# RDF50 Series

DC-DC Converter

XP Power

## 50 Watts

- Ultra Wide 12:1 Input Range (14-160 VDC)
- Single Output
- Industry Standard 1/4 Brick
- -40 °C to +100 °C Operation
- 3000 VDC Isolation
- Output Trim -20/+10%
- Remote On/Off and Remote Sense
- Complies with EN50155
- Meets EN50121-3-2
- 3 Year Warranty



**Dimensions:**

**RDF50:**
1.45 x 2.28 x 0.5" (36.8 x 57.9 x 12.7 mm)

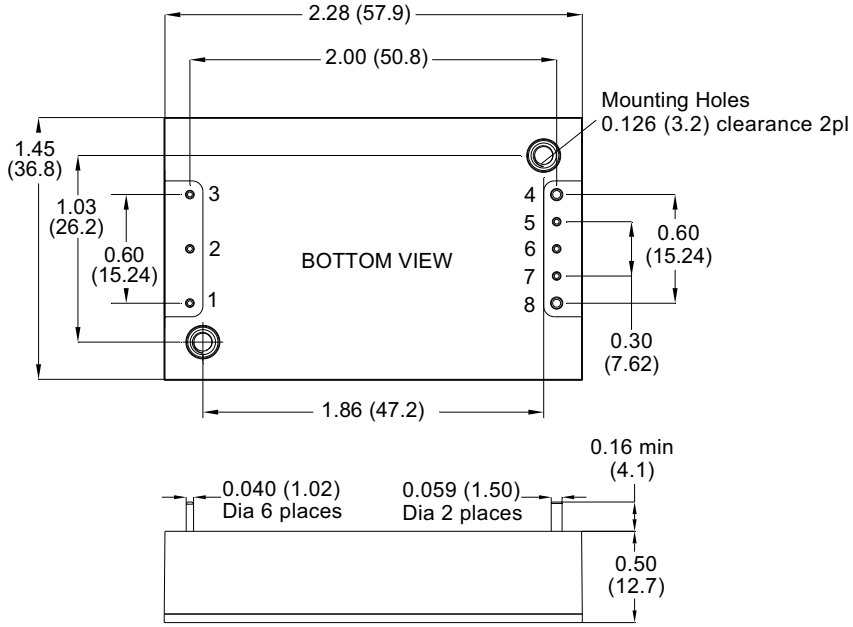
## Models & Ratings

| Input Voltage | Output Voltage | Output Current | Input Current[1] | | Ripple & noise[2] | Efficiency[3] | Max. capacitive load | Model Number |
|---|---|---|---|---|---|---|---|---|
| | | | No Load | Full Load | | | | |
| 14-160 VDC | 5 V | 6.00 A | 5 mA | 2.90 A | 100 mV | 83.0% | 4700 µF | RDF5072WS05 |
| | 12 V | 4.20 A | 5 mA | 4.30 A | 150 mV | 87.0% | 3300 µF | RDF5072WS12 |
| | 24 V | 2.10 A | 5 mA | 4.20 A | 240 mV | 89.0% | 1200 µF | RDF5072WS24 |
| | 48 V | 1.05 A | 5 mA | 4.25 A | 480 mV | 88.0% | 680 µF | RDF5072WS48 |

### Notes

*1. Typical at 14 VDC input.*
*2. Measured at 20 MHz bandwidth and 10 µF electrolytic capacitor.*
*3. Measured at 72 VDC input.*

## Mechanical Details




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

### Notes

1. All dimensions are in inches (mm)
2. Weight: 0.24 lbs (109 g) approx.
3. Tolerance: x.x = ±0.5 (x.xx = ±0.25)
x.xx = ±0.02 (x.xxx = ±0.01)

