Features

ICE Technology*

- +115°C Maximum Case Temperature
- -45°C Minimum Case Temperature
- Built-in EMC Filter
- Baseplate Case Style
- 2250VDC Isolation
- Wide 4:1 Input Voltage Range
- EN-50155 and EN-50121-3-2 Certified

RECOM
DC/DC Converter

RPR50-11024S-B

50 Watt 4:1
2" x 1.6"
Baseplate Style
Single Output

5 YEAR warranty

Description

The RPR50 series DC/DC converters are designed for railway rolling stock applications. Besides covering all the input voltages from 40VDC up to 160VDC, the converters have a very wide operating temperature range of -45°C to +115°C. The RPR50 has a baseplate case for high vibration or bulkhead-mounting applications. It is EN-50155 and EN-50121-3-2 certified.

Selection Guide

Part Number	Input Voltage Range [VDC]	Input Current [mA]	Output Voltage [VDC]	Output Current [mA]	Efficiency typ. [%]	Max. Capacitive Load [µF]
RPR50-11024S-B	40-160	520	24	2080	88	470

Notes:
Note1: Typical values at nominal input voltage and full load.

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

BASIC CHARACTERISTICS

Parameter	Condition	Min.	Typ.	Max.
Input Voltage Range	nom. Vin= 110VDC	40VDC	110VDC	160VDC
Transient Input Voltage	≤100ms			180VDC
Inrush Current	with EMC Filter			50A
	without EMC Filter			40A
Under- Voltage Lockout	DC-DC ON	39VDC		
	DC-DC OFF			36VDC
Remote ON/OFF	ON / high logic	Open, 8V		60V
	OFF / low logic	Short, 0V		1.2V
Remote OFF Input Voltage	nominal input		5mA	
Start Up Time	when use CTRL function		20ms	
Internal Operating Frequency		220kHz	260kHz	300kHz
Output Voltage Trimming			±10%	
Efficiency	typ. Vin, full load	87%	88%	
Minimum Load		0%		
Output Ripple and Noise	20MHz limited, 1µF output MLCC		240mVp-p	360mVp-p

Efficiency vs. Load

Efficiency vs. Input Voltage
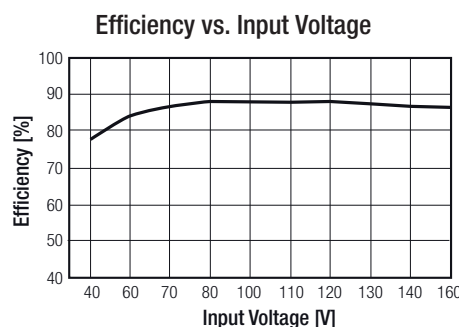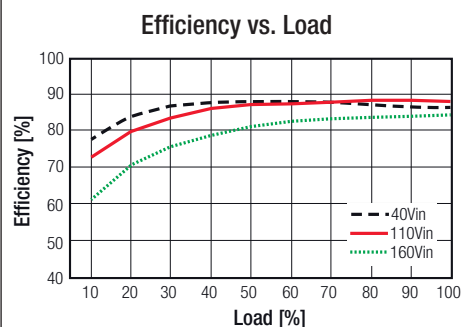
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EN-50155 Certified
EN-60950-1 Certified

RoHS compliant 6 from 6 COMPLIANT PRODUCTS

REACH compliant

CE

* 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 @ ta= 25°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: (Vout at Pins) X (Iout) $\leq$ rated output power.
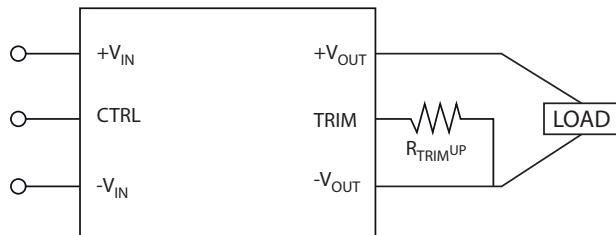
Figure 1. Trim connections to increase output voltage using fixed resistors

