RDF50 Series

DC-DC CONVERTER

50W BASEPLATE COOLED

The RDF50 Series delivers 50W and offers single output voltages ranging from 5V to 48V. With an ultra-wide 12:1 input range of 14 to 160VDC, which covers standard industrial voltages and meets all requirements of the EN50155 transportation standard.

With world-wide industrial safety approvals and compliance to transportation standards, high efficiency, high reliability, 3kVAC reinforced isolation, remote on/off and wide output trimming, the RDF50 series benefits system designers with easy integration into a wide range of applications including; renewable energy, battery systems, autonomous equipment, factory automation and harsh railway applications.

Features

- Single voltage outputs from 5V to 48VDC
- Wide output voltage trim and remote sense
- 10:1 ultra-wide input range 16 to 160VDC
- Industry standard quarter brick format
- High efficiency, up to 89%
- 3kVAC reinforced input to output isolation
- ITE safety approvals and EN50155 compliance
- Remote On/Off and remote sense
- -40°C to +100°C operating temperature
- Overvoltage, overload, and short circuit protection
- 3 year warranty

Applications

Autonomous Equipment

Industrial Electronics & Robotics

Railway

Dimensions

36.8 x 57.9 x 12.7 mm (1.45” x 2.28” x 0.5”)

Models & Ratings

Model Number[1,2]	Input Voltage	Output Voltage	Output Current	Input Current[3]		Maximum Capacitive Load	Ripple & Noise[4]	Efficiency[5]
				No Load	Full Load			
RDF5072WS05	14-160 VDC	5V	6.00A	5mA	2.90A	4700µF	100mV	83%
RDF5072WS12		12V	4.20A		4.30A	3300µF	150mV	87%
RDF5072WS24		24V	2.10A		4.20A	1200µF	240mV	89%
RDF5072WS48		48V	1.05A		4.25A	680µF	480mV	88%

Notes:

1. For negative logic option, add suffix -N.
2. For threaded baseplate option, add suffix -T.
3. Typical at 14VDC input.
4. Measured at 20MHz bandwidth and 10µF electrolytic capacitor.
5. Measured at 72VDC input.

Input

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Input Voltage Range	14		160	VDC	24, 48, 72 & 110VDC nominal inputs
Input Surge			200	VDC	For 100ms
Undervoltage Lockout		14.6		VDC	On
		12.0			Off
Lockout Hysteresis		1.5		VDC	
Idle Current		3	5	mA	When output is inhibited
Inrush Current			0.1	A^2s	
Input Reflected Ripple Current		40		mA pk-pk	Through 10µH inductor

Output

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Output Voltage	5		48	VDC	See Models & Ratings
Output Trim	-20		+10	%	See Application note
Initial Set Accuracy			±1.0	%	At full load
Minimum Load	No minimum load required				
Line Regulation			±0.5	%	From minimum to maximum input at full load
Load Regulation			±0.2	%	From 0% to full load
Transient Response			±5	%	Maximum deviation, recovering to less than 1% in 250µs for 25% step load change.
Start Up Time		15		ms	
Output Voltage Rise Time		10		ms	
Ripple & Noise	See Models & Ratings, measured using external 10µF MLCC				
Overload Protection	110	180	200	%	
Short Circuit Protection	Continuous hiccup mode, with autorecovery				
Maximum Capacitive Load	See Models & Ratings table				
Temperature Coefficient			0.02	%/°C	
Overvoltage Protection	115	125	140	%	
Remote On/Off	Output is on if remote on/off (pin 2) is open or high (3.5-160VDC) Output turns off if remote on/off (pin 2) is low (option -N for Negative logic)				

General

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency		88		%	See Models & Ratings table
Isolation	3000			VDC	Input to Output, 60s
	2500				Input to Case, 60s
	500			VAC	Output to Case, 60s
Isolation Resistance	10^9			Ω	
Isolation Capacitance		1000		pF	Input to output
		1500			Input to Case
		10000			Output to Case
Switching Frequency	180	200	220	kHz	Fixed
Power Density			30	Win^3	
Mean Time Between Failure		780		khrs	MIL-HDBK-217F, +25 °C GB
Weight		61.5 (0.136)		g (lb)	

