

## MAIN FEATURES

- Universal input voltage range (90 – 305 V<sub>AC</sub>)
- Input surge current limiting (< 20 A at 230 V<sub>AC</sub> nominal)
- 340 W at natural convection 460 W forced air cooling ratings
- Open frame, 3 x 5" industrial standard foot print
- High efficiency up to 94.5%
- 24, 48 and 56 V<sub>DC</sub> standard output voltages
- Low stand-by consumption (<0.35 W)
- Active PFC, EN61000-3-2 compliant (Class C, >20% load)
- Low earth / touch leakage current (<250 / 100 μA)
- Over temperature, OV, OC and SC protections.
- Stand by +5 V, 1 A output
- Remote On / Off signal
- Power good and remote sense signals
- IT Audio Video IEC 62368-1 2<sup>nd</sup> edition compliant
- Design compliant to UL8750 for LED lighting
- Design compliant to IEC 60335-1 for House Hold Appliances
- RoHS 3 compliant (Directive EU 2015/863)
- Operable up to 5000 m altitude



## DESCRIPTION

The DDP460 series of Industrial and LED lighting grade AC-DC power supplies provides the compact form factor and high efficiency that the marketplace demands.

The series can provide up to 460 W of regulated DC power from 90 to 305 V<sub>AC</sub> input operative range, in a 3.0 x 5.0 x 1.51" form factor. The DDP460 series comes in an open frame compact package to facilitate system integration and thermal management in space constraint and closed environments, thanks also to its 94% high efficiency which generate less heat.

The series comes in 24, 48 and 56 V<sub>DC</sub> standard output voltages with additional 12 and 36 V<sub>DC</sub> output voltages variant which will be available upon business case evaluation. It offers a +5 V<sub>DC</sub> stand-by output capable of 1 A. Available control signals include Power Good (P\_OK), Remote On / Off (-PS\_On) and Remote Sense terminals (RS+, RS-).

The series can be operated over the -40 to 70 °C ambient temperature range with output power derating factor applied above 50 °C and below -20 °C start up.

Protection features include, slow blow fuses on both AC lines, input under voltage lockout (IUV), output over-current (OC), output short-circuit (SC), output over-voltage (OV) and over-temperature (OT).

The series is compliant and certified to the latest IEC 62368-1 standard for IT and Audio/Video equipment. Its design and construction make it compatible with UL 8750, for LED lighting applications, and IEC 60335-1 / 61558-1 safety standard for household appliance.

The series meets the EN55032/11 EMC limits of Class B for conducted and Class A for radiated emissions as well as the IEC/EN 61000-3 for harmonic content and EN 55024, EN 61000-6-2 standards for immunity.

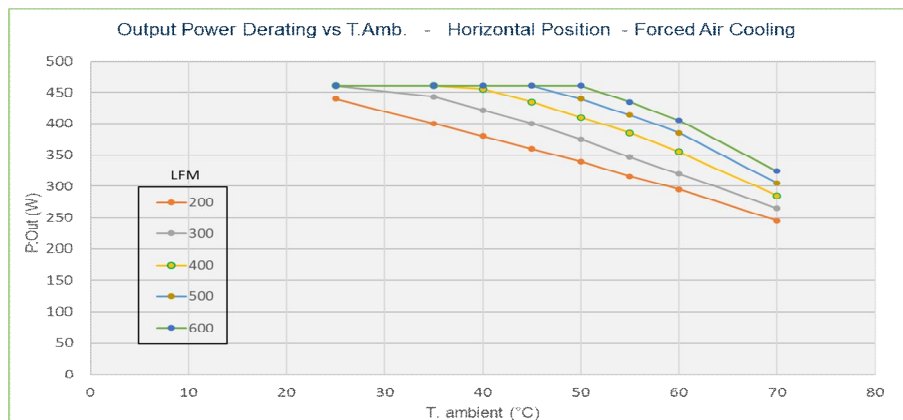
## MARKET SEGMENTS AND APPLICATIONS

- LED Video Wall Display and SSL Lighting
- Industrial Process Control and Automation
- Telecommunications
- Laboratory / Analysis Equipment
- Test and Measurement Equipment
- Household appliance

