Features

Regulated Converters

- 4:1 Wide Input Range
- 3kVAC Reinforced Insulation for 110Vin
  2.25kVDC Basic Insulation for 24Vin & 48Vin
- Efficiency up to 91%
- No Minimum Load Required
- UL60950-1, EN50155 & IEC/EN60950-1 Certified

RECOM
DC/DC Converter

RP240H-RW

240 Watt Half Brick Single Output

3 YEAR warranty

EN50155 Certified
IEC/EN60950-1 Certified
UL60950-1 Certified

Description

The half-brick RP240H series DC/DC converters are designed for railway rolling stock and high voltage battery applications. Each series has three 4:1 input voltage range options to cover all input voltages from 9VDC up to 160VDC with isolated and regulated 5V to 48VDC outputs. The converters have high efficiencies and metal baseplates to permit a wide operating temperature range from -40°C to +85°C (when mounted on a suitable heatsink). The case is fitted with threaded inserts to allow secure mounting to the PCB or bulkhead for use in high shock and vibration environments. The converters are EN50155, UL60950 and IEC/EN60950 certified. The RP240H-RW series have a three year warranty.

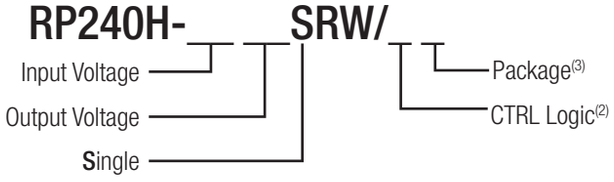
Selection Guide

Part Number	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [mA]	Input[1] Current [mA]	Output Power [W]	Efficiency[1] typ. [%]	Max. Capacitive Load [µF]
RP240H-2405SRW	9-36	5	36000	8333	180	90	72000
RP240H-2412SRW	9-36	12	15000	8427	180	89	12500
RP240H-2415SRW	9-36	15	12000	8333	180	90	8000
RP240H-2424SRW	9-36	24	7500	8333	180	90	3100
RP240H-2448SRW	9-36	48	3700	8314	177.5	89	770
RP240H-4805SRW	16.5-75	5	40000	4578	200	91	80000
RP240H-4812SRW	16.5-75	12	18000	5000	216	90	15000
RP240H-4815SRW	16.5-75	15	14000	4807	210	91	9000
RP240H-4824SRW	16.5-75	24	9000	5000	216	90	3700
RP240H-4848SRW	16.5-75	48	4500	5000	216	90	930
RP240H-11005SRW	43-160	5	44000	2247	220	89	88000
RP240H-11012SRW	43-160	12	20000	2451	240	89	16600
RP240H-11015SRW	43-160	15	16000	2424	240	90	10600
RP240H-11024SRW	43-160	24	10000	2451	240	89	4100
RP240H-11048SRW	43-160	48	5000	2451	240	89	1000

Notes:

Note1: Efficiency is tested by nominal Vin, full load and at 25°C.

Model Numbering



Ordering Examples

RP240H-2405SRW/N = 24V Input, 5V Output, Single, Neg. CTRL function
RP240H-11012SRW/P = 110V Input, 12V Output, Single, Pos. CTRL function
RP240H-2405SRW/N-HC = 24V Input, 5V Output, Single, Neg. CTRL function with premounted Heat-sink

Notes:

Note2: 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)
Note3: add suffix "-HC" for premounted Heat-sink
(compatible with all other suffixes)

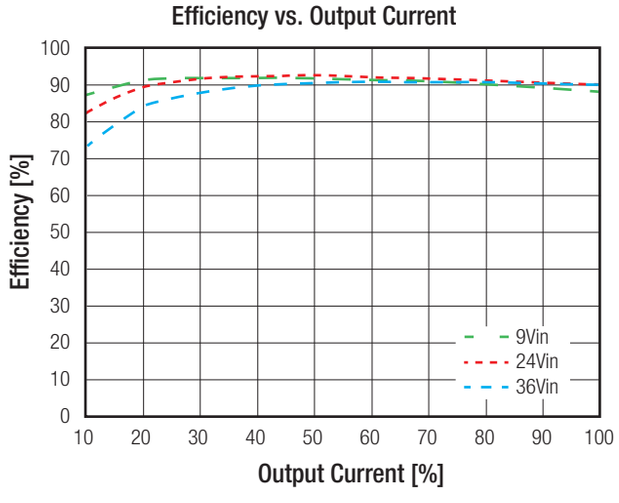
RP240H-RW
Series

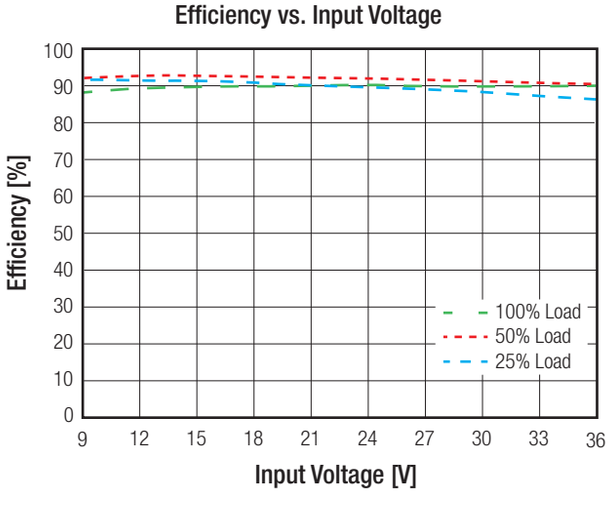
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

BASIC CHARACTERISTICS

Parameter	Condition		Min.	Typ.	Max.
Internal Input Filter					Pi-Type
Input Voltage Range	nom Vin = 24V nom Vin = 48V nom Vin = 110V		9VDC 16.5VDC 43VDC	24VDC 48VDC 110VDC	36VDC 75VDC 160VDC
Input Surge Voltage	Vin = 24V, 1s max. Vin = 48V, 1s max. Vin = 110V, 1s max.				50VDC 100VDC 185VDC
Quiescent Current	Vin = 24V Vin = 48V Vin = 110V		30mA 20mA 10mA		45mA 25mA 15mA
Start-up time	constant resistive load	Power up Remote ON/OF		75ms 75ms	
Internal Operating Frequency			225kHz	250kHz	275kHz
Minimum Load			0%		
Ripple and Noise	Measured by 20MHz BW with a 1µF/25V X7R MLCC & a 22µF/25V POS Cap with a 1µF/25V X7R MLCC & a 22µF/25V POS Cap with a 4.7µF/50V X7R MLCC with a 2.2µF/100V X7R MLCC	5 Vout 12, 15Vout 24Vout 48Vout		75mVp-p 100mVp-p 200mVp-p 300mVp-p	
Under Voltage Lockout (UVLO)	Vin = 24V	DC-DC ON DC-DC OFF	 7.3VDC		9VDC 8.1VDC
	Vin = 48V	DC-DC ON DC-DC OFF	 15.5VDC		18VDC 16.3VDC
	Vin = 110V	DC-DC ON DC-DC OFF	 33.0VDC		43VDC 36.0VDC
ON/OFF Control	Positive Logic	DC-DC ON DC-DC OFF	Open or 3.0V < Vr < 12V Short or 0V < Vr < 1.2V		
	Negative Logic	DC-DC ON DC-DC OFF	Short or 0V < Vr < 1.2V Open or 3.0V < Vr < 12V		
Input Current of CTRL pin			-0.5mA		1mA
Standby Current				3mA	
Output Trim			-20%		+10%
Remote Sense	% of set Vout				10%

