

Features

ICE Technology*

- +115°C Maximum Case Temperature
- -45°C Minimum Case Temperature
- Built-in EMC Filter
- Ribbed Case Style
- 2250VDC Isolation
- Wide 4:1 Input Voltage Range
- Built-in EMC Filter, EN-55022 Class B

Description

The RPP40 series 4:1 input range DC/DC converters are ideal for high end industrial applications and COTS Military applications where a very wide operating temperature range of -45°C to +115°C is required. Although the case size is very compact, the converter contains a built-in EMC filter EN-55022 Class B without the need for any external components. The RPP40 is available in a ribbed case style for active cooling. They are UL-60950-1 certified.

Selection Guide

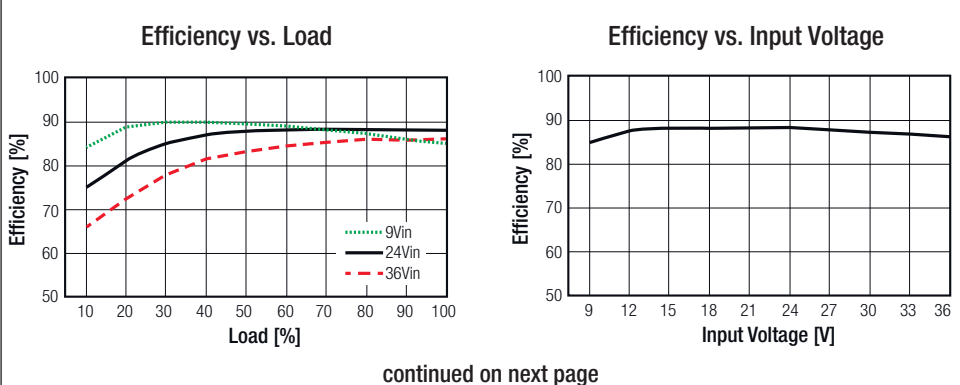
| Part Number | Input Voltage Range [VDC] | Input Current [mA] | Output Voltage [VDC] | Output Current [mA] | Efficiency typ. [%] | Max. Capacitive Load [μ F] |
|--------------|---------------------------|--------------------|----------------------|---------------------|---------------------|---------------------------------|
| RPP40-2412SW | 9-36 | 1920 | 12 | 3300 | 88 | 1000 |

Notes:

Note1: values at nominal input voltage and full load.

Specifications (measured @ $t_a = 25^\circ\text{C}$, nominal input voltage, full load and after warm-up)

| BASIC CHARACTERISTICS | | | | |
|------------------------------|---|-----------|------------|------------|
| Parameter | Condition | Min. | Typ. | Max. |
| Input Voltage Range | nom. $V_{in} = 24\text{VDC}$ | 9VDC | 24VDC | 36VDC |
| Transient Input Voltage | $\leq 100\text{ms}$ | | | 50VDC |
| Inrush Current | with EMC Filter without EMC Filter | | | 20A 40A |
| Under Voltage Lockout | DC-DC ON DC-DC OFF | 8.5VDC | | 8VDC |
| Remote ON/OFF | ON / high logic: $V_{in} > 12\text{V}$ $V_{in} = 9-36\text{V}$ | Open, | 5V 8V | |
| Remote OFF Input Voltage | OFF / low logic | Short, 0V | | 1.2V |
| Remote OFF Input Current | nominal input | | 5mA | |
| Start-up Time | when use CTRL function | | 20ms | |
| Internal Operating Frequency | | 220kHz | 260kHz | 300kHz |
| Output Trimming Voltage | | | $\pm 10\%$ | |
| Efficiency | typ. V_{in} , full load | 87% | 88% | |
| Minimum Load | | 0% | | |
| Output Ripple and Noise | 20MHz limited, $1\mu\text{F}$ output MLCC | | 120mVp-p | 180mVp-p |



RECOM

DC/DC Converter

RPP40-2412SW

40 Watt 4:1
2" x 1.2" 
Ribbed Style
Single Output



UL-60950-1 Certified
EN-55022 Certified

* ICE Technology

ICE (Innovation in Converter Excellence) uses state-of-the-art techniques to minimise internal power dissipation and to increase the internal temperature limits to extend the ambient operating temperature range to the maximum.

Specifications (measured @ $t_a = 25^\circ\text{C}$, nominal input voltage, full load and after warm-up)

Trimming Output Voltage

Only the single output converters have a trim function that allows users to adjust the output voltage from +10% to -10%, please refer to the trim table that follow for details. Adjustment to the output voltage can be used with a simple fixed resistor as shown in Figures 1 and 2. A single fixed resistor can increase or decrease the output voltage depending on its connection. Resistor should be located close to the converter. If the trim function is not used, leave the trim pin open.

