

Features

Regulated Converters

- 10:1 Ultra wide input voltage range
- 3kVAC/1 Minute reinforced insulation
- UL/IEC/EN60950-1 certified, CE marked
- EN50155 Compliant
- Efficiency up to 90%
- -40°C To +93.5°C Baseplate temperature range

Description

The half-brick RPA200H series DC/DC converter is designed for railway rolling stock and high voltage battery applications. It has a 10:1 input voltage range to cover all input voltages from nominal 24VDC up to 110VDC (including EN50155 transients) in a single product and offers isolated and regulated 12V or 24VDC outputs. The converter has a consistently high efficiency over the entire input voltage range and comes with a metal baseplate to permit a wide operating temperature range from -40°C to +93.5°C (when suitably cooled). The case is fitted with threaded inserts to allow secure mounting to the PCB or bulk-head for use in high shock and vibration environments. The converter is compliant to EN50155 and certified to UL/IEC/EN60950 and comes with a three year warranty.

Selection Guide

Part Number	Nom. Input Voltage Range ⁽¹⁾ [VDC]	Output Voltage [VDC]	Output Current [A]	Efficiency typ. ⁽²⁾ [%]	Max. Capacitive Load ⁽³⁾ [μF]
RPA200H-11012SRUW ⁽⁴⁾	16.8-137.5	12	16.7	90	2200
RPA200H-11024SRUW ⁽⁴⁾	16.8-137.5	24	8.5	88	1000

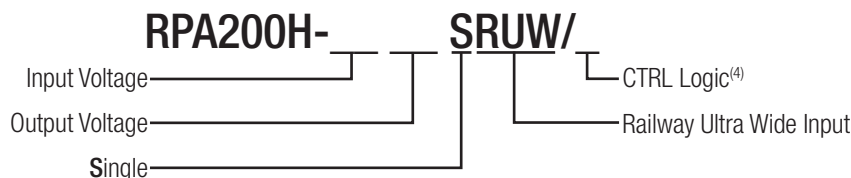
Notes:

Note1: Refer to input voltage graph

Note2: Efficiency is tested at nominal input and full load at +25°C ambient

Note3: Max. Cap Load is tested at nominal input and full resistive load

Model Numbering



Ordering Examples

RPA200H-11012SRUW/P = 110V Input, 12V Output, Single, Pos. CTRL function

RPA200H-11012SRUW/N = 110V Input, 12V Output, Single, Neg. CTRL function

Notes:

Note4: standard part is with suffix "/P" for positive logic (1=ON, 0=OFF) or add suffix "/N" instead for negative logic (0=ON, 1=OFF)

Specifications (measured @ $t_a = 25^\circ\text{C}$, nom. Vin, full load and after warm-up unless otherwise stated)

BASIC CHARACTERISTICS					
Parameter	Condition		Min.	Typ.	Max.
Internal Input Filter	Pi-Type				
Input Voltage Range	start up Vin = 110VDC		16.8VDC	110VDC	137.5VDC
Input Surge Voltage	<100ms				156VDC
Under Voltage Lockout (UVLO)	DC-DC ON		15.6VDC	16.0VDC	16.4VDC
	DC-DC OFF		13.6VDC	14.0VDC	14.4VDC
Over Voltage Lockout (OVLO)	DC-DC ON		142VDC	146VDC	150VDC
	DC-DC OFF		154VDC	156VDC	160VDC
Input Current Range	Vin = 16.8V	12Vout	13.5A	14A	14.5A
		24Vout	14A	14.5A	15A
continued on next page					

RECOM
DC/DC Converter

RPA200H-RUW

200 Watt
Half Brick
Single Output



UL US
E224736

UL60950-1 certified
IEC/EN60950-1 certified
EN50155 compliant
CE marked

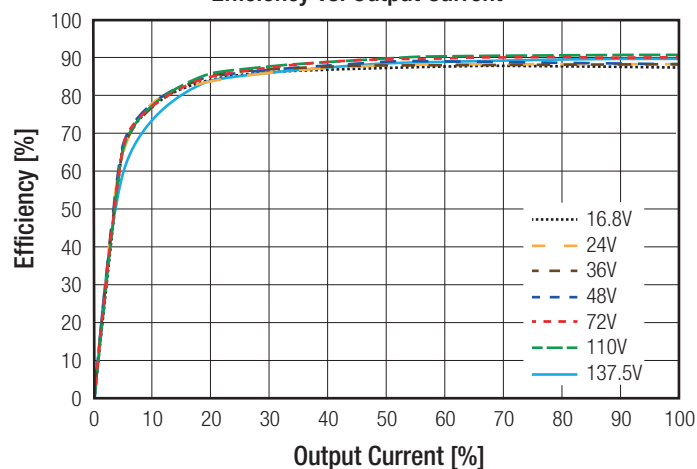
Specifications (measured @ $T_a = 25^\circ\text{C}$, nom. V_{in} , full load and after warm-up unless otherwise stated)