RP240H-2405SRW





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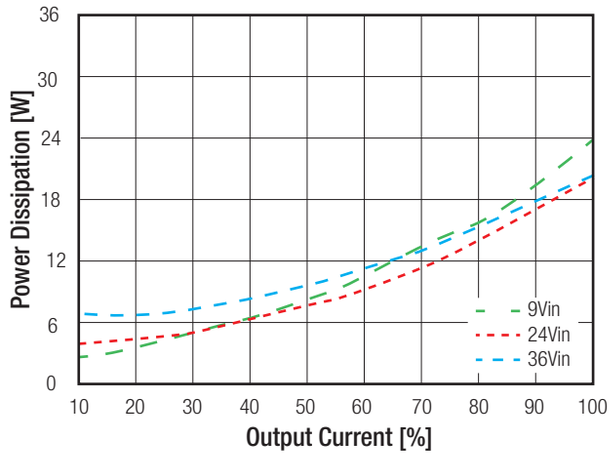
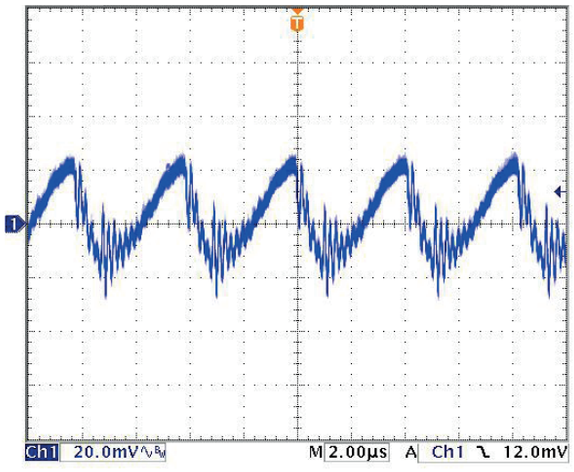
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

RP240H-2405SRW

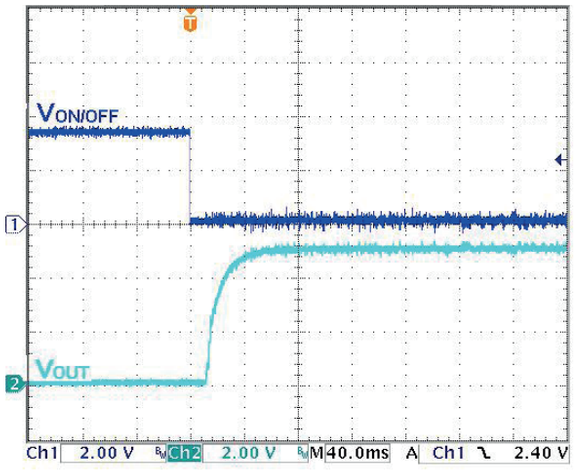
Power Dissipation vs. Output Current



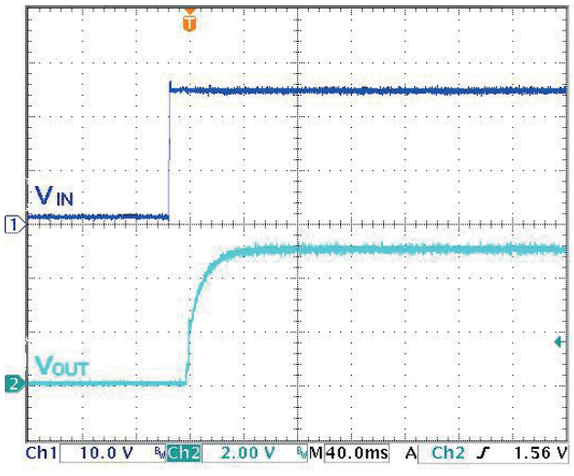
Typical Output Ripple and Noise/full load



ON/OFF Control Start up Rise Characteristic

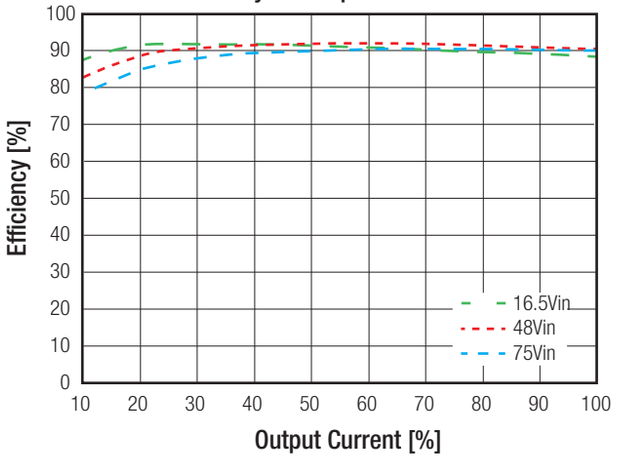


Power up Start-up Rise Characteristic

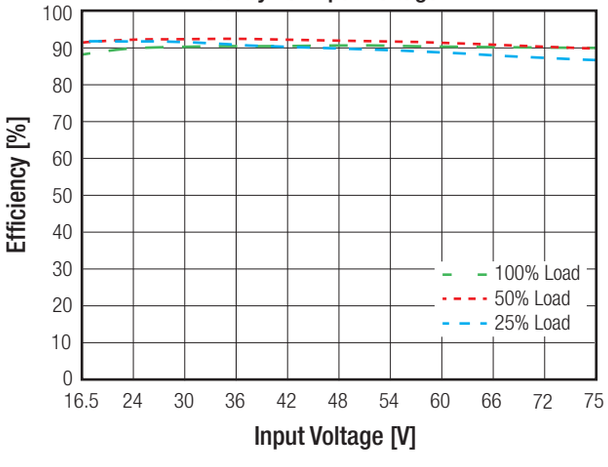


RP240H-4805SRW

Efficiency vs. Output Current



Efficiency vs. Input Voltage



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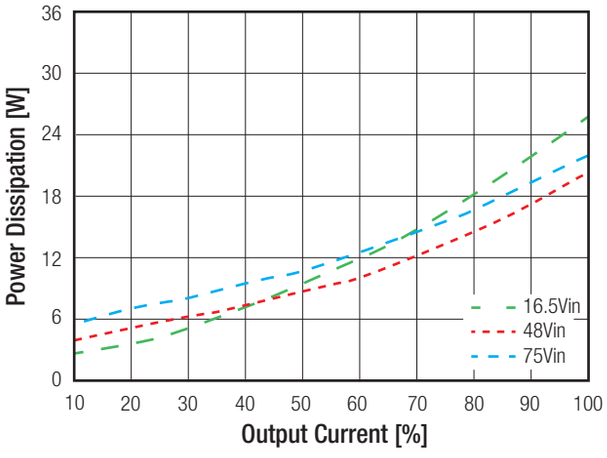
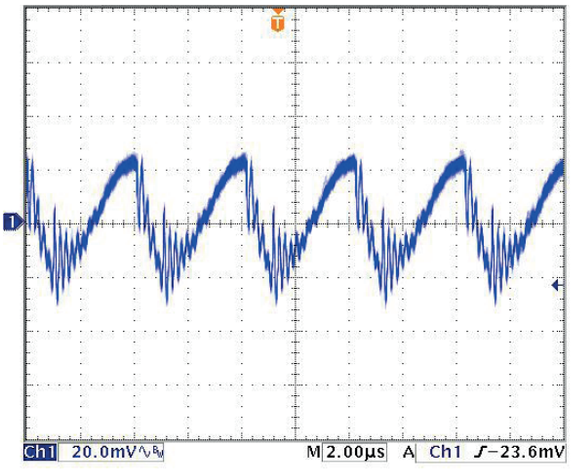
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

RP240H-4805SRW

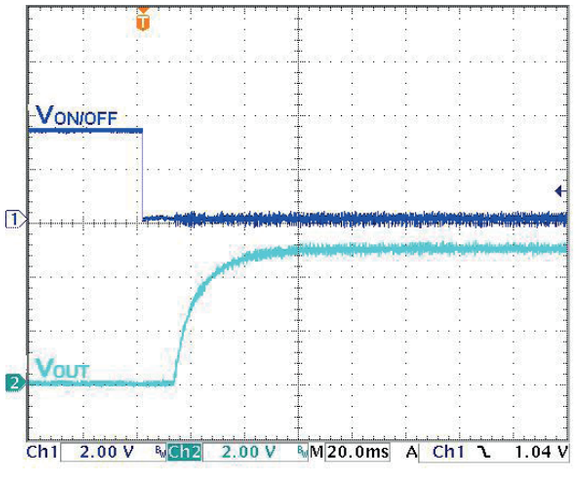
Power Dissipation vs. Output Current



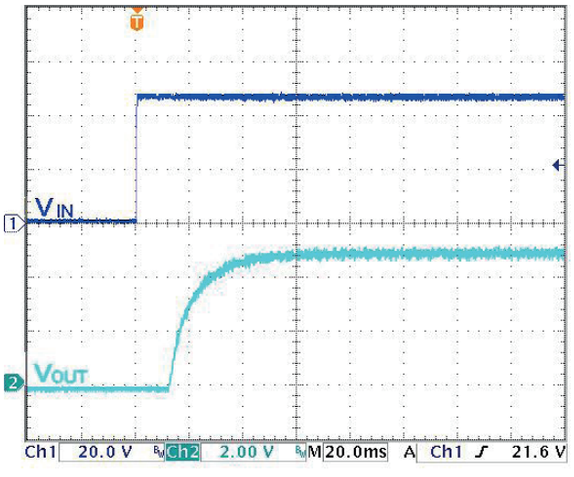
Typical Output Ripple and Noise/full load



