Features

Regulated Converters

- 4:1 Wide Input Range
- 3kVAC Reinforced Insulation for 110Vin
  2.25kVDC Basic Insulation for 24Vin & 48Vin
- Efficiency up to 90%
- No Minimum Load Required
- EN50155 Certified
- IEC/EN60950-1 Certified

RECOM
DC/DC Converter

RP120Q-RW

120 Watt Quarter Brick Single Output

3 YEAR warranty

Description

The quarter-brick RP120Q 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 base-plates 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 and IEC/EN60950 certified. The RP120Q-RW series have a three year warranty.

EN50155 Certified
IEC/EN60950-1 Certified

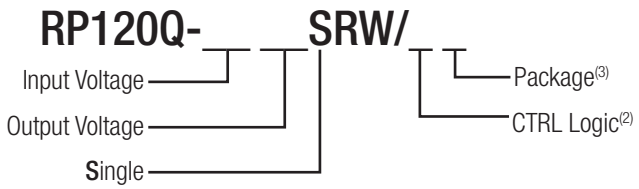
Selection Guide

Part Number	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [mA]	Input Current [mA]	Output Power [W]	Efficiency(1) typ. [%]	Max. Capacitive Load [µF]
RP120Q-2405SRW	9-36	5	24000	5618	120	89	48000
RP120Q-2412SRW	9-36	12	10000	5682	120	88	8300
RP120Q-2415SRW	9-36	15	8000	5618	120	89	5300
RP120Q-2424SRW	9-36	24	5000	5682	120	88	2100
RP120Q-2448SRW	9-36	48	2500	5682	120	88	520
RP120Q-4805SRW	16.5-75	5	24000	2809	120	89	48000
RP120Q-4812SRW	16.5-75	12	10000	2809	120	89	8300
RP120Q-4815SRW	16.5-75	15	8000	2777	120	90	5300
RP120Q-4824SRW	16.5-75	24	5000	2777	120	90	2100
RP120Q-4848SRW	16.5-75	48	2500	2777	120	90	520
RP120Q-11005SRW	40-160	5	24000	1225	120	89	48000
RP120Q-11012SRW	40-160	12	11000	1363	132	88	9170
RP120Q-11015SRW	40-160	15	8600	1317	130	89	5730
RP120Q-11024SRW	40-160	24	5500	1348	132	89	2290
RP120Q-11048SRW	40-160	48	2700	1323	130	89	560

Notes:

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

Model Numbering



Ordering Examples

RP120Q-2405SRW/N = 24V Input, 5V Output, Single, Neg. CTRL function
RP120Q-11012SRW/P = 110V Input, 12V Output, Single, Pos. CTRL function
RP120Q-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)

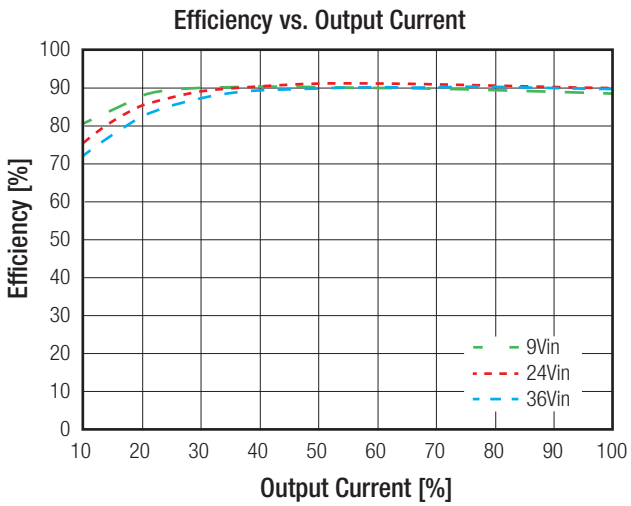
RP120Q-RW
Series

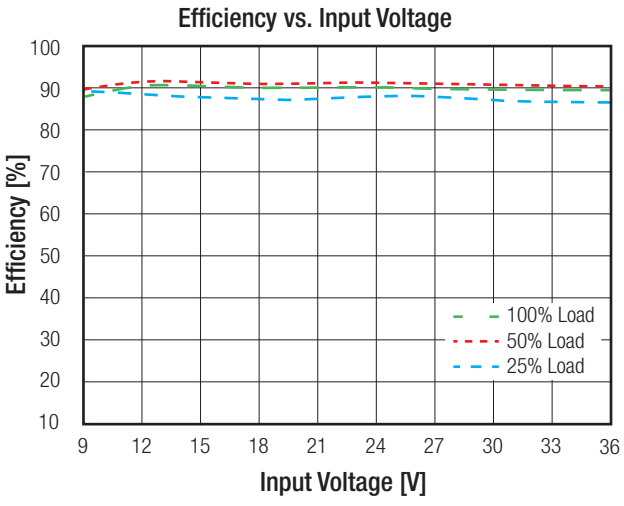
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

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 40VDC	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			25ma 15mA 8mA	
Start-up time	Power up ON/OFF Control			75ms 75ms	100ms 100ms
Internal Operating Frequency			270kHz	300kHz	330kHz
Minimum Load			0%		
Ripple and Noise	Measured by 20MHz BW with a 22µF/25V X7R MLCC with a 22µF/25V X7R MLCC 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	33VDC		43VDC 36VDC
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%

RP120Q-2405SRW



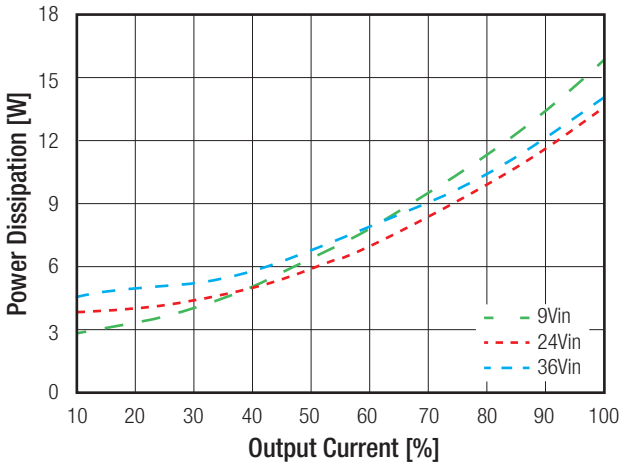


continued on next page

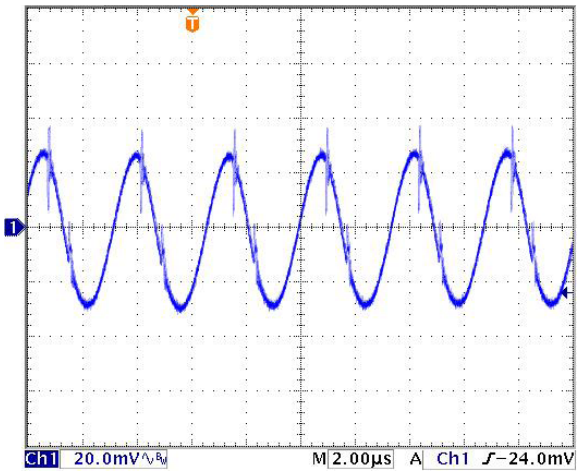
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