BASIC CHARACTERISTICS

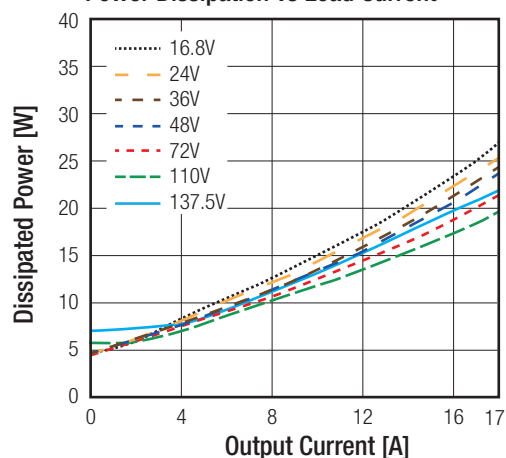
Parameter	Condition	Min.	Typ.	Max.
Quiescent Current	12 & 24Vout	30mA	60mA	90mA
Output Voltage Trimming		-20%		+10%
Minimum Load		0%		
Start-up Time	Power up Remote ON/OFF	200ms 200ms		460ms 460ms
Rise Time	Vout from 10% to 90%			100ms
ON/OFF Control	Positive Logic DC-DC ON DC-DC OFF	Open or $3 < V_r < 5\text{VDC}$ Short or $0 < V_r < 0.4\text{VDC}$		
	Negative Logic DC-DC ON DC-DC OFF	Short or $0 < V_r < 0.4\text{VDC}$ Open or $3 < V_r < 5\text{VDC}$		
Input Current of CTRL pin	DC-DC ON DC-DC OFF		0.1mA 0.1mA	0.2mA 0.2mA
Standby Current				30mA
Internal Operating Frequency			140kHz	
Output Ripple and Noise	5Hz to 20MHz BW	12Vout 24Vout		420mVp-p 100mVp-p
Remote Sense				10%

RPA200H-11012SRUW

Efficiency vs. Output Current

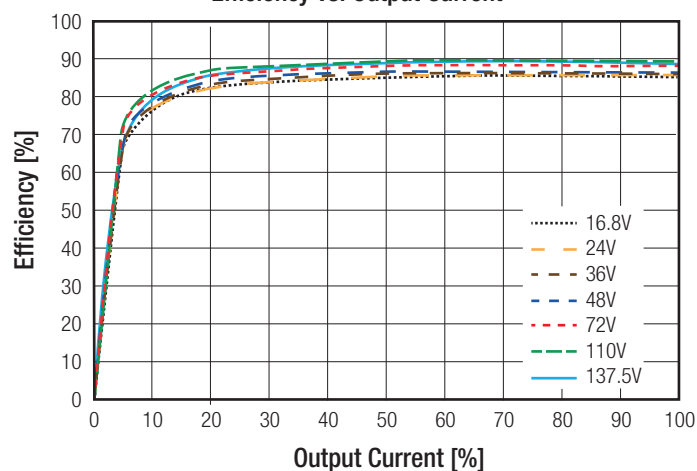


Power Dissipation vs Load Current

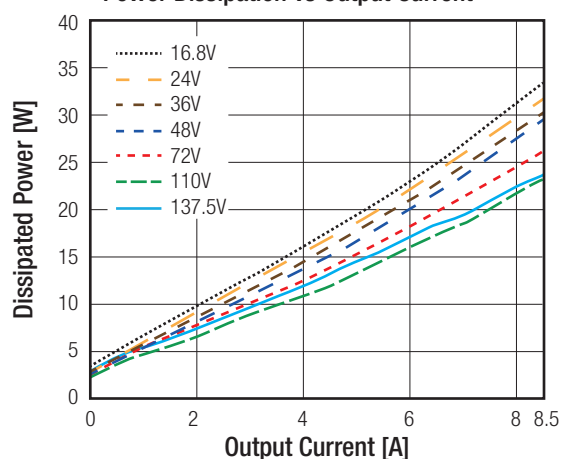


RPA200H-11024SRUW

Efficiency vs. Output Current



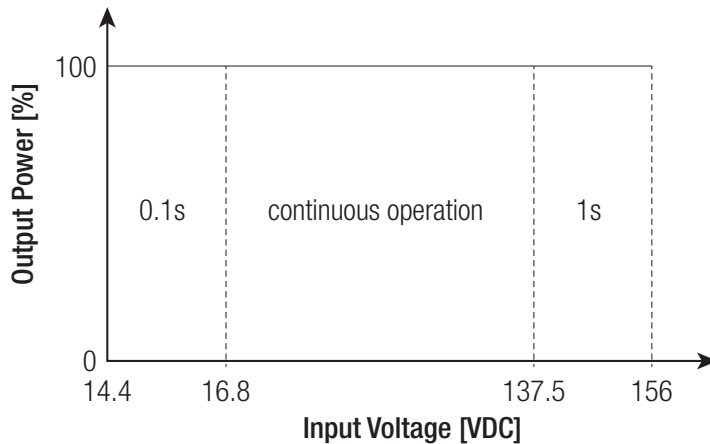
Power Dissipation vs Output Current



continued on next page

Specifications (measured @ Ta = 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

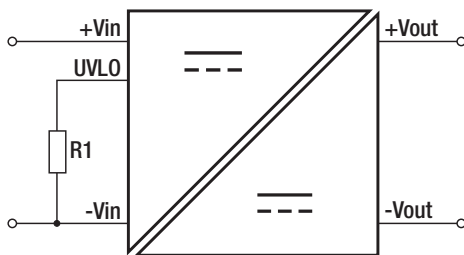
Input Voltage Range



Continuous full power operation is certified between 16.8V and 137.5V, including full load start-up.

