Features

Regulated Converter

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

RECOM
DC/DC Converter

RP20-FR

20 Watt 2“ x 1“ Single and Dual Output

3 YEAR warranty

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 (1) Current [mA]	Efficiency (1) typ. [%]	Max. Capacitive Load [µF]
RP20-243.3SFR (2,3)	9-36	3.3	4500	728	85	7000
RP20-2405SFR (2,3)	9-36	5	4000	947	88	5000
RP20-2412SFR (2,3)	9-36	12	1670	938	89	850
RP20-2415SFR (2,3)	9-36	15	1330	945	88	700
RP20-483.3SFR (2,3)	18-75	3.3	4500	364	85	7000
RP20-4805SFR (2,3)	18-75	5	4000	473	88	5000
RP20-4812SFR (2,3)	18-75	12	1670	469	89	850
RP20-4815SFR (2,3)	18-75	15	1330	467	89	700
RP20-1103.3SFR (2,3)	43-160	3.3	4500	159	85	7000
RP20-11005SFR (2,3)	43-160	5	4000	209	87	5000
RP20-11012SFR (2,3)	43-160	12	1670	207	88	850
RP20-11015SFR (2,3)	43-160	15	1330	206	88	700
RP20-2412DFR (2,3)	9-36	±12	±833	947	88	±500
RP20-2415DFR (2,3)	9-36	±15	±667	937	89	±350
RP20-4812DFR (2,3)	18-75	±12	±833	473	88	±500
RP20-4815FDFR (2,3)	18-75	±15	±667	468	89	±350
RP20-11012DFR (2,3)	43-160	±12	±833	207	88	±500
RP20-11015DFR (2,3)	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
UL/CAN62368-1 certified
IEC/EN62368-1 certified
EN50155 certified
EN55032 compliant
EN55024 compliant
EN50121-3-2 compliant

Model Numbering

RP20-__ __ FR/ _ -

- nom. Input Voltage
- nom. Output Voltage
- Single or Dual
- “Package (3)”
- “CTRL Logic (2)”

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

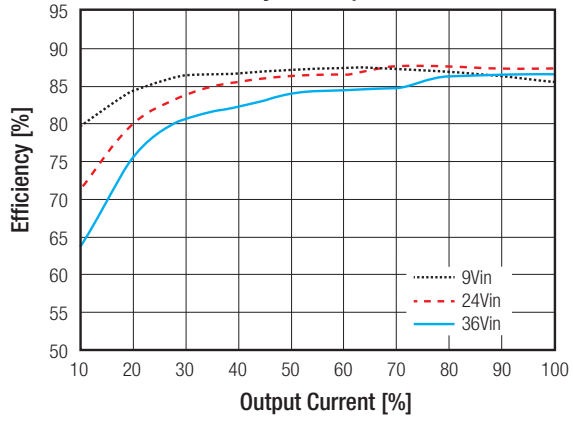
Parameter	Condition		Min.	Typ.	Max.
Input Filter	nom. Vin = 24VDC, nom. Vin = 48VDC				Common Mode Choke
	nom. Vin = 110VDC				Pi-Type
Input Voltage Range	nom. Vin = 24VDC		9VDC	24VDC	36VDC
	nom. Vin = 48VDC		18VDC	48VDC	75VDC
	nom. Vin = 110VDC		43VDC	110VDC	160VDC
Input Surge Voltage	100s max.	nom. 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				30mAp-p	
Start-up Time	Power up				30ms
	ON/OFF CTRL				30ms
ON/OFF CTRL (4)	Positive Logic	DC-DC ON	Open or 3.0VDC < V_{CTRL}< 15VDC		
		DC-DC OFF	Short or 0VDC < V_{CTRL}< 1.2VDC		
	Negative Logic	DC-DC ON	Short or 0VDC < V_{CTRL}< 1.2VDC		
		DC-DC OFF	Open or 3.0VDC < V_{CTRL}< 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	3.3Vout, 5Vout		75mVp-p	
		12Vout, 15Vout		100mVp-p	

Notes:

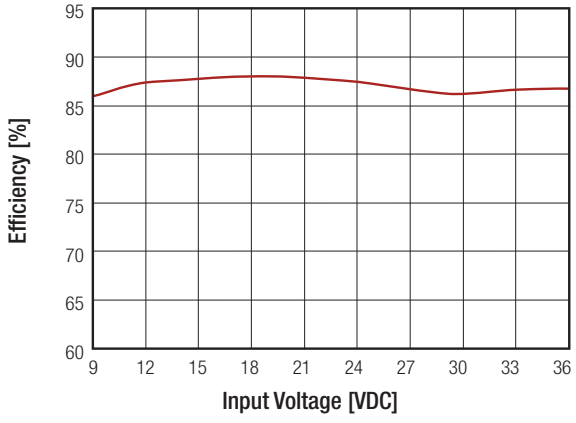
Note4: If suffix "XC" is specified, pin6 will be absent. If fitted, the ON/OFF control function can be positive or negative logic. The pin voltage is referenced to -Vin pin