## MODEL CODING AND OUTPUT RATINGS

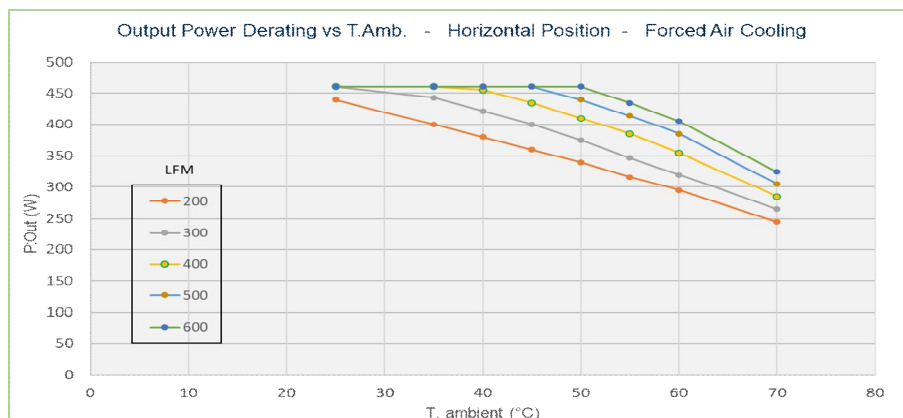
Model Code	V1 Nominal [V <sub>DC</sub> ]	V <sub>AC</sub> Range [V]	I1 [A]	I <sub>SB</sub> [A]	Cooling Mode	Max Combined Output Power [W]
DDP460-US12-OF	12	≥90	TBD	1.0	Natural convection	TBD
		≥100	TBD	1.0		TBD
		≥180	TBD	1.0		TBD
		90-305	TBD	1.0	>600 LFM forced air	TBD
DDP460-US24-OF	24	≥90	14.1	1.0	Natural convection	340
		≥100	15	1.0		360
		≥180	17.3	1.0		415
		90-305	19.2	1.0	>600 LFM forced air	460
DDP460-US36-OF	36	≥90	TBD	1.0	Natural convection	TBD
		≥100	TBD	1.0		TBD
		≥180	TBD	1.0		TBD
		90-305	TBD	1.0	>600 LFM forced air	TBD
DDP460-US48-OF	48	≥90	7.1	1.0	Natural convection	340
		≥100	7.5	1.0		360
		≥180	9.6	1.0		460
		90-305	9.6	1.0	>600 LFM forced air	460
DDP460-US56-OF	56	≥90	6.25	1.0	Natural convection	350
		≥100	6.6	1.0		370
		≥180	8.2	1.0		460
		90-305	8.2	1.0	>600 LFM forced air	460

