RDH600 Series

DC-DC Converter

XP Power

600 Watts

- Wide 4:1 Input Range
- Covers 72 & 110 VDC for Rail Applications
- Complies with EN50155
- Meets EN50121-3-2
- Single Output
- Industry Standard Full Brick
- -40 °C to +100 °C Operation
- Output Trim 60-110%
- Remote On/Off
- 3 Year Warranty

Dimensions:

RDH600:
2.4 x 4.6 x 0.5" (61.0 x 116.8 x 12.7 mm)

Models & Ratings

Input Voltage	Output Voltage	Output Current	Input Current		Ripple & noise[1]	Efficiency[2]	Max. capacitive load	Model Number
			No Load	Full Load[3]				
43-160 V	12 V	50.0 A	25 mA	16.00 A	120 mV	87%	10000 µF	RDH60072WS12
	24 V	25.0 A	25 mA	15.85 A	240 mV	88%	5000 µF	RDH60072WS24
	28 V	21.4 A	25 mA	15.85 A	280 mV	88%	5000 µF	RDH60072WS28
	48 V	12.5 A	25 mA	15.85 A	480 mV	88%	5000 µF	RDH60072WS48

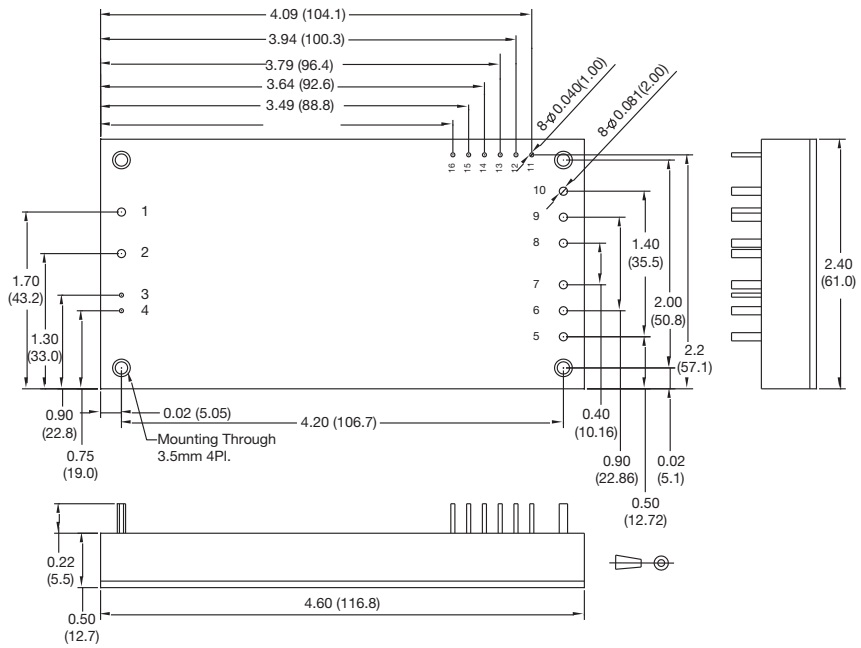
Notes

1. Measured at 20 MHz bandwidth pk-pk, full load, 10 µF aluminum solid and 1.0 µF ceramic capacitors.

2. Measured at 110 V input and full load.

3. Measured at 43 VDC input.

Mechanical Details



Pin	Function
1	-Vin
2	+Vin
3	REM-
4	REM+
5-7	+Vout
8-10	-Vout
11	-Sense
12	+Sense
13	Trim
14	Current Share
15	Power Good
16	Auxilliary, 7-13 V/20 mA

Notes

1. All dimensions are in inches (mm)
2. Weight: 0.485 lbs (220 g) approx.
3. Tolerance: x.xx = ±0.02 (x.x = ±0.5)
   x.xxx = ±0.01 (x.xx = ±0.25)

Input

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Input Voltage Range	43		160	VDC	72/110 V nominal inputs
Input Surge			180	VDC for 100 ms	
Undervoltage Lockout	On: >41 V	42	43	VDC	On
	Off: <39 V	40	41		Off
Lockout Hysteresis		2		VDC	
Idle Current	1		10	mA	When output is inhibited
Inrush Current			1	A^2s	
Recommended Input Fuse		20		A	Time delay
Input Reflected Ripple Current		40		mA pk-pk	Through 12 µH inductor