Once running, the converter will operate for short periods of time over an extended input voltage range down to 14.4V and up to 156V, thus covering all EN50155 under-voltage and over-voltage transient conditions.

UNDER VOLTAGE LOCKOUT



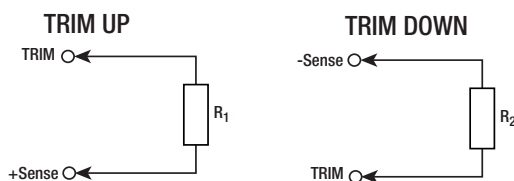
The RPA200H series has an adjustable under voltage lockout which will shut down the converter according to following settings.

Input Voltage [VDC]	24	36	48	72	110
Turn Off Threshold [VDC]	14	20.6	27.5	40	64
Turn On Threshold [VDC]	16	24	32	46.5	74
Resistor R1 [kΩ]	open	27.4	13	6.81	3.57

OUTPUT VOLTAGE TRIMMING

Output Voltage Trimming

RPA200H-RUW converters offer the feature of trimming the output voltage over a certain range around the nominal value by using external trim resistors. The values for trim resistors shown in trim tables below are according to standard E96 values; therefore, the specified voltage may slightly vary.



Trim Calculation

Trim Up:

$$R_1 = \left(\frac{45}{\Delta V_{out}} + 40 \right) k\Omega \quad R_1 = \left(\frac{95}{\Delta V_{out}} + 90 \right) k\Omega$$

Practical Example:

Trim Up:

$$V_{out} = 12V, \Delta V_{out} = +10\% (13.2V)$$

$$R_1 = \left(\frac{45}{0.1} + 40 \right) k\Omega = 490k\Omega$$

V_{out} = Output Voltage

ΔV_{out} = Output Voltage Change in %

R_1 = trim up resistor

R_2 = trim down resistor

Trim Down:

$$R_2 = \left(\frac{5.11}{\Delta V_{out}} - 10.22 \right) k\Omega$$

Trim down:

$$V_{out} = 24V, \Delta V_{out} = -8\% (22V)$$

$$R_2 = \left(\frac{5.11}{0.08} - 10.22 \right) k\Omega = 53.65k\Omega$$

continued on next page

Specifications (measured @ $T_a = 25^\circ\text{C}$, nom. V_{in} , full load and after warm-up unless otherwise stated)

Trim up:

RPA200H-11012SRUW

Trim up	1	2	3	4	5	6	7	8	9	10	%
$V_{out} =$	12.12	12.24	12.36	12.48	12.60	12.72	12.84	12.96	13.08	13.20	Volts
$R_1 =$	4530	2320	1540	1150	931	787	681	604	536	487	kOhms

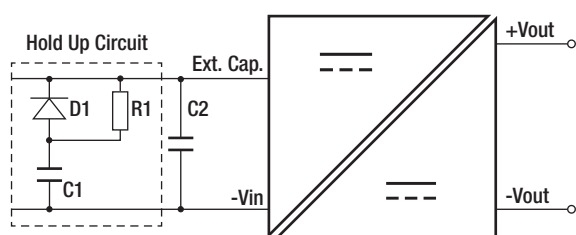
RPA200H-11024SRUW

Trim up	1	2	3	4	5	6	7	8	9	10	%
$V_{out} =$	24.24	24.48	24.72	24.96	25.20	25.44	25.68	25.92	26.16	26.40	Volts
$R_1 =$	9530	4870	3240	2490	2000	1690	1430	1270	1150	1050	kOhms

Trim down RPA200H series

Trim down	1	2	3	4	5	6	7	8	9	10	%
$R_2 =$	499	243	162	118	90.9	75	63.4	53.6	46.4	41.2	kOhms
Trim down	11	12	13	14	15	16	17	18	19	20	%
$R_2 =$	36.5	32.4	28.7	26.1	23.7	22.1	20	18.2	16.5	15.4	kOhms

EXTERNAL CAPACITOR

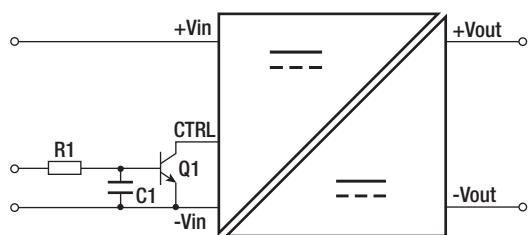


A $240\mu\text{F}/200\text{V}$ capacitor (C2) is required for normal operation.