ON/OFF Control Start up Rise Characteristic

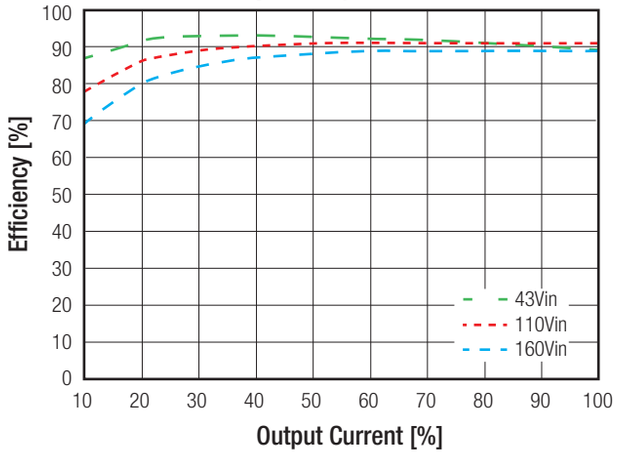


Power up Start-up Rise Characteristic

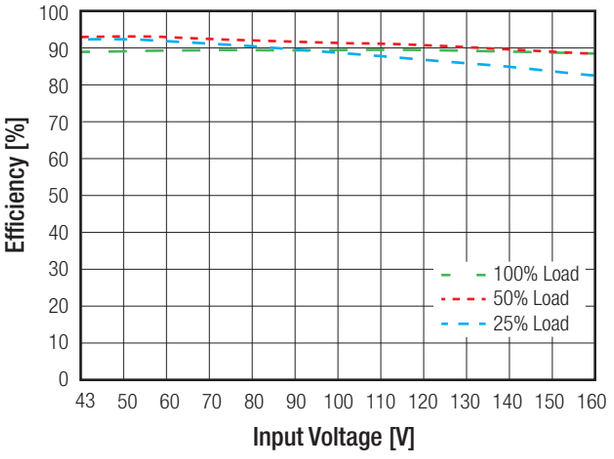


RP240H-11005SRW

Efficiency vs. Output Current



Efficiency vs. Input Voltage



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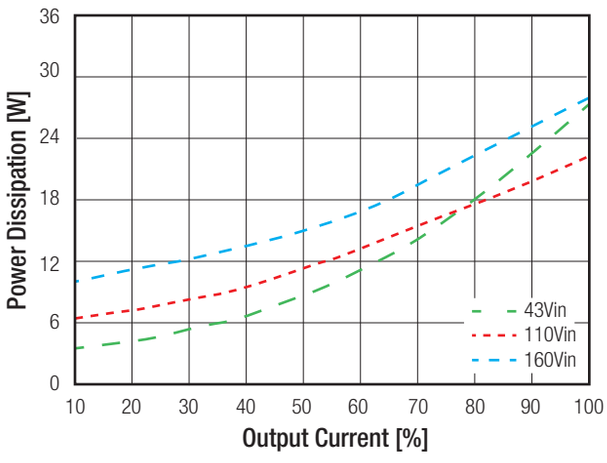
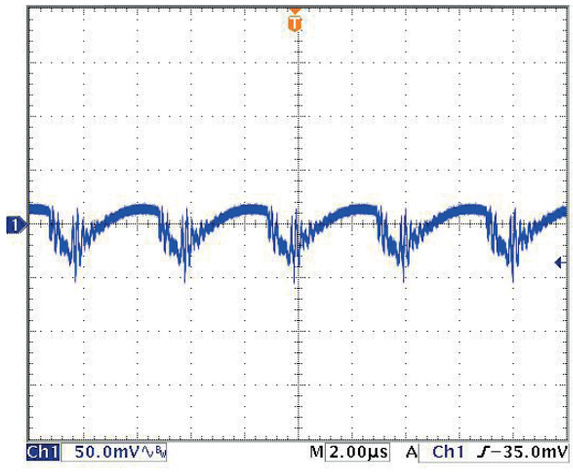
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

RP240H-11005SRW

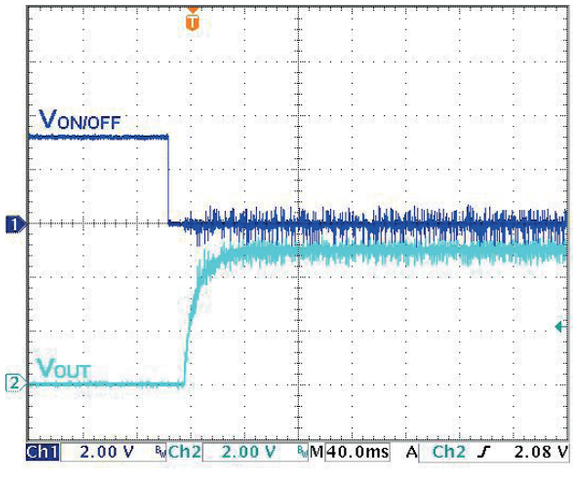
Power Dissipation vs. Output Current



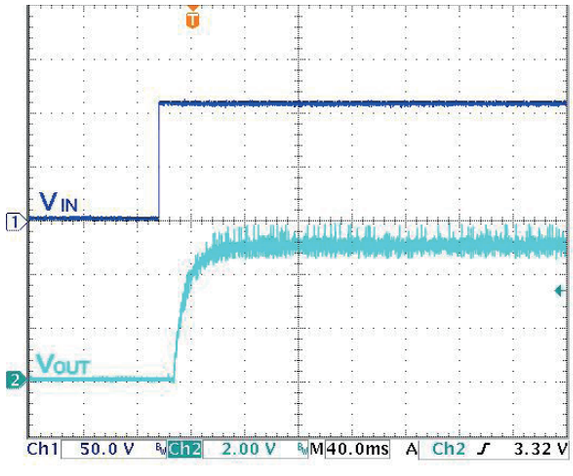
Typical Output Ripple and Noise/full load



ON/OFF Control Start up Rise Characteristic



Power up Start-up Rise Characteristic

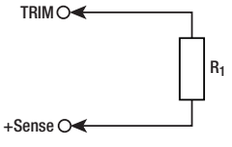


OUTPUT TRIM

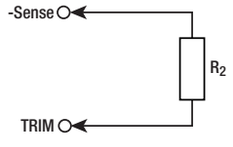
Output Voltage Trimming

RP240H-RW 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; they also can be calculated with below shown equation.