RP120Q-2405SRW

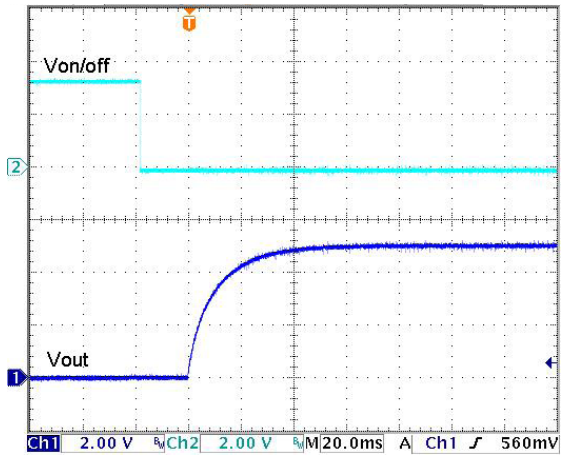
Power Dissipation vs. Output Current



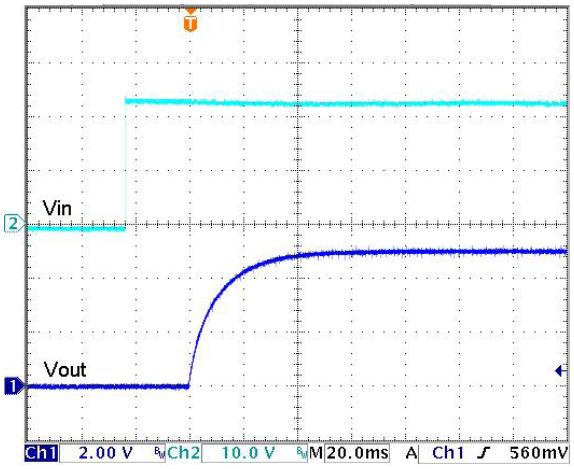
Typical Output Ripple and Noise/full load



ON/OFF Control Start up Rise Characteristic

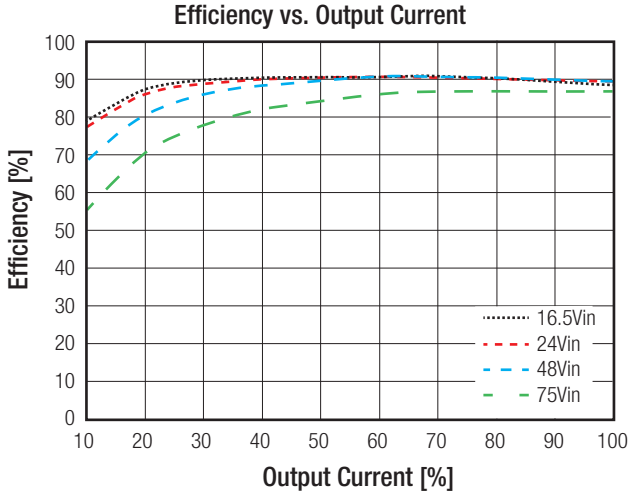


Power up Start-up Rise Characteristic

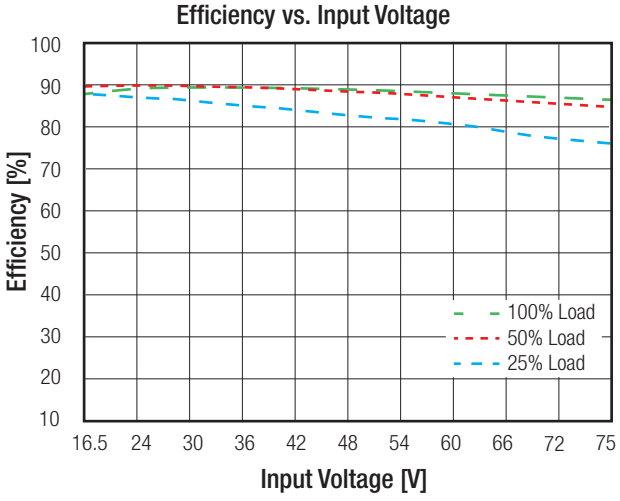


RP120Q-4805SRW

Efficiency vs. Output Current



Efficiency vs. Input Voltage

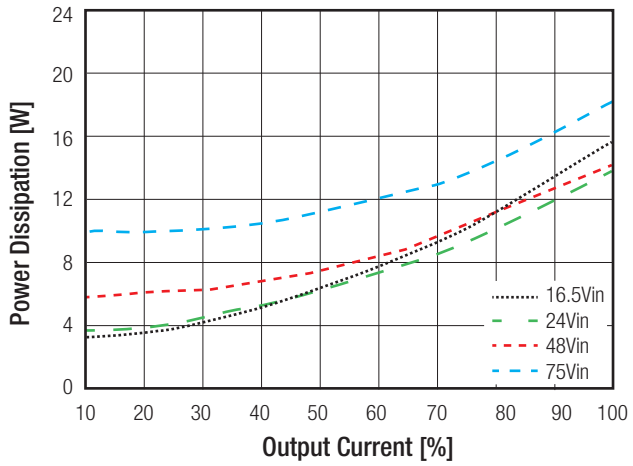


continued on next page

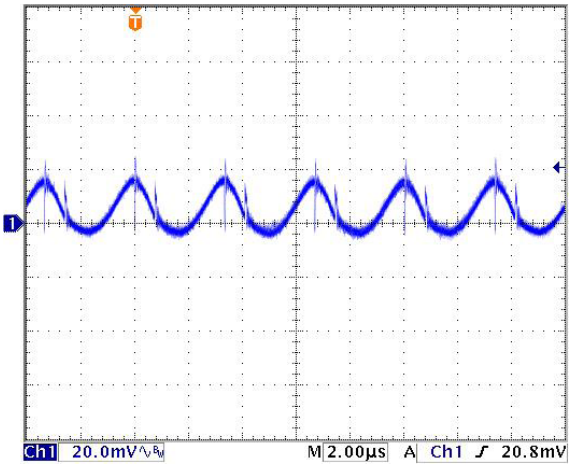
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

RP120Q-4805SRW

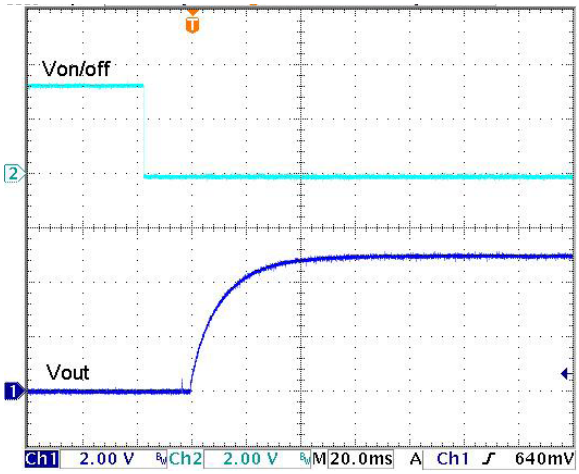
Power Dissipation vs. Output Current



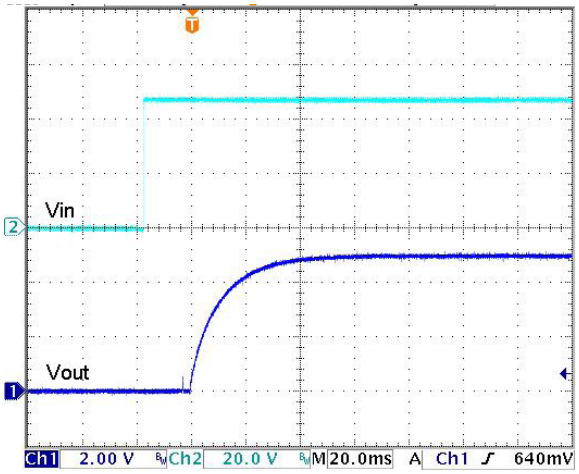
Typical Output Ripple and Noise/full load