## OUTPUT POWER DERATING CURVES



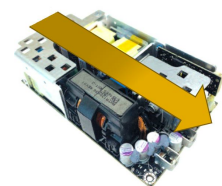
**V<sub>OUT</sub>: 24 V<sub>DC</sub>**

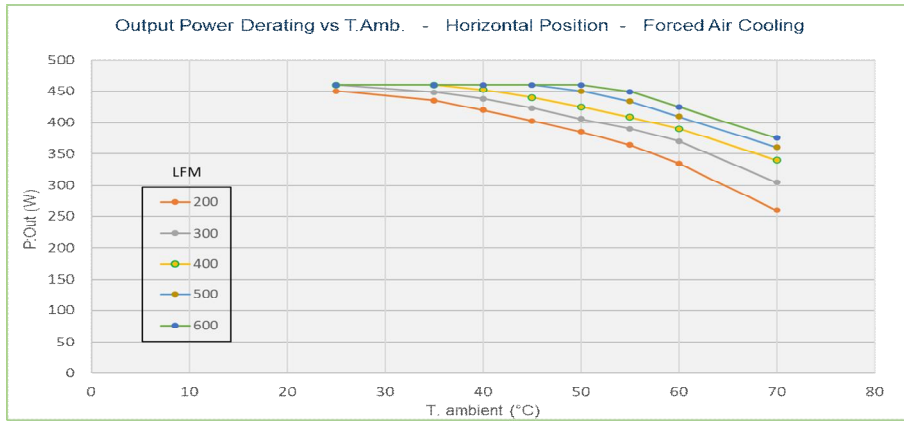
**V<sub>IN</sub>: ≥90V<sub>AC</sub>**



**V<sub>OUT</sub>: 48, 56 V<sub>DC</sub>**

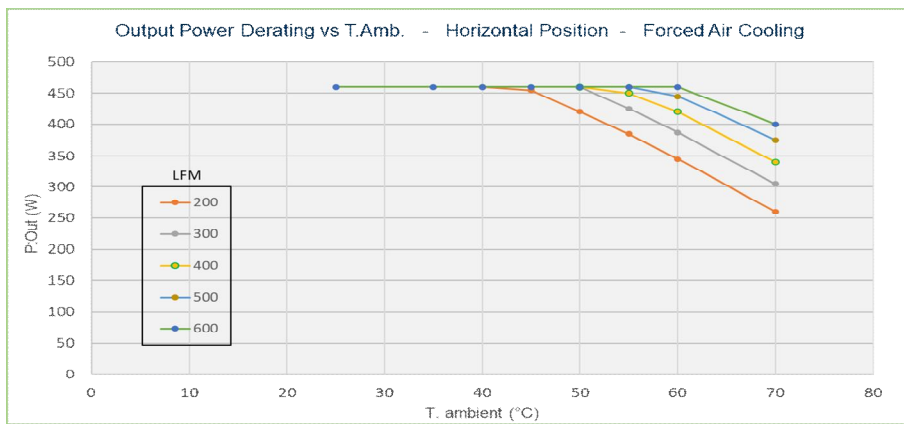
**V<sub>IN</sub>: ≥90V<sub>AC</sub>**





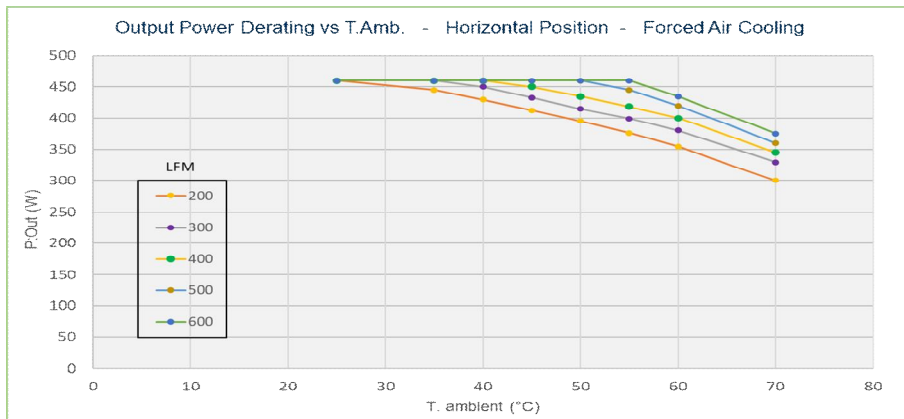
**V<sub>OUT</sub>: 24 V<sub>DC</sub>**

**V<sub>IN</sub>: ≥100V<sub>AC</sub>**



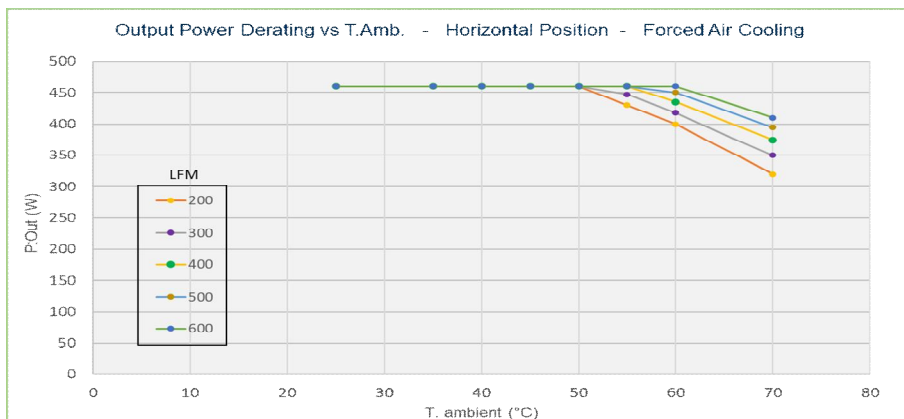
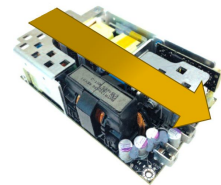
**V<sub>OUT</sub>: 48, 56 V<sub>DC</sub>**

**V<sub>IN</sub>: ≥100V<sub>AC</sub>**



**V<sub>OUT</sub>: 24 V<sub>DC</sub>**

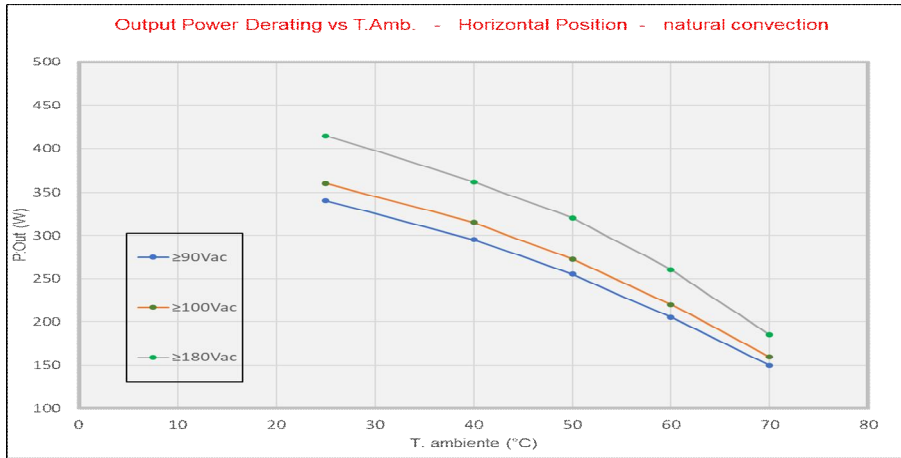
**V<sub>IN</sub>: ≥180V<sub>AC</sub>**



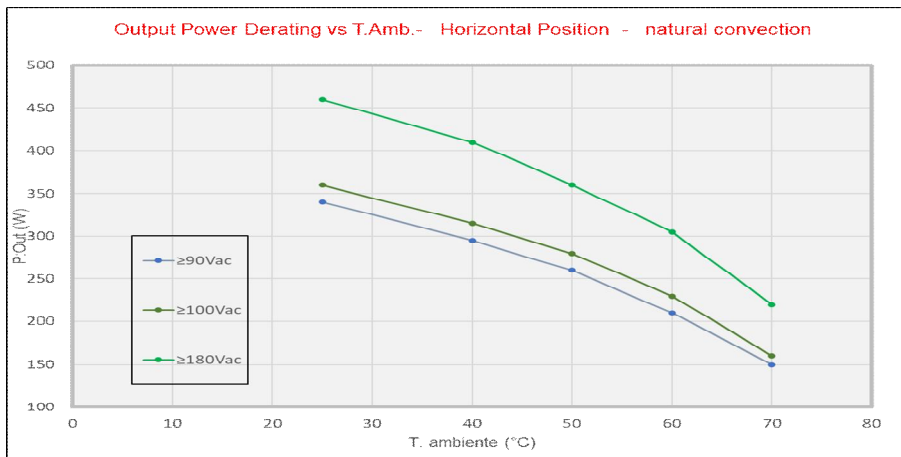
**V<sub>OUT</sub>: 48, 56 V<sub>DC</sub>**