Output

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Output Voltage	12		48	VDC	See Models and Ratings table
Output Trim	-40		+10	%	See Application Note
Initial Set Accuracy			±1.5	%	At full load and 110 V input
Minimum Load	0			%	No minimum load required
Line Regulation			±0.2	%	From minimum to maximum input at full load
Load Regulation			±0.5	%	From 0% to full load
Transient Response		±3.0	±5.0	%	Maximum deviation, recovering to less than 1% in 500 µs for 25% step load change.
Start Up Time			250	ms	
Output Voltage Rise Time			50	ms	
Ripple & Noise				mV pk-pk	See models and ratings table
Overload Protection	110	125	160	%	
Short Circuit Protection					Continuous hiccup mode, with auto recovery
Maximum Capacitive Load					See Models and Ratings table
Temperature Coefficient			0.02	%/°C	
Overvoltage Protection	115	125	140	%	
Remote On/Off	Ouput is on if REM+ (pin 4) is open or high (3.5-75 VDC) WRT REM- (pin 3) or -Vin Output turns off if REM+ (pin 4) is low (<1.2 VDC max) WRT REM- (pin 3) or -Vin				

General

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency		88		%	See Models and Ratings table
Isolation: Input to Output	2250			VDC	60 s
Isolation: Input to Case	2250			VDC	60 s
Isolation: Output to Case	1500			VDC	60 s
Isolation Resistance	10^7			Ω	
Isolation Capacitance		4000		pF	Input to output
Switching Frequency		250		kHz	
Power Density			109	W/in^3	
Mean Time Between Failure		450		kHrs	MIL-HDBK-217F, +25 °C GB
Weight		0.485 (220.0)		lb (g)	

Environmental

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating Base Plate Temperature	-40		+100	°C	
Storage Temperature	-55		+105	°C	
Thermal Protection		+110		°C	Measured on baseplate
Humidity			95	%RH	Non-condensing
Cooling					Base plate cooled

Safety Approvals

Agency	Standard	Test Level	Notes & Conditions
UL	cUL60950-1		ITE
EN	EN50155		Railway