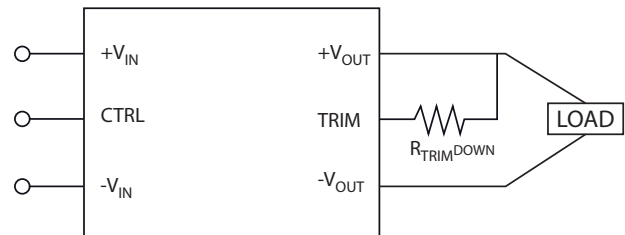**Figure 2.** Trim connections to decrease output voltage using fixed resistors

Trim up register value (KΩ)										
Vout	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
24VDC	457.3	221.2	128.1	84.5	56.6	38.1	24.7	14.6	6.9	0.7

Trim down register value (KΩ)										
Vout	-1%	-2%	-3%	-4%	-5%	-6%	-7%	-8%	-9%	-10%
24VDC	642.7	333.5	194.3	123.8	84.9	59	40.3	26.2	15	6.9

REGULATIONS

Parameter	Condition	Value
Output Voltage Accuracy	50% load	±1.5% max.
Line Voltage Regulation	low line to high line	±0.3% max.
Load Voltage Regulation	10% to 100% load	±0.5% max.
Transient Recovery Time	25% load step change, ΔIo/Δt=2.5A/us	800µs typ.
Transient Peak Deviation	25% load step change, ΔIo/Δt=2.5A/us	±2%Vout max.

PROTECTIONS

Parameter	Condition	Value
Surge Resistance	$\leq$10ms	250VDC
Output Power Protection (OPP)	Hiccup Mode	120% typ.
Over Voltage Protection (OVP)	10% load	120% typ.
Over Temperature Protection (OTP)	case temperature	120°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	100MΩ min.
Isolation Capacitance	I/P to O/P	330pF typ.

Notes:

Note2:   This Power Module is not internally fused. A input fuse must be always used. Recommended Fuse: T2A

RECOM

DC/DC Converter

RPR50-11024S-B
Series

ENVIRONMENTAL

Parameter	Condition	Value
Operating Case Temperature Range	start up by -45°C	-45°C to (see calculation)
Temperature Coefficient		±0.04% / °C max.
Thermal Impedance	natural convection mounting at FR4 (254x254mm) PCB	vertical 4.8°C/W horizontal 7°C/W
Humidity		95%, non condensing
MTBF (+50°C G.B.)	according to MIL-HDBK-217F according to BellCore-TR-332	609 x 10³ hours 1541 x 10³ hours

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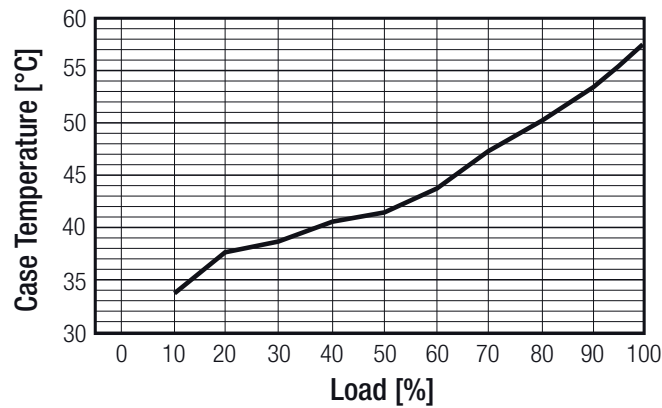
Calculation

$R_{thcase-ambient}$ = 4.8°C/W (vertical)

$R_{thcase-ambient}$ = 7°C/W (horizontal)

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

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

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

Practical Example:

Take the RPR50-11024S-B with 50% load. What is the maximum ambient operating temperature? Use converter vertical in application.

Eff_{min} = 87% @ V_{nom}

P_{OUT} = 50W

P_{OUTapp} = 50 x 0.5 = 25W

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

η = ~88% (from Eff vs Load Graph)

$$P_{dissipation} = \frac{25}{0.88} - 25 = 3.41W$$

$$R_{th} = \frac{T_{casemax} - T_{ambient}}{P_{dissipation}} \quad --> 4.8°C/W = \frac{115°C - T_{ambient}}{3.41W}$$

$T_{ambientmax}$ = $\underline{98.6°C}$

RECOM

DC/DC Converter

RPR50-11024S-B
Series

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

SAFETY AND CERTIFICATIONS

Certificate Type	Report / File Number	Standard / Edition
IEC/EN General Safety	SPCLVD1108088-1	IEC/EN-60950-1 2nd Edition