Environmental

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating Base Plate Temperature	-40		+100	°C	
Storage Temperature	-55		+125	°C	
Thermal Protection		107		°C	
Humidity			95	%RH	Non-condensing
Cooling	Base plate cooled				

EMC: Emissions

Phenomenon	Standard	Test Level	Notes & Conditions
ITE	EN55032		See Application Notes
Railway Equipment	EN50121-3-2		See Application Notes

EMC: Immunity

Phenomenon	Standard	Test Level	Criteria	Notes & Conditions
Railway Equipment	EN50121-3-2			See Application Notes
ESD Immunity	EN61000-4-2	±6kV/±8kV	A	Contact Discharge/Air Discharge
Radiated Immunity	EN61000-4-3	20Vrms	A	
EFT/Burst	EN61000-4-4	±2kV	A	With external electrolytic capacitor 68µF/400V across input pins
Surge	EN61000-4-5	±2kV	A	
Conducted immunity	EN61000-4-6	10 Vrms	A	See application notes
Magnetic Fields	EN61000-4-8	3A/m	A	

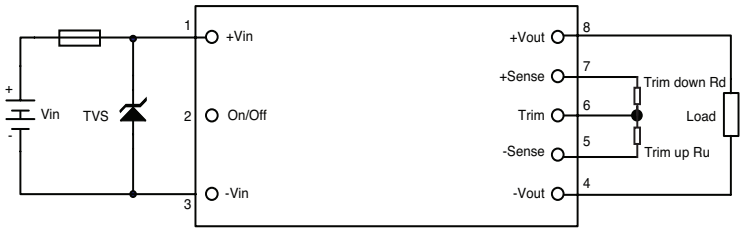
Safety Approvals

Safety Agency	Standard	Test Level	Notes & Conditions
UL	UL60950-1, UL62368-1		Pending
EN	EN50155		Railway, evaluated to EN62368-1
CE	Meets all applicable directives		
UKCA	Meets all applicable legislation		

Application Notes

Input Fusing and Safety Considerations

The RDF50 series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 6A fast acting 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 SMDJ180A.



Output Voltage Adjustment

The Trim input permits the user to adjust the output voltage up by 10% or down by 20%. 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 Vout (+) (or +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	5V	12V	24V	48V
%	Rd (kΩ)			
1	215.8	687.3	1703	3294
2	103.0	327.1	807.8	1588
3	65.40	207.0	509.2	1019
4	46.60	147.0	359.9	735.1
5	35.32	110.9	270.3	564.5
6	27.80	86.96	210.6	450.7
7	22.43	69.81	167.9	369.5
8	18.40	56.95	135.9	308.5
9	15.27	46.94	111.0	261.1
10	12.76	38.94	91.16	223.2
11	10.71	32.39	74.87	192.2
12	9.00	26.93	61.20	166.3
13	7.55	22.31	49.82	144.5
14	6.31	18.35	39.97	125.7
15	5.24	14.92	31.44	109.5
16	4.30	11.92	23.97	95.28
17	3.47	9.277	17.29	82.73
18	2.73	6.923	11.53	71.58
19	2.07	4.817	6.298	61.60
20	1.48	2.921	1.583	52.62