TRIM UP



TRIM DOWN



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

OUTPUT TRIM

Trim Calculation

$$R_1 = \left[\frac{100*Vout+\Delta Vout * Vout)}{1.225*\Delta Vout} - \frac{(100+2\Delta Vout)}{\Delta Vout} \right] k\Omega$$

$$R_2 = \left[\frac{100}{\Delta Vout} - 2 \right] k\Omega$$

Vout = Output Voltage
ΔVout = Output Voltage Trim in %
R1 = trim up resistor
R2 = trim down resistor

Practical Example:

Trim Up:

Vout = 5V, ΔVout = 10% (5.5V)

$$R_1 = \left[\frac{100*Vout+\Delta Vout * Vout)}{1.225*\Delta Vout} - \frac{(100+2\Delta Vout)}{\Delta Vout} \right] k\Omega = \frac{100*5 +10*5}{1.225*10} - \frac{100+2*10}{10} = 44.89 - 12 = 33.2k\Omega$$

Trim down:

Vout = 5V, ΔVout = -10% (4.5V)

$$R_2 = \left[\frac{100}{\Delta Vout} - 2 \right] k\Omega = \frac{100}{10} - 2 = 8.06k\Omega$$

RP240H-xx05SRW

Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout =	5.05	5.10	5.15	5.20	5.25	5.30	5.35	5.4	5.45	5.50	Volts
R_1 =	309	158	105	78.7	63.4	53.6	46.4	40.2	36.5	33.2	kOhms

RP240H-xx12SRW

Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout =	12.12	12.24	12.36	12.48	12.60	12.72	12.84	12.96	13.08	13.20	Volts
R_1 =	887	453	301	226	182	154	133	118	105	95.3	kOhms

RP240H-xx15SRW

Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout =	15.15	15.30	15.45	15.60	15.75	15.90	16.05	16.20	16.35	16.50	Volts
R_1 =	1130	576	383	294	237	196	169	150	137	124	kOhms

RP240H-xx24SRW

Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout =	24.24	24.48	24.72	24.96	25.20	25.44	25.68	25.92	26.16	26.40	Volts
R_1 =	1870	953	634	487	392	332	280	249	226	205	kOhms

RP240H-xx48SRW

Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout =	48.48	48.96	49.44	49.92	50.40	50.88	51.36	51.84	52.32	52.80	Volts
R_1 =	3830	1960	1300	991	806	681	576	511	464	422	kOhms

Trim Down all Vout's

Trim down	1	2	3	4	5	6	7	8	9	10	%
R_2 =	97.6	47.5	31.6	23.2	18.2	14.7	12.1	10.5	9.09	8.06	kOhms
Trim down	11	12	13	14	15	16	17	18	19	20	%
R_2 =	7.15	6.34	5.76	5.11	4.64	4.22	3.92	3.57	3.24	3.01	kOhms

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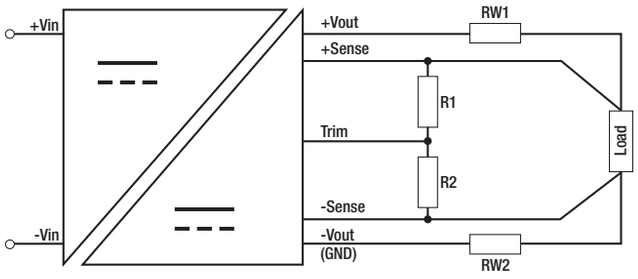
Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

Remote Sense



The output voltage can be adjusted by both trim and remote sense. The maximum combined adjustment range ±10%. Derate the maximum output power if using the trim or sense function.

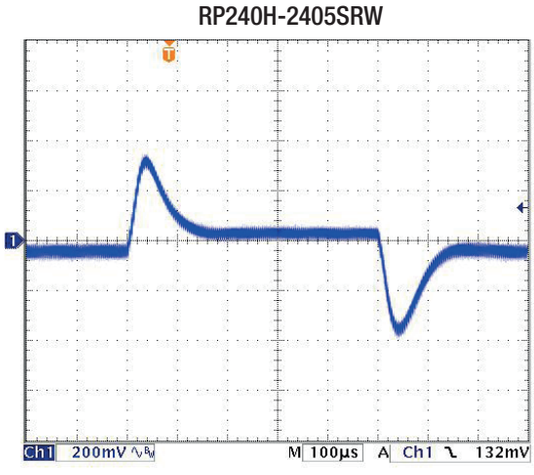
R_{W1} ... wire losses +
R_{W2} ... wire losses -
R_1 ... trim up resistor
R_2 ... trim down resistor

REGULATIONS

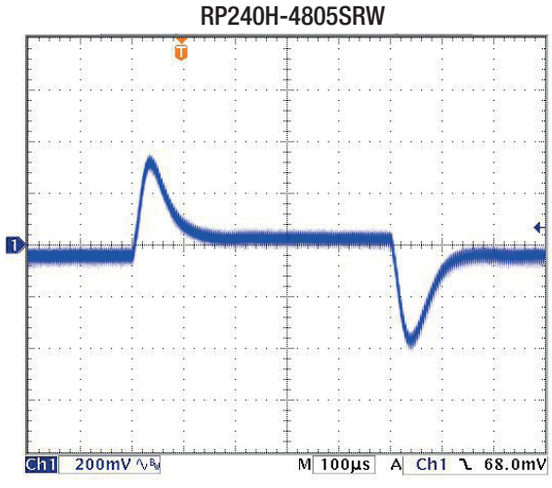
Parameter	Condition	Value
Output Accuracy		±1.0%
Line Regulation	low line to high line at full load	±0.1%
Load Regulation	0% to 100% load	±0.1%
Transient Response	25% load step change	200µs typ.; 250µs max.

Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load at nom.Vin

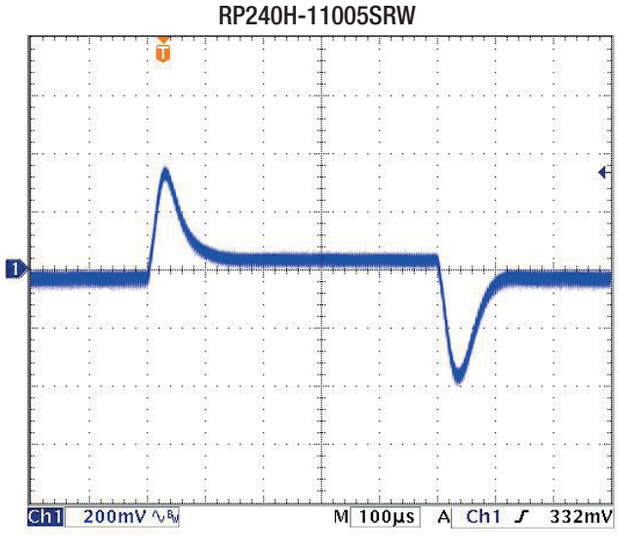
RP240H-2405SRW



RP240H-4805SRW



RP240H-11005SRW



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

PROTECTIONS

Parameter	Condition		Value
Short Circuit Protection (SCP)	below 100mΩ		continuous, automatic recovery
Over Voltage Protection (OVP)	% of nom. Vout		115%-130%, Hiccup Mode
Over Load Protection (OLP)	% Iout rated		120%-150%, Hiccup Mode
Over Temperature Protection (OTP)			+120°C
Isolation Voltage	110Vin	I/P to O/P I/P or O/P to Baseplate	3kVAC/1minute 1.5kVAC/1minute
	24Vin, 48Vin	I/P to O/P I/P or O/P to Baseplate	2.25kVDC/1minute 1.6kVDC/1minute
Isolation Resistance	500 VDC		1GΩ min.
Isolation Capacitance			2500pF max.
Isolation Grade	110Vin 24Vin, 48Vin		Reinforced Insulation Basic Insulation

Notes:

Note4: An input fuse is required if the mains supply isn't over-current protected. Recommended fuse: T100A slow blow.

ENVIRONMENTAL

Parameter	Condition	Value
Operating Case Temperature Range	Baseplate	-40°C to +115°C
Maximum Case Temperature		115°C
Temperature Coefficient		±0.02%/°C max.
Thermal Impedance	vertical direction by natural convection (0.1m/s) without Heat-sink vertical direction by natural convection (0.1m/s) with Heat-sink	6.1°C/W 4.6°C/W
Operating Humidity		5% - 95% RH
Pollution Degree		PD2
Shock		according to EN61373 standard
Thermal Shock		according to MIL-STD-810F standard
Vibration		according to EN61373 standard
Fire protection on railway vehicles		according to EN45545-2, 2013 standard
MTBF	according to MIL-HDBK-217F standard, 25°C	296.1 x 10^3 hours

Thermal Calculation

$R_{thcase\text{-}ambient}$ = 6.1°C/W (vertical)
$R_{thcase\text{-}ambientHC}$ = 4.6°C/W (vertical)

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

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

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
$R_{thcase\text{-}ambient}$ = Thermal Impedance

Practical Example:

Take the RP240H-2405SRW with 9V input Voltage and 50% load. What is the maximum ambient operating temperature? Use converter vertical in application without airflow.

