

## DESCRIPTION

DDP400HV is a series of high efficiency, small form factor AC-DC power supplies operating at 277/347/480V<sub>AC</sub> inputs.

The series provides a steady 400 W of regulated DC power through the full input range of 249 to 528 V<sub>AC</sub>. Available in 24, 36 and 48 V models. Each model includes an auxiliary 12V<sub>DC</sub> and 5V<sub>DC</sub> stand-by outputs. Control signals include AC\_OK and remote on/off.

The DDP400HV series comes in an IP67 sealed enclosure with flying leads for both input and output. An optional heat-sink is available or the DDP400HV may be installed directly to the end equipment with heat transferred by conduction.

By converting energy at 93% typical efficiency, the DDP400HV series generates less heat facilitating thermal management in space constrained system and offering high reliability.

Full output power rating from -35 to 50 °C, with operation up to 70 °C with de-rating and is capable to start up from -40 °C.



IP67 c  us 

## KEY FEATURES

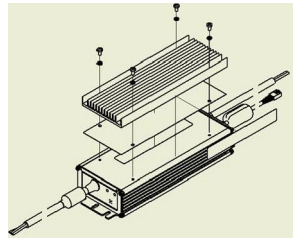
- Wide input voltage range (249-528 V<sub>AC</sub>)
- 400 W rated power (420 W peak)
- Extremely high efficiency (93% typical)
- Low stand-by consumption (<2.8 W at 480 V<sub>AC</sub>)
- 24, 36 and 48 V standard output variants
- Active PFC, EN61000-3-2 Class C at >100 W load
- Low earth leakage current
- Over temperature protection
- OV, OC, and short circuit protections
- +5 V, 2 A stand-by output
- +12 V, 1 A auxiliary / fan output
- Remote On / Off and power good signals
- RoHS-6 compliant (EU directive 2011/65/UE)
- 4000 m altitude operation.

## MARKET SEGMENT AND APPLICATIONS

- Large Format Display Power
- Large Venues and Stadium Lighting
- High Powered Street Lighting
- Large Area Parking
- High Bay Industrial Space
- Architectural Lighting
- Outdoor Lighting
- Horticultural Lighting

## MODEL CODING AND OUTPUT RATINGS

Model Grade and Output Power	Output Nominal Voltage	Package/Fan Options
DDP400HV-	24 V <sub>DC</sub> : <b>US24-</b>	Sealed Conduction/Convection Cooling: <b>SC</b>
DDP400HV-	36 V <sub>DC</sub> : <b>US36-</b>	
DDP400HV-	48 V <sub>DC</sub> : <b>US48-</b>	

DP400HV	-	US	24	-	SC	Heat-sink can be ordered as an accessory using the code:  <b>RHPS384PH-3</b>  Mounting kit includes 4X screws M4x8, 4X split washer and a thermally conductive graphite sheet	
	36						
	48						

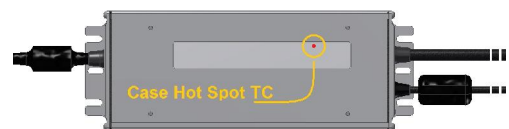
Model Number	V1 [V]	I1 <sup>1</sup> without heatsink [A]	I1 <sup>2</sup> with heatsink [A]	V1 <sup>3</sup> Ripple [mV]	V2 [V]	I2 <sup>1</sup> without heatsink [A]	I2 <sup>2</sup> with heatsink [A]	V2 <sup>3</sup> Ripple [mV]	5V <sub>SB</sub> [V]	I5V <sub>SB</sub> <sup>1</sup> without heatsink [A]	I5V <sub>SB</sub> <sup>2</sup> with heatsink [A]	5V <sub>SB</sub> <sup>3</sup> Ripple [mV]
DDP400HV- US24-SC	24	13.33	16.66	240	12	1	1	240	5	2	2	50
DDP400HV- US36-SC	36	8.88	11.11	360	12	1	1	240	5	2	2	50
DDP400HV- US48-SC	48	6.66	8.33	480	12	1	1	240	5	2	2	50

<sup>1</sup> The combined output power of V1, V2 and 5V<sub>SB</sub> without the optional heat-sink, must not exceed 400W at 25°C, 320W at 50 °C, and 215W at 70 °C ambient temperature (480 V<sub>AC</sub>). See de-rating curves below.

