus Communication or UART
16	I <sup>2</sup> C SCL		I <sup>2</sup> C Bus Clock (Internal 10kΩ pull-up to 3.3V)
17	FAN_FAIL/TEMP WARNING		Fan Failure/Temp Warning Reporting (High means fan fails and/or overtemperature rating; 10kΩ pull up to 3.3V) See circuit diagram on page 7.
18	SYNC		Connect parallel units to synchronise output turn on
19	VPROG		0 to 5V to set Vout from 0 to 105% <sup>(1)</sup> (50.8kΩ internal resistance between Vprog and SGND <sup>(2)</sup> )
20	RS+		Positive Remote Sense
21	RS-		Negative Remote Sense
22	IPROG		0 to 5V to set Current Limit from 0 to 110% of rated current <sup>(1)</sup> (50.8kΩ internal resistance between Iprog and SGND)
23	ISHARE		0 to 2.6V for current sharing of units in parallel
24	PMBUS_EN		Selecting Digital (open) or Analog (low) mode for VPROG & IPROG (Internal 10kΩ pull up to 3.3V)
25	ACOK	Collector	See circuit diagram on page 7. Uncommitted opto-isolator. Circuit conducting means AC is within range.
26	ACOK Return	Emitter	
27	5VSBY		5V/2A Standby
28	5VSBY		5V/2A Standby
29	5VSBY_RTN		5V/2A Standby Return
30	5VSBY_RTN		5V/2A Standby Return

### Notes:

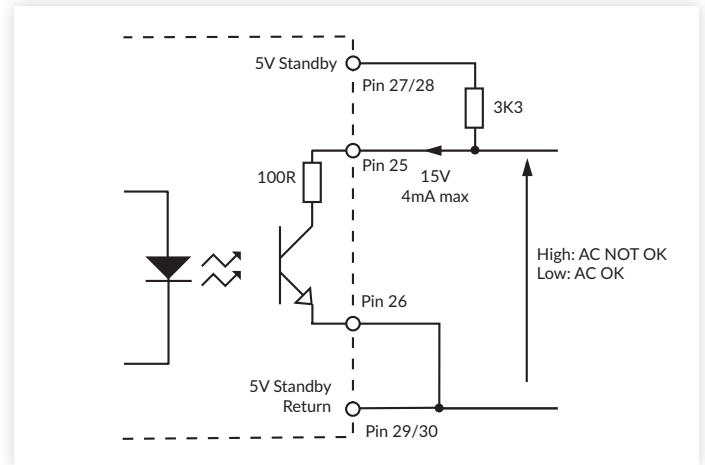
1. In analog mode, the default Vout & Iout settings are 0% when Vprog & Iprog are open circuit.
2. To activate analog mode, PMBus\_EN must be pulled down to SGND. Default if left open is digital programming.