**V<sub>IN</sub>: ≥180V<sub>AC</sub>**

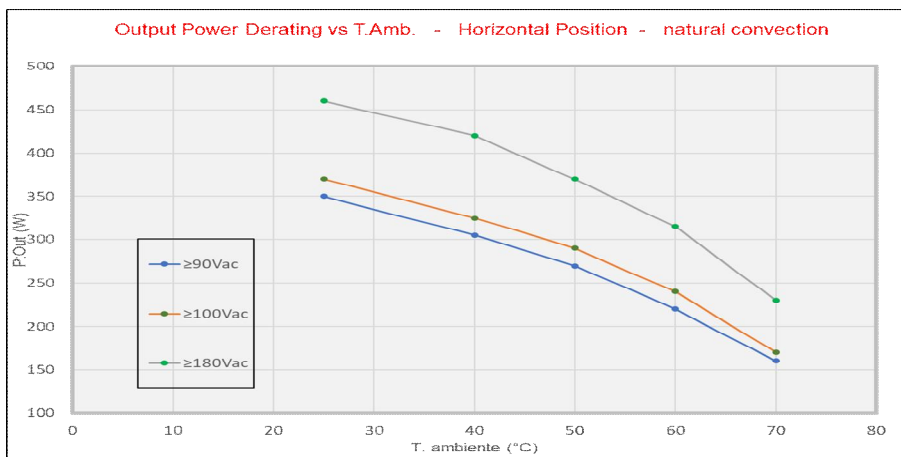




**V<sub>OUT</sub>: 24 V<sub>DC</sub>**



**V<sub>OUT</sub>: 48 V<sub>DC</sub>**



**V<sub>OUT</sub>: 56 V<sub>DC</sub>**



The above curves come from a climatic static chamber and a specific set up therefore they represent a thermal performance approximation of a DDP460 installed into a system where not all the variables can be controlled. Although they are a reasonable reference, it is always a recommended practice to monitor the power supply critical components temperature when operating into a system (see below hot-spots thermal map).

## INPUT SPECIFICATIONS

Specification	Test Conditions / Notes	Min.	Nominal	Max.	Units
<b>AC Input Voltage</b>	PS starts and operates at 85 V <sub>AC</sub> at all load conditions	90	100-277	305	V <sub>RMS</sub>
<b>Input Frequency</b>	440 Hz with reduced PFC and output power rating - Consult factory for details.	47	50/60	440	Hz
<b>Input Current</b>	RMS at 180 V <sub>AC</sub> , maximum load, 50 / 60 Hz RMS at 85 V <sub>AC</sub> , maximum load, 50 / 60 Hz	-	-	3.5 7.0	A
<b>Inrush Current (peak)</b>	Cold start, 25 °C ambient, full load				
	115 V <sub>AC</sub>	-	-	10	A
	230 V <sub>AC</sub>	-	-	20	
	277 V <sub>AC</sub>	-	-	24	
<b>Fusing</b>	Time Lag, 8A, 300V, on each AC lines	-	-	8	A
<b>Efficiency (24V<sub>DC</sub>)</b>	At 115 V <sub>AC</sub> , 20% rated load	-	91	-	
	50% rated load	-	93.5	-	
	100% rated load	-	92	-	%
	At 230 / 277 V <sub>AC</sub> , 20% rated load	-	91.5	-	
	50% rated load	-	94	-	
	100% rated load	-	94.5	-	
<b>Efficiency (48, 56V<sub>DC</sub>)</b>	At 115 V <sub>AC</sub> , 20% rated load	-	90.5	-	
	50% rated load	-	94	-	
	100% rated load	-	93.5	-	%
	At 230 / 277 V <sub>AC</sub> , 20% rated load	-	91	-	
	50% rated load	-	94.5	-	
	100% rated load	-	95.5	-	
<b>Input Power Consumption</b>	Power on, 115 V <sub>AC</sub> , no load	-	-	4	
	Power on, 230 V <sub>AC</sub> , no load	-	-	4	W
	Stand by, 115, 230 V <sub>AC</sub> , no load	-	-	0.35	
<b>Power Factor</b>	From 50 to 100% of rated load, At 277, 230, 115 V <sub>AC</sub> , 50 / 60 Hz	0.90	-	-	-
<b>THDi</b>	From 50 to 100% rated load, 115/230/277 V <sub>AC</sub> 50/60 Hz	-	-	20	%
<b>Harmonic Current Fluctuations and Flicker</b>	Complies with EN 61000-3-2 at 230 V <sub>AC</sub> , 50/60 Hz, Class A, any load Complies with EN 61000-3-2 at 230 V <sub>DC</sub> , 50/60 Hz, Class D, > 35 W load Complies with EN 61000-3-2 Class C at 230 V <sub>AC</sub> , 50/60 Hz, >150 W load Complies with EN 61000-3-3 at nominal voltages and full load				
<b>Earth Leakage Current</b>	Normal conditions				
	115 V <sub>RMS</sub> , 60 Hz	-	100	-	
	230 V <sub>RMS</sub> , 50 Hz	-	180	-	μA
	264 V <sub>RMS</sub> , 60 Hz (worst case)	-	200	-	
	277 V <sub>RMS</sub> , 50 Hz	-	250	290	
<b>Touch Leakage Current</b>	264 V <sub>RMS</sub> , 60 Hz				
	Normal Condition (NC)	-	-	100	μA
	Single Fault Condition (SFC)	-	-	500	

