

# Features

- Wide 4:1 input voltage range
- 2.25kVDC isolation
- Efficiency up to 89%
- Six-sided continuous shield
- EN50155, UL/IEC/EN60950-1 certified

# Regulated Converter



## RP20-FR

20 Watt

2" x 1"

Single and Dual Output



### Description

The RP20-FR series wide range input DC/DC converters are certified to UL60950-1 and cUL 60950-1. This makes them ideal for all telecom and industrial applications where approved safety standards are required. The 110VDC input versions have been especially designed for railway applications.

### Selection Guide

Part Number	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [mA]	Input <sup>(1)</sup> Current [mA]	Efficiency <sup>(1)</sup> typ. [%]	Max. Capacitive Load [μF]
RP20-243.3SFR <sup>(2,3)</sup>	9-36	3.3	4500	728	85	7000
RP20-2405SFR <sup>(2,3)</sup>	9-36	5	4000	947	88	5000
RP20-2412SFR <sup>(2,3)</sup>	9-36	12	1670	938	89	850
RP20-2415SFR <sup>(2,3)</sup>	9-36	15	1330	945	88	700
RP20-483.3SFR <sup>(2,3)</sup>	18-75	3.3	4500	364	85	7000
RP20-4805SFR <sup>(2,3)</sup>	18-75	5	4000	473	88	5000
RP20-4812SFR <sup>(2,3)</sup>	18-75	12	1670	469	89	850
RP20-4815SFR <sup>(2,3)</sup>	18-75	15	1330	467	89	700
RP20-1103.3SFR <sup>(2,3)</sup>	43-160	3.3	4500	159	85	7000
RP20-11005SFR <sup>(2,3)</sup>	43-160	5	4000	209	87	5000
RP20-11012SFR <sup>(2,3)</sup>	43-160	12	1670	207	88	850
RP20-11015SFR <sup>(2,3)</sup>	43-160	15	1330	206	88	700
RP20-2412DFR <sup>(2,3)</sup>	9-36	±12	±833	947	88	±500
RP20-2415DFR <sup>(2,3)</sup>	9-36	±15	±667	937	89	±350
RP20-4812DFR <sup>(2,3)</sup>	18-75	±12	±833	473	88	±500
RP20-4815DFR <sup>(2,3)</sup>	18-75	±15	±667	468	89	±350
RP20-11012DFR <sup>(2,3)</sup>	43-160	±12	±833	207	88	±500
RP20-11015DFR <sup>(2,3)</sup>	43-160	±15	±667	204	89	±350

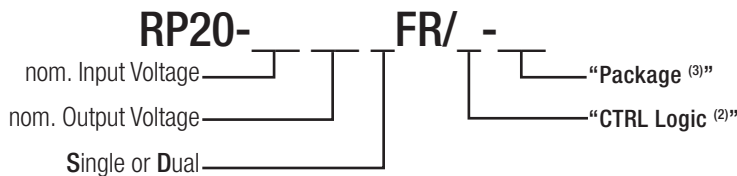
**Notes:**

Note1: Maximum values at nominal input voltage and full load



UL60950-1 certified  
 IEC/EN60950-1 certified  
 IEC/EN62368-1 certified  
 EN50155 certified  
 EN55032 compliant  
 EN55024 compliant  
 EN50121-3-2 compliant

### Model Numbering



**Notes:**

- Note2: standard part is with suffix "P" for positive logic (1=ON, 0=OFF)  
 add suffix "N" for CTRL function with negative logic (0=ON, 1=OFF)  
 or add suffix "XC" for omitted CTRL pin (refer to "Dimension Drawing (mm)")
- Note3: add suffix "-HC" for premounted Heat-sink with clamps

#### Ordering Examples

- RP20-2405SFR = 24V input, 5V output, single, positive Logic CTRL pin
- RP20-4812DFR/N-HC = 48V input, ±12V output, dual, negative Logic CTRL pin, Heat-sink premounted
- RP20-11005SFR/XC = 110V input, 5V output, single, no CTRL pin