<sup>2</sup> The combined output power of V1, V2 and 5V<sub>SB</sub> with the optional heat-sink must not exceed 400W up to 50°C and 275W at 70°C ambient temperature (480 V<sub>AC</sub>). See de-rating curves below.

<sup>3</sup> Peak-to-Peak measured at 20 MHz Bandwidth.

All ratings in the table above refer to 480 V<sub>AC</sub> and 50°C ambient temperature. In any case, the chassis hot spot temperature T<sub>c</sub> shall never exceed 90 °C



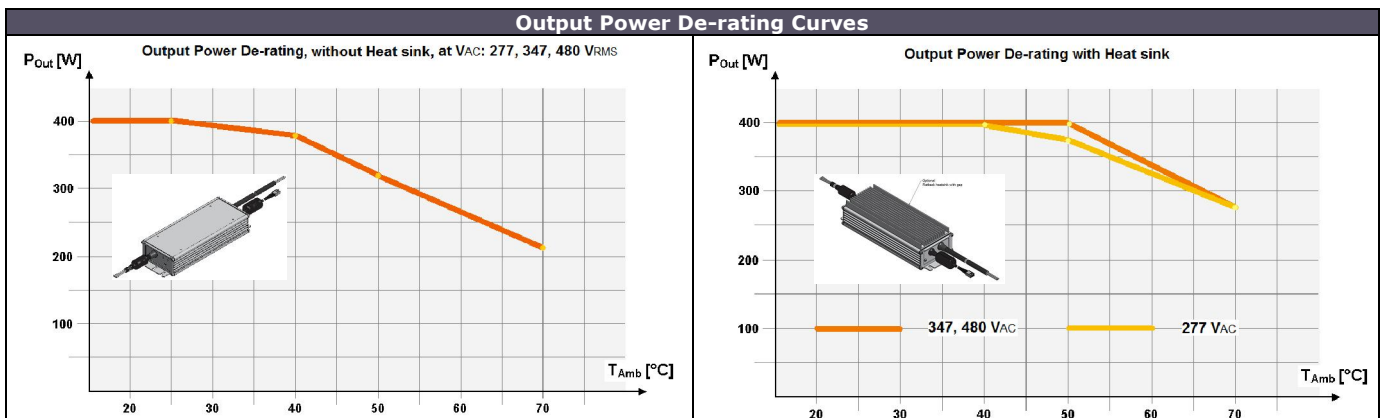
## INPUT SPECIFICATIONS

Specification	Test Conditions / Notes	Min.	Nominal	Max.	Units
<b>AC Input Voltage</b>	PS starts and operates at 249 V <sub>AC</sub> at all load conditions	249	277/347/480	528	V <sub>AC</sub>
<b>DC Input Voltage</b>		300	365	400	V <sub>DC</sub>
<b>Input Frequency</b>		47	50/60	63	Hz
<b>Input Current</b>	RMS at 249 V <sub>AC</sub> , maximum load	-	-	1.8	A
<b>Inrush Current</b>	Peak at 480 V <sub>AC</sub> , cold start, no damage	-	-	60	A
<b>Fusing</b>	2X Time Lag, 500 V <sub>AC</sub> /400V <sub>DC</sub> on ACL1 and ACL2	-	-	5.0	A
<b>Efficiency</b>	480 V <sub>AC</sub> at 20% load	-	89.0	-	%
	480 V <sub>AC</sub> at 50% load	-	92.6	-	
	480 V <sub>AC</sub> at 100% load	-	93.5	-	
	277 V <sub>AC</sub> at 20% load	-	89.6	-	
	277 V <sub>AC</sub> at 50% load	-	92.5	-	
	277 V <sub>AC</sub> at 100% load	-	92.6	-	
<b>Input Power Consumption</b>	Power on, 480 V <sub>AC</sub> , no load	-	3.9	4.5	W
	Stand by, 480 V <sub>AC</sub> , no load	-	2.8	3.3	
<b>Power Factor</b>	From 50% to 100% rated load, 277/347/480 V <sub>AC</sub> , 50 / 60 Hz	0.90	-	-	-
<b>THD</b>	From 50% to 100% rated load, 277/347/480 V <sub>AC</sub> , 50 / 60 Hz	-	-	20	%
<b>Harmonic Current</b>	Complies with EN-61000-3-2 Class C 277/347/480 V <sub>AC</sub> , 50 / 60 Hz, load >100 W				
<b>Fluctuations and Flicker</b>	Complies with EN-61000-3-3 at 277/347/480 V <sub>AC</sub> , 50 / 60 Hz, full load				
<b>Leakage Current</b>	Normal operation, 480 V <sub>AC</sub> , 60 Hz Neutral connected to Earth	-	-	750	µA