ON/OFF Control Start up Rise Characteristic

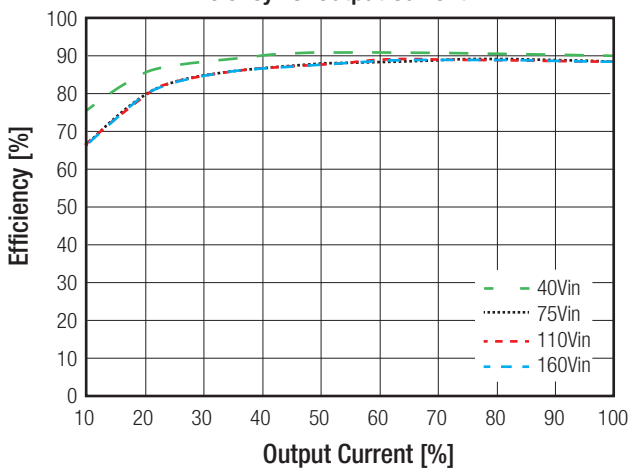


Power up Start-up Rise Characteristic

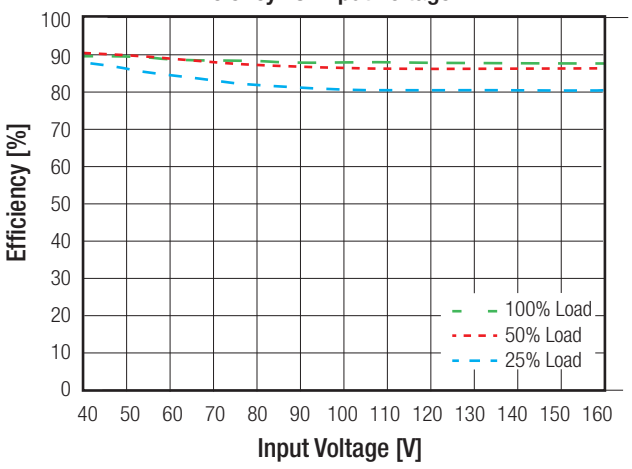


RP120Q-11005SRW

Efficiency vs. Output Current



Efficiency vs. Input Voltage

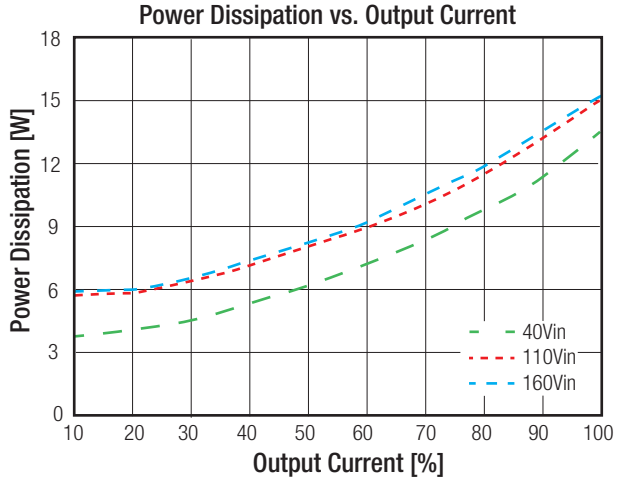


continued on next page

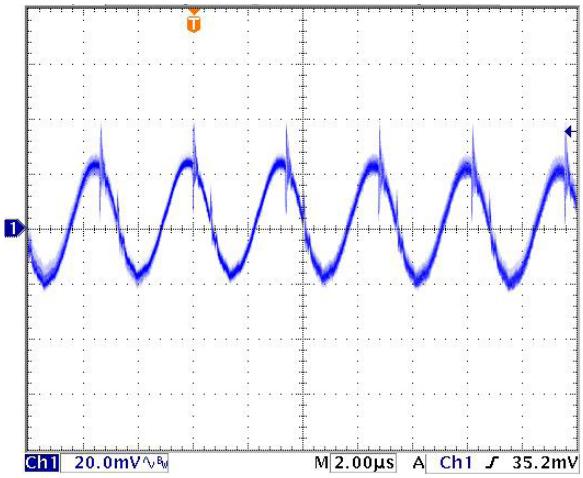
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

RP120Q-11005SRW

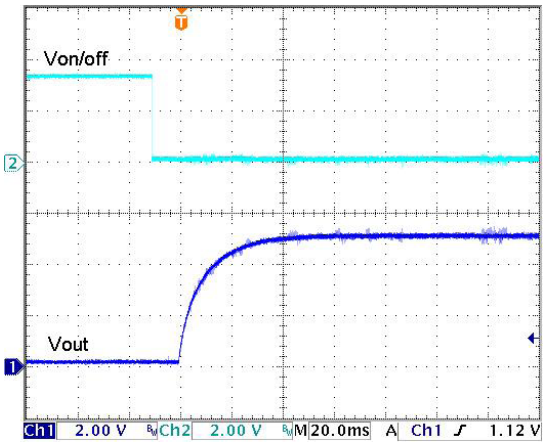
Power Dissipation vs. Output Current



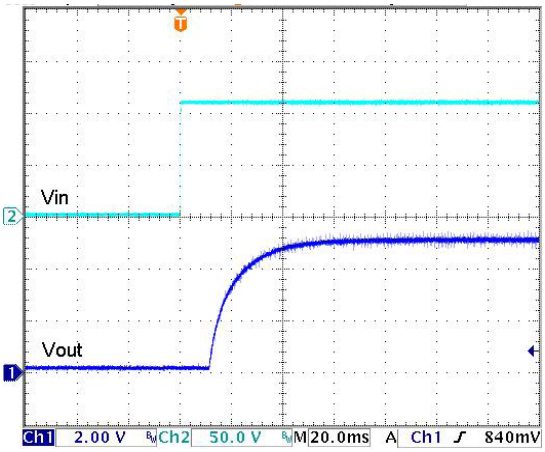
Typical Output Ripple and Noise/full load



ON/OFF Control Start up Rise Characteristic



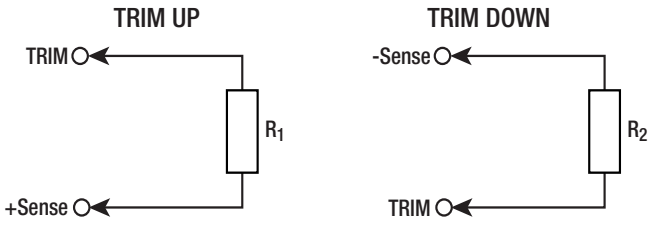
Power up Start-up Rise Characteristic



OUTPUT TRIM

Output Voltage Trimming

RP120Q-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.



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

OUTPUT TRIM

Trim Calculation

$$R_1 = \left[\frac{511*Vout+5.11\Delta Vout * Vout)}{1.225*\Delta Vout} - \frac{(511+10.22\Delta Vout)}{\Delta Vout} \right] k\Omega$$

$$R_2 = \left[\frac{511}{\Delta Vout} - 10.22 \right] k\Omega$$

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)

$$R_1 = \left[\frac{511*Vout+5.11\Delta Vout * Vout)}{1.225*\Delta Vout} - \frac{(511+10.22\Delta Vout)}{\Delta Vout} \right] k\Omega = \frac{511*5 +5.11*10*5}{1.225*10} - \frac{511+10.22*10}{10} = 229.43 - 61.32 = 169k\Omega$$

Trim down:

Vout = 5V, ΔVout = -10% (4.5V)

$$R_2 = \left[\frac{511}{\Delta Vout} - 10.22 \right] k\Omega = \frac{511}{10} - 10.22 = 41.2k\Omega$$

RP120Q-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 =	1580	806	536	402	324	247	237	205	187	169	KOhms

RP120Q-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 =	4530	2320	1540	1150	931	787	681	604	536	487	KOhms

RP120Q-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 =	5760	2940	1960	1470	1210	1020	866	768	698	619	KOhms

RP120Q-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 =	9530	4870	3240	2940	2000	1690	1470	1270	1150	1050	KOhms

RP120Q-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 =	19600	9945	6650	5110	4120	3400	3010	2610	2370	2150	KOhms

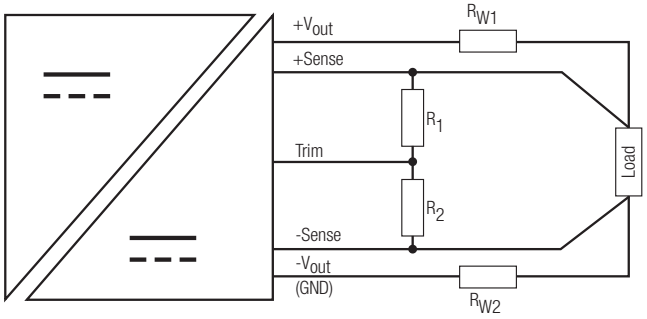
Trim Down all Vout's

Trim down	1	2	3	4	5	6	7	8	9	10	%
R_2 =	499	243	162	118	909	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	21.5	19.6	18.2	16.5	15.4	KOhms

continued on next page

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.