## Input

| Characteristic | Minimum | Typical | Maximum | Units | Notes & Conditions |
|---|---|---|---|---|---|
| Input Voltage Range | 14 | | 160 | VDC | Covers 24, 48, 72 & 110 VDC nominal inputs |
| Input Surge | | | 200 | VDC | For 100 ms |
| Undervoltage Lockout | On: >13.4 V | 13.7 | 14.0 | VDC | On |
| | Off: <11.9 V | 12.2 | 12.5 | | Off |
| Lockout Hysteresis | | 1.5 | | VDC | |
| Idle Current | | 3 | 5 | mA | When output is inhibited |
| Inrush Current | | | 0.1 | $A^2s$ | |
| Recommended Input Fuse | | 8 | | A | Time delay type |
| Input Reflected Ripple Current | | 40 | | mA pk-pk | Through 10 µH inductor |

## Output

| Characteristic | Minimum | Typical | Maximum | Units | Notes & Conditions |
|---|---|---|---|---|---|
| Output Voltage | 5 | | 48 | VDC | See Models and Ratings table |
| Output Trim | -20 | | +10 | % | See Application Note |
| Initial Set Accuracy | | | ±1.0 | % | At full load |
| Minimum Load | 0 | | | % | 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 for single/dual output |
| Transient Response | | | ±5.0 | % | Maximum deviation, recovering to less than 1% in 250 µs for 25% step load change. |
| Start Up Time | | 15 | | ms | |
| Output Voltage Rise Time | | 10 | | ms | |
| Ripple & Noise | | | | mV pk-pk | See models and ratings table |
| Overload Protection | 110 | 180 | 200 | % | |
| 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 | Output is on if remote on/off (pin 2) is open or high (3.5-160 VDC)<br>Output turns off if remote on/off (pin 2) is low | | | | |

## General

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

## Environmental

| Characteristic | Minimum | Typical | Maximum | Units | Notes & Conditions |
|---|---|---|---|---|---|
| Operating Base Plate Temperature | -40 | | +100 | °C | |
| Storage Temperature | -55 | | +105 | °C | |
| Thermal Protection | | 107 | | °C | |
| Humidity | | | 95 | %RH | Non-condensing |
| Cooling | | | | | Base plate cooled |

## Safety Approvals

| Agency | Standard | Notes & Conditions |
|---|---|---|
| UL | cUL60950-1 | ITE |