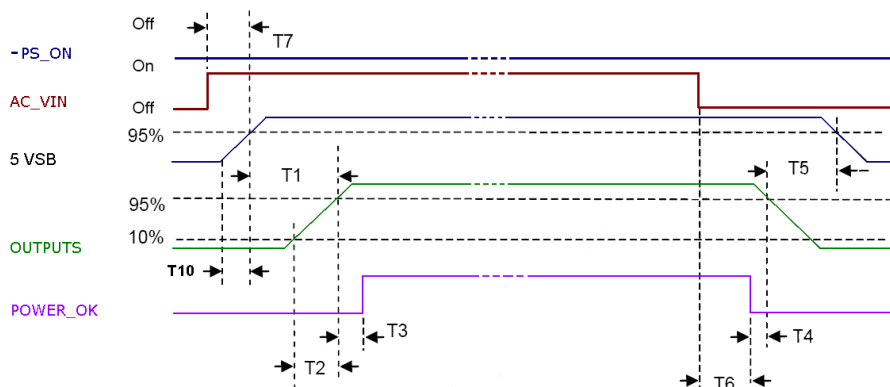
## OUTPUT SPECIFICATIONS

Specification	Test Conditions / Notes	Min.	Nom.	Max.	Units
<b>V1 Output Voltages</b>	±0.5% set point accuracy	-	12	-	V
			24		
			36		
			48		
			56		
<b>V1 Output Power Rating</b>	Natural Convection (see graph above)	-	-	460	W
	Forced air cooling (see graph above)	-	-	460	
	Peak power	-	-	520	
<b>5V<sub>SB</sub> Output Voltage</b>	±3% set point accuracy, 20% load.	-	5	-	V
<b>5V<sub>SB</sub> Output Current</b>		-	-	1.0	A
<b>V1 Voltage Adjustment Range</b>	Manually by potentiometer	-	-	±5	%V1
<b>V1 Load-Line-Cross Regulation</b>	V <sub>AC</sub> : 85 – 305 V <sub>RMS</sub> ; I1: 0 – 100%	-	-	±2	%V1
<b>5V<sub>SB</sub> Load-Line-Cross regulation</b>	V <sub>AC</sub> : 85 – 305 V <sub>RMS</sub> ; I <sub>5SB</sub> : 0 – 100%	-	-	±5	%5V <sub>SB</sub>
<b>V1 Line Regulation</b>	V <sub>AC</sub> : 85 – 305 V <sub>RMS</sub>	-	-	±0.1	%V1
<b>Transient Response: V1, 5V<sub>SB</sub> Voltage Deviation</b>	50% load changes at 1 A/μs	-	-	±5	%V1
	0.5 A load minimum load applied				%5V <sub>SB</sub>
<b>V1 Ripple and Noise</b>	Rated load, Peak-to-peak, 20 MHz BW. (100 nF ceramic, 10 μF tantalum at load)	-	-	1	%V1
<b>V1 Start-up Rise Time</b>	85 < V <sub>IN</sub> < 305, any load conditions.	10	-	100	ms
<b>Start-up Delay</b>	V1 in regulation after de-asserting PS_ON	-	-	200	ms
	V1 in regulation after AC is applied (worst case: 85 V <sub>AC</sub> )	-	-	750	
	5V <sub>SB</sub> in regulation after AC is applied (worst case: 85 V <sub>AC</sub> )	-	-	500	
<b>Turn-on Overshoot</b>		-	-	5	%V1
		-	-	5	%V <sub>SB</sub>
<b>V1 Hold-up Time</b>	At nominal V <sub>IN</sub> , full load	16	-	-	ms
<b>Minimum Load</b>	V1 and 5V <sub>SB</sub>	0	-	-	A
<b>Maximum Load Capacitance</b>	V1: 12 V <sub>DC</sub>	-	-	28000	μF
	V1: 24 V <sub>DC</sub>	-	-	14000	
	V1: 36 V <sub>DC</sub>	-	-	12000	
	V1: 48 V <sub>DC</sub>	-	-	10000	
	V1: 54 V <sub>DC</sub>	-	-	8000	