Eff_{min} = 91.5% @ V_{nom}

P_{OUT} = 180W

P_{OUTapp} = 180 x 0.5 = 90W

η = 91.5% (Efficiency vs. Load Graph)

$$P_{dissipation} = \frac{90}{0.915} - 90 = 8.36W$$

without Heat-sink

$$R_{th} = \frac{T_{casemax} - T_{amb}}{P_{dissipation}} \text{ --> } 6.1°C/W = \frac{115\text{-}T_{amb}}{8.36W}$$

T_{amb} = **64°C**

with Heat-sink

$$R_{thHC} = \frac{T_{casemax} - T_{amb}}{P_{dissipation}} \text{ --> } 4.6°C/W = \frac{115\text{-}T_{amb}}{8.36W}$$

T_{ambHC} = **76.5°C**

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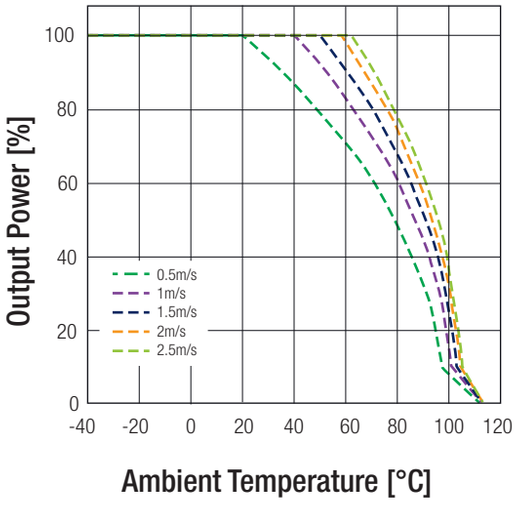
Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

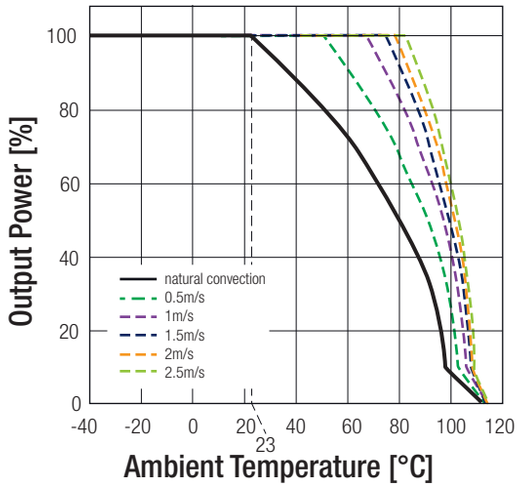
Derating Graph[5]

(@ Chamber - tested with forced convection)

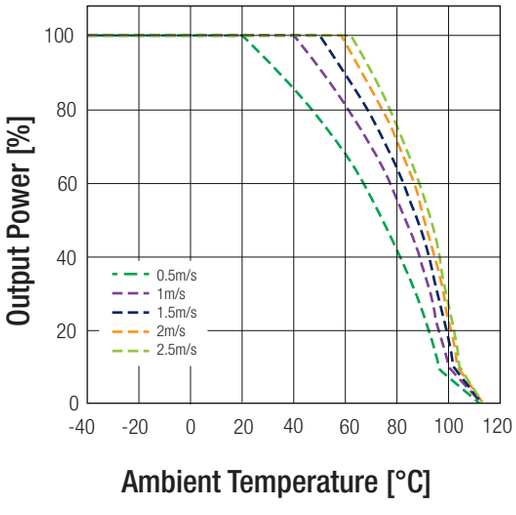
RP240H-2405SRW



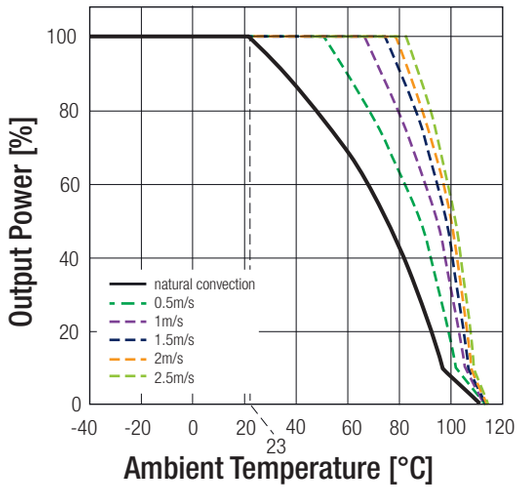
RP240H-2405SRW-HC



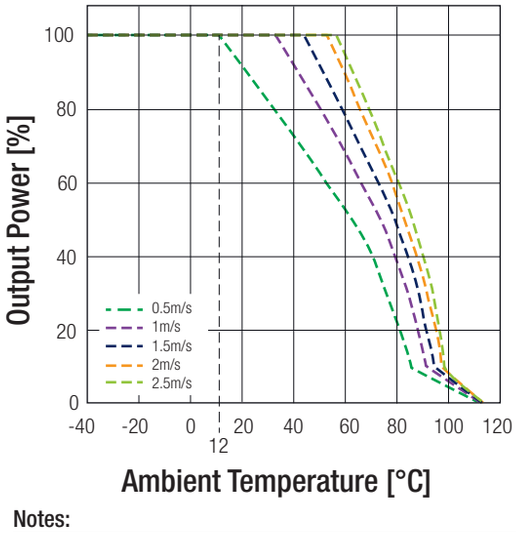
RP240H-4805SRW



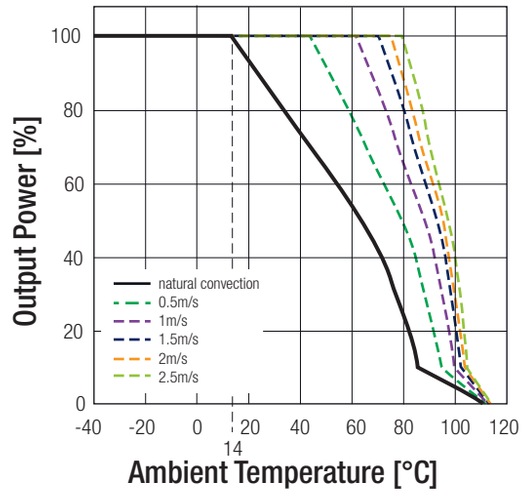
RP240H-4805SRW-HC



RP240H-11005SRW



RP240H-11005SRW-HC



Notes:

Note5: Derating graphs are valid only for the shown part numbers. If you need detailed derating-information about a part-number not shown here please contact our technical support service at techsupportAT@recom-power.com

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

SAFETY AND CERTIFICATIONS		
Certificate Type (Safety)	**Report / File Number**	**Standard**
Information Technology Equipment, General Requirements for Safety	E196683	UL60950-1, 2nd Edition CSA C22.2 No. 60950-1-07
IEC/EN Information Technology Equipment - General Requirments for Safety	TW1608033-001, TW1608036-001, TW1608037-001	IEC60950-1, 2nd Edition, 2005 EN60950-1, 1st Edition, 2006
Railway Applications - Electrical Equipment used on rolling stock	16A081501E-C	EN50155, 2007

EMI Compliance	**Condition**	**Standard / Criterion**
Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement	with external components	EN55022, Class A and Class B
Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement		EN55011, Class A and Class B
ESD Electrostatic discharge immunity test	Air ±8kV and Contact ±6kV	EN61000-4-2, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	20 V/m	EN61000-4-3, Criteria A
Fast Transient and Burst Immunity(6)	±2kV	EN61000-4-4, Criteria A
Surge Immunity(6)	EN55024 & EN50155 ±2kV	EN61000-4-5, Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields	10 Vr.m.s	EN61000-4-6, Criteria A
Power Magnetic Field Immunity	100A/m continuous; 1000A/m 1s	EN61000-4-8, Criteria A