Trim adjustments higher than the specified range can have an adverse effect on the converter's performance and are not recommended. Excessive voltage differences between output voltage sense voltage, in conjunction with trim adjustment of the output voltage; can cause the OVP circuitry to activate. Thermal derating is based on maximum output current and voltage at the converter's output pins. Use of the trim and sense function can cause output voltages to increase, thereby increasing output power beyond the converter's specified rating. Therefore: $(V_{out \text{ at Pins}}) \times (I_{out}) \leq \text{rated output power}$.

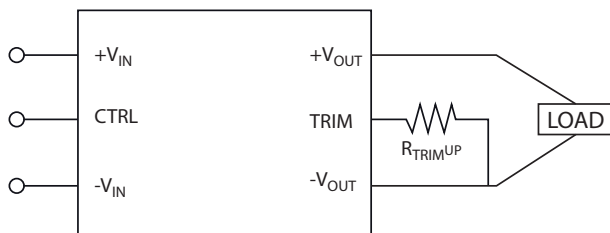


Figure 1. Trim connections to increase output voltage using fixed resistors

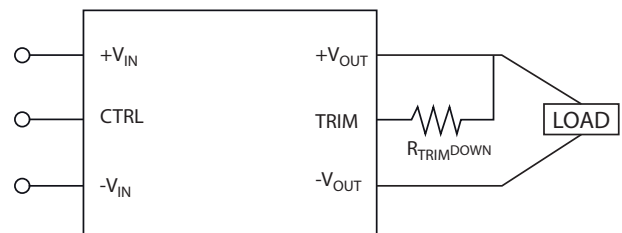


Figure 2. Trim connections to decrease output voltage using fixed resistors

| | Trim up resistor value (K Ω) | | | | | | | | | |
|-------|--------------------------------------|------|------|------|------|------|------|-----|-----|-----|
| Vout | 1% | 2% | 3% | 4% | 5% | 6% | 7% | 8% | 9% | 10% |
| 12VDC | 238.7 | 113. | 68.2 | 46.3 | 32.1 | 22.4 | 15.4 | 9.8 | 6.5 | 3.2 |

| | Trim down resistor value (K Ω) | | | | | | | | | |
|-------|--|-------|------|------|------|------|------|-----|-----|------|
| Vout | -1% | -2% | -3% | -4% | -5% | -6% | -7% | -8% | -9% | -10% |
| 12VDC | 322.2 | 137.2 | 81.1 | 53.1 | 35.5 | 24.0 | 16.0 | 9.7 | 5.0 | 1.3 |

REGULATIONS

| Parameter | Condition | Value |
|--------------------------|---|------------------------|
| Output Voltage Accuracy | 50% load | $\pm 1.5\%$ max. |
| Line Voltage Regulation | low line to high line | $\pm 0.3\%$ max. |
| Load Voltage Regulation | 10% to 100% load | $\pm 0.5\%$ max. |
| Transient Response | 25% load step change, $\Delta I_o/\Delta t = 2.5\text{A}/\mu\text{s}$ | 800 μs typ. |
| Transient Peak Deviation | 25% load step change, $\Delta I_o/\Delta t = 2.5\text{A}/\mu\text{s}$ | $\pm 2\% V_{out}$ max. |

PROTECTIONS

| Parameter | Condition | Value |
|-----------------------------------|---|--|
| Output Power Protection (OPP) | Hiccup Mode | 120% typ. |
| Over Voltage Protection (OVP) | 10% load | 120% typ. |
| Over Temperature Protection (OTP) | case temperature | 120 $^\circ\text{C}$, auto-recovery |
| Isolation Voltage | I/P to O/P, at 70% RH I/P to Case, O/P to Case | 2250VDC / 1 Minute 1500VDC / 1 Minute |
| Isolation Resistance | I/P to O/P, at 70% RH | 100M Ω min. |
| Isolation Capacitance | I/P to O/P | 1500pF typ. |

Notes:

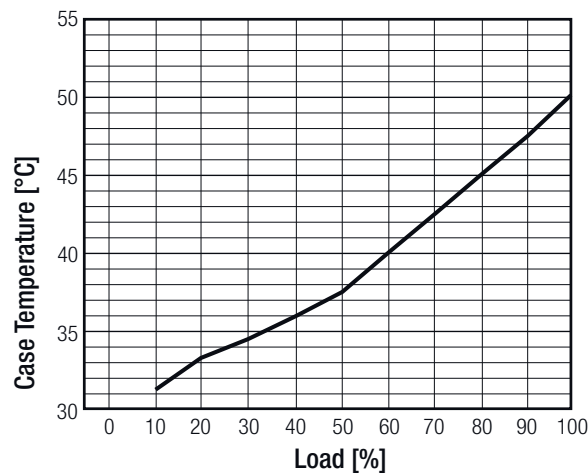
Note2: This Power Module is not internally fused. A input fuse must be always used. Recommended Fuse: T6.3A

Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

| ENVIRONMENTAL | | | |
|-----------------------------|--|------------------------|---|
| Parameter | Condition | | Value |
| Relative Humidity | | | 95%, non condensing |
| Temperature Coefficient | | | ±0.04% / °C max. |
| Thermal Impedance | natural convection, mounting at FR4 (254x254mm) PCB | vertical horizontal | 4.6°C/W 6.4°C/W |
| Operating Temperature Range | start up at -45°C | | -45°C to (see calculation) |
| Maximum Case Temperature | | | +115°C |
| MTBF | according to MIL-HDBK-217F (+50°C G.B.) according to BellCore-TR-332 (+50°C G.B.) | | 609 x 10 ³ hours 1541 x 10 ³ hours |

Derating Graph

(Ta= +25°C, natural convection, typ. Vin and vertical mounting)



Calculation

$$R_{th\text{case-ambient}} = 4.6^{\circ}\text{C/W (vertical)}$$

$$R_{th\text{case-ambient}} = 6.4^{\circ}\text{C/W (horizontal)}$$

$$R_{th\text{case-ambient}} = \frac{T_{\text{case}} - T_{\text{ambient}}}{P_{\text{dissipation}}}$$

$$P_{\text{dissipation}} = P_{\text{IN}} - P_{\text{OUT}} = \frac{P_{\text{OUTapp}}}{\eta} - P_{\text{OUTapp}}$$

- T_{case} = Case Temperature
- T_{ambient} = Environment Temperature
- $P_{\text{dissipation}}$ = Internal losses
- P_{IN} = Input Power
- P_{OUT} = Output Power
- η = Efficiency under given Operating Conditions
- $R_{th\text{case-ambient}}$ = Thermal Impedance

Practical Example:

Take the RPP40-2412SW with 50% load. What is the maximum ambient operating temperature? Use converter vertical in application.

$$\text{Eff}_{\text{min}} = 87\% @ V_{\text{nom}}$$

$$P_{\text{OUT}} = 40\text{W}$$

$$P_{\text{OUTapp}} = 40 \times 0.5 = 20\text{W}$$

$$P_{\text{dissipation}} = \frac{P_{\text{OUTapp}}}{\eta} - P_{\text{OUTapp}}$$

$$\eta = \sim 88\% \text{ (from Eff vs Load Graph)}$$

$$P_{\text{dissipation}} = \frac{20}{0.88} - 20 = 2.73\text{W}$$

$$R_{th} = \frac{T_{\text{casemax}} - T_{\text{ambient}}}{P_{\text{dissipation}}} \rightarrow 4.6^{\circ}\text{C/W} = \frac{115^{\circ}\text{C} - T_{\text{ambient}}}{2.73\text{W}}$$

$$T_{\text{ambientmax}} = \underline{\underline{102.4^{\circ}\text{C}}}$$

continued on next page

Specifications (measured @ $t_a = 25^\circ\text{C}$, nominal input voltage, full load and after warm-up)

Soldering

Hand Soldering

Hand Soldering is the least preferred method because the amount of solder applied, the time the soldering iron is held on the joint, the temperature of the iron and the temperature of the solder joint are variable.

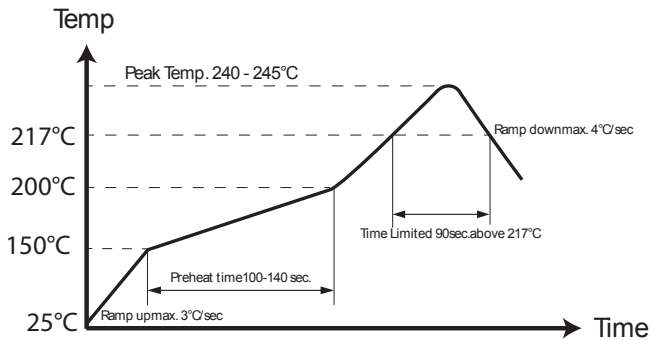
The recommended hand soldering guideline is listed in Table 1. The suggested soldering process must keep the power module's internal temperature below the critical temperature of 217°C continuously.