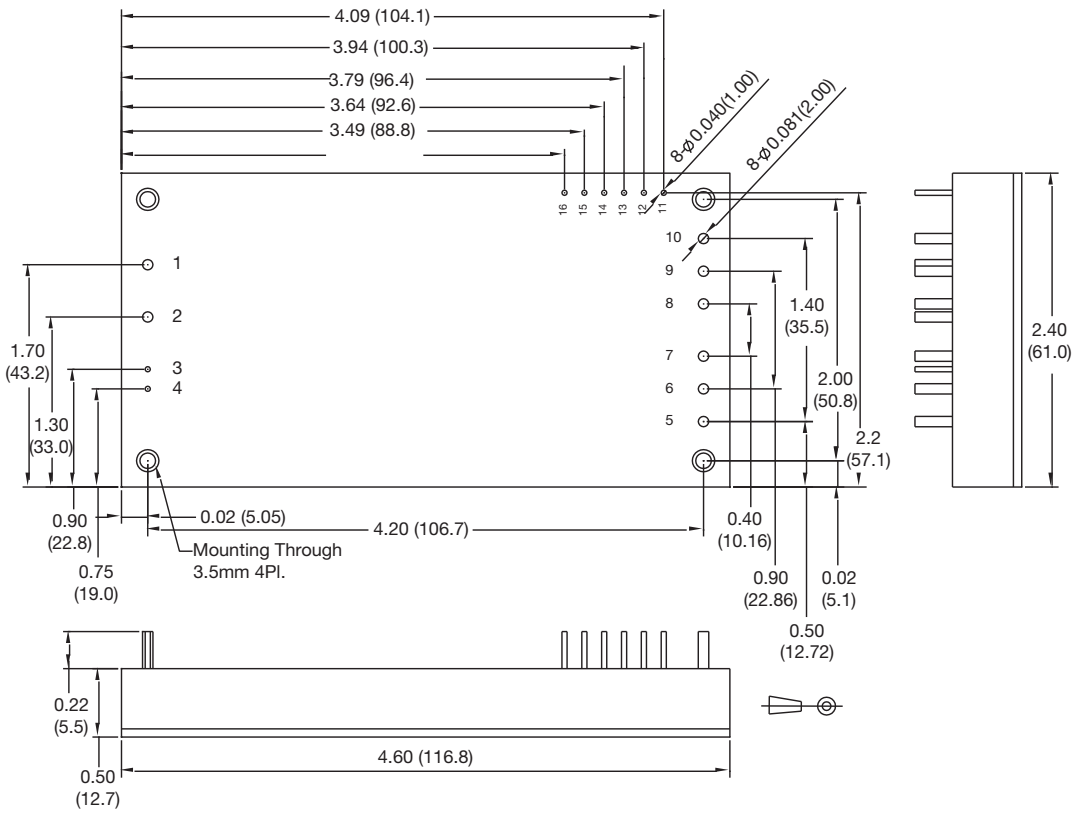
EMC: Emissions

Phenomenon	Standard	Test Level	Notes & Conditions
Conducted	EN50121-3-2		See Application Notes
Radiated	EN50121-3-2		See Application Notes

EMC: Immunity

Phenomenon	Standard	Test Level	Criteria	Notes & Conditions
Railway Equipment	EN50121-3-2			See Application Note
ESD Immunity	EN61000-4-2	±6 kV/±8 kV	A	Contact Discharge/Air Discharge
Radiated Immunity	EN61000-4-3	20 V/m	A	
EFT/Burst	EN61000-4-4	2 kV	A	External capacitor required such as Rubycon 4XF Series, 220 µF/200V
Surge	EN61000-4-5	±2 kV/±1 kV	B	L-E/L-L, External TVS, 1.5 KE 180 A Littlefuse
Conducted Immunity	EN61000-4-6	10 V rms	A	

Mechanical Details



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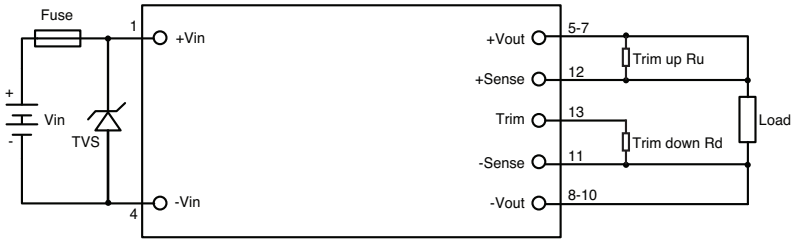
Notes

1. All dimensions are in inches (mm)
2. Weight: 0.485 lbs (220 g) approx.
3. Tolerance: x.xx = ±0.02 (x.x = ±0.5)
   x.xxx = ±0.01 (x.xx = ±0.25)

Application Notes

Input Fusing and Safety Considerations

The RDH600 series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 20 A time delay fuse. It is recommended that the circuit has a transient voltage suppressor diode (TVS) across the input terminals to protect the unit against surge or spike voltages and input reverse voltage (as shown). A suitable part would be 1.5 KE180 A Littlefuse.



Output Voltage Adjustment

The Trim input permits the user to adjust the output voltage up by 10% or down by 40%. This is accomplished by connecting an external resistor between the Trim pin and either the +Sense pin or the -Sense pin.

To Trim Down

Connecting an external resistor (Rd) between the Trim pin and the -Sense pin decreases the output voltage. The following table can be used to determine the required external resistor value to obtain a percentage output voltage change of Δ%.