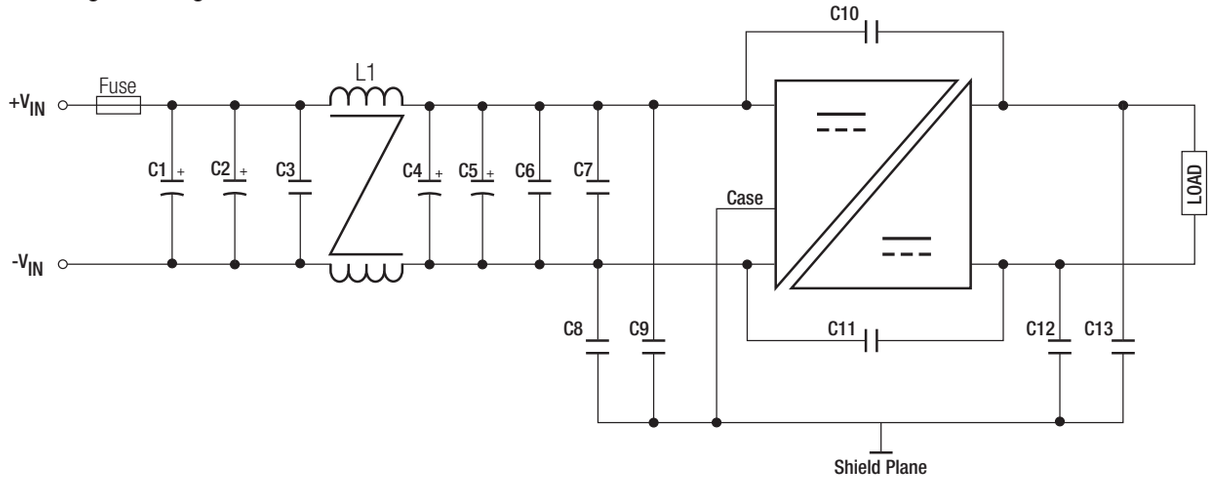
Notes:

Note6: An external input filter capacitor is required if the module has to meet EN61000-4-4 and EN61000-4-5.

The **24Vin** and **48Vin** version recommend 2pcs of aluminium elecrolytic capacitor to connect in parallel.
Recom suggest: Nippon Chemi-con KY series, 220µF/100V.

The **110Vin** version recommend 3pcs of aluminium electrolytic capacitor to connect in parallel.
Recom suggest: Rubycon BXF series, 100µF/250V

EMI Filtering according to EN55022/11Class A and EN50121-1



MODEL	C1, C2, C4, C5	C3, C6, C7	C8, C9, C10, C11, C13	C12	L1
RP240H-24xxSRW	470µF, 50V Al cap. (lie down) Chemi-con KY	4.7µF, 50V 1812 MLCC	1000pF, 3kV 1808 MLCC	3300pF, 3kV 1808 MLCC	45µH CMC
RP240H-48xxSRW	220µF, 100V Al cap. (lie down) Chemi-con KY	2.2µF, 100V 1812 MLCC		1000pF, 3kV 1808 MLCC	224µH CMC
RP240H-110xxSRW	150µF, 200V Al cap. (lie down) Chemi-con KXJ	1µF, 250V 1812 MLCC			521µH CMC

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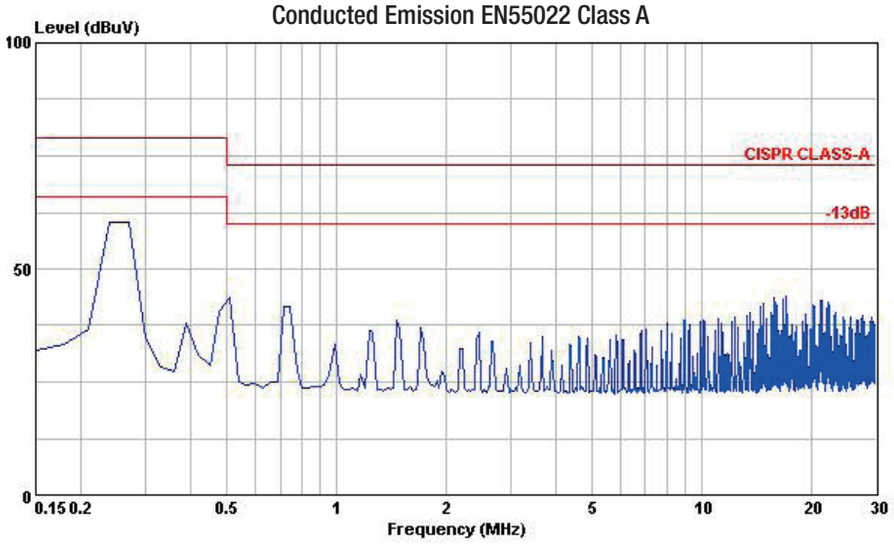
Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