To meet power supply interruptions, an external circuit comprised of a capacitor (C1), a $100\text{R } 10\text{W}$ resistor (R1) and a FX2000D diode (D1) is required.

C1	24Vin	36Vin	48Vin	72Vin	96Vin	110Vin
For 10ms	2300 μF	2300 μF	2300 μF	2300 μF	1200 μF	800 μF
For 30ms	6900 μF	6900 μF	6900 μF	6900 μF	3600 μF	2400 μF

REMOTE ON/OFF

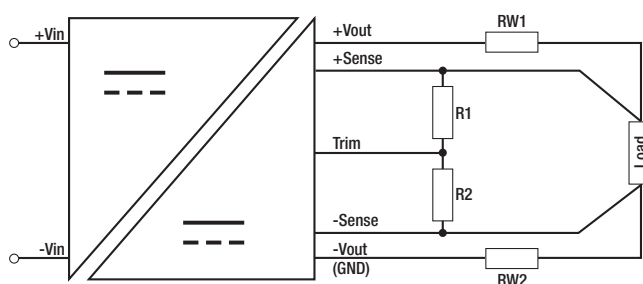


Remote on/off can be controlled by an external voltage or transistor between the CTRL terminal and the $V_{in}(-)$ terminal.

For negative logic if the remote on/off feature is not used, short the on/off pin to $V_{in}(-)$.

For positive logic if the remote on/off feature is not used, leave the on/off pin floating.

REMOTE SENSE



The output voltage can be adjusted by both trim and remote sense. The maximum combined adjustment range is $\pm 10\%$. Derate the maximum output power if using the trim or sense function to increase the output voltage.

R_{W1} ... wire losses +
 R_{W2} ... wire losses -
 R_1 ... trim up resistor
 R_2 ... trim down resistor

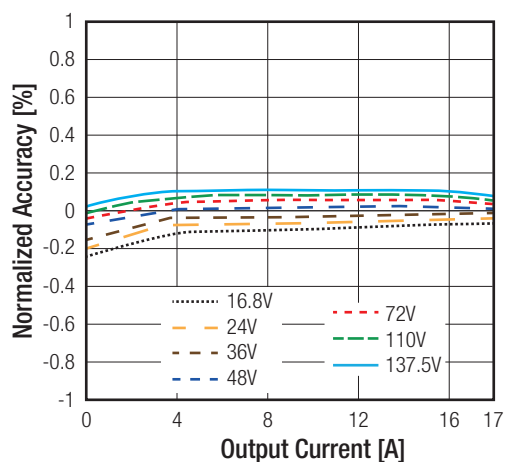
Specifications (measured @ Ta = 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

REGULATION

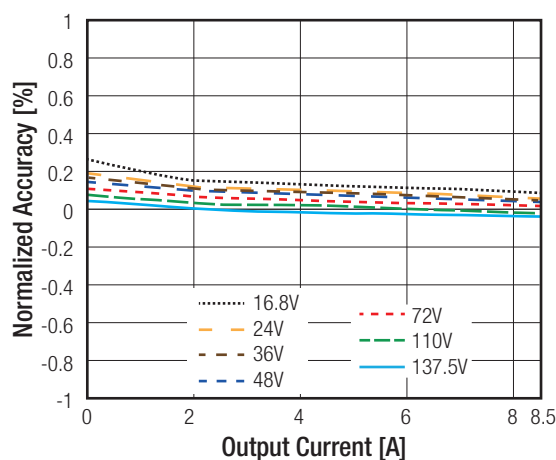
Parameter	Condition		Value
Output Accuracy			±1.0% max.
Line Regulation	Vin = 16.8 to 137.5V, Iout = full load		±0.01% typ. to ±0.2% max.
Load Regulation	Iout = Iout min to Iout max.		±0.05% typ. to ±0.2% max.
Transient Response	72V, 0.1A/μs	12Vout	50% Iout max to 75%
			75% Iout max to 50%
		24Vout	50% Iout max to 75%
			75% Iout max to 50%

Accuracy vs Load

RPA200H-11012SRUW



RPA200H-11024SRUW



PROTECTION

Parameter	Condition		Value
Over Voltage Protection (OVP)			110-130%, auto recovery
Over Current Protection (OCP)			hiccup Mode
Over Temperature Protection (OTP)	@ tc point		105°C, automatic recovery after cooling down
Isolation Voltage ⁽⁵⁾	I/P to O/P	rated for 1 minute	3kVAC, 4.2kVDC
	I/P to Base	rated for 1 minute	3kVAC, 4.2kVDC
	O/P to Base	rated for 1 minute	3kVAC, 4.2kVDC
Isolation Resistance			10MΩ typ.
Isolation Capacitance			500pF
Leakage Current			0.42mA
Insulation Grade			Reinforced

Notes:

Note5: For repeat Hi-Pot testing, reduce the time and/or the test voltage

Note6: An input fuse is required if the mains supply is not over-current protected. Recommended fuse T40A slow blow type

Specifications (measured @ $T_a = 25^\circ\text{C}$, nom. Vin, full load and after warm-up unless otherwise stated)