**Specifications** (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

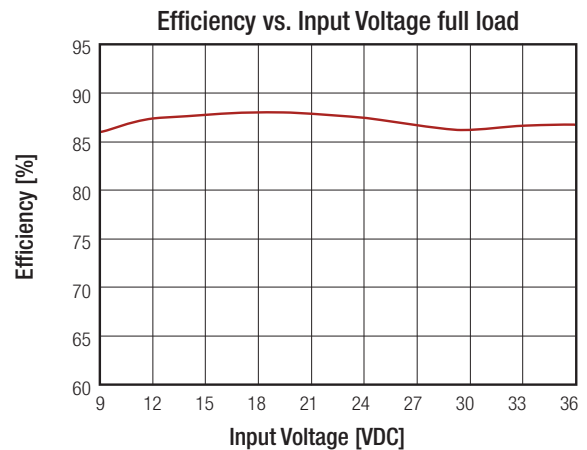
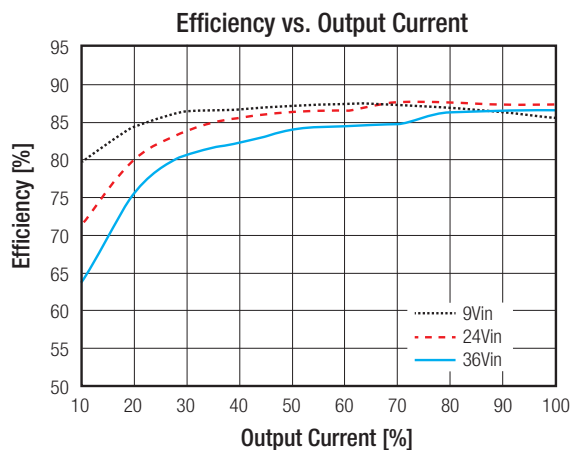
**BASIC CHARACTERISTICS**

Parameter	Condition	Min.	Typ.	Max.	
Input Filter	nom. Vin = 24VDC, nom. Vin = 48VDC	Common Mode Choke			
	nom. Vin = 110VDC	Pi-Type			
Input Voltage Range	nom. Vin = 24VDC	9VDC	24VDC	36VDC	
	nom. Vin = 48VDC	18VDC	48VDC	75VDC	
	nom. Vin = 110VDC	43VDC	110VDC	160VDC	
Input Surge Voltage	100s max.	nom. Vin = 24VDC		50VDC	
		nom. Vin = 48VDC		100VDC	
		nom. Vin = 110VDC		170VDC	
Under Voltage Lockout (UVLO)	nom. Vin = 24VDC	DC-DC ON		9VDC	
		DC-DC OFF	8VDC		
	nom. Vin = 48VDC	DC-DC ON			18VDC
		DC-DC OFF		16VDC	
	nom. Vin = 110VDC	DC-DC ON			43VDC
		DC-DC OFF		40VDC	
Output Voltage Trimming	refer to "OUTPUT VOLTAGE TRIMMING"	-10%		+10%	
Input Reflected Ripple Current			30mA <sub>p-p</sub>		
Start-up Time	Power up			30ms	
	ON/OFF CTRL			30ms	
ON/OFF CTRL <sup>(4)</sup>	Positive Logic	DC-DC ON	Open or 3.0VDC < V <sub>CTRL</sub> < 15VDC		
		DC-DC OFF	Short or 0VDC < V <sub>CTRL</sub> < 1.2VDC		
	Negative Logic	DC-DC ON	Short or 0VDC < V <sub>CTRL</sub> < 1.2VDC		
		DC-DC OFF	Open or 3.0VDC < V <sub>CTRL</sub> < 15VDC		
Input Current of CTRL pin	DC-DC ON	-0.5mA		+1.0mA	
Standby Current	DC-DC OFF		2.5mA		
Internal Operating Frequency		297kHz	330kHz	363kHz	
Output Ripple and Noise	measured at 20MHz BW with a 1µF/50V X7R MLCC	3.3V <sub>out</sub> , 5V <sub>out</sub>	75mV <sub>p-p</sub>		
		12V <sub>out</sub> , 15V <sub>out</sub>	100mV <sub>p-p</sub>		

**Notes:**

Note4: If suffix "XC" is specified, pin6 will be absent. If fitted, the ON/OFF control function can be positive or negative logic. The pin voltage is referenced to -Vin pin