## OUTPUT SPECIFICATIONS

Specification	Test Conditions / Notes	Min.	Nom.	Max.	Units
<b>V1 Output Voltage</b>	+RS closed on +V1, 6% rated load 24V (0.5% set point accuracy) 36V (0.5% set point accuracy) 48V (0.5% set point accuracy)	-	24 36 48	-	V
<b>V1 Output Power Rating</b>	All models (see output de-rating curves) Peak (less than 10 seconds, after P_OK high)	-	-	400 420	W
<b>V2 Output Voltage</b>	All models Load on V2: from 5 to 1000 mA Load on V1: from 0.1 A to I1 rated	11.25	12.5	13.75	V
<b>V2 Output Current</b>	All models	-	-	1	A
<b>5V<sub>SB</sub> Output Voltage</b>	All models (3% set point accuracy)	-	5	-	V
<b>5V<sub>SB</sub> Output Current</b>	All models	-	-	2	A
<b>V1 Load-Line-Cross Regulation</b>	V <sub>AC</sub> : 249 – 528 V <sub>RMS</sub> V1 Load: 0 – 16.7 A (24V) 0 – 11.11 A (36V) 0 – 8.33 A (48V) V2 Load: 0 – 1 A 5V <sub>SB</sub> Load: 0 – 2 A	-	-	±2	%V1
<b>5V<sub>SB</sub> Load-Line-Cross regulation</b>	V <sub>AC</sub> : 249 – 528 V <sub>RMS</sub> V1 Load: 0 – 16.7 A (24V) 0 – 11.11 A (36V) 0 – 8.33 A (48V) V2 Load: 0 – 1 A 5V <sub>SB</sub> Load: 0 – 2 A	-	-	±5	%5V <sub>SB</sub>
<b>V1 Line Regulation</b>	V <sub>AC</sub> : 249 – 528 V <sub>RMS</sub>	-	-	±0.1	%V1
<b>Transient Response (Voltage Deviation) V1, 5V<sub>SB</sub></b>	25% load changes at 1 A/μs 24 V at 1000 μF Load / I <sub>OUT</sub> > 0.5 A 36V at 820 μF Load / I <sub>OUT</sub> > 0.5 A 48V at 560 μF Load / I <sub>OUT</sub> > 0.5 A 5V <sub>SB</sub> at 560 μF Load / I <sub>OUT</sub> > 0.1 A	-	-	±5	%V1 %5V <sub>SB</sub>
<b>V1 Ripple &amp; Noise</b>	All models, Peak-to-peak, 20 MHz BW 100 nF ceramic and 10 μF tantalum caps at the load	-	-	1	%V1
<b>Start-up Rise Time</b>	249 < V <sub>AC</sub> < 528, any load conditions for V1, V2, 5V <sub>SB</sub>	2	-	80	ms
<b>Start-up Delay</b>	V1 in regulation after PS_ON is asserted V1 in regulation after AC is applied 5V <sub>SB</sub> in regulation after AC is applied	-	-	0.2 1.7 1.5	s
<b>Turn-on Overshoot</b>	At 500 mA output current, V1 in regulation within 50 ms	-	10 10 10	-	%V1 %V2 %V <sub>SB</sub>
<b>V1 Hold-up Time</b>	277/347/480 V <sub>AC</sub> , full load 277/347/480 V <sub>AC</sub> , 365 W load 277/347/480 V <sub>AC</sub> , 200 W load	-	16 20 35	-	ms
<b>Minimum Load *</b>	All models; V1, V2 and 5V <sub>SB</sub>	0	-	-	A
<b>V1 Maximum Load Capacitance</b>	277/347/480 V <sub>AC</sub> , 25 °C ambient 24 V 36 V 48 V	-	-	16000 10000 7000	μF

\* When the load on the main output is less than 100 mA, V2 output voltage might regulate below its minimum value. Contact ROAL Electronics for details.