Certificate Type (Environmental)	Conditions	Standard / Criterion
EMI	with external Filter	EN-55022, Class A
ESD	±8kV Air Discharge, ±6kV Contact Discharge	EN-61000-4-2, Criteria B
Radiated Immunity	Level 3, 10V/M	EN-61000-4-3, Criteria A
Fast Transient	±4kV Applied	EN-61000-4-4, Criteria B
Surge	±4kV Applied	EN-61000-4-5, Criteria B
Conducted Immunity	Level 3, 10V rms	EN-61000-4-6, Criteria A
Vibration	50-150Hz, along X,Y and Z	EN-60068-2-6
Thermal Cycling (complies with MIL-STD-810F)	12 cycles	EN-60068-2-14
Shock	5g / 30ms	EN-60068-2-27

EMC Filtering - Suggestions
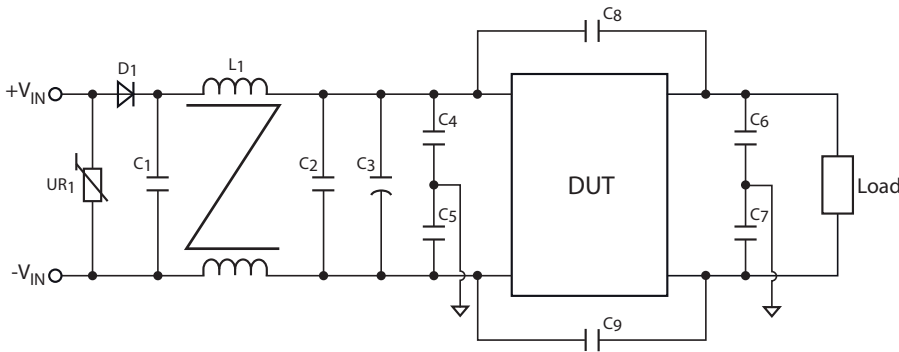
It is recommended to add UR1 and D1 in railway application. C1, C2, C3 & L1 can be modified for required EMI standards. To meet EN61000-4-2, module case should be earth grounded. We offer independent case pin option on request, the location is between pin 2 and pin 6.

Standard	UR1	D1	C1	L1	C2	C3	C4, C5, C6, C7	C8, C9
EN55022 Class A	MOV 14D361K	250V / 3A	1.5µF/250V	1200µH ±20%	470nF/250V	680µF/250V	0.47nF (Y1 CAP)	1nF (Y1 CAP)
EN61000-4-2, 3, 4, 5, 6			N/A					

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 temprature 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 sol-dering profile below for recommended temperature profile parameters.