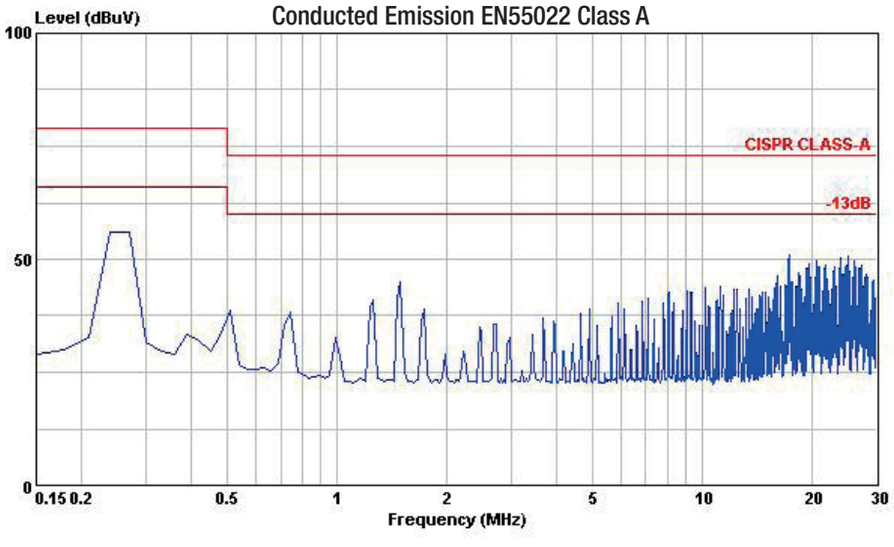
RP240H-2405SRW

Conducted Emission EN55022 Class A



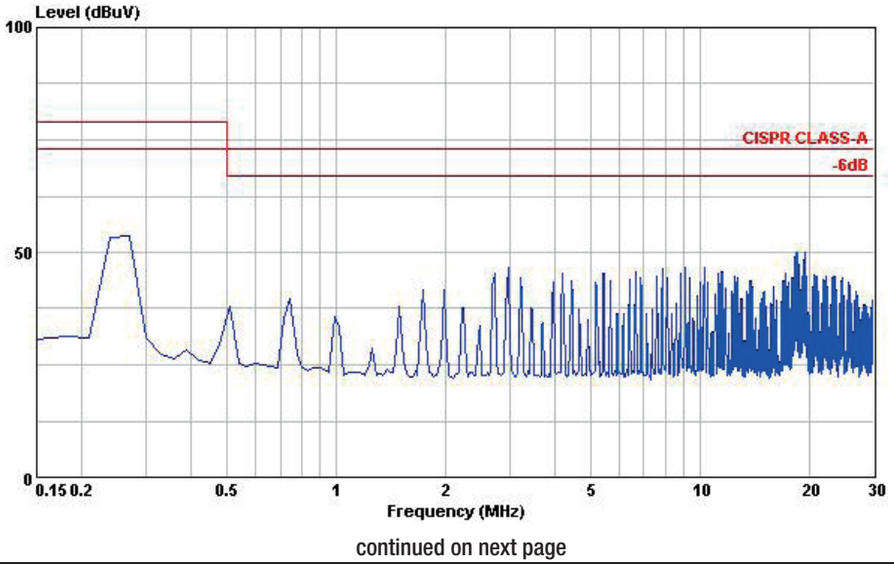
RP240H-4805SRW

Conducted Emission EN55022 Class A



RP240H-11005SRW

Conducted Emission EN55022 Class A



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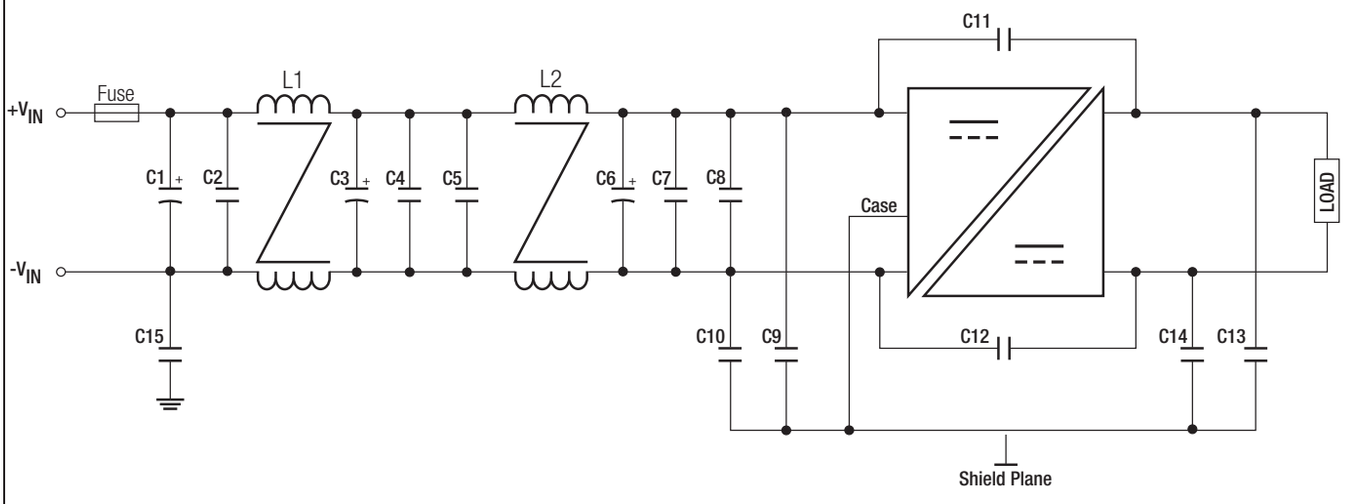
Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

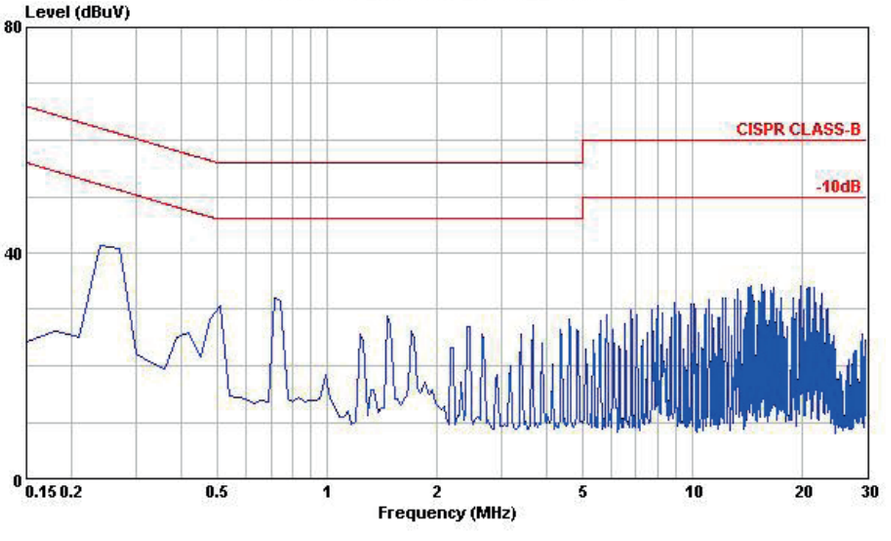
EMI Filtering according to EN55022/11 Class B



MODEL	C1, C3, C6	C2, C4, C5, C7, C8	C9, C10	C11	C12	C13, C14	C15	L1, L2
RP240H-24xxSRW	470µF, 50V Al cap. (lie down) Chemi-con KY	4.7µF, 50V 1812 MLCC	10nF, 2kV 1812 MLCC	1000pF, 3kV 1808 MLCC	4700pF, 3kV 1812 MLCC	10nF, 2kV 1812 MLCC	N/A	45µH CMC
RP240H-48xxSRW	220µF, 100V Al cap. (lie down) Chemi-con KY	2.2µF, 100V 1812 MLCC		2200pF, 3kV 1808 MLCC			1000pF, 3kV 1808 MLCC	224µH CMC
RP240H-110xxSRW	150µF, 200V Al cap. (lie down) Chemi-con KXJ	1µF, 250V 1812 MLCC	2200pF, 3kV 1808 MLCC		2200pF, 3kV 1808 MLCC	1000pF, 3kV 1808 MLCC		521µH CMC

RP240H-2405SRW

Conducted Emission EN55022 Class B



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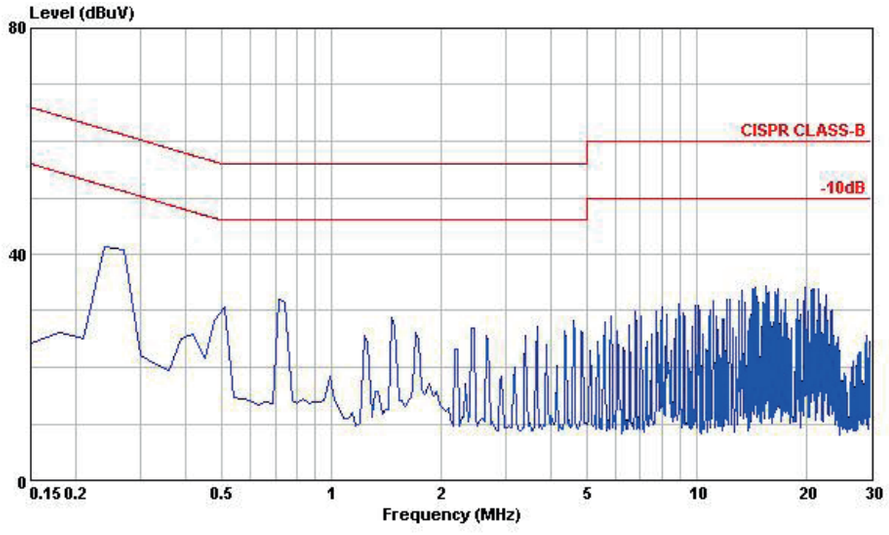
Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

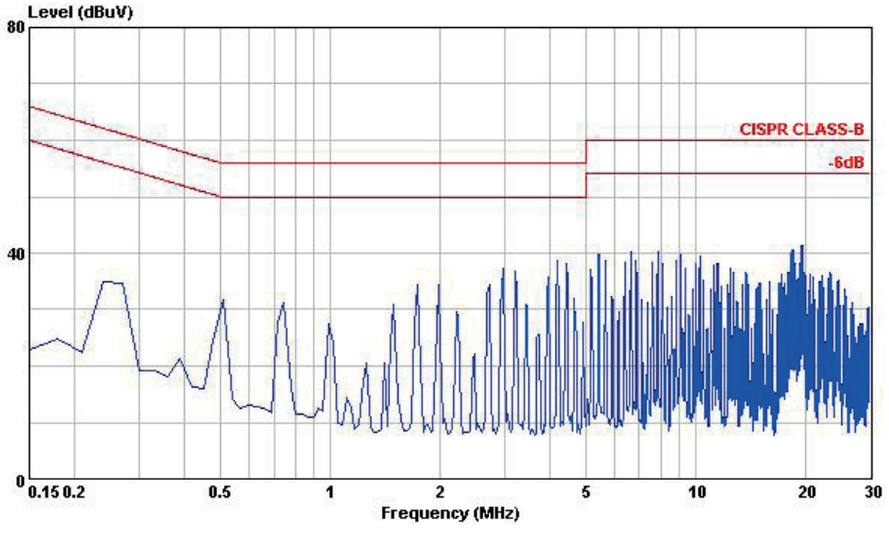
RP240H-4805SRW

Conducted Emission EN55022 Class B



RP240H-11005SRW

Conducted Emission EN55022 Class B



DIMENSIONS and PHYSICAL CHARACTERISTICS

Parameter	Type		Value
Material	Case	24Vin, 48Vin	Metal
		110Vin	Plastic
	Baseplate	110Vin	Aluminium
	Potting		Silicone (UL94 V-0)
Packaging Dimension (LxWxH)	without Heat-sink		61.0 x 57.9 x 12.7mm
	with Heat-sink		61.0 x 57.9 x 24.13mm
Packaging Weight	without Heat-sink		105g
	with Heat-sink		157g