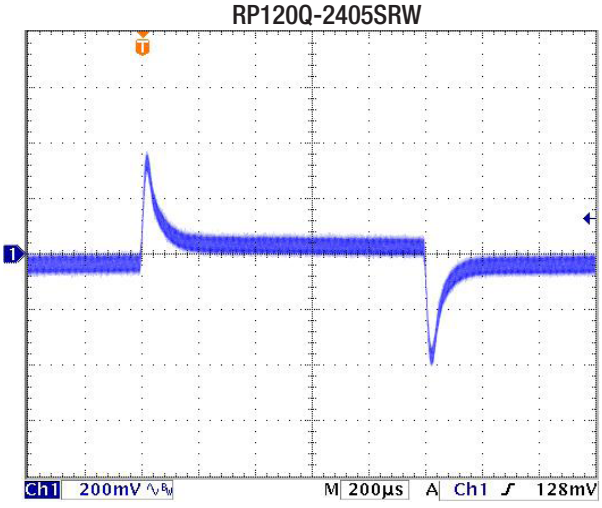
R_{W1} ... wire losses +
R_{W2} ... wire losses -
R_1 ... trim up resistor
R_2 ... trim down resistor

REGULATIONS

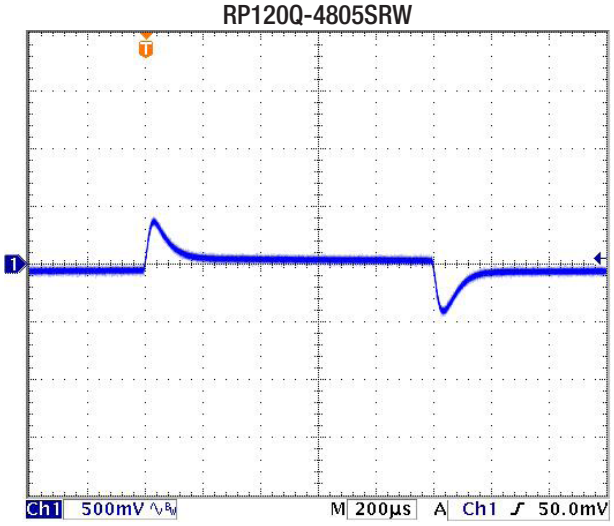
Parameter	Condition		Value
Output Accuracy			±1.0%
Line Regulation	low line to high line at full load		±0.1%
Load Regulation	0% to 100% load	5Vout	±0.2%
		others	±0.1%
Transient Response	25% load step change		250µs typ.

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

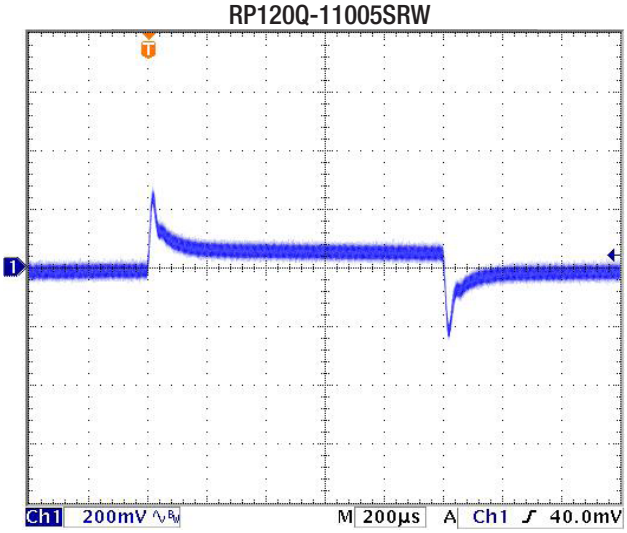
RP120Q-2405SRW



RP120Q-4805SRW



RP120Q-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		110%-140%, Hiccup Mode
Over Temperature Protection (OTP)			+110°C
Isolation Voltage	110Vin	I/P to O/P I/P or O/P to Baseplate	3kVDC/1minute 1.5kVDC/1minute
	24Vin, 48Vin	I/P to O/P I/P or O/P to Baseplate	2.25kVDC/1minute 2.25kVDC/1minute
Isolation Resistance	500 VDC		1GΩ min.
Isolation Capacitance			1500pF 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: T50A slow blow.

ENVIRONMENTAL

Parameter	Condition	Value
Operating Baseplate Temperature Range		-40°C to +100°C
Maximum Case Temperature		100°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	9°C/W 7.1°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	507.0 x 10^3 hours

Thermal Calculation

$R_{thcase\text{-}ambient}$ = 9°C/W (vertical)
$R_{thcase\text{-}ambientHC}$ = 7.1°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 RP120Q-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% @ V_{nom}

P_{OUT} = 120W

P_{OUTapp} = 120 x 0.5 = 60W

η = 91% (Efficiency vs. Load Graph)

$$P_{dissipation} = \frac{60}{0.91} - 60 = 5.93W$$

without Heat-sink

$$R_{th} = \frac{T_{casemax} - T_{amb}}{P_{dissipation}} \text{ --> } 9°C/W = \frac{100\text{-}T_{amb}}{5.93W}$$

T_{amb} = **46°C**

with Heat-sink

$$R_{thHC} = \frac{T_{casemax} - T_{amb}}{P_{dissipation}} \text{ --> } 7.5°C/W = \frac{100\text{-}T_{amb}}{5.93W}$$

T_{ambHC} = **57°C**

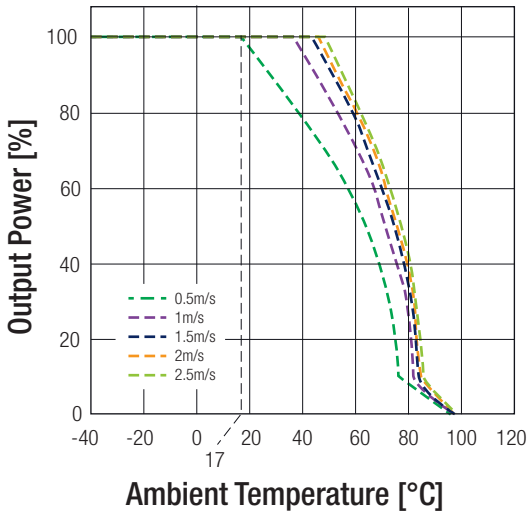
continued on next page

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

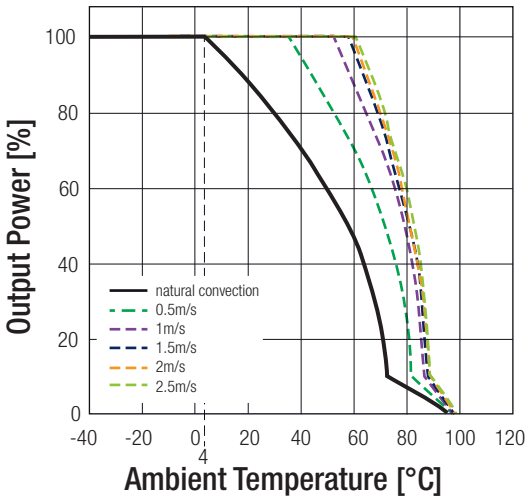
Derating Graph[5]

(@ Chamber - tested with forced convection)