**RP20-2405SFR**

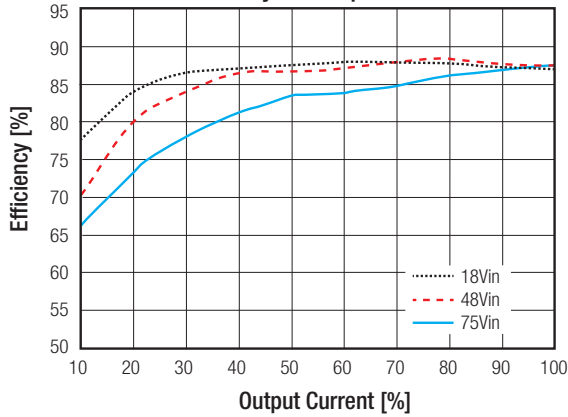


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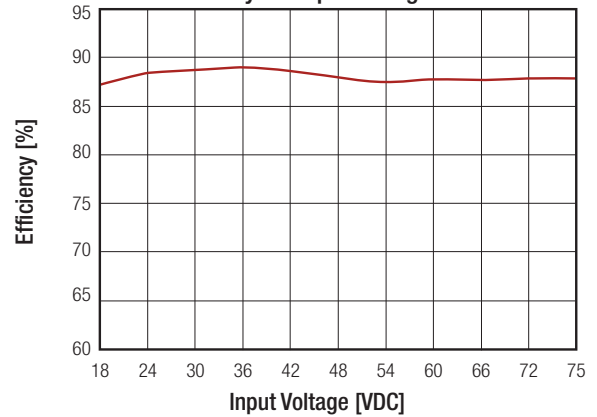
Specifications (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

**RP20-4805SFR**

Efficiency vs. Output Current

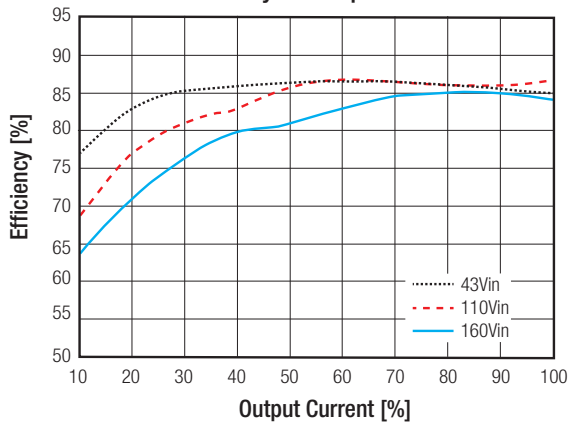


Efficiency vs. Input Voltage full load

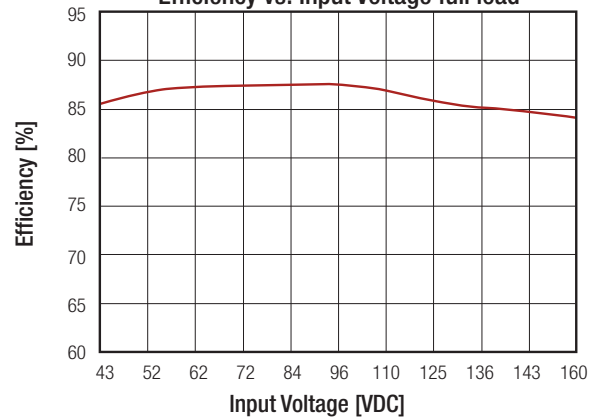


**RP20-11005SFR**

Efficiency vs. Output Current

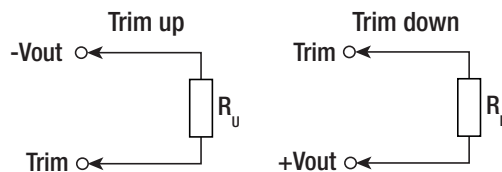


Efficiency vs. Input Voltage full load



**OUTPUT VOLTAGE TRIMMING**

Single output Powerline converters offer the feature of trimming the output voltage over a certain range around the nominal value by using external trim resistors. No general equation can be given for calculating the trim resistors, but the following trimtables give typical values for choosing these trimming resistors. If voltages between the given trim points are required, extrapolate between the two nearest given values to work out the resistor required or use a variable resistor to set the output voltage. Output can be externally trimmed by using the method shown below.