## Signals & Controls

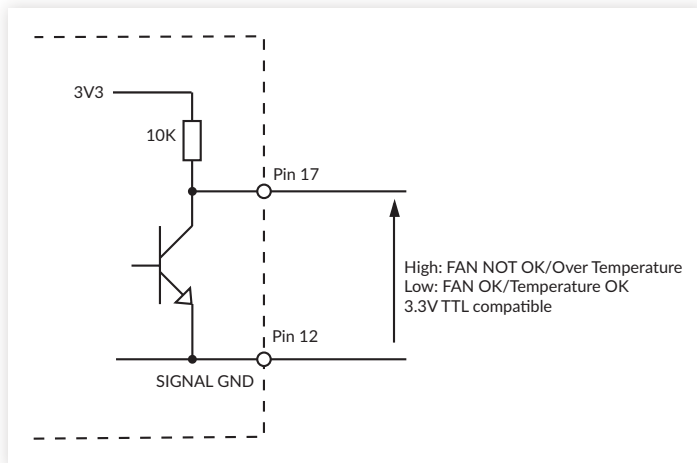
### DC OK



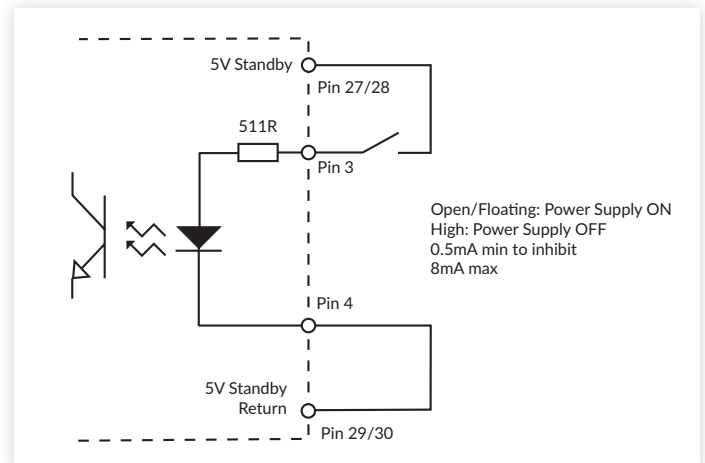
### AC OK



### Fan Fail/Temperature Warning

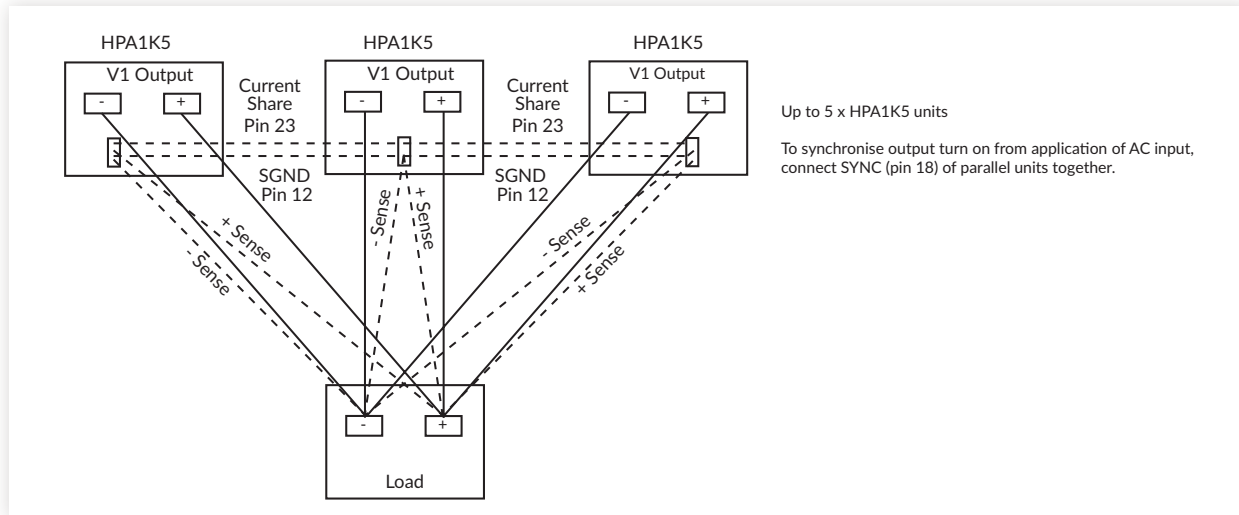


### Inhibit

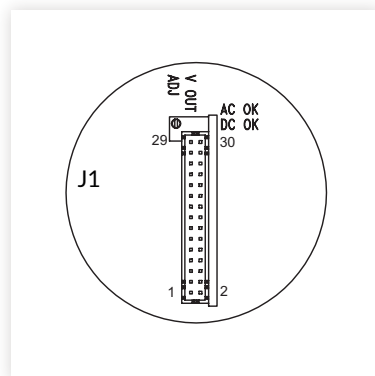


## Signals & Controls

### Current Share



## LED Signals



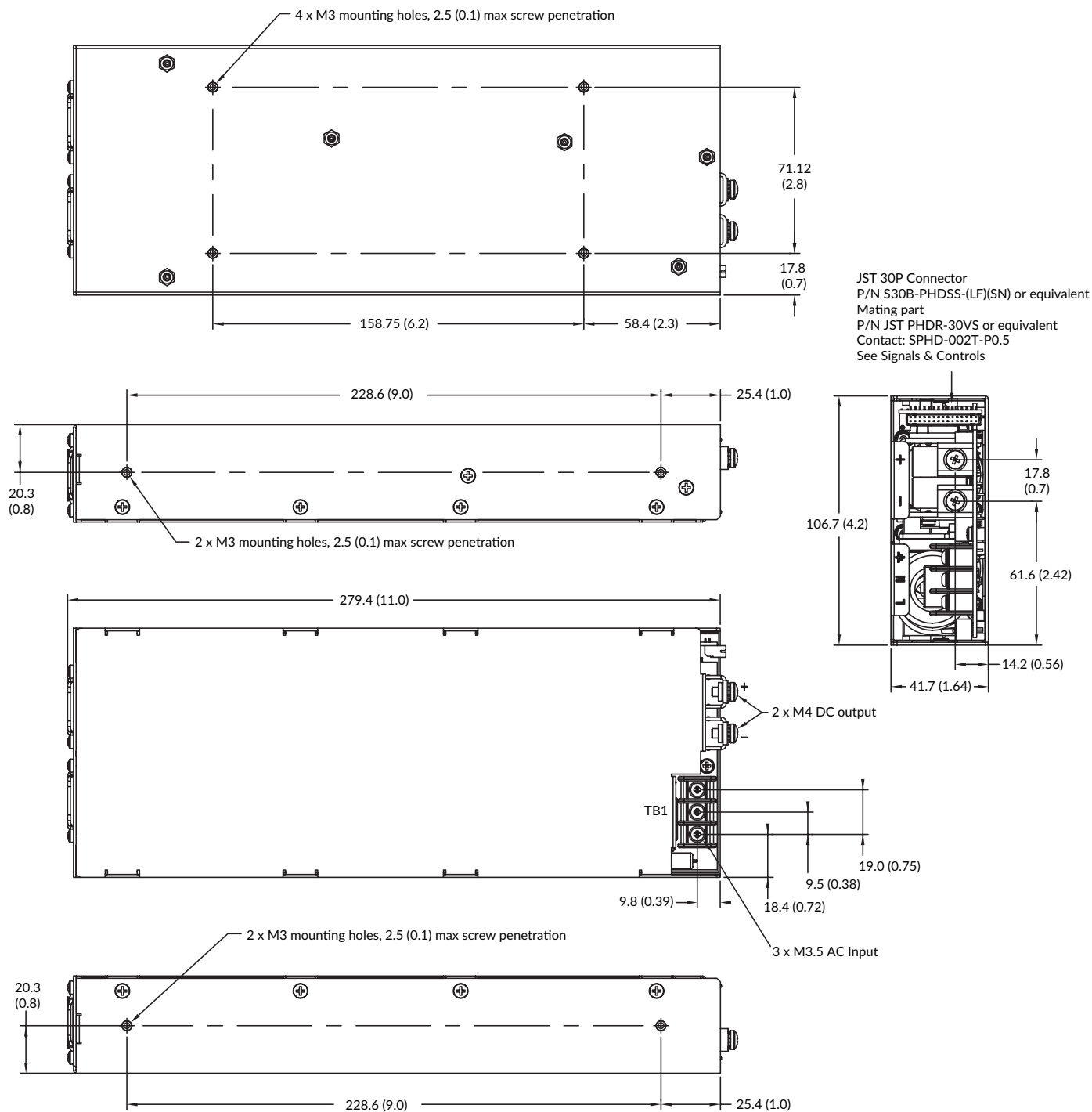
Conditions	LED State		Signals			
	AC OK	DC OK	AC OK	DC OK	FAN_FAIL/TEMP	Remote Inhibit
AC input OK	ON	ON <sup>(3)</sup>	LOW	LOW	LOW	LOW
AC not present or too low	OFF	OFF	HIGH	HIGH	LOW	X <sup>(2)</sup>
AC Present but out of range or PFC failure or no Primary to secondary communication	Blink (0.2s ON, 0.2s OFF)	OFF	HIGH	HIGH	LOW	X <sup>(2)</sup>
Output Over Voltage	ON	OFF	LOW	HIGH	LOW	LOW