ENVIRONMENTAL

Parameter	Condition	Value
Operating Temperature Range	refer to derating graphs	-40°C to $+93.5^\circ\text{C}$
Maximum Baseplate Temperature		$+100^\circ\text{C}$
Temperature Coefficient		$0.007\%/^\circ\text{C}$
Thermal Impedance		refer to Rth tables
Operating Altitude		5000m
Operating Humidity		5%-95% RH
Pollution Degree (PD)		PD2
Fire protection on railway vehicles	refer to page 8	according to EN45545-2 standard
MTBF	according to Telcordia SR332 Issue 2 Method I standard, 25°C	1480×10^3 hours

Notes:

Note7: Following calculations are made with RPA200H-11012SRUW/P.
Used Test PCB: 160x100mm 105µm (Eurocard), double layer

Thermal Derating with Fan Cooling, Double Layer PCB and Heat-sink

Thermal Impedance	
airflow [m/s]	Rth [$^\circ\text{C}/\text{W}$]
0.1	3.3
0.2	2.62
0.5	2.0
0.8	1.57
1.0	1.22
1.5	0.75

Thermal Calculation

$I_{\text{out}} = 50\%$

$R_{\text{th}} = 3.3^\circ\text{C}/\text{W}$

$P_{\text{DISS}} = 10.94\text{W}$

$T_{\text{ICmax}} = 100^\circ\text{C}$

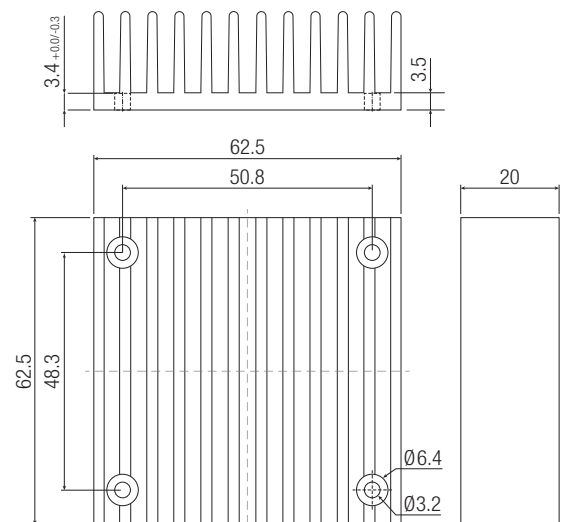
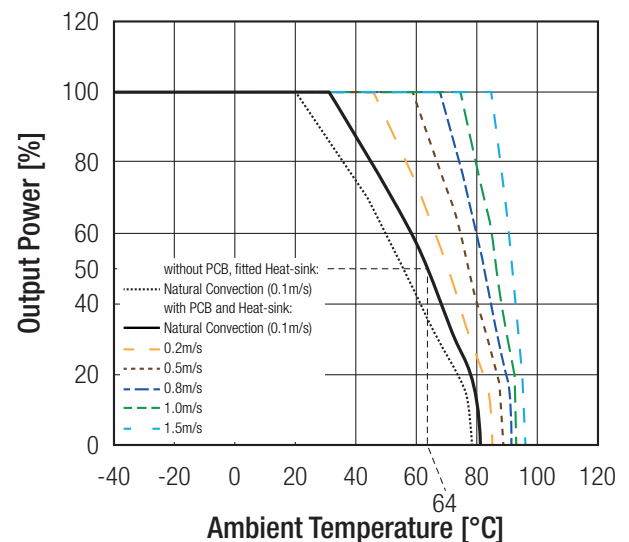
$$T_{\text{OVER}} = R_{\text{th}} \times P_{\text{DISS}} = 3.3^\circ\text{C}/\text{W} \times 10.94\text{W} = +36^\circ\text{C}$$

$$T_{\text{AMBmax}} = T_{\text{ICmax}} - T_{\text{OVER}} = 100^\circ\text{C} - 36^\circ\text{C} = +64^\circ\text{C}$$

Dimension Drawing Heat-sink (mm)

Notes:

Note8: For further Heat-sink details please contact our Tech Support Team
techsupportAT@recom-power.com



continued on next page

Specifications (measured @ $T_a = 25^\circ\text{C}$, nom. V_{in} , full load and after warm-up unless otherwise stated)

Thermal Derating with Fan Cooling and Double Layer PCB

Thermal Impedance	
airflow [m/s]	R_{th} [$^\circ\text{C}/\text{W}$]
0.1	3.8
0.2	3.12
0.5	2.5
0.8	2.07
1.0	1.72
1.5	1.25