**RP20-xx3.3SFR**

Trim up	1	2	3	4	5	6	7	8	9	10	[%]
Vout =	3.333	3.366	3.399	3.432	3.465	3.498	3.531	3.564	3.597	3.63	[VDC]
R <sub>u</sub> =	385.07	191.51	126.99	94.73	75.37	62.47	53.25	46.34	40.96	36.66	[kΩ]
Trim down	1	2	3	4	5	6	7	8	9	10	[%]
Vout =	3.267	3.234	3.201	3.168	3.135	3.102	3.069	3.036	3.003	2.97	[VDC]
R <sub>d</sub> =	116.72	54.78	34.13	23.81	17.62	13.49	10.54	8.33	6.60	5.23	[kΩ]

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**Specifications** (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

**RP20-xx05SFR**

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	[VDC]
R <sub>ij</sub> =	253.45	125.70	83.18	61.83	49.05	40.53	34.45	29.89	26.34	23.50	[kΩ]
Trim down	1	2	3	4	5	6	7	8	9	10	[%]
Vout =	4.95	4.90	4.85	4.80	4.75	4.70	4.65	4.60	4.55	4.50	[VDC]
R <sub>o</sub> =	248.34	120.59	78.01	56.72	43.94	35.42	29.34	24.78	21.23	18.39	[kΩ]

**RP20-xx12SFR**

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	[VDC]
R <sub>ij</sub> =	203.22	99.06	64.33	46.97	36.56	29.61	24.65	20.93	18.04	15.72	[kΩ]
Trim down	1	2	3	4	5	6	7	8	9	10	[%]
Vout =	11.88	11.76	11.64	11.52	11.40	11.28	11.16	11.04	10.92	10.8	[VDC]
R <sub>o</sub> =	776.56	380.72	248.78	182.81	143.22	116.83	97.99	83.84	72.85	64.06	[kΩ]

**RP20-xx15SFR**

Trim up	1	2	3	4	5	6	7	8	9	10	[%]
Vout =	15.15	15.3	15.45	15.60	15.75	15.90	16.05	16.20	16.35	16.50	[VDC]
R <sub>ij</sub> =	161.56	78.22	50.45	36.56	28.22	22.67	18.70	15.72	13.41	11.56	[kΩ]
Trim down	1	2	3	4	5	6	7	8	9	10	[%]
Vout =	14.85	14.70	14.55	14.40	14.25	14.10	13.95	13.80	13.65	13.50	[VDC]
R <sub>o</sub> =	818.22	401.56	262.67	193.22	151.56	123.78	103.94	89.06	77.48	68.22	[kΩ]

**REGULATIONS**

Parameter	Condition		Value
Output Accuracy			±1.0%
Line Regulation	low line to high line, full load	Single	±0.2%
		Dual	±0.5%
Load Regulation	0% to 100% load	Single	±0.2%
		Dual	±1.0%
	10% to 90% load	Single	±0.1%
		Dual	±0.8%
Cross Regulation	asymmetrical 25%<>100% load		±5.0%
Transient Response Recovery Time	25% load step change		250µs typ.

**PROTECTIONS**

Parameter	Condition		Value
Short Circuit Protection (SCP)			continuous, automatic recovery
Over Voltage Protection (OVP)	zener diode clamp	3.3Vout	3.7VDC - 5.4VDC
		5Vout	5.6VDC - 7.0VDC
		12Vout	13.5VDC - 19.6VDC
		15Vout	16.8VDC - 20.5VDC

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**Specifications** (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

### PROTECTIONS (continuous)

Parameter	Condition	Value
Over Load Protection (OLP)	% Iout rated	150% typ.
Isolation Voltage <sup>(5)</sup>	I/P to O/P	2.25kVDC/1minute
	I/P to O/P to case	1.6kVDC/1minute
Isolation Resistance	Viso= 500VDC	1GΩ min.
Isolation Capacitance		3000pF max.