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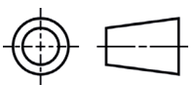
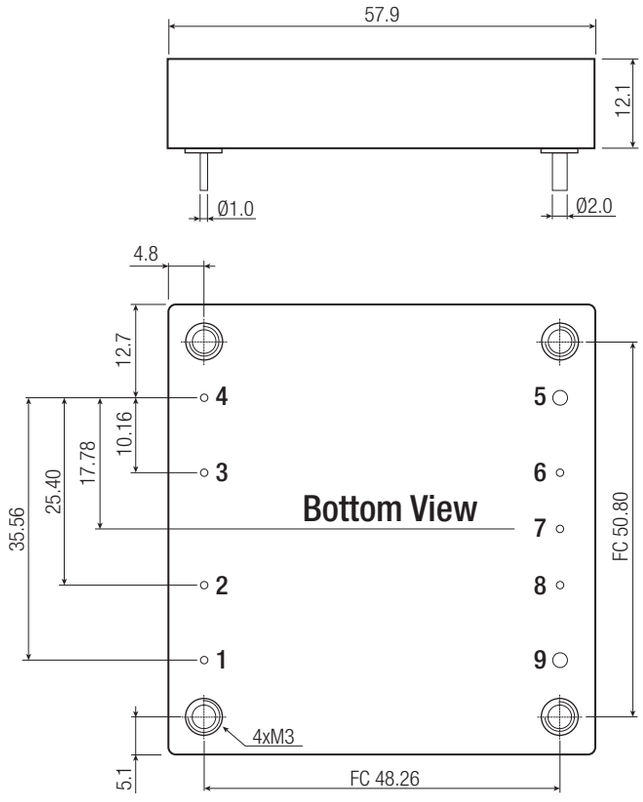
RP240H-RW Series

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

Dimension Drawing (mm)



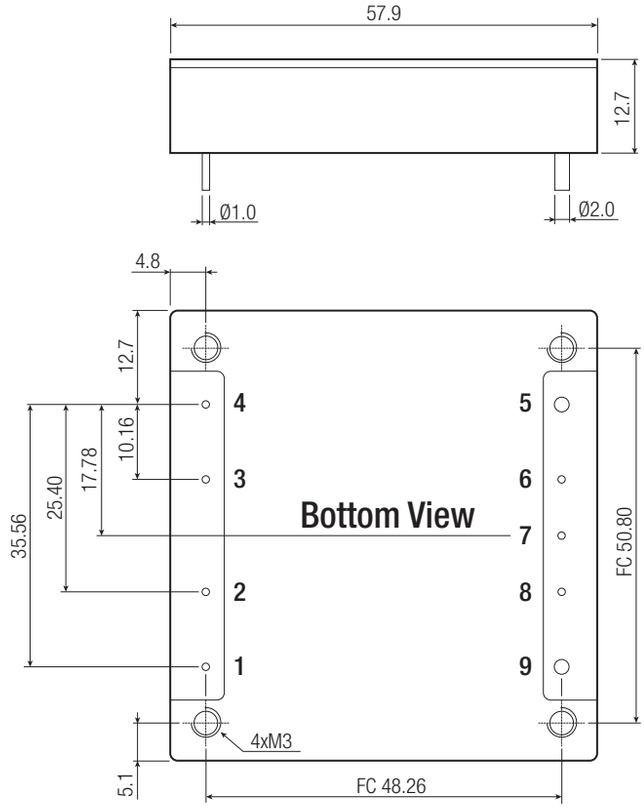
24Vin, 48Vin



Pin Connections	
Pin #	Single
1	+Vin
2	CTRL
3	Case
4	-Vin
5	-Vout
6	-Sense
7	Trim
8	+Sense
9	+Vout

FC= Fixing Centers for Heat-sink
Pin Pitch Tolerance ±0.25mm
Pin Dimension Tolerance ±0.1mm
XX.X ± 0.5mm
XX.XX ± 0.25mm

110VIn



Pin Connections	
Pin #	Single
1	+Vin
2	CTRL
3	Case
4	-Vin
5	-Vout
6	-Sense
7	Trim
8	+Sense
9	+Vout

FC= Fixing Centers for Heat-sink
Pin Pitch Tolerance ±0.25mm
Pin Dimension Tolerance ±0.1mm
XX.X ± 0.5mm
XX.XX ± 0.25mm

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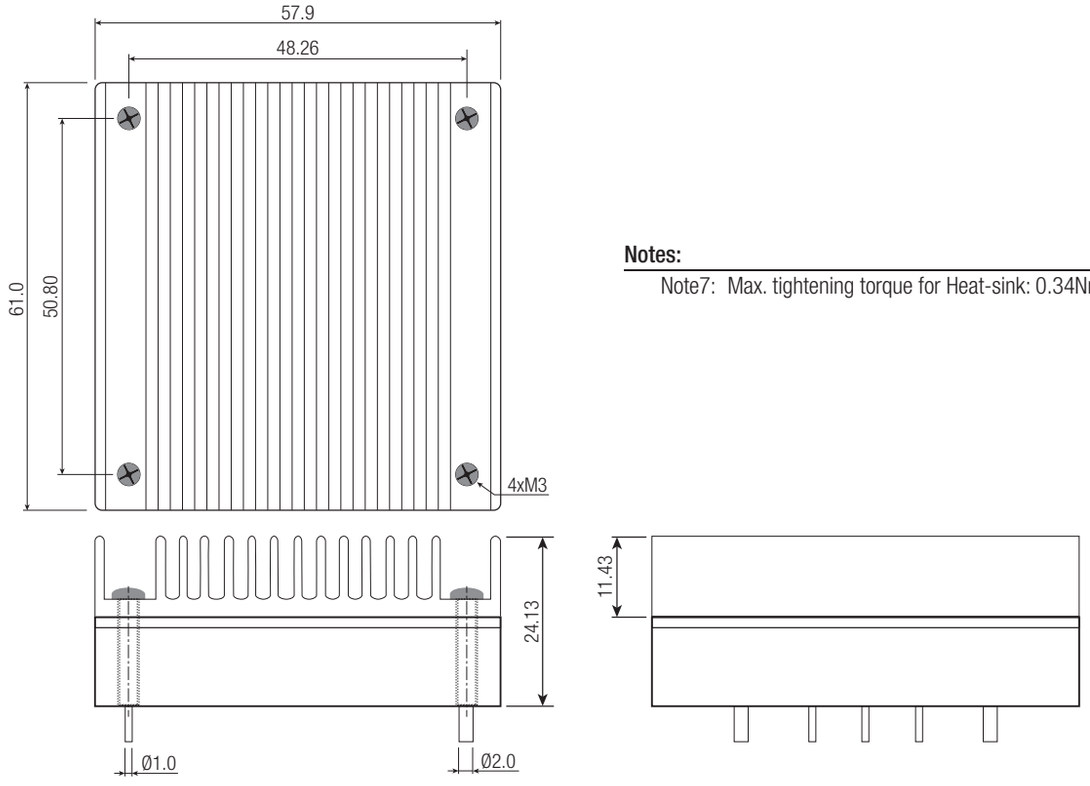
Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

110Vin with Heat-sink



Notes:

Note7: Max. tightening torque for Heat-sink: 0.34Nm

PACKAGING INFORMATION			
Parameter	**Type**		**Value**
Packaging Dimension	Tray	without Heat-sink	157.0 x 88.0 x 12.8mm
		with Heat-sink	157.0 x 88.0 x 24.8mm
Packaging Quantity			2pcs.
Storage Temperature Range			-55°C to +125°C
Storage Humidity			5% - 95% RH