Thermal Calculation

$I_{out} = 50\%$

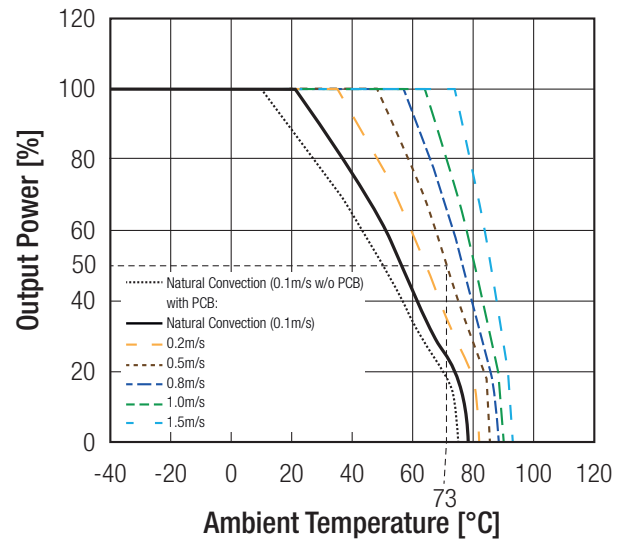
$R_{th} = 2.5^\circ\text{C}/\text{W}$

$P_{DISS} = 10.94\text{W}$

$T_{ICmax} = 100^\circ\text{C}$

$$T_{OVER} = R_{th} \times P_{DISS} = 2.5^\circ\text{C}/\text{W} \times 10.94\text{W} = +27.4^\circ\text{C}$$

$$T_{AMBmax} = T_{ICmax} - T_{OVER} = 100^\circ\text{C} - 27.4^\circ\text{C} = +73^\circ\text{C}$$



Thermal Derating with Water Cooling

Thermal Impedance	
flow [l/min]	R_{th} [$^\circ\text{C}/\text{W}$]
2.3	0.31

Thermal Calculation

$I_{out} = 100\%$

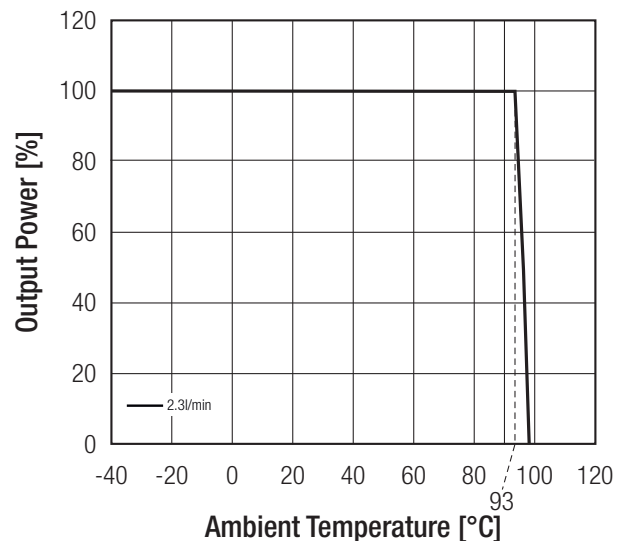
$R_{th} = 0.31^\circ\text{C}/\text{W}$

$P_{DISS} = 20.79\text{W}$

$T_{ICmax} = 100^\circ\text{C}$

$$T_{OVER} = R_{th} \times P_{DISS} = 0.31^\circ\text{C}/\text{W} \times 20.79\text{W} = +6.5^\circ\text{C}$$

$$T_{AMBmax} = T_{ICmax} - T_{OVER} = 100^\circ\text{C} - 6.5^\circ\text{C} = +93.5^\circ\text{C}$$



Notes:

Note9: For further details about the water cooling please contact our Tech Support Team techsupportAT@recom-power.com

SAFETY AND CERTIFICATIONS

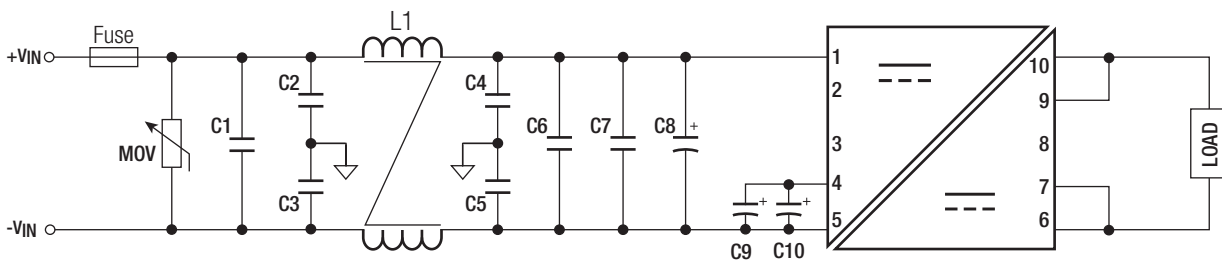
Certificate Type (Safety)	Report / File Number	Standard
Information Technology Equipment, General Requirements for Safety	E224736-A54	UL60950-1, 2nd Edition, 2014 CSA C22.2 No. 60950, 2nd Edition, 2014
IEC/EN Information Technology Equipment - General Requirements for Safety (CB Scheme)	E224736-A54-CB-1	IEC60950-1, 2nd Edition, 2005+ AM2, 2013 EN60950-1, 1st Edition, 2006 + AM2, 2013
Railway Applications - Electrical Equipment used on rolling stock	designed to meet	EN50155, 1st Edition, 2007
RoHS		RoHS 2011/65/EU + AM2015/863