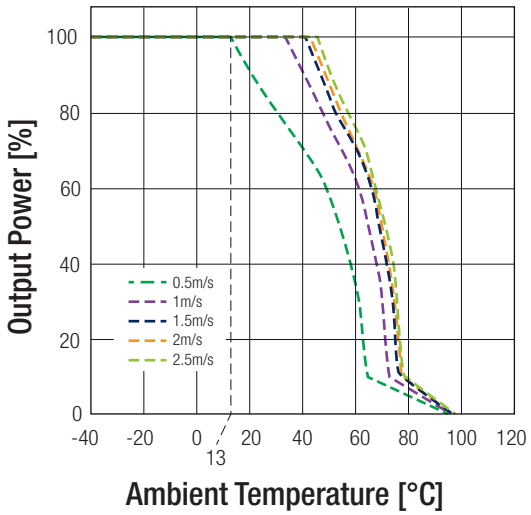
RP120Q-2405SRW



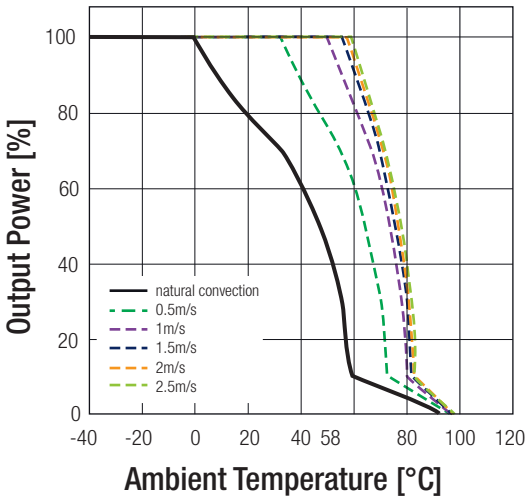
RP120Q-2405SRW-HC



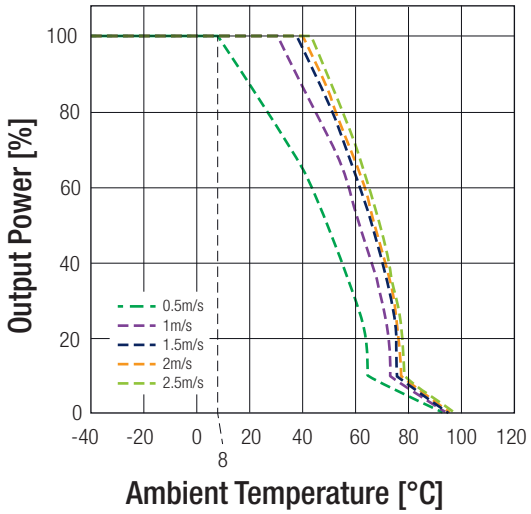
RP120Q-4805SRW



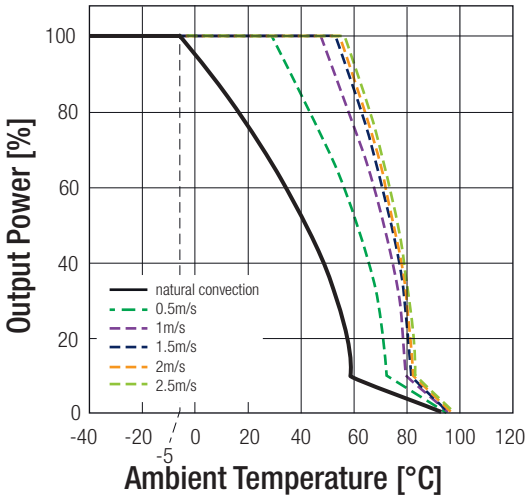
RP120Q-4805SRW-HC



RP120Q-11005SRW



RP120Q-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**
IEC/EN Information Technology Equipment - General Requirments for Safety	TW1608086-001	IEC/EN60950-1, 2nd Edition, 2005
Railway Applications - Electrical Equipment used on rolling stock	TW1608078-001	EN50155, 2007

EMI Compliance	**Condition**	**Standard / Criterion**
Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement	with external filter	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

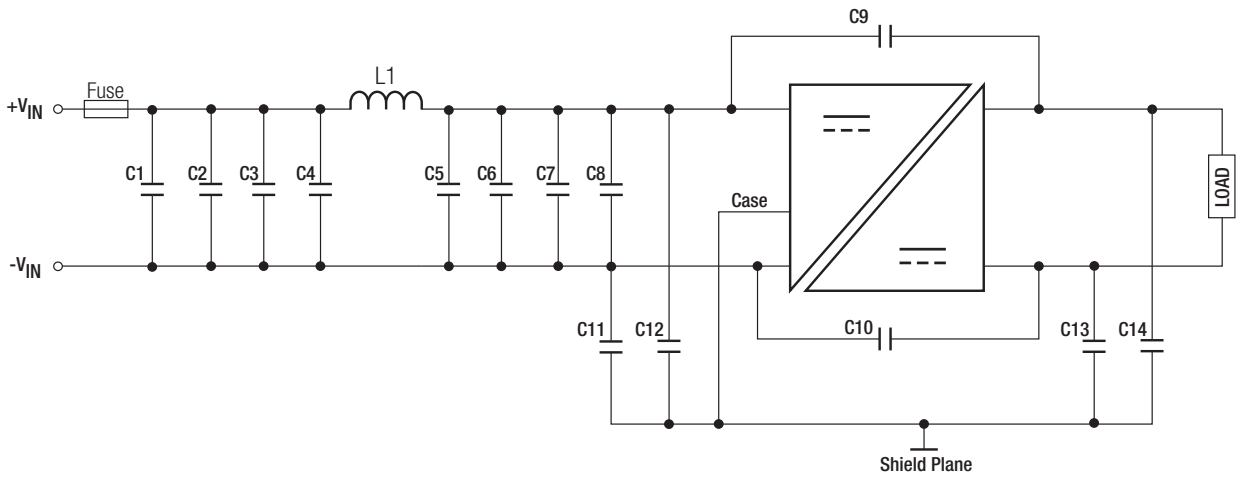
Notes:

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 2pcs of aluminium electrolytic capacitor to connect in parallel.
Recom suggest: Nippon Chemi-con KXJ series, 150µF/200V

EMI Filtering according to EN55022/11 Class A and EN50121-1 (24Vin and 48Vin)



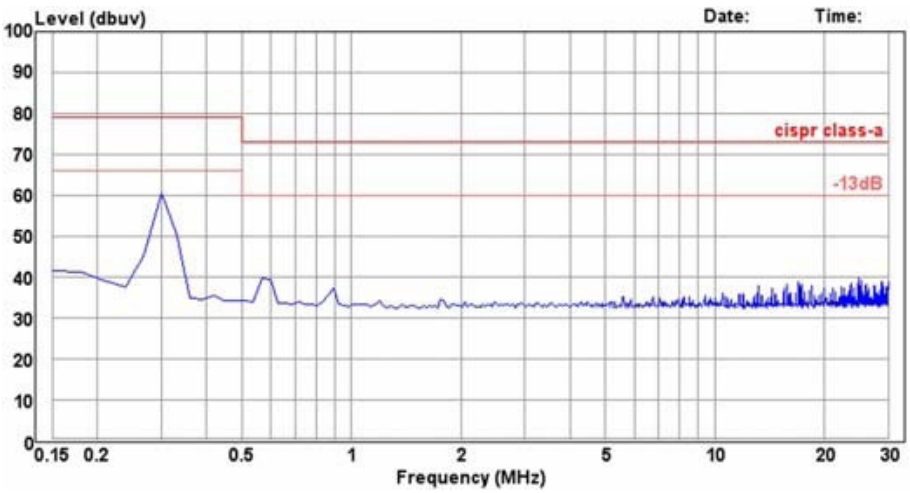
MODEL	C1	C2, C3, C4	C5	C6, C7, C8	C9 to C14	L1
RP120Q-24xxSRW	N/A	6.8µF, 50V 1812 MLCC	N/A	6.8µF, 50V 1812 MLCC	1000pF, 3kV 1808 MLCC	0.68µH, 17A SMD Inductor
RP120Q-48xxSRW	4.7µF, 100V 1812 MLCC	4.7µF, 100V 1812 MLCC	4.7µF, 100V 1812 MLCC	4.7µF, 100V 1812 MLCC	1000pF, 3kV 1808 MLCC	3.3µH, 10A SMD Inductor