**Notes:**

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

Note6: Refer to local safety regulations if input over-current protection is also required. Recommended fuse: slow blow type

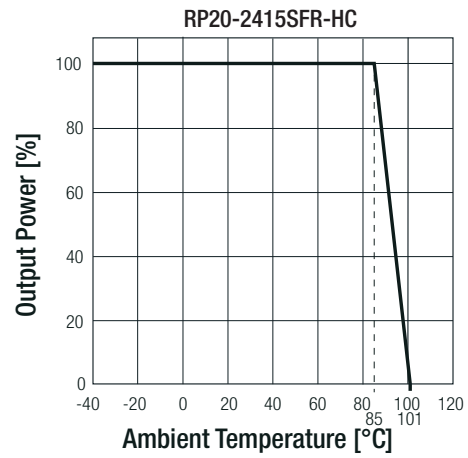
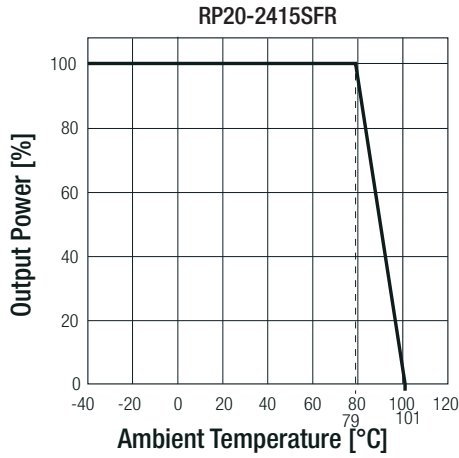
### ENVIRONMENTAL

Parameter	Condition	Value
Operating Temperature Range	without derating	-40°C to +79°C
	with derating	-40°C to +101°C
Maximum Case Temperature		+105°C
Temperature Coefficient		±0.02%/K max.
Thermal Impedance	@ natural convection 0.1m/s	without heat-sink 12K/W
		with heat-sink 10K/W
Operating Altitude		5000m
Operating Humidity	non-condensing	5% - 95% RH
Pollution Degree		PD2
Environmental testing Part 2-1: Tests Test A: Cold	Temperature: -40°C Dwell Time: 2 hours	according to EN60068-2-1:2007
Environmental testing Part 2-2: Tests Test B: Dry heat	Temperature: +85°C Dwell Time: 6 hours	according to EN60068-2-2:2007
Environmental testing Part 2-30: Tests Test Db: Damp heat, cyclic (12 h + 12 h cycle)	Temperature: +25 to +55°C Humidity: 90% to 100%RH Test Duration: 24 hours/cycle, 2 cycles, total 48 hours	according to EN60068-2-30:2005
Railway applications – Rolling stock equipment – Shock and vibration tests	Random vibration test 5Hz to 150Hz, Z-Axis 1.01m/s <sup>2</sup> (0.103Grms), Y-Axis, X-Axis 0.70m/s <sup>2</sup> (0.0714Grms), Duration 10min/Axis	according to EN61373:2010
Railway applications - Fire protection on railway vehicles - Part 2: Requirements for fire behaviour of materials and components		according to EN45545-2:2013
Fire hazard testing Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products	Oxygen index test	according to EN ISO 4589-2 0I
Fire hazard testing Part 11-10: Test flames – 50 W horizontal and vertical flame test methods	Glow-wire test	according to EN60695-2-11
Environmental Engineering Considerations and Laboratory Tests (Vibration)	Vibration waveform: Random waveform P.S.D Level: 0.04g <sup>2</sup> /Hz (7.76Grms) Duration: 1 hour/axis (X, Y and Z)"	according to MIL-STD-810F
Environmental Engineering Considerations and Laboratory Tests (Shock)	Pulse shape: Terminal-peak saw tooth Impact acceleration: 50g Pulse duration: 11ms Number of shocks: 18 (3 for each axis (X, Y and Z)	according to MIL-STD-810F
Environmental Engineering Considerations and Laboratory Tests (combined Temperature/Altitude)	Operating 0 to +40°C / 0 to 40000feet Non-Operating -40 to +70°C / 0 to 50000feet	according to MIL-STD-810F
MTBF	according to MIL-HDBK-217F, G.B.	1523 x 10 <sup>3</sup> hours

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**Specifications** (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

Derating Graph <sup>(7)</sup>



**Notes:**

Note7: 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 RECOM Techsupport for detailed information