## SIGNALS / CONTROLS

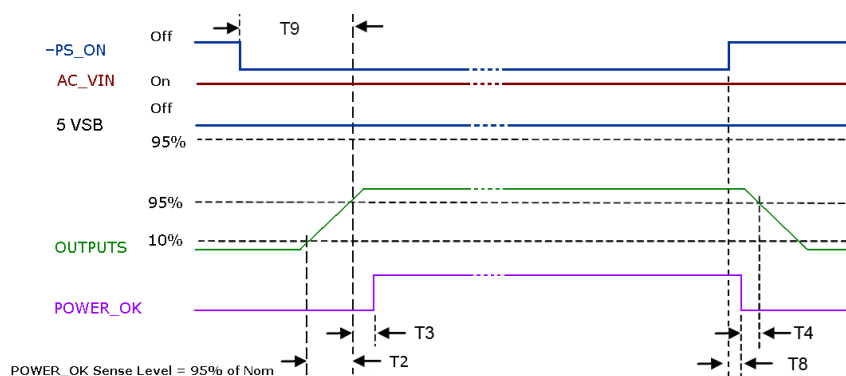
Signal	Notes	Min	Typ	Max	Unit
<b>-PS_ON</b>	Active low, +5 V TTL signal compatible. Input low voltage	0	-	2.0	V
	Input high voltage ( $I_{IN} = 200 \mu A$ )	3.0	-	-	V
	V1 and V2 disabled when PS_ON is open				
<b>P_OK</b>	5V <sub>SB</sub> not affected by PS_ON				
	V1 and V2 enabled with PS_ON connected to RTN				
	+5 V TTL compatible				
	Logic level low (<10 mA sinking)	-	-	0.7	V
	Logic level high (100 $\mu A$ sourcing)	2.4	-	5	V
<b>5V<sub>SB</sub> output</b>	Low to high time after V1 in regulation	0.05	-	0.1	s
	Power down warning time	1	-	-	ms
	Active and in regulation after a $90 < V_{AC} < 264$ is applied	-	-	200	ms
	5V <sub>SB</sub> not affected by PS_ON				

## SIGNALS TIMING



Above waveforms are expected with AC Input ON/OFF:

5 V <sub>SB</sub> On – V1 On	$50 \text{ ms} \leq T1 \leq 250 \text{ ms}$
V1 Rise Time	$5 \text{ ms} \leq T2 \leq 85 \text{ ms}$
5 V <sub>SB</sub> Rise Time	$1 \text{ ms} \leq T10 \leq 10 \text{ ms}$
V1 On – P_OK delay	$30 \text{ ms} \leq T3 \leq 100 \text{ ms}$
Power down warning <sup>1</sup>	$T4 \geq 5 \text{ ms}$
V1 Off – 5V <sub>SB</sub> Off <sup>2</sup>	$T5 \geq 1.2 \text{ s}$
AC Off – P_OK Low	$T6 \geq 10 \text{ ms} (115/ 230 V_{AC})$
AC_ON – 5V <sub>SB</sub> turn On time	$T7 \leq 1000 \text{ ms}$



Above waveforms are expected with PS\_ON Signal ON/OFF state change:

V1 Rise Time	$5 \text{ ms} \leq T2 \leq 85 \text{ ms}$
V1 On – P_OK delay	$30 \text{ ms} \leq T3 \leq 100 \text{ ms}$
Power down warning <sup>1</sup>	$1 \text{ ms} \leq T4 \leq 5 \text{ ms}$
-PS_ON – P_OK down	$T8 \leq 1 \text{ ms}$
-PS_ON – V1 On Timing	$T9 \leq 200 \text{ ms}$

<sup>1</sup> T4 parameter measurement setup will assume at least 10% of the maximum load on each output.

<sup>2</sup> T5 parameter measurement setup will assume at least 50% of the maximum load on main output.

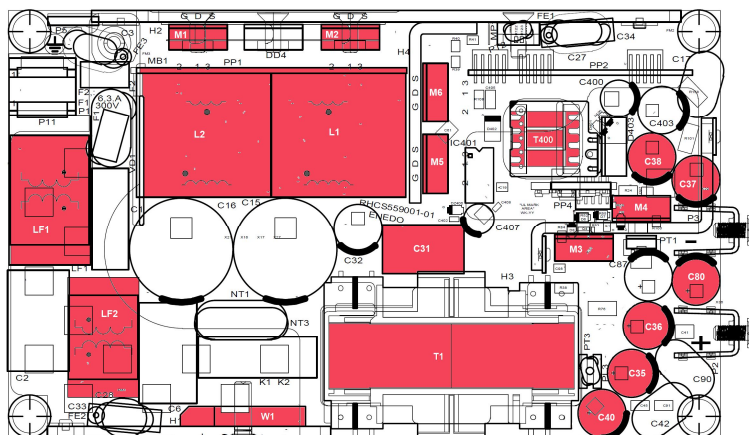
## PROTECTION FEATURES

Specification	Test Conditions / Notes	Min.	Nominal	Max.	Units
Input Under Voltage	Auto-recovering, hiccup mode.	58	65	75	V <sub>AC</sub>
Input Fuse	Time lag, 8A, 300V on both AC lines	-	-	8	A
Over Current	At nominal input voltages V1: Hiccup mode, auto-recovering 5V <sub>SB</sub> : Hiccup mode, auto-recovering:	115	-	160	%I <sub>Rated</sub>
Short Circuit	At nominal input voltages V1: Hiccup mode, auto-recovering. 5V <sub>SB</sub> : Hiccup mode, auto-recovering.	-	-	-	
Over Voltage	V1, Power shut down, latch off. 5V <sub>SB</sub> , Hiccup mode, auto-recovering.	110	-	145	%V <sub>NOM</sub>
Over Temperature (on secondary side)	Hiccup mode, auto-recovering.	-	-	-	°C
Isolation: Input-to-Output	Reinforced	5660	-	-	V <sub>DC</sub>
Isolation: Input-to-Earth	Basic  Production tested at 2121 V <sub>DC</sub>	4000	-	-	V <sub>AC</sub>
		2121	-	-	V <sub>DC</sub>
		1500	-	-	V <sub>AC</sub>
Isolation: V1 to 5V <sub>SB</sub> and Signals	Basic	1500	-	-	V <sub>AC</sub>
Isolation: Output-to-Earth	Basic	1500	-	-	V <sub>AC</sub>
Equipment Protection Class		Class I			