Wave Soldering

High temperature and long soldering time will result in IMC layer increasing in thickness and thereby shorten the solder joint lifetime. Therefore the peak temperature over 245°C is not suggested due to the potential reliability risk of components under continuous high-temperature. In the meanwhile, the soldering time of temperature above 217°C should be less than 90 seconds. Please refer to the soldering profile below for recommended temperature profile parameters.

Table 1 Hand-Soldering Guideline

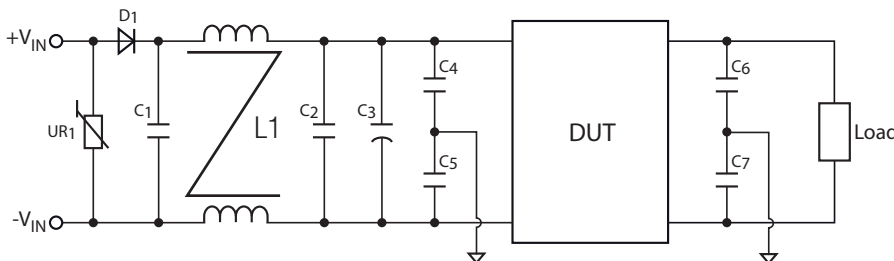
| Parameter | Single-side Circuit Board | Double-side Circuit Board | Multi-layers Circuit Board |
|------------------------|----------------------------|----------------------------|----------------------------|
| Soldering Iron Wattage | 90W | 90W | 90W |
| Tip Temperature | $385 \pm 10^\circ\text{C}$ | $420 \pm 10^\circ\text{C}$ | $420 \pm 10^\circ\text{C}$ |
| Soldering Time | 2-6 seconds | 4-10 seconds | 4-10 seconds |



SAFETY AND CERTIFICATIONS

| Certificate Type (Safety) | Report Number | Standard |
|--|--|--------------------------|
| Information Technology Equipment, General Requirements for Safety | E224236 | UL-60950-1, 1st Edition |
| Certificate Type (Environmental) | Condition | Standard / Criterion |
| Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement | | EN55022, Class B |
| ESD Immunity Test | $\pm 8\text{kV}$ Air Discharge, $\pm 6\text{kV}$ Contact Discharge | IEC61000-4-2, Criteria B |
| RF Field Strength Susceptibility Test | 10V/m | IEC61000-4-3, Criteria A |
| Electrical Fast Transient Test / Burst Immunity Text | $\pm 4\text{kV}$ Applied | IEC61000-4-4, Criteria B |
| Surge Immunity Test | $\pm 4\text{kV}$ Applied | IEC61000-4-5, Criteria B |
| Conducted Disturbance Susceptibility Test | 10V rms | IEC61000-4-6, Criteria A |
| Vibration | 50-150Hz, along X, Y and Z | EN60068-2-6 |
| Thermal Cycling (complies with MIL-STD-810F) | 12 cycles | EN60068-2-14 |
| Shock | 5g / 30ms | EN60068-2-27 |

EMC Filtering - Suggestions



It is recommended to add UR1, D1 and C1 in railway application. C1, L1, C2 and C3 can be modified for required EMI standards. To meet EN61000-4-2, module case should be earth grounded. We offer independent case pin option on request, the location is upon pin 1.