### Eu and RoW

ROAL Electronics S.p.A.  
Via Jesina 56/A  
60022 – Castelfidardo (AN) - Italy  
Tel: +39 071 721461  
Fax: +39 071 72146 480

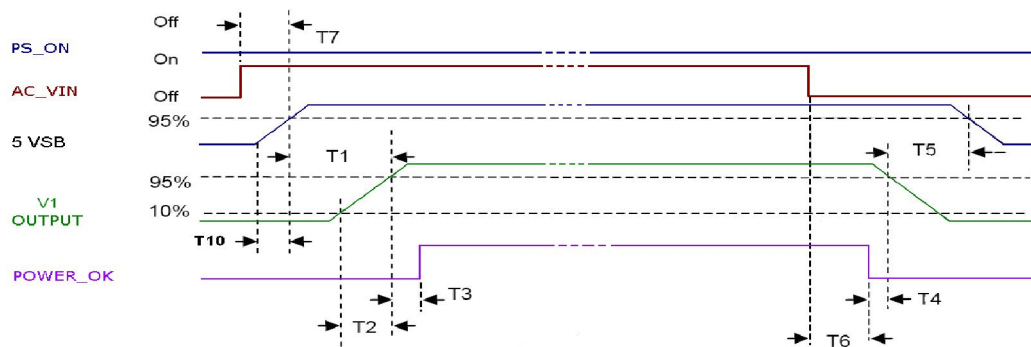
### North America

ROAL Electronics USA, Inc.  
701, Main St. Suite 405  
Stroudsburg, PA18360  
Phone: +1 570 421 5750  
Fax: +1 570 421 5687  
DS\_DDP400HV Series\_Rev11

## SIGNALS / CONTROLS

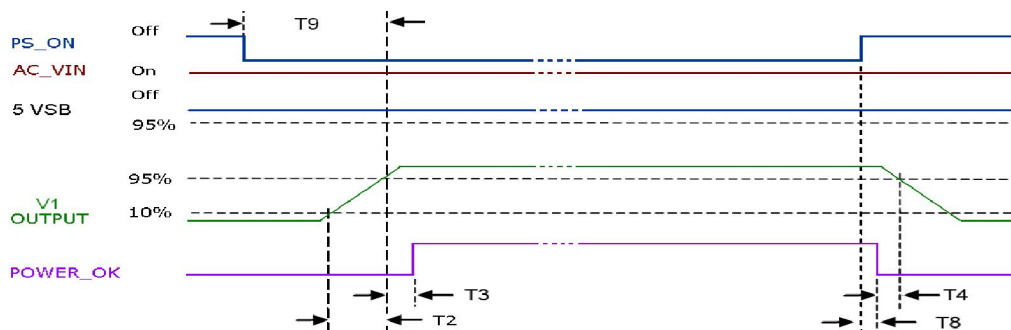
Signal	Notes	Min	Typ	Max	Unit
<b>PS_ON</b>	Active low, +5 V TTL signal compatible. Input low voltage	0	-	2.0	V
	Input high voltage ( $I_{IN}= 200 \mu A$ )	3.0	-	-	V
	V1 and V2 disabled when PS_ON is open 5V <sub>SB</sub> not affected by PS_ON				
<b>P_OK</b>	V1 and V2 enabled with PS_ON connected to RTN +5 V TTL compatible				
	Logic level low (<10 mA sinking)	-	-	0.7	V
	Logic level high (100 $\mu A$ sourcing)	2.4	-	5.5	V
	P-OK Delay Time after V1 in regulation (T3 of the below graph)	50	-	100	ms
	Power down warning time	1	-	-	ms
<b>5V<sub>SB</sub> output</b>	Active and in regulation after a $249 < V_{AC} < 528$ is applied	-	-	1.5	s
	5V <sub>SB</sub> not affected by PS_ON				