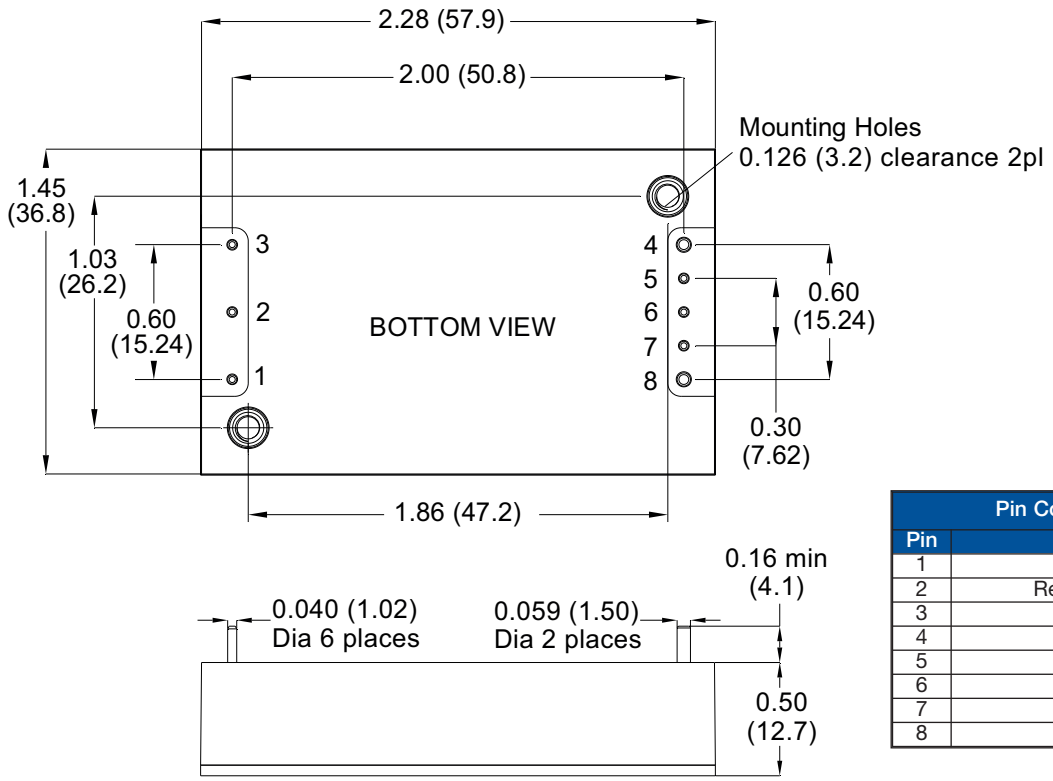
## EMC: Emissions

| Phenomenon | Standard | Test Level | Notes & Conditions |
|---|---|---|---|
| ITE | EN55032 | Class A | 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 | ±6 kV/±8 kV | A | Contact Discharge/Air Discharge |
| Radiated Immunity | EN61000-4-3 | 20 V rms | A | |
| EFT/Burst | EN61000-4-4 | ±2 kV | A | With external electrolytic capacitor 68 µF/400 V across input pins |
| Surge | EN61000-4-5 | ±2 kV | A | With external electrolytic capacitor 68 µF/400 V across input pins |
| Conducted Immunity | EN61000-4-6 | 10 V rms | A | |
| Magnetic Fields | EN61000-4-8 | 3 A/m | A | |

## Mechanical Details




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

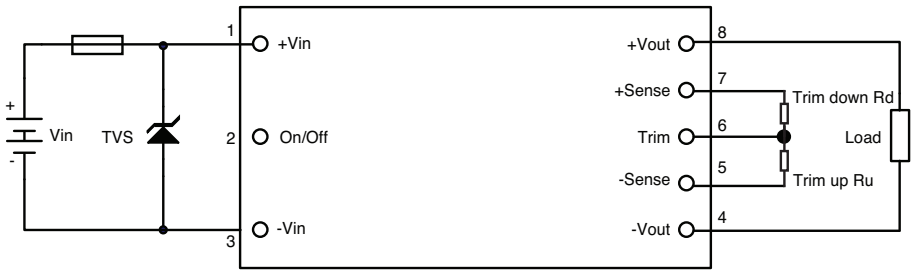
### Notes

1. All dimensions are in inches (mm)
2. Weight: 0.24 lbs (109 g) approx.
3. Tolerance: x.x = ±0.5 (x.xx = ±0.25), x.xx = ±0.02 (x.xxx = ±0.01)

## 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 30 A 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 1.5KE180A.




### 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%.

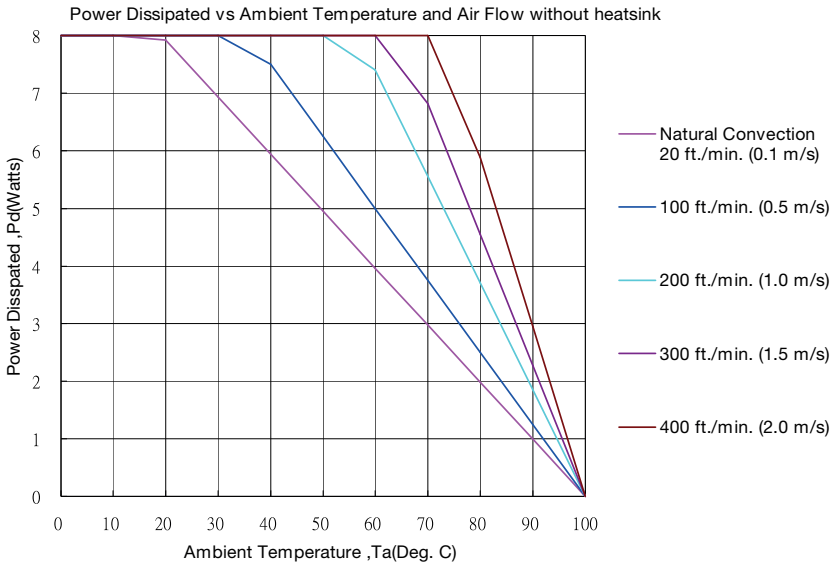
| Trim Up % | 5 V | 12 V | 24 V | 48 V |
|---|---|---|---|---|
| | Rtrim_down (kΩ) | | | |
| 1 | 215.8 | 687.3 | 1703 | 3294 |
| 2 | 103.0 | 327.1 | 807.8 | 1588 |
| 3 | 65.40 | 207.0 | 509.2 | 1019 |
| 4 | 46.60 | 147.0 | 359.9 | 735.1 |
| 5 | 35.32 | 110.9 | 270.3 | 564.5 |
| 6 | 27.80 | 27.80 | 210.6 | 450.7 |
| 7 | 22.43 | 22.43 | 167.9 | 369.5 |
| 8 | 18.40 | 18.40 | 135.9 | 308.5 |
| 9 | 15.27 | 15.27 | 111.0 | 261.1 |
| 10 | 12.76 | 12.76 | 91.16 | 223.2 |
| 11 | 10.71 | 10.71 | 74.87 | 192.2 |
| 12 | 9.00 | 9.00 | 61.30 | 166.3 |
| 13 | 7.55 | 7.55 | 49.82 | 144.5 |
| 14 | 6.31 | 6.31 | 39.97 | 125.7 |
| 15 | 5.24 | 5.24 | 31.44 | 109.5 |
| 16 | 4.30 | 4.30 | 23.97 | 95.28 |
| 17 | 3.47 | 3.47 | 17.39 | 82.73 |
| 18 | 2.73 | 2.73 | 11.53 | 71.58 |
| 19 | 2.07 | 2.07 | 6.298 | 61.60 |
| 20 | 1.48 | 1.48 | 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 % | 5 V | 12 V | 24 V | 48 V |
|---|---|---|---|---|
| | Rtrim_up (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 |