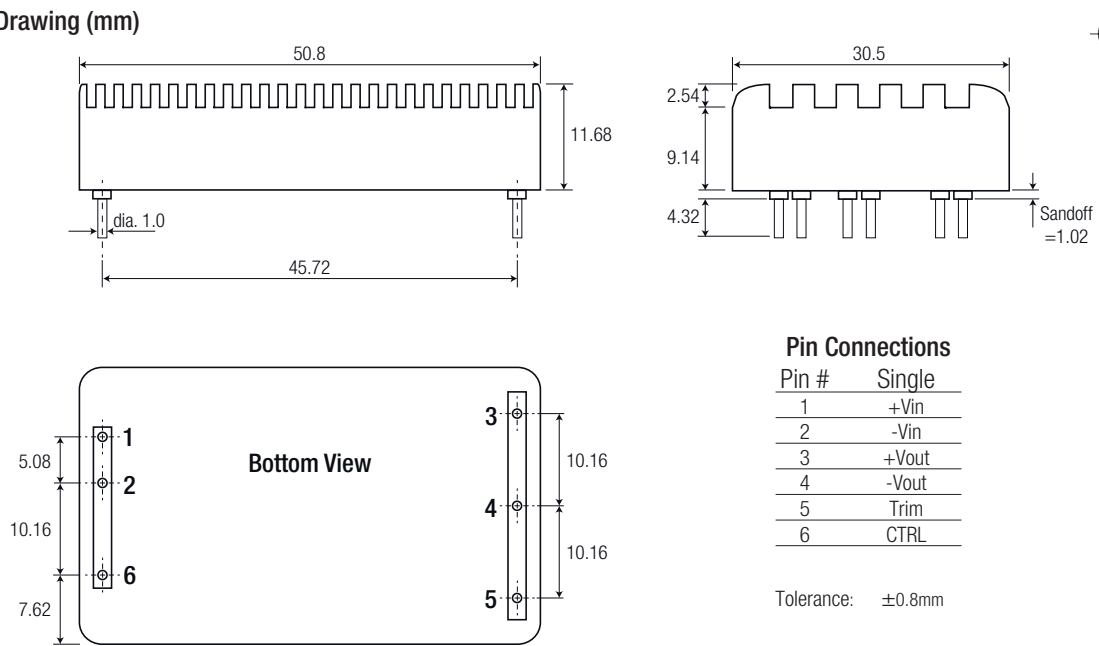
| Standard | UR1 | D1 | C1 | L1 | C2 | C3 | C4, C5, C6, C7 |
|-------------------------|-------------|----------|--------------------------|------------------------------|-------------------------|-------------------------|----------------|
| EN55022 Class B | MOV 14D361K | 50V / 9A | 1.5 μF / 250V | 550 μH $\pm 20\%$ | 6.8 μF / 50V | 330 μF / 50V | 0.47nF Y1-Cap |
| EN61000-4-2, 3, 4, 5, 6 | | | N/A | N/A | N/A | | |

Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

DIMENSION AND PHYSICAL CHARACTERISTICS

| Parameter | Value |
|---------------------------|----------------------|
| Material ⁽³⁾ | Aluminium |
| Package Dimension (LxWxH) | 50.8 x 30.5 x 12.7mm |
| Package Weight | 39g |

Dimension Drawing (mm)



Pin Connections

| Pin # | Single |
|-------|--------|
| 1 | +Vin |
| 2 | -Vin |
| 3 | +Vout |
| 4 | -Vout |
| 5 | Trim |
| 6 | CTRL |

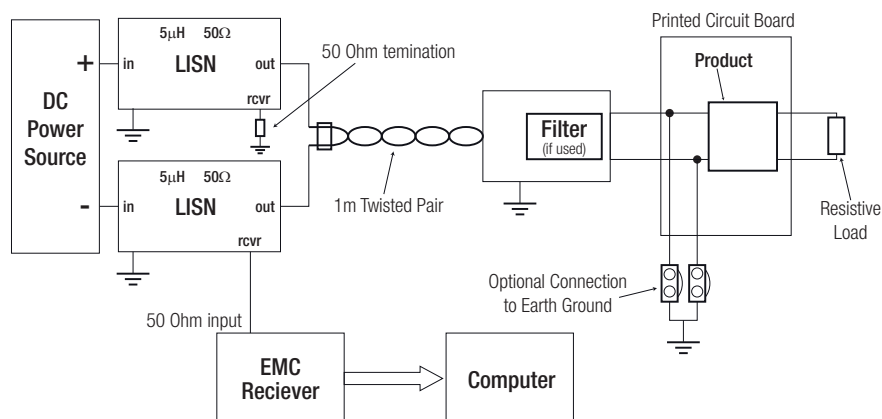
Tolerance: ±0.8mm

Notes:

Note3: To ensure a good all-round electrical contact, the bottom plate is pressed firmly into place into the aluminium case. The hydraulic press can leave tooling marks and deformations to both the case and plate. The case is anodised aluminium, so there will be natural variations in the case colour and the aluminium is not scratch resistant. Any resultant marks, scratches and colour variations are cosmetic only and do not affect the operation or performance of the converters.

INSTALLATION and APPLICATION

Test Set-up



PACKAGING INFORMATION

| Parameter | Type | Value |
|-----------------------------|------|-----------------------|
| Packaging Dimension (LxWxH) | Tube | 160.0 x 55.0 x 20.0mm |
| Packaging Quantity | | 4 pcs |
| Storage Temperature Range | | -55°C to +125°C |

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