## SIGNALS TIMINGS



### Above waveforms are expected with AC Input ON/OFF:

5V <sub>SB</sub> On - V1 On	$40 \text{ ms} \leq T1 \leq 200 \text{ ms}$
V1 Rise Time	$2 \text{ ms} \leq T2 \leq 80 \text{ ms}$
5V <sub>SB</sub> Rise Time	$4 \text{ ms} \leq T10 \leq 40 \text{ ms}$
V1 On - Power_OK delay	$50 \text{ ms} \leq T3 \leq 100 \text{ ms}$
Power down warning <sup>1</sup>	$T4 \geq 1 \text{ ms}$
V1off - 5V <sub>SB</sub> Off	$T5 \geq 500 \text{ ms}$ (V1 load > 200 W)
AC Off - P_OK low	$T6 \geq 15 \text{ ms}$ (277/347/480 Vac)
AC_On - 5V <sub>SB</sub> On time	$T7 \leq 1.5 \text{ s}$ (249 to 528Vac)



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

V1 Rise Time	$2 \text{ ms} \leq T2 \leq 80 \text{ ms}$
V1 On - P_OK delay	$50 \text{ ms} \leq T3 \leq 100 \text{ ms}$
Power down warning <sup>1</sup>	$15 \text{ ms} \leq T4 \leq 30 \text{ ms}$
PS_ON - Power down warning	$T8 \leq 2 \text{ ms}$
PS_ON - V1 On delay	$T9 \leq 200 \text{ ms}$

<sup>1</sup> T4 parameter measurement setup will assume 100% of the maximum load on each output (400W max total power).



## PROTECTION FEATURES

Specification	Test Conditions / Notes	Min.	Nominal	Max.	Units
<b>Input Under Voltage Lockout</b>	Auto Recovery, Hiccup Mode	175	195	-	V <sub>AC</sub>
<b>Input Fuse</b>	2X Time Lag, 500 Vac/400Vdc on ACL1 and ACL2	-	-	5.0	A
<b>Over Current 277/347/480 V<sub>AC</sub></b>	V1: Hiccup mode, auto-recovery	106	-	118	%
	V2: PTC limiting, auto-recovery	-	-	-	%
	5V <sub>SB</sub> : Hiccup mode, auto-recovery	125	-	250	%
<b>Short Circuit 277/347/480 V<sub>AC</sub></b>	V1: Hiccup mode, auto-recovery	-	-	-	
	V2: PTC limiting, auto-recovery	-	-	-	
	5V <sub>SB</sub> : Hiccup mode, auto-recovery	-	-	-	
<b>Over Voltage</b>	V1: Hiccup mode, auto-recovery	125	-	140	%V <sub>NOM</sub>
	5V <sub>SB</sub> : Hiccup mode, auto-recovery	120	-	160	%V <sub>NOM</sub>
<b>Over Temperature (on primary stage)</b>	Shut down, latch off	-	-	-	
<b>Over Temperature (on secondary side)</b>	Hiccup mode with auto-recovery	-	-	-	
<b>Isolation Input-Output</b>	Reinforced Not tested in production	4242	-	-	V <sub>DC</sub>
<b>Isolation Input to Earth</b>	Basic	2780	-	-	V <sub>DC</sub>