Table 1 Hand-Soldering Guideline			
Parameter	Single-side Circuit Boad	Double-side Circuit Board	Multi-layers Circuit Board
Soldering Iron Wattage	90W	90W	90W
Tip Temperature	385 ±10°C	420 ±10°C	420 ±10°C
Soldering Time	2-6 seconds	4-10 seconds	4-10 seconds
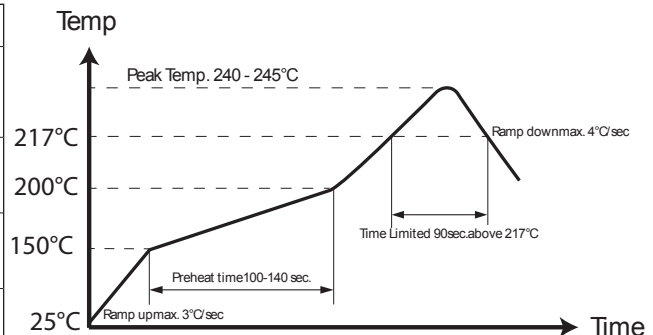
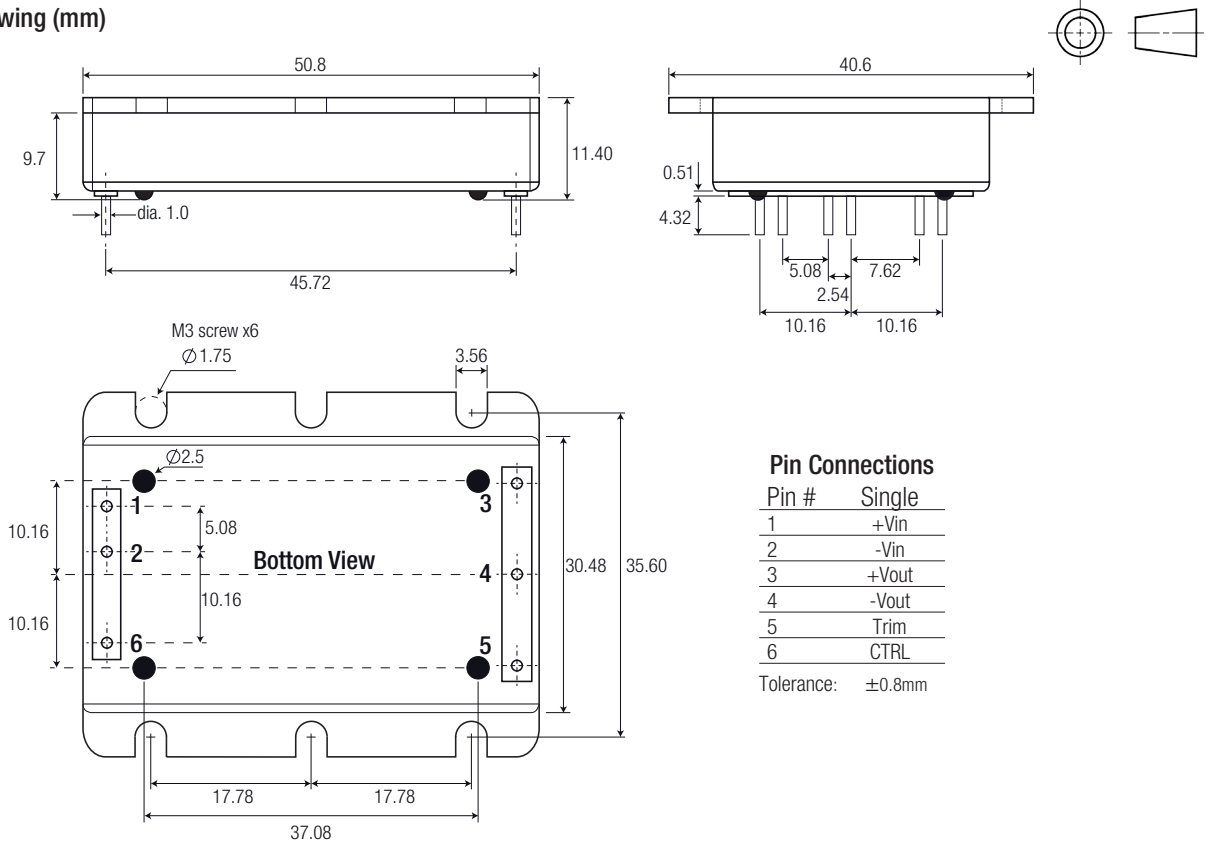**Specifications** (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

DIMENSION AND PHYSICAL CHARACTERISTICS

Parameter	Value
Case Material	Aluminium
Package Dimension (LxWxH)	50.8 x 40.6 x 11.4mm
Package Weight	40g

Dimension Drawing (mm)

M3 screw x6
∅1.75
∅2.5
Bottom View

Pin Connections

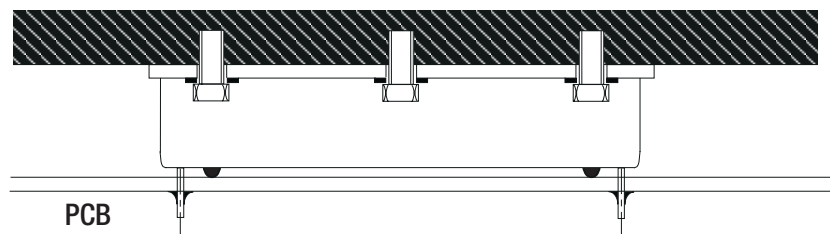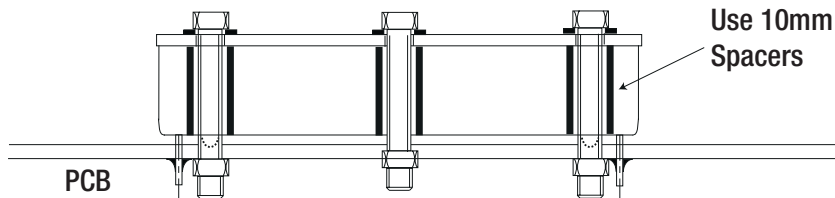| Pin #	Single
1	+Vin
2	-Vin
3	+Vout
4	-Vout
5	Trim
6	CTRL