## Thermal Resistance Information




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

## Airflow Derating Graph

## Example (Without Heatsink)

To determine the minimum airflow necessary for a RDF5072S12 operating at an input voltage of 72 V, an output current of 4.20 A, 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

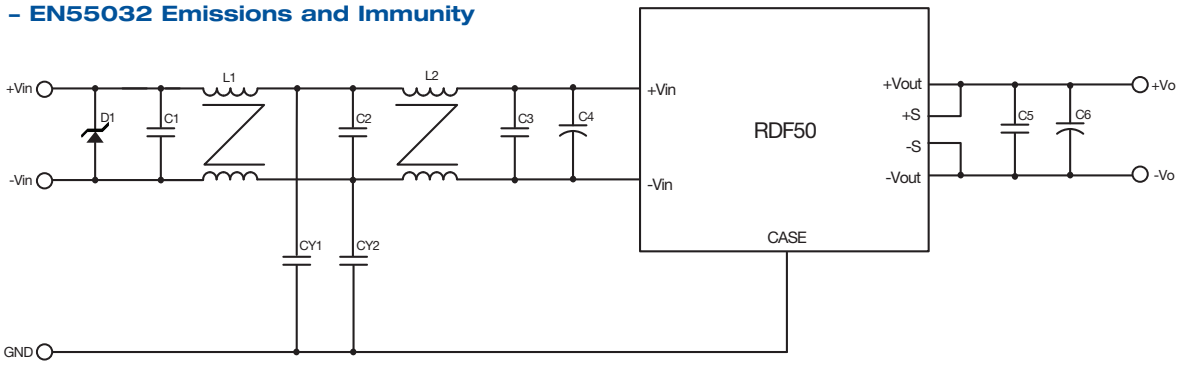
Where Pi = Input power, Po = Output Power and η = Efficiency

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

Minimum airflow= 200 ft./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 environment. Ta is ambient temperature and Tc is case temperature.

## EMC Filter – EN55032 Emissions and Immunity




| C1, C3, C3 | C4 | C5 | C6 | CY1, CY2 | D1 | L1, L2 |
|---|---|---|---|---|---|---|
| 1 µF/250 V 1812 Ceramic Cap. | 82 µF/250 V KXJ Series Aluminium Cap. | 1 µF/100 V 1206 Ceramic Cap. | 22 µF/100 V Solid Aluminium Cap. | 1500 pF | 1.5 KE 180 A | URT24-50055H 5.5 mH |

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