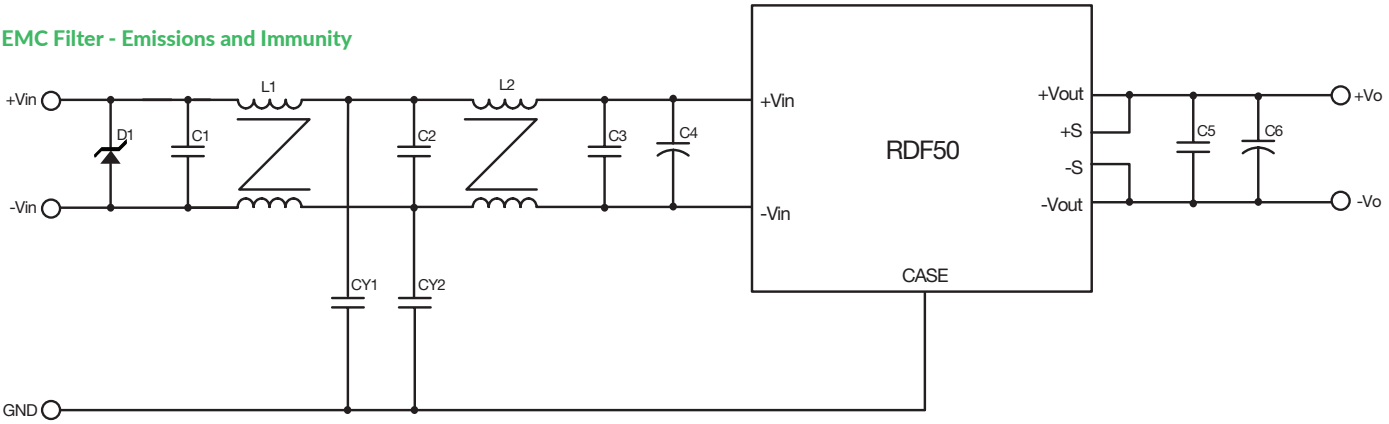
To Trim Up

Connecting an external resistor (Ru) between the Trim pin and the Vout (-) (or -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	5V	12V	24V	48V
%	Ru (kΩ)			
1	50.45	154.1	164.0	147.3
2	24.34	74.95	78.64	71.29
3	15.63	48.56	50.18	45.93
4	11.28	35.37	35.94	33.24
5	8.67	27.45	27.40	25.63
6	6.93	22.17	21.71	20.56
7	5.69	18.41	17.64	16.94
8	4.75	15.58	14.59	14.22
9	4.03	13.38	12.22	12.10
10	3.45	11.62	10.32	10.41

Application Notes

EMC Filter - Emissions and Immunity



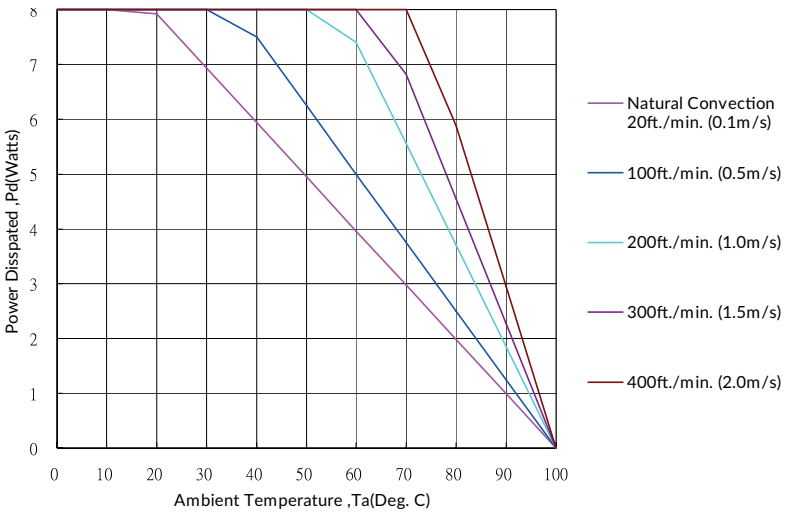
C1, C2, C3	C4	C5	C6	CY1, CY2	D1	L1, L2
1µF/250V 1812 Ceramic Cap.	82µF/250V KXJ Series Aluminium Cap.	2.2uF/100V, 1210 MLCC	4.7uF/100V, 1812 MLCC	1500pF	1.5KE 180A	URT24-50055H 5.5mH

Notes:

C4 UNITED CHEMI-CON KXJ series or equivalent, CY1, CY2 MURATA Y1 capacitors or equivalent, L1, L2 BULL WILL URT24-05055H or equivalent.