Tolerance: ±0.8mm

INSTALLATION and APPLICATION

Mounting Instruction

Baseplate Case Fixing - Mounting onto Heatsink/Bulkhead

PCB

Baseplate Case Fixing - Anti Vibration Mounting onto PCB

Use 10mm Spacers

PCB

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

Test Set-up
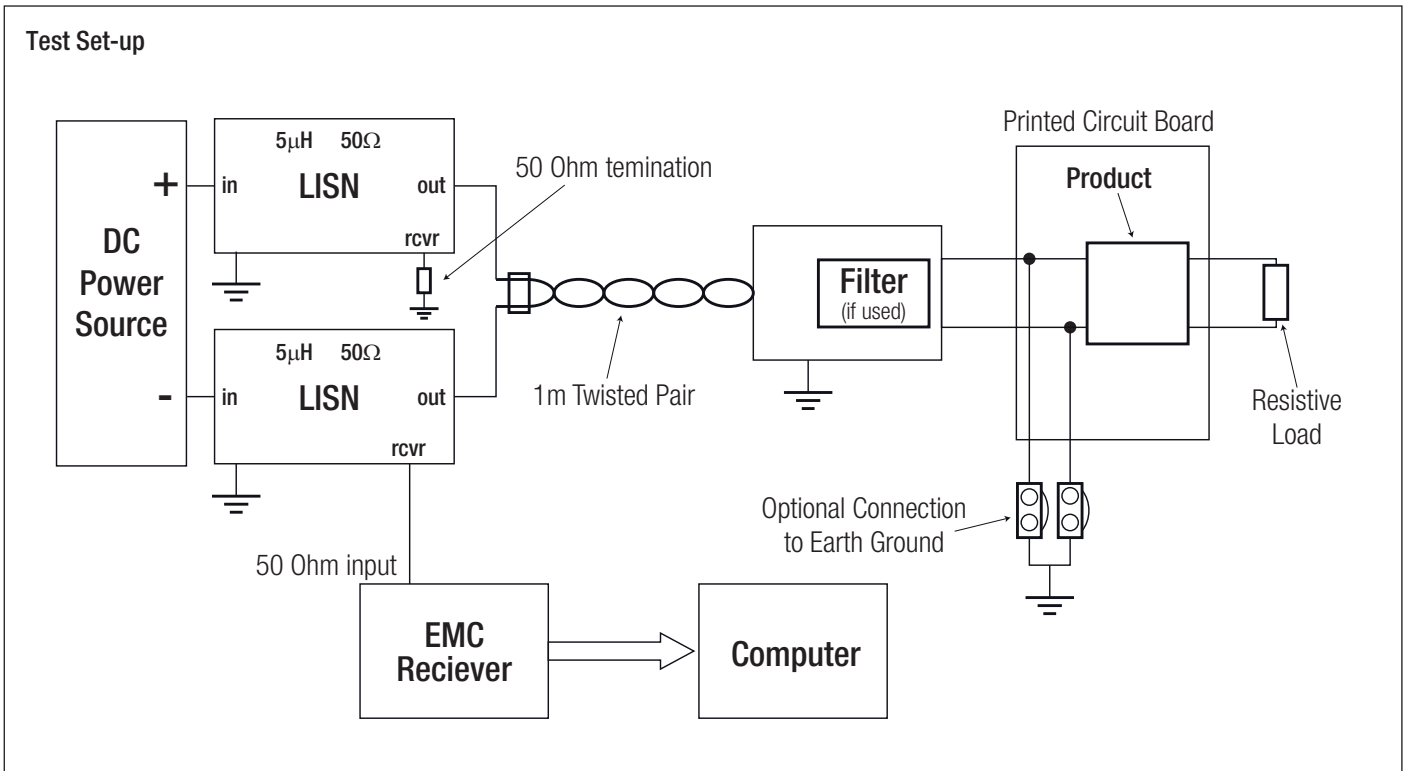
PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimensions (LxWxH)	Tube	200.0 x 55.0 x 20.0mm
Packaging Quantity		4pcs
Storage Temperature Range		-55°C to +125°C