continued on next page

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

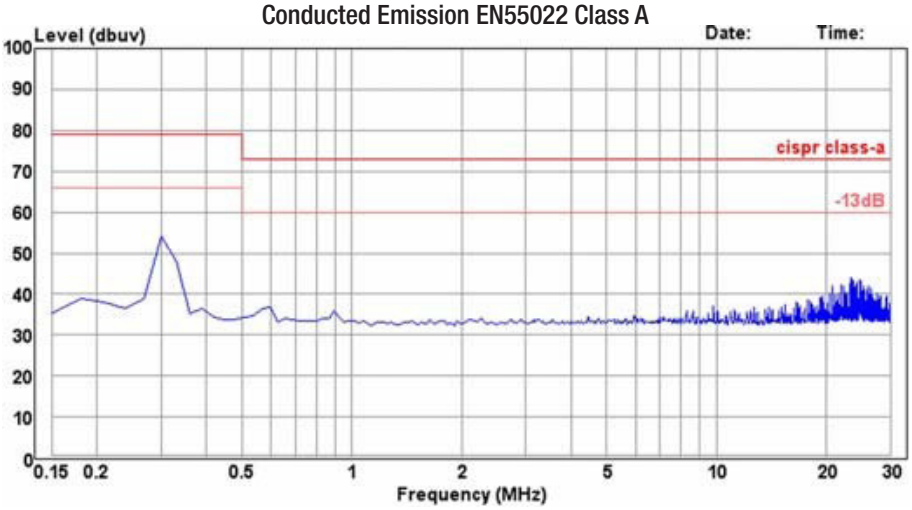
RP120Q-2405SRW

Conducted Emission EN55022 Class A

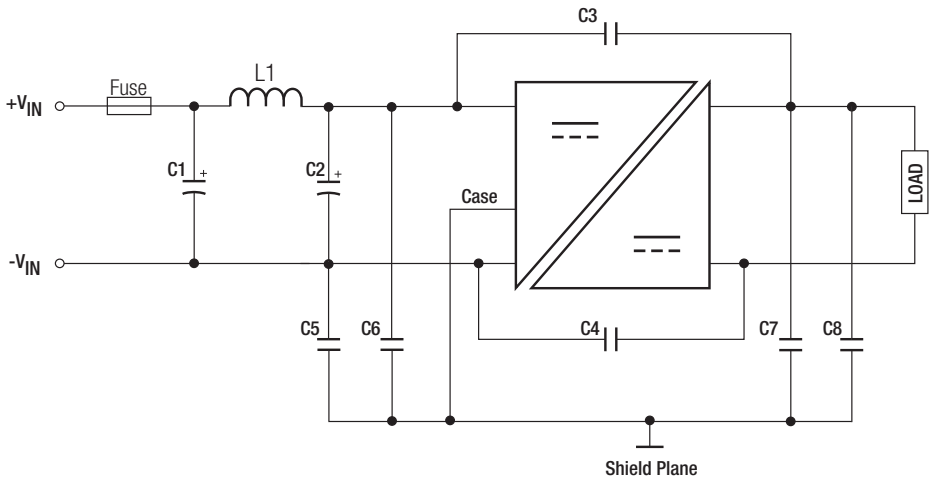


RP120Q-4805SRW

Conducted Emission EN55022 Class A



EMI Filtering according to EN55022/11 Class A and EN50121-1 (110Vin)



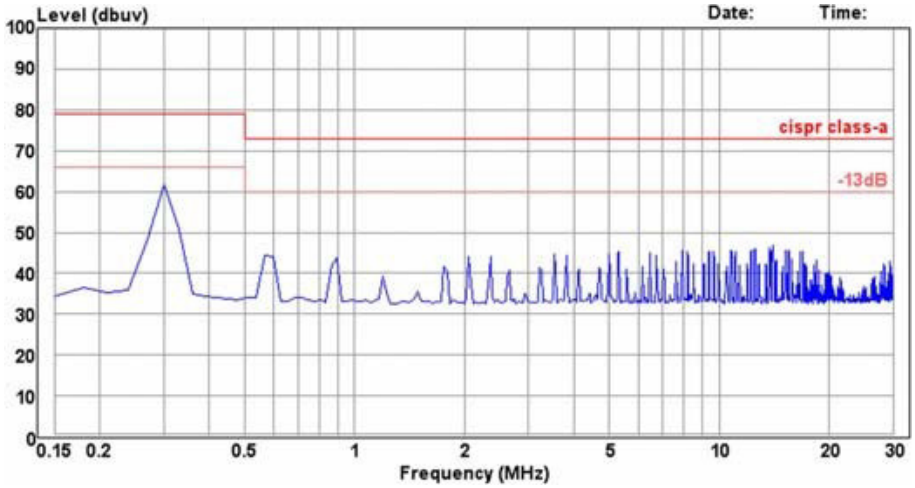
MODEL	C1, C2	C3 to C8	L1
RP120Q-110xxSRW	39µF, 250V Al cap. (lie down) Rubycon BXF	1000pF, 3kV 1808 MLCC	30.1µH, 5A SMD Inductor

continued on next page

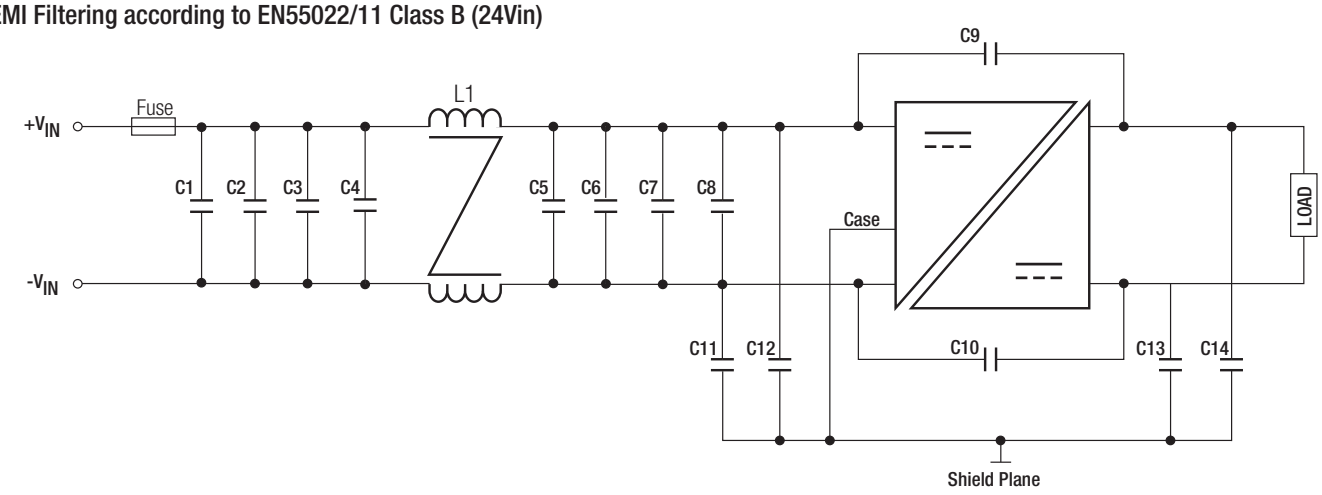
Specifications (measured @ ta= 25°C, nominal input voltage, full load and after warm-up)