Trim Down%	12 V	24 V	28 V	48 V
	Rd (kΩ)			
1	387.92	396.61	603.07	387.92
2	235.74	238.95	301.84	235.74
3	168.34	169.98	199.92	168.34
4	130.30	131.30	148.68	130.30
5	105.88	106.54	117.84	105.88
6	88.87	89.34	97.24	88.87
7	76.34	76.69	82.50	76.34
8	66.73	67.00	71.44	66.73
9	59.12	59.33	62.83	59.12
10	52.95	53.12	55.94	52.95
11	47.84	47.99	50.30	47.84
12	43.55	43.67	45.60	43.55
13	39.88	39.99	41.62	39.88
14	36.72	36.81	38.21	36.72
15	33.97	34.04	35.25	33.97
16	31.54	31.61	32.66	31.54
17	29.40	29.46	30.38	29.40
18	27.48	27.53	28.35	27.48
19	25.76	25.81	26.53	25.76
20	24.21	24.25	24.89	24.21
21	22.80	22.83	23.41	22.80
22	21.51	21.54	22.07	21.51
23	20.34	20.37	20.84	20.34
24	19.26	19.28	19.71	19.26
25	18.26	18.28	18.67	18.26
26	17.34	17.36	17.72	17.34
27	16.48	16.50	16.83	16.48
28	15.69	15.71	16.01	15.69
29	14.95	14.97	15.24	14.95
30	14.26	14.27	14.53	14.26
31	13.61	13.62	13.86	13.61
32	13.00	13.01	13.23	13.00
33	12.43	12.44	12.64	12.43
34	11.89	11.90	12.09	11.89
35	11.38	11.39	11.56	11.38
36	10.90	10.91	11.07	10.90
37	10.44	10.45	10.60	10.44
38	10.01	10.02	10.16	10.01
39	9.599	9.608	9.739	9.599
40	9.209	9.217	9.34	9.209

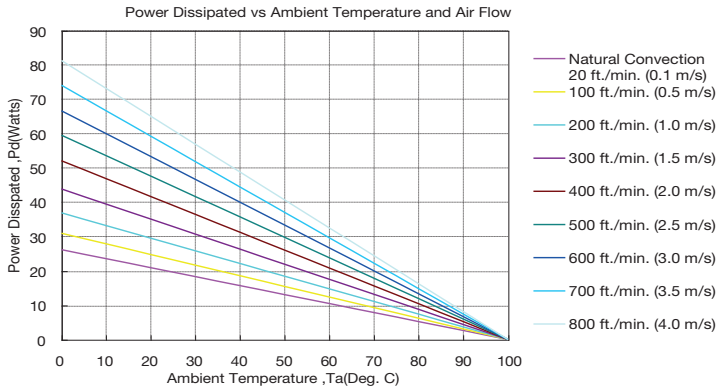
To Trim Up

Connecting an external resistor (Ru) between the +Vout pin and the +Sense pin increases the output voltage. The following table can be used to determine the required external resistor value to obtain a percentage output voltage change of Δ%.

Trim Up %	12 V	24 V	28 V	48 V
	Ru (kΩ)			
1	0.049	0.106	0.272	0.196
2	0.168	0.345	0.55	0.673
3	0.288	0.583	0.829	1.15
4	0.407	0.822	1.107	1.627
5	0.526	1.061	1.385	2.104
6	0.645	1.299	1.664	2.582
7	0.765	1.538	1.942	3.059
8	0.884	1.776	2.221	3.536
9	1.003	2.015	2.499	4.013
10	1.123	2.253	2.777	4.49

Application Notes

Thermal Resistance Information



Air Flow Rate	Typical Rca
Natural Convection 20 ft/min (0.1 m/s)	3.82 °C/W
100 ft/min (0.5 m/s)	3.23 °C/W
200 ft/min (1.0 m/s)	2.71 °C/W
300 ft/min (1.5 m/s)	2.28 °C/W
400 ft/min (2.0 m/s)	1.92 °C/W
500 ft/min (2.5 m/s)	1.68 °C/W
600 ft/min (2.5 m/s)	1.50 °C/W
700 ft/min (2.5 m/s)	1.35 °C/W
800 ft/min (2.5 m/s)	1.23 °C/W

Airflow Derating Graph

Example (Without Heatsink)

To determine the minimum airflow necessary for a RDH60072WS12 operating at an input voltage of 110 V, an output current of 30 A, and a maximum ambient temperature of 30°C:

Determine Power dissipation (Pd): $Pd = Pi-Po = Po(1-\eta)/\eta$,

$Pd = 12\,V \times 30\,A \times (1-0.87)/0.87 = 54$ Watts

Where Pi = Input power, Po = Output Power and η = Efficiency

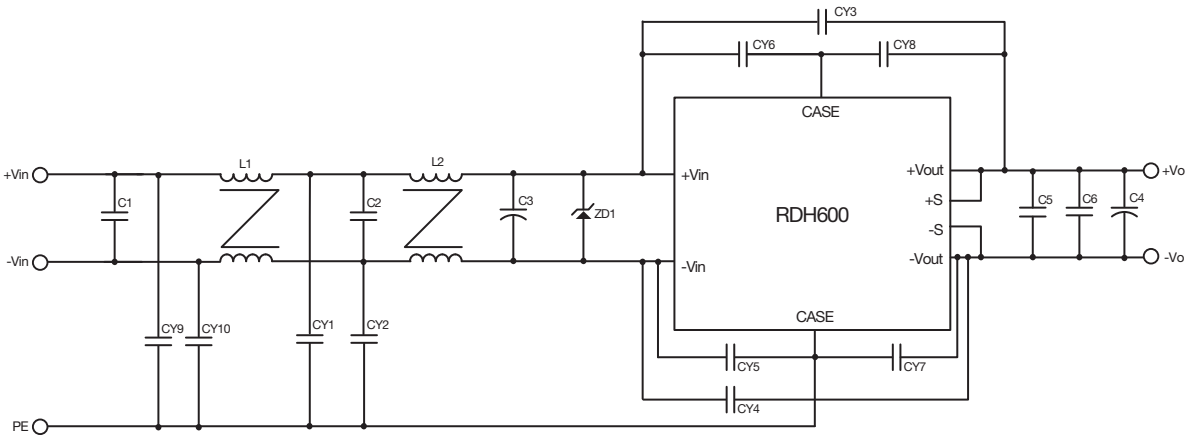
Determine airflow from airflow derating graph using data points for Pd=54 W and Ta = 30 °C

Minimum airflow= 800 ft./min.

To check that the maximum case temp of 100 °C is not exceeded:
Maximum temperature rise is
$\Delta T = Pd \times Rca = 54.0 \times 1.23 = 66.42$ °C.
Maximum case temperature is
$Tc = Ta + \Delta T = 96.42$°C <100°C.
Where: Rca is the thermal resistance from case to ambient environment. Ta is ambient temperature and Tc is case temperature.

Application Notes

EMC Filter – Emissions and Immunity



Model	C1	C2	C3	C4	C5	C6	CY1	CY2	CY3	CY4
RDH60072WS12 RDH60072WS24	X2 CAP, 0.47 µF	X2 CAP, 0.47 µF	220 µF/ 200 V, YXF	470 µF/ 50 V, KY	10 µF/50 V	1 µF/50 V	Y1 CAP, 470 pF	Y1 CAP, 470 pF	Y1 CAP, 2200 pF	Y1 CAP, 2200 pF
	CY5	CY6	CY7	CY8	CY9	CY10	L1	L2	ZD1	
	Y1 CAP, 4700 pF	Y1 CAP, 4700 pF	Y1 CAP, 10000 pF	Y1 CAP, 10000 pF	NC	NC	3.8 mH	3.8 mH	1.5KE180A	
RDH60072WS28	C1	C2	C3	C4	C5	C6	CY1	CY2	CY3	CY4
	X2 CAP, 0.47 µF	X2 CAP, 0.47 µF	220 µF/ 200 V, YXF	470 µF/ 50 V, KY	10 µF/50 V	1 µF/50 V	Y1 CAP, 470 pF	Y1 CAP, 470 pF	Y1 CAP, 1000 pF	Y1 CAP, 1000 pF
	CY5	CY6	CY7	CY8	CY9	CY10	L1	L2	ZD1	
	Y1 CAP, 4700 pF	Y1 CAP, 4700 pF	Y1 CAP, 10000 pF	Y1 CAP, 10000 pF	NC	NC	3.8 mH	3.8 mH	1.5KE180A	
RDH60072WS48	C1	C2	C3	C4	C5	C6	CY1	CY2	CY3	CY4
	X2 CAP, 0.47 µF	X2 CAP, 0.47 µF	220 µF/ 200 V, YXF	470 µF/ 63 V, KY	4.7 µF/ 100 V	1 µF/100 V	Y1 CAP, 470 pF	Y1 CAP, 470 pF	Y1 CAP, 1000 pF	Y1 CAP, 1000 pF
	CY5	CY6	CY7	CY8	CY9	CY10	L1	L2	ZD1	
	Y1 CAP, 4700 pF	Y1 CAP, 4700 pF	Y1 CAP, 10000 pF	Y1 CAP, 10000 pF	Y1 CAP, 4700 pF	Y1 CAP, 4700 pF	3.8 mH	3.8 mH	1.5KE180A	