Current Limit (Constant current response)	ON	Blink (0.2s ON, 0.2s OFF)	LOW	LOW or HIGH <sup>(3)</sup>	LOW	LOW
Fan Failure/Thermal Shutdown	ON	OFF	LOW	HIGH	HIGH <sup>(1)</sup>	LOW
Remote OFF	ON	Blink (1.0s ON, 1.0s OFF)	LOW	HIGH	LOW	HIGH
PMBus Operation OFF	ON	Blink (1.0s ON, 1.0s OFF)	LOW	HIGH	LOW	LOW

### Notes:

1. In case of fan failure, and/or overtemperature, FAN\_FAIL/Temp Warning signal will be set 10s before output shutdown.
2. Don't care / not applicable.
3. DC\_OK LED is ON if Output Voltage  $\geq$  VOUT\_UV\_FAULT\_LIMIT, if Output Voltage  $<$  VOUT\_UV\_FAULT\_LIMIT, the DC\_OK LED will be OFF



## Mechanical Details



### Notes:

1. All dimensions are in mm (inches).
2. Weight 1.9kg (4.2lb).

3. Signal Connector: P/N JST S30B-PHDSS (LF) (SN) or equivalent  
Mates with P/N JST PHDR-30VS or equivalent  
Contact: SPHD-002T-P0.5