**SAFETY AND CERTIFICATIONS**

Certificate Type (Safety)	Condition	Standard
Information Technology Equipment, General Requirements for Safety	E196683	UL60950-1, 2nd Edition, 2014 CAN/CSA-C22.2 No. 60950-1-07, 2nd Edition, 2014
Information Technology Equipment, General Requirements for Safety (LVD)	TW1708011-001	IEC60950-1:2005, 2nd Edition + A2:2013 EN60950-1:2006 + A2:2013
Audio/Video, information and communication technology equipment - Part1: Safety requirements 2nd Edition	SPCLVD2103048-2	IEC62368-1:2014 2nd Edition
		EN62368-1:2014+AC:2015
		CAN/CSA-C22.2 No. 62368-1-14 2nd Edition
Railway Applications - Electrical Equipment used on rolling stock	15A100702E-C	EN50155:2007
EAC	RU-AT.49.09571	TP TC 004/2011
RoHS2		RoHS-2011/65/EU + AM-2015/863
EMC Compliance (Railway)	Condition	Standard / Criterion
Railway Applications - Electromagnetic Compatibility		EN50121-3-2:2006
ESD Electrostatic Discharge Immunity Test	Air ±2, ±4, ±8kV Contact ±2, ±4, ±6kV	EN61000-4-2, Criteria A
Radiated, Radio-Frequency, Electromagnetic Field Immunity Test	20V/m (80-1000MHz) 10V/m (1400-2100MHz) 5V/m (2100-2500MHz)	EN61000-4-3, Criteria A
Fast Transient and Burst Immunity <sup>(8)</sup>	DC Power Port: ±2kV	EN61000-4-4, Criteria A
Surge Immunity <sup>(8)</sup>	DC Power Port: L-L ±0.5, 1kV DC Power Port: L-E ±0.5, 1, 2kV	EN61000-4-5, Criteria A
Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields	DC Power Port: 10V	EN61000-4-6, Criteria A

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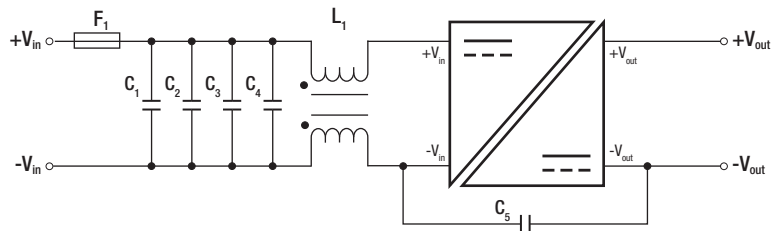
**Specifications** (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

EMC Compliance (Multimedia)	Condition	Standard / Criterion
Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement	without external filter	EN55011, Class A
	without external filter	EN55011, Class B
Electromagnetic compatibility of multimedia equipment - Emission requirements (24Vin and 48Vin)	without external filter	EN55032, Class A
	without external filter	EN55032, Class B
Electromagnetic compatibility of multimedia equipment - Emission requirements (110Vin)	without external filter with external filter	EN55032, Class A EN55032, Class B
Information Technology Equipment - Immunity Characteristics - Limits and Methods of Measurement		EN55024:2010 + A1:2015
ESD Electrostatic Discharge Immunity Test	Air ±2, ±4, ±8kV Contact ±2, ±4, ±6kV	IEC61000-4-2:2008, Criteria A
Radiated, Radio-Frequency, Electromagnetic Field Immunity Test	20V/m (80-1000MHz)	IEC61000-4-3:2006 + A2:2010, Criteria A
Fast Transient and Burst Immunity	DC Power Port: ±2kV	IEC61000-4-4:2012, Criteria A
Surge Immunity	DC Power Port: ±0.5, ±1, ±2kV	IEC61000-4-5:2014, Criteria A
Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields	DC Power Port: 10V	IEC61000-4-6:2013, Criteria A
Power Magnetic Field Immunity	50Hz 1A/m	IEC61000-4-8:2009, Criteria A

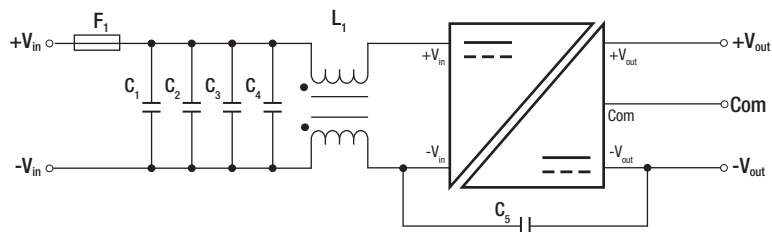
**Notes:**

Note8: An external input filter capacitor is required if the module has to meet EN61000-4-4, -5  
The filter Recom suggests: 24VDC and 48VDC input. Nippon chemi-con KY series, 220µF/100V  
110VDC input: Rubycon BXF series, 100µF/250V