## ENVIRONMENTAL SPECIFICATIONS

Specification	Test Conditions / Notes	Min	Nominal	Max	Units
Operating Temperature Range	Start up at -40 °C at <20% load. No de-rating up to 50°C at >600 LFM	-40	-	50	°C
Operating Temperature Range with De-rating	See de-rating curves and conditions in the Output Specifications section	-	-	70	°C
Storage Temperature		-40	-	85	°C
Humidity	RH, Non-condensing Operating. Non-operating	-	-	90	%
Operating Altitude	Power de-rating above 1800 m	-	-	95	%
Shock	<b>EN 60068-2-27</b> Operating: Half sine, 30 g, 18 ms, 3 axes, 6x each (3 positive and 3 negative). Non-Operating: Half sine, 50 g, 11 ms, 3 axes, 6x each (3 positive and 3 negative).	-	-	5000	m
Vibration	<b>EN 60068-2-64</b> Operating: Sine, 10 – 500 Hz, 1 g, 3 axes, 1 oct/min., 60 min. Random, 5 – 500 Hz, 0.02 g <sup>2</sup> /Hz, 1 g <sub>RMS</sub> , 3 axes, 30 min. Non-Operating: 5 – 500 Hz, 2.46 g <sub>RMS</sub> (0.0122 g <sup>2</sup> /Hz), 3 axes, 30 min.	-	-	-	-
MTBF	Full Load, 40 °C ambient 80% Duty cycle, Telcordia SR-332 Issue 2	400.000	-	-	Hours
Useful Life	Worst nominal V <sub>IN</sub> , 80% load, 40 °C ambient.	-	5	-	Years

To ensure the power supply proper operation when installed in a system or device, the hot-spots components operating temperature should not exceed the corresponding maximum limits shown in the table alongside.



Hot Components PCB Reference	Maximum Operating Temperature [°C]
T1	130
T400	110
W1	125
LF1, LF2	120
L1, L2	120
M1, M2	120
M3, M4	120
M5, M6	120
C31	105
C35, C36, C40, C80	105
C37, C38	105



## ELECTROMAGNETIC COMPATIBILITY (EMC) – EMISSIONS

Phenomenon	Conditions / Notes	Standard	Equipment/Performance Class
<b>Conducted</b>	115, 230, 277 V <sub>RMS</sub> . Maximum load.	EN 55032 (ITE) EN 55011 (ISM) FCC Part 15	B
<b>Radiated</b>	At 3 m distance	EN 55022 (ITE) EN 55011 (ISM) FCC Part 15	A*
<b>Line Voltage Fluctuation and Flicker</b>	At 20%, 50% and 100% maximum load. Nominal input voltages	EN 61000-3-3	
<b>Harmonic Current</b>	230 V <sub>AC</sub> input voltage, 50 / 60 Hz	EN 61000-3-2	A, D
<b>Emission</b>	230 V <sub>AC</sub> 50 / 60 Hz, >150 W load	EN 61000-3-2	C

(\*) Radiated emission should be assessed at system level.

## ELECTROMAGNETIC COMPATIBILITY (EMC) – IMMUNITY

Phenomenon	Conditions / Notes	Standard	Test Level	Criteria
	<b>Reference standards for ITE</b>	<b>EN 55024</b>		
	<b>Reference standard for Industrial/IMS equipment</b>	<b>EN 61000-6-2</b>		
<b>ESD</b>	15 kV air discharge, 8 kV contact, at any point of the system.	EN 61000-4-2	4	A
<b>Radiated Field</b>	10 V/m, 80-1000 MHz, 1 KHz, 80% AM.	EN 61000-4-3	3	A
<b>Electric Fast Transient Surge</b>	±2 kV on AC power port for 1 minute	EN 61000-4-4	3	A
	±2 kV line to line; ± 4 kV line to earth on AC power port	EN 61000-4-5	4	A
<b>Conducted RF Immunity</b>	10 V <sub>RMS</sub> , 0,15-80 MHz, 1 kHz/2 Hz 80% AM	EN 61000-4-6	3	A
<b>Dips and Interruptions</b>	<b>200 – 277 V<sub>AC</sub>:</b> Drop-out to 0% for 10 ms Dip to 40% for 5 cycles (100 ms) Dip to 70% for 25 cycles (500 ms) Drop-out to 0% for 5 s	EN61000-4-11 EN61000-4-11 EN61000-4-11 EN61000-4-11		A A A B
	<b>100 – 127 V<sub>AC</sub>:</b> Drop-out to 0% for 10 ms Dip to 40% for 5 cycles (100 ms) Dip to 70% for 25 cycles (500 ms) Drop-out to 0% for 5 s	EN 61000-4-11 EN 61000-4-11 EN 61000-4-11 EN 61000-4-11		A A (<100 W), B (>100 W) A B