Thermal Resistance Information

Power dissipated vs Ambient Temperature and Air Flow without heatsink



Airlow Derating Graph

Air Flow Rate	Typical Rca
Natural Convection 20ft/min (0.1m/s)	10.1°C/W
100ft/min (0.5m/s)	8.0°C/W
200ft/min (1.0m/s)	5.4°C/W
300ft/min (1.5m/s)	4.4°C/W
400ft/min (2.0m/s)	3.4°C/W

Example without Heatsink

To determine the minimum airflow necessary for a RDF5072S12 operating at an input voltage of 72V, an output current of 4.20A, and a maximum ambient temperature of 40°C:

Determine Power dissipation (Pd): Pd = Pi-Po = Po(1-η)/η,

Pd =12 V× 4.2 A×(1-0.87)/0.87=7.53Watts

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

Determine airflow from airflow derating graph using data points for Pd=7.53 W and Ta = 40°C

Minimum airflow= 200ft./min.

To check that the maximum case temp of 100°C is not exceeded: Maximum temperature rise is

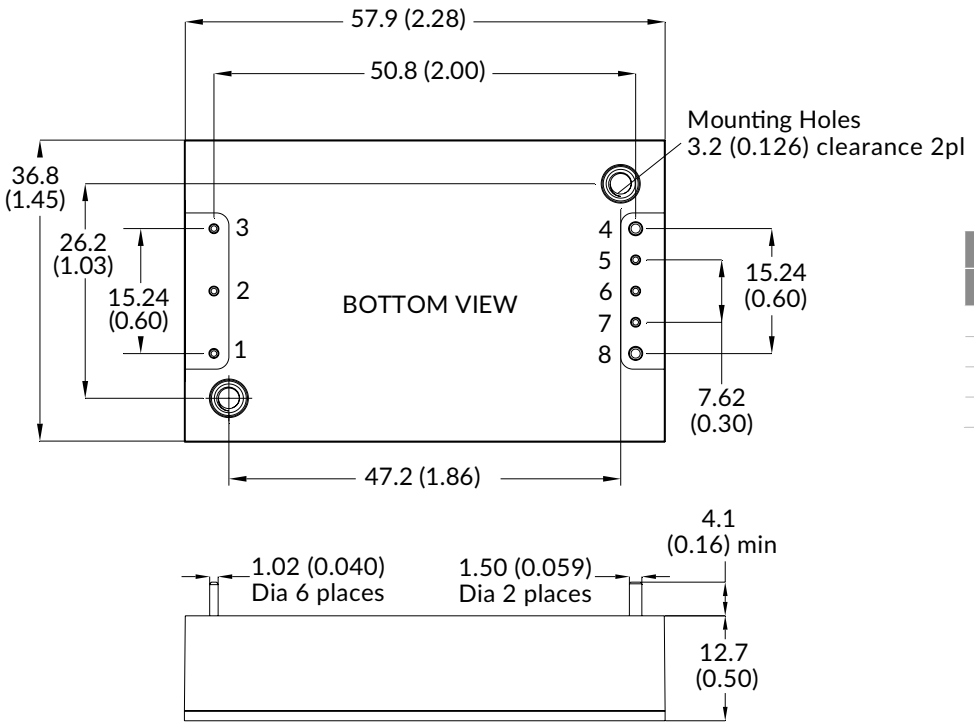
ΔT = Pd × Rca=7.53x5.4 = 40.67°C.

Maximum case temperature is

Tc=Ta+ΔT=80.67°C <100°C.

Where: Rca is the thermal resistance from case to ambient enviroment. Ta is ambient temperature and Tc is case temperature.

Mechanical Details



Pin Connections			
Pin	Function	Pin	Function
1	+Vin	5	-Sense
2	Remote On/Off	6	Trim
3	-Vin	7	+Sense
4	-Vout	8	+Vout

Notes:

1. All dimensions are in mm (inches)
2. Tolerance: x.x = ±0.5 (x.xx = ±0.25), x.xx = ±0.02 (x.xxx = ±0.01)
3. Option -T for baseplate with screw threads