**EMI Filtering according to EN55032 Class B (110Vin Single)**



**EMI Filtering according to EN55032 Class B (110Vin Dual)**



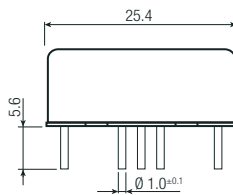
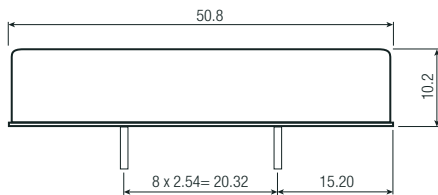
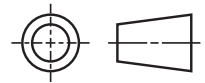
**Component List**

MODEL	C1	C2/C3/C4	C5	L1
RP20-110xxSFR RP20-110xxDFR	39µF/250V Al Cap. (lie down) Rubycon BX	0.47µF/250V 1812 MLCC	1000pF/3kV 1808 MLCC	CMC: 470µH ref.: WE-SL5 744272471

**Specifications** (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

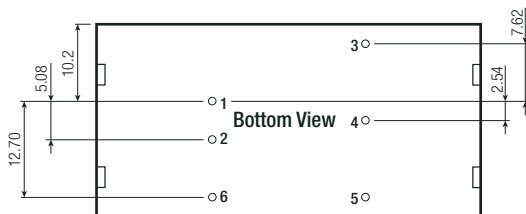
DIMENSIONS and PHYSICAL CHARACTERISTICS		
Parameter	Type	Value
Materials	case	nickel coated copper
	base	FR4 PCB
	potting	silicone (UL94 V-0)
Dimensions (LxWxH)	without Heat-sink	50.8 x 25.4 x 10.2mm
	with Heat-sink	56.8 x 25.4 x 16.8mm
Weight	without Heat-sink	30g
	with Heat-sink	40.89g

Dimension Drawing (mm)

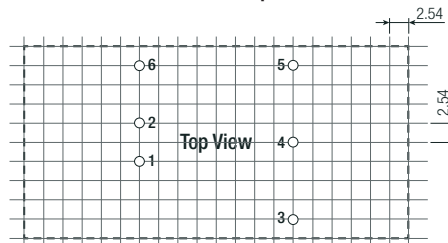


**Pinning Information**

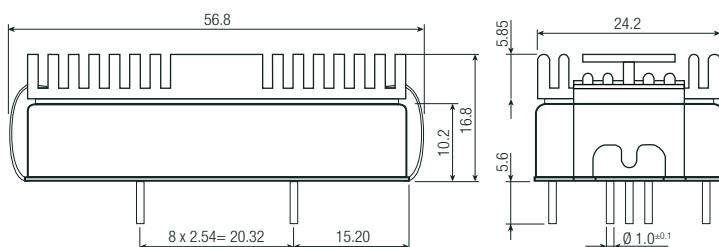
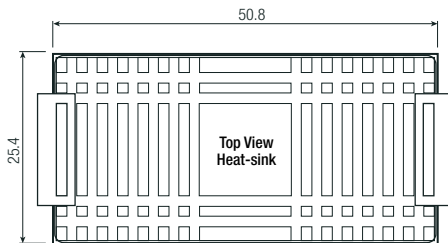
Pin #	Single	Dual
1	+Vin	+Vin
2	-Vin	-Vin
3	+Vout	+Vout
4	Trim <sup>(4)</sup>	Com
5	-Vout	-Vout
6	CTRL <sup>(2)</sup>	CTRL <sup>(2)</sup>



**Recommended Footprint Details**



Dimension Drawing with Heat-sink (mm)



Tolerance:  
xx.x= ±0.5mm  
xx.xx= ±0.25mm



**Specifications** (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

PACKAGING INFORMATION			
Parameter	Type		Value
Packaging Dimension (LxWxH)	tube	without heat-sink	255.0 x 55.0 x 22.0mm
	tray	with heat-sink	302.5 x 222.0 x 20.0mm
Packaging Quantity	tube	without heat-sink	9pcs
	tray	with heat-sink	20pcs
Storage Temperature Range			-55°C to +125°C
Storage Humidity	non-condensing		5% - 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.