RP120Q-11005SRW

Conducted Emission EN55022 Class A



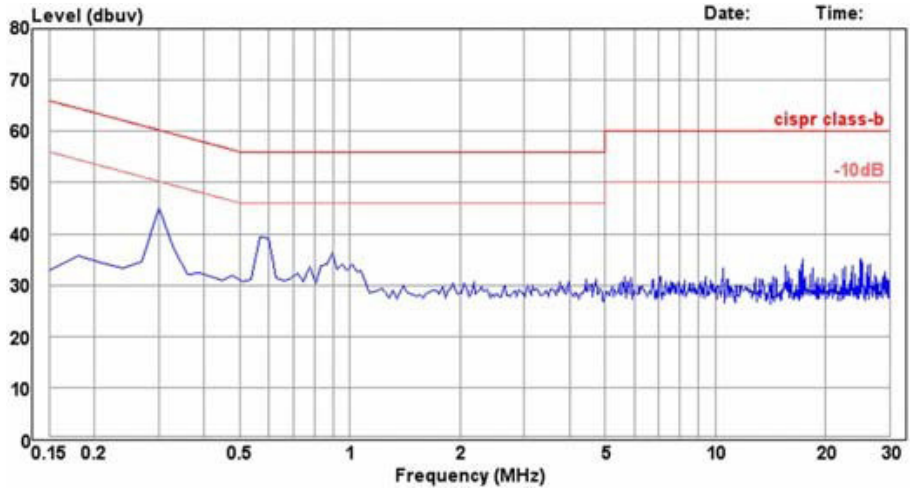
EMI Filtering according to EN55022/11 Class B (24Vin)



MODEL	C1 to C8	C9, C10, C13, C14	C11, C12	L1
RP120Q-24xxSRW	10µF, 50V 1812 MLCC	1000pF, 3kV 1808 MLCC	2200pF, 3kV 1812 MLCC	285µH CMC

RP120Q-2405SRW

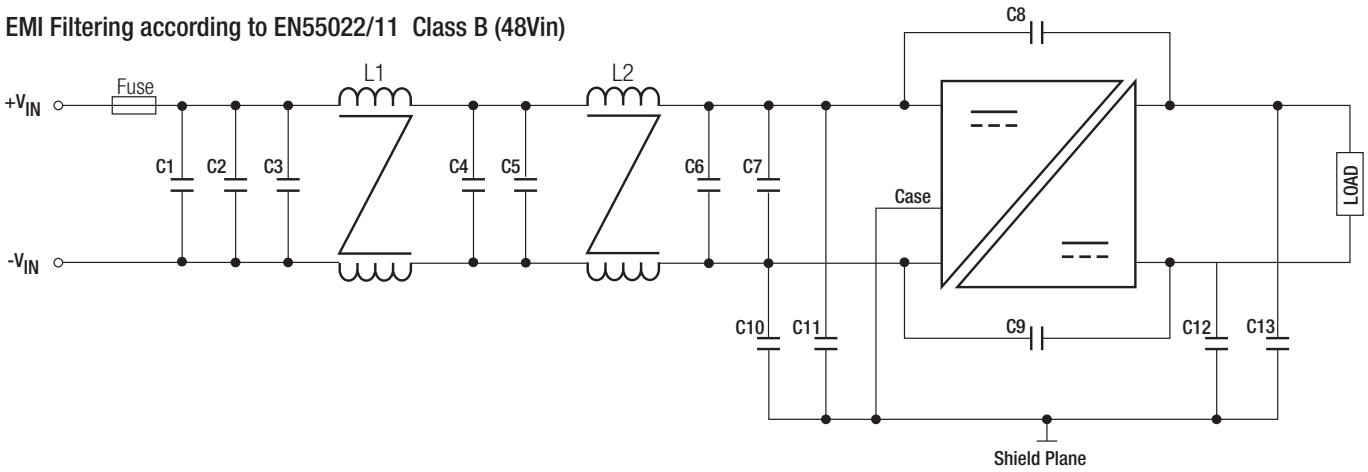
Conducted Emission EN55022 Class B



continued on next page

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

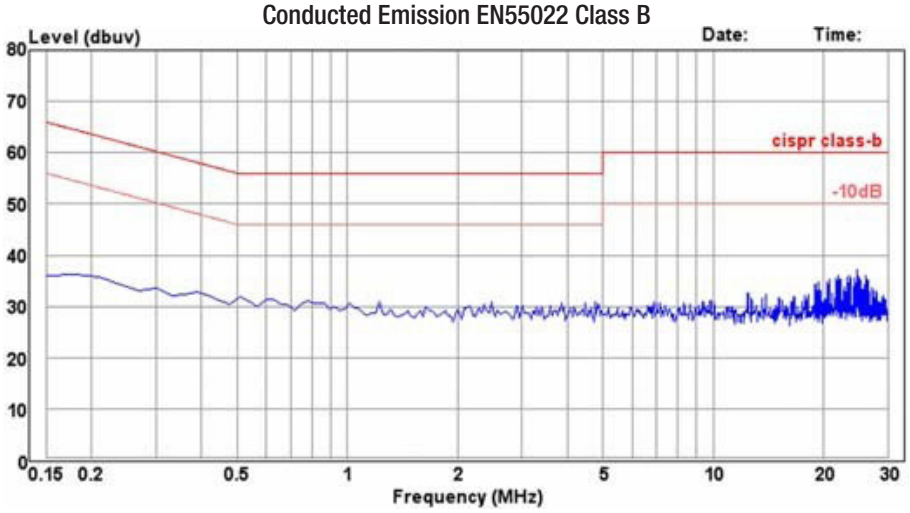
EMI Filtering according to EN55022/11 Class B (48Vin)



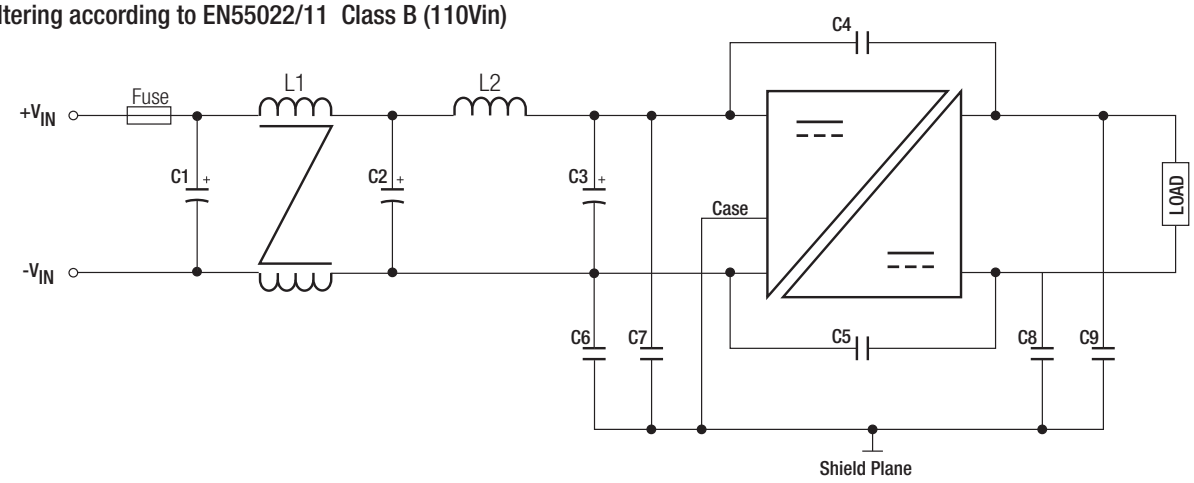
MODEL	C1 to C7	C8 to C13	L1	L2
RP120Q-48xxSRW	4.7µF, 100V 1812 MLCC	1000pF, 3kV 1808 MLCC	620µH CMC	285µH CMC

RP120Q-4805SRW

Conducted Emission EN55022 Class B



EMI Filtering according to EN55022/11 Class B (110Vin)