## ENVIRONMENTAL SPECIFICATIONS

Specification	Test Conditions / Notes	Min	Nominal	Max	Units
<b>Operating Temperature Range</b>		-35	-	50	°C
<b>De-rated Operating Temperature Range</b>	Without heat-sink (277/347/480 V <sub>AC</sub> ) 400W at 25 °C 375W at 40°C Linear derating from 40°C to 70°C 320W at 50°C 215W at 70°C				
	With heat-sink (480 V <sub>AC</sub> ) 400W up to 50°C Linear derating from 50°C to 70°C 275W at 70 °C				
<b>Storage Temperature Range</b>		-40	-	85	°C
<b>Humidity</b>	RH, Non-condensing Operating	-	-	90	%
	Non-operating	-	-	95	%
<b>Operating Altitude</b>		-	-	4000	m
<b>Shock</b>	<b>EN 60068-2-64</b> Operating: 5-500 Hz, 1 GRMS (0.002 g <sup>2</sup> /Hz), 3 axes, 30 min. Non-Operating: 5-500 Hz, 2.46 GRMS (0.0122 g <sup>2</sup> /Hz), 3 axes, 30 min.				
<b>Vibration</b>	<b>EN 60068-2-27</b> Operating: 30 G /18 ms HALF SINE, 3 axes, 6x axes (3 positive and 3 negative). Non-Operating: 50 G /11ms HALF SINE, 3 axes, 6x axes (3 positive and 3 negative).				
<b>MTBF</b>	277/347/480V <sub>AC</sub> , Full load, 40°C ambient 80% Duty cycle, Telcordia SR-332 Issue 2	-	400000	-	Hours
<b>Useful Life</b>	277/347/480 V <sub>AC</sub> 300 W, 40°C ambient, natural convection	-	52000	-	Hours
	300 W, 25°C ambient, natural convection	-	145000	-	Hours
<b>Cooling</b>	Convection with or without heat-sink and conduction providing an adequate thermal path between the unit and the external environment. Case hot spot temperature T <sub>c</sub> shall not exceed 90 °C in any working condition.				





## ELECTROMAGNETIC COMPATIBILITY (EMC) - EMISSIONS

Phenomenon	Conditions / Notes	Standard	Equipment Performance Class
<b>Conducted</b>	277/347/480 V <sub>AC</sub> , full load	FCC Part 15	B
		EN55022 EN55015	B
<b>Radiated</b>	At 10 m distance	FCC Part 15	B
		EN55022 EN55015	B
<b>Line Voltage Fluctuation and Flicker</b>	277/347/480 V <sub>AC</sub> At 20%, 50% and 100% rated load	EN 61000-3-3	
<b>Harmonic Current Emission</b>	277/347/480 V <sub>AC</sub> All load conditions > 100 W	EN 61000-3-2	C




## ELECTROMAGNETIC COMPATIBILITY (EMC) - IMMUNITY

Phenomenon	Conditions / Notes	Standard	Test Level	Performance criteria
<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>	3 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
<b>Surge</b>	± 4kV line to line, ± 6 kV line to earth on AC power port.	EN 61000-4-5		B
<b>Conducted RF Immunity</b>	3 V <sub>RMS</sub> , 0,15-80 MHz, 1 kHz 80% AM	EN 61000-4-6	3	A
<b>Dips and Interruptions</b>	Drop-out to 0% for 10 ms	EN61000-4-11		A
	Dip to 40% for 5 cycles (100 ms)	EN61000-4-11		B
	Dip to 70% for 25 cycles (500 ms)	EN61000-4-11		B
	Interrupts > 95% for 5 s	EN61000-4-11		B