continued on next page

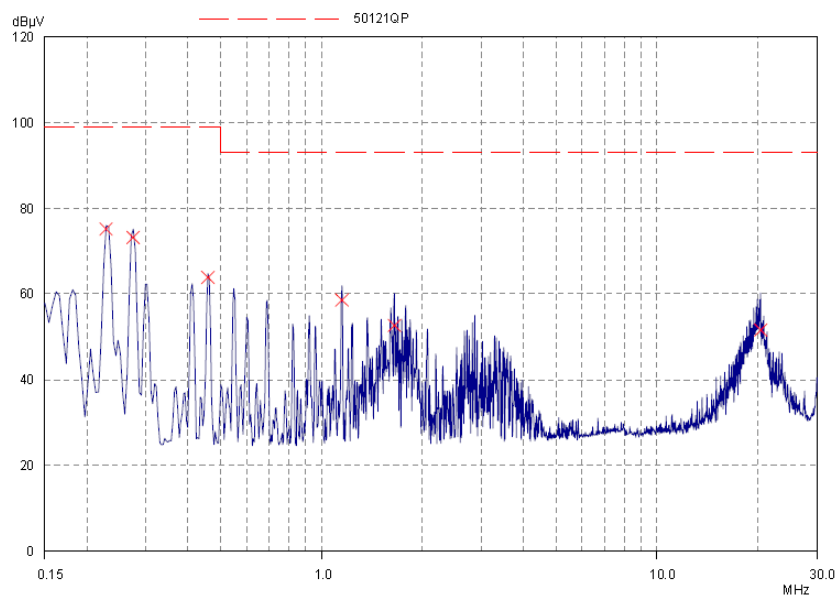
Specifications (measured @ Ta = 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

EMC Compliance	Condition	Standard / Criterion
Railway applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus	with external components	EN50121-3-2, 2015
Electromagnetic compatibility of multimedia equipment - Emission requirements	with external components	EN55032 Class B
Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement		EN55011
Fire hazard testing - Part 11-10: Test flames - 50W horizontal and vertical flame test methods	Vertical Flame Test	EN60695-11-10, 2013, HL1, HL2, HL3, V-0
Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods; Glow-wire flammability test method for end-products	30s to glow-wire temp., 850°C	EN60695-2-11,2000, HL1, HL2, HL3
Plastics - Determination of burning behaviour by oxygen index - Part 2: Ambient-temperature test	OI% (min) 42.6% OI% (min) 36.8%	EN ISO 4589-2, 2006, HL1, HL2, HL3 EN ISO 4589-2, 1999 + A1,2006, HL1, HL2, HL3
ESD Electrostatic discharge immunity test	Air ±8kV, Contact ±6kV	EN61000-4-2, Criteria B
Radiated, radio-frequency, electromagnetic field immunity test	80-1000MHz, 20V/m 800-1000MHz, 20V/m 1400-2100MHz, 10V/m 2100-2500MHz, 5V/m	EN61000-4-3, Criteria A
Fast Transient and Burst Immunity	±2kV	EN61000-4-4, Criteria A
Surge Immunity	±1kV (diff), ±2kV (com)	EN61000-4-5, Criteria B
Immunity to conducted disturbances, induced by radio-frequency fields	10V	EN61000-4-6, Criteria A

EMC Filtering according to EN50121-3-2



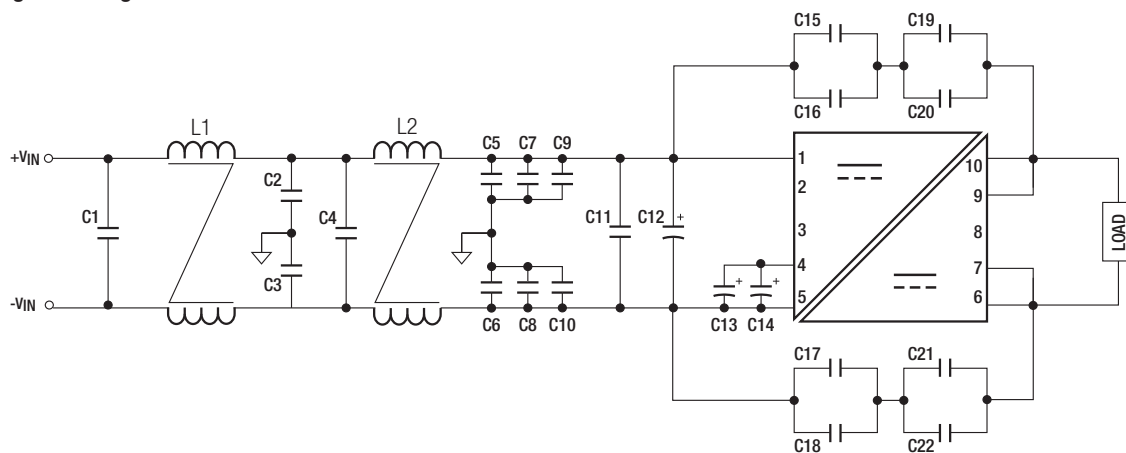
MOV	C1	C2, C3, C4, C5	L1	C6, C7	C8	C9, C10
EPCOS B72207S0131K101	100nF 275VAC	1000pF, 300VAC	1mH CMC	0.47µF 250V	100µF 200V	120µF 200V