MODEL	C1, C2, C3	C4 to C9	L1	L2
RP120Q-110xxSRW	39µF, 250V Al cap. (lie down) Rubycon BXF	1000pF, 3kV 1808 MLCC	735µH CMC	30.1µH, 5A SMD Inductor

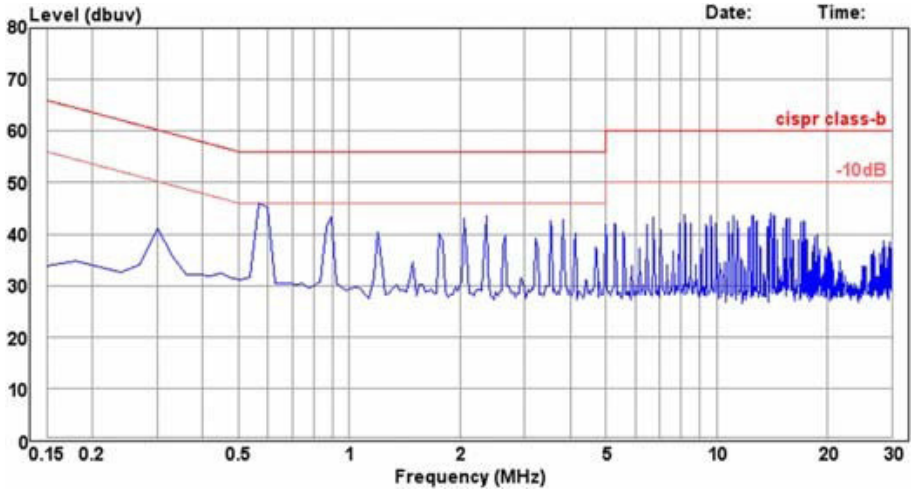
continued on next page

RP120Q-RW Series

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

RP120Q-110xxSRW

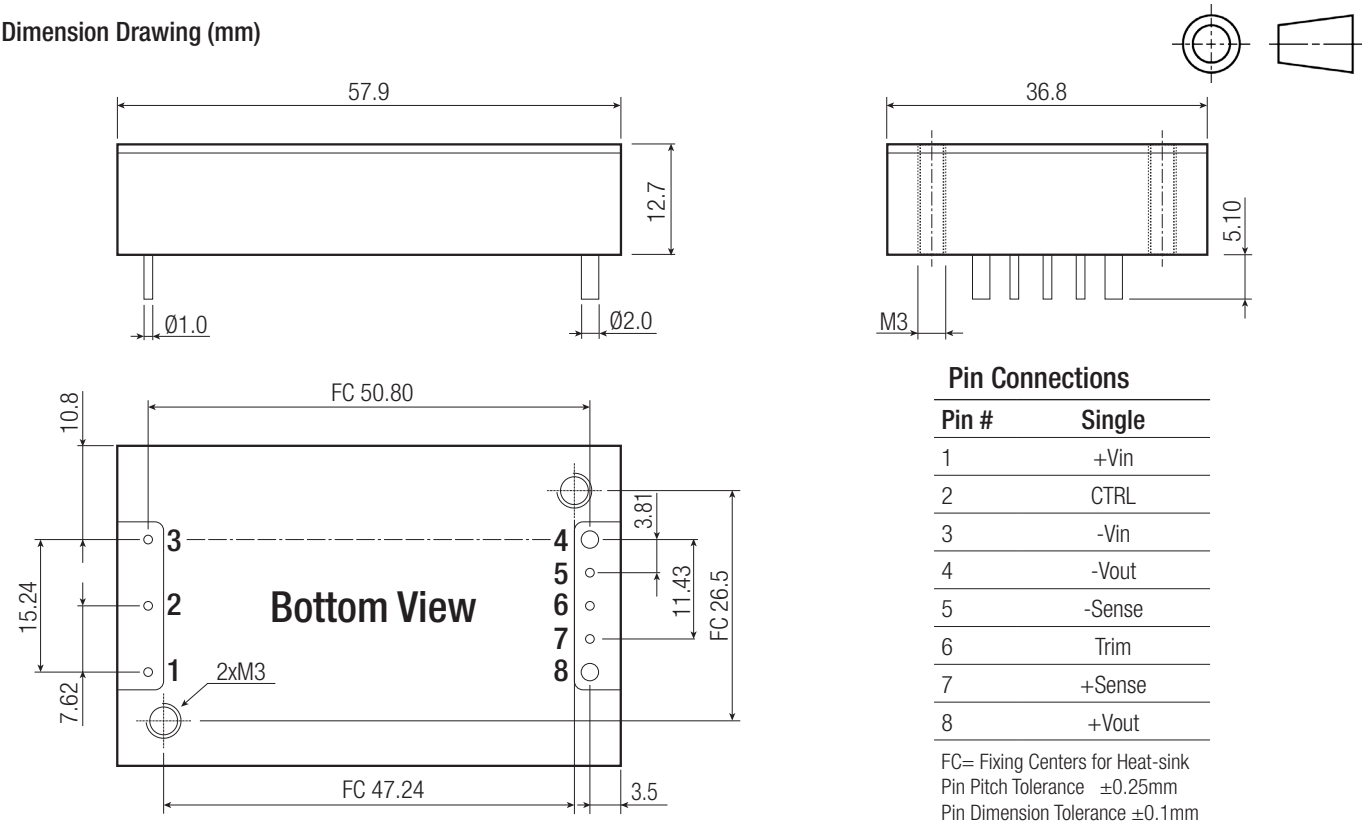
Conducted Emission EN55022 Class B



DIMENSIONS and PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	Case	Plastic
	Baseplate	Aluminium
	Potting	Silicone (UL94 V-0)
Packaging Dimension (LxWxH)	without Heat-sink	57.9 x 36.6 x 12.7mm
	with Heat-sink	57.9 x 36.6 x 18.8mm
Packaging Weight	without Heat-sink	64g
	with Heat-sink	88g

Dimension Drawing (mm)



Pin Connections

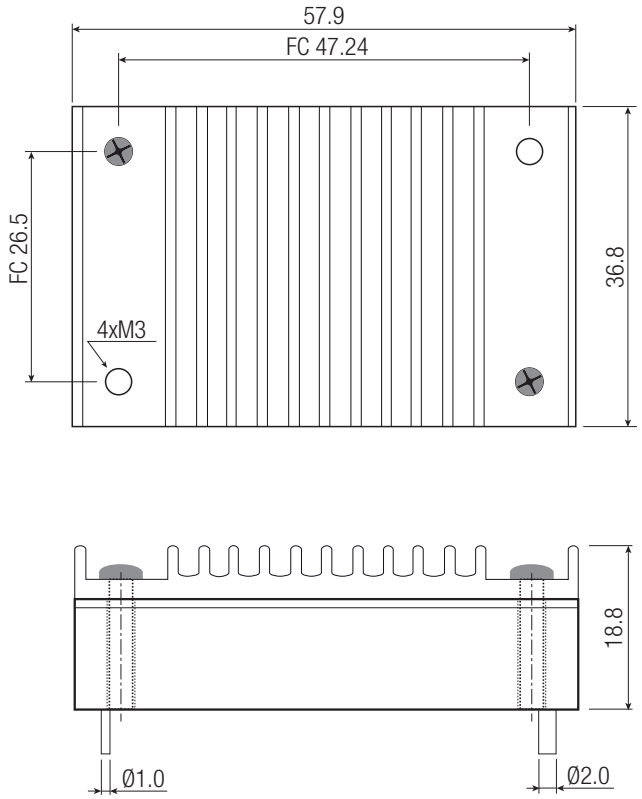
Pin #	Single
1	+Vin
2	CTRL
3	-Vin
4	-Vout
5	-Sense
6	Trim
7	+Sense
8	+Vout

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

continued on next page

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

Heat-sink



Notes:

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

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