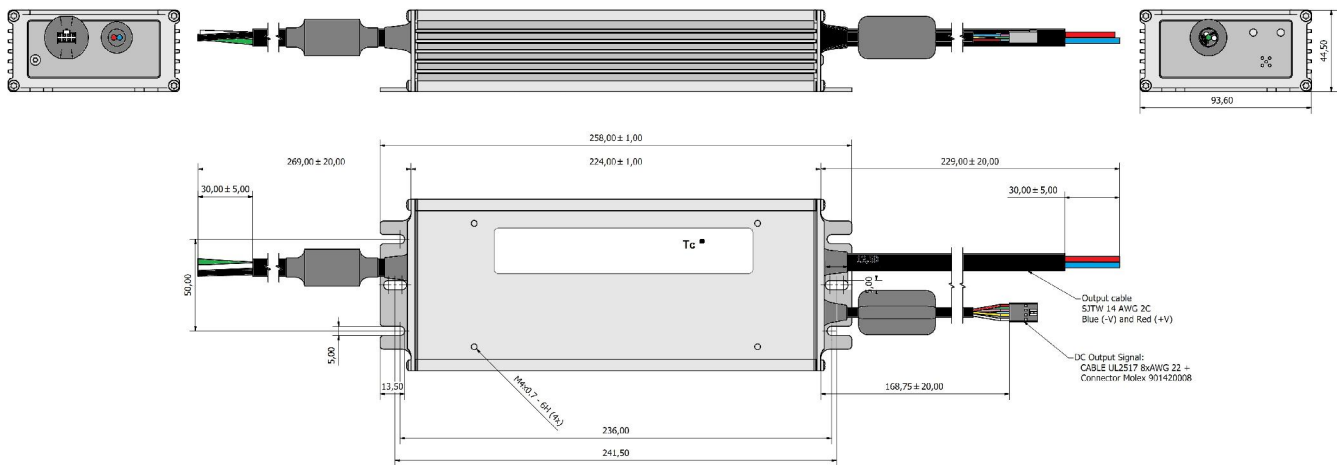


## SAFETY AGENCIES APPROVAL

Certification Body	Safety Standards and file numbers
<b>CSA/UL</b>	 - UL Recognized (E330583.FKSZ2,8) according to UL 8750 and CSA C22.2 No 250, suitable for dry and damp locations, rated HL, meaning Class I, Division 2 hazardous (Classified) location luminaires. Auxiliary output, I/O signals and stand by output are Class 2 rated.
<b>CE</b>	CE Mark for EU according to EN 60950-1: 2006/A11:2009, EN 60950-1:2006/A12: 2011, EN 60950-1:2006/A1: 2010, EN 60950-1: 2006/A2: 2013, EN 60950-1: 2006

## OUTLINE DRAWING AND CONNECTIONS \_ SEALED BOX

<b>Overall dimensions:</b>	Without heat-sink	(93.6 X 258.0 X 44.5) mm; (3.69 X 10.16 X 1.75) in
	With heat-sink	(93.6 X 258.0 X 59.2) mm; (3.69 X 10.16 X 2.33) in
<b>Weight:</b>	Without heat-sink	1900 g; 4.188 lb
	With heat-sink	2185 g; 4.817 lb



Connections	Wires Gauge and Length	Assignment	Colour / Pin
<b>AC Input</b>	STW 3X 18AWG, 105 °C – 600 V, water resistant 60 °C, stranded wires, 269.0 ± 20 mm extension from chassis.	AC L1	Black
		AC L2	White
		Protective Earth (PE)	Green
<b>DC Output</b>	SJTW 2X14 AWG 105°C/300V, water resistant 60 °C, stranded wires, 229.0±20 mm from chassis.	+V1 Output (+V1)	Red
		V1 Return (RTN)	Blue
<b>Auxiliary Voltages Control Signals</b>	Wires: SJTW 8X 22AWG, 105°C - 300V, water resistant 60°C, black external insulation, 169±20mm extension from chassis to connector.  Housed by Connector: Molex 90142-0008 Terminals: Molex 90119-0109 (Tin plating)  Mates with Molex 90130-1106 or equivalent. Terminals: Tin plating termination	+5 V Stand-by Output (+5V <sub>SB</sub> )	Red – 1
		Output Power Good (P_OK)	Green – 2
		- Fan Voltage (-V2)	Brown – 3
		Remote On/Off (PS_ON)	Grey/Purple – 4
		+ Terminal Remote Sense (+RS)	Yellow – 5
		Stand-by/Signals Return (RTN)	Blue – 6
		+ Fan Voltage (+V2)	White – 7
		Stand-by/Signals Return (RTN)	Black – 8

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### Eu and RoW

ROAL Electronics S.p.A.  
Via Jesina 56/A  
60022 – Castelfidardo (AN) - Italy  
Tel: +39 071 721461  
Fax: +39 071 72146 480

### North America

ROAL Electronics USA, Inc.  
701, Main St. Suite 405  
Stroudsburg, PA18360  
Phone: + 1 570 421 5750  
Fax: +1 570 421 5687  
DS\_DDP400HV Series\_Rev11