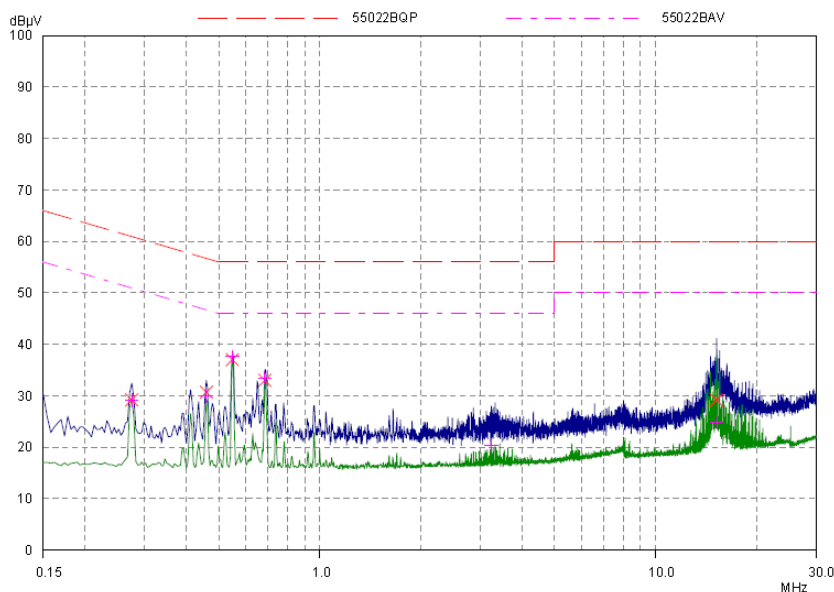
continued on next page

Specifications (measured @ $T_a = 25^\circ\text{C}$, nom. V_{in} , full load and after warm-up unless otherwise stated)

EMC Filtering according to EN55032 Class B



C1, C4, C11	L1, L2	C2, C3, C5, C6, C7, C8, C9, C10	C12	C13, C14	C15, C16, C17, C18, C19, C20, C21, C22,
0.47 μF , 250V MLCC	1mH CMC	1.5pF, 3kV	100 μF 200V	120 μF 200V	6.8pF, 2kV



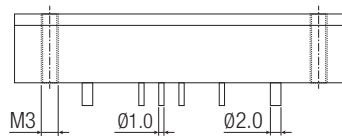
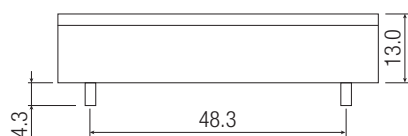
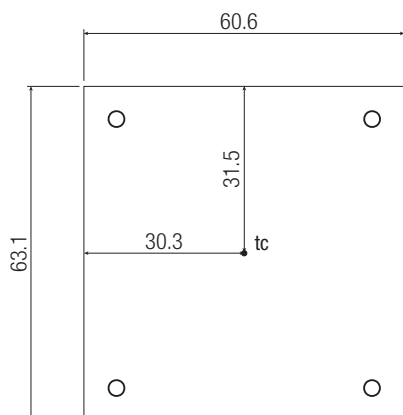
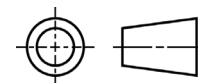
DIMENSIONS and PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	baseplate case potting	aluminum plastic (UL94V-2) low smoke silicone (UL94V-0)
Package Dimensions (LxWxH)		60.6 x 63.1 x 13.0mm
Package Weight		125.0g typ.

continued on next page

Specifications (measured @ Ta = 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

Dimension Drawing (mm)



Pin Connections

Pin #	Single
1	+Vin
2	UVLO
3	CTRL
4	Ext. Cap.
5	-Vin
6	-Vout
7	-Sense
8	Trim
9	+Sense
10	+Vout

Pin Pitch Tolerance $\pm 0.25\text{mm}$
Pin dimension tolerance $\pm 0.1\text{mm}$
XX.X $\pm 0.5\text{mm}$
XX.XX $\pm 0.25\text{mm}$
FC $\pm 0.25\text{mm}$

PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimensions (LxWxH)	tube	355.0 x 63.5 x 20.6mm
Packaging Quantity		5pcs
Storage Temperature Range		-55°C to +125°C
Storage Humidity		95% RH

The product information and specifications may be subject to changes even without prior written notice. The product has been designed for various applications; its suitability lies in the responsibility of each customer. The products are not authorized for use in safety-critical applications without RECOM's explicit written consent. A safety-critical application is an application where a failure may reasonably be expected to endanger or cause loss of life, inflict bodily harm or damage property. The applicant shall indemnify and hold harmless RECOM, its affiliated companies and its representatives against any damage claims in connection with the unauthorized use of RECOM products in such safety-critical applications.