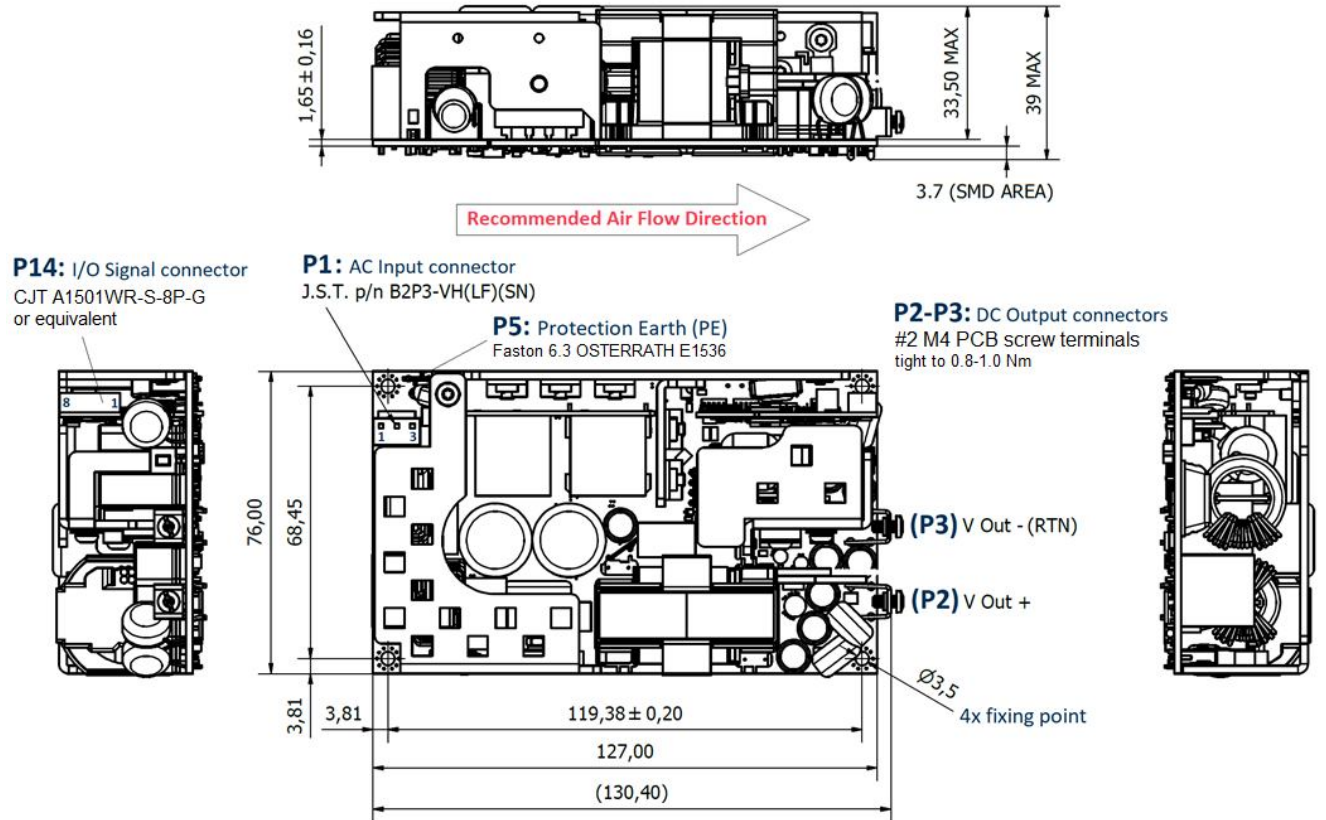
## SAFETY AGENCIES APPROVALS

Certification Body	Safety Standards and file numbers	Category
<b>CSA/UL</b>	CSA C22.2 No. 62368-1, UL 62368-1	Audio Video and Information Technology Equipment
<b>IEC IECCE CB Certification</b>	IEC/EN 62368-1	Audio Video and Information Technology Equip.
<b>CE</b>	Directive 2014/35/EU: Electrical Safety: Low Voltage electrical equipment (LVD) Directive 2014/30/EU: Electromagnetic Compatibility (EMC) Directive EU 2015/863: RoHS 3	Audio Video and Information Technology Equipment
Designed to meet IEC/EN/UL/CSA 61010-1, IEC/EN 60335-1 or IEC/EN 61558-1 and UL8750		

## OUTLINE DRAWING AND CONNECTIONS – OPEN FRAME CHASSIS (-OF)

Overall dimensions: 76.2 x 127.0 x 38.5 mm (3.00 x 5.00 x 1.51 in)

Weight: 400 g (0.88 lb)



Signals Connector – P14	
Pin Ref.	Function
8	RS <sup>-</sup>
7	RS <sup>+</sup>
6	P_OK
5	-PS_On
4	RTN
3	RTN
2	+5V <sub>SB</sub>
1	+5V <sub>SB</sub>

CJT A1501WR-S-8P-G (or equivalent), mates with:  
CJT A1501H-8P (housing)  
CJT A1501-GP (terminals) or equivalent.

AC Input Connector – P1	
P1 Pin Ref.	Function
1	L1
2	NP
3	L2

JST B2P3-VH(LF)(SN)  
Mates with  
JST NVAR-02VS (housing)  
JST SVT-41T-P1.1 (terminal)  
Use 16 AWG minimum wires

**P5: Protection Earth (PE)**  
Faston 6.3 OSTERRATH E1536

DC Output Connector – P2, P3	
Pin Ref.	Function
P2	+V1
P3	RTN

2x M4 screw terminals  
KEYSTONE 7792  
(tight to 0.8-1.0 Nm)  
Max deep screws 7 mm

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