RP20-2405SFR

Efficiency vs. Output Current



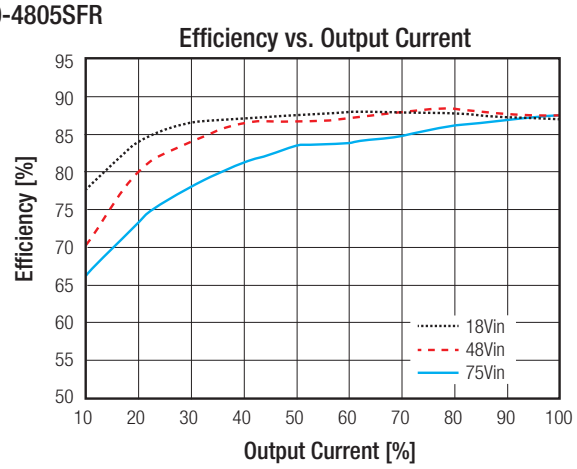
Efficiency vs. Input Voltage full load

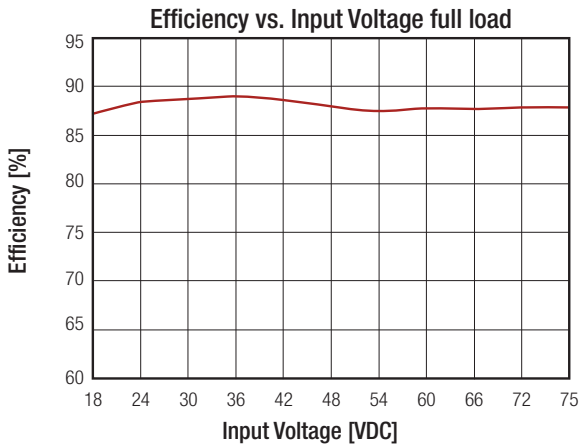


continued on next page

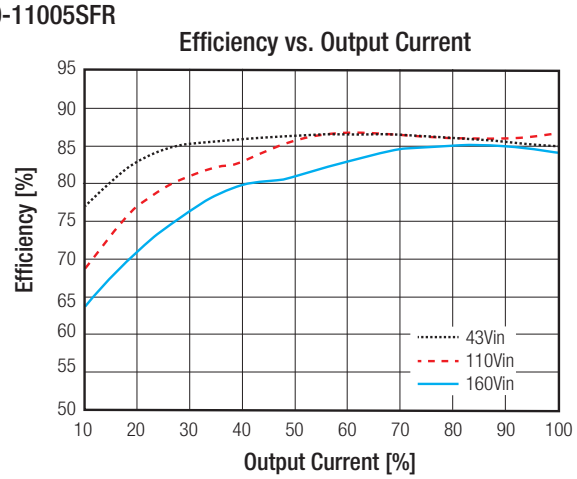
Specifications (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

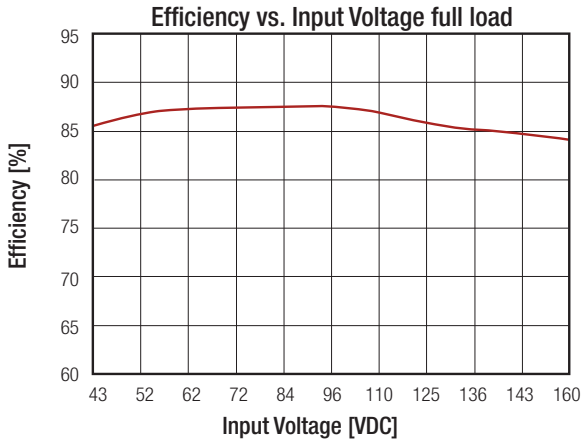
RP20-4805SFR





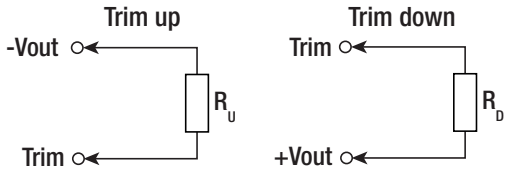
RP20-11005SFR





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_U =	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_D =	116.72	54.78	34.13	23.81	17.62	13.49	10.54	8.33	6.60	5.23	[kΩ]

continued on next page

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_U =	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_D =	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_U =	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_D =	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_U =	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_D =	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

continued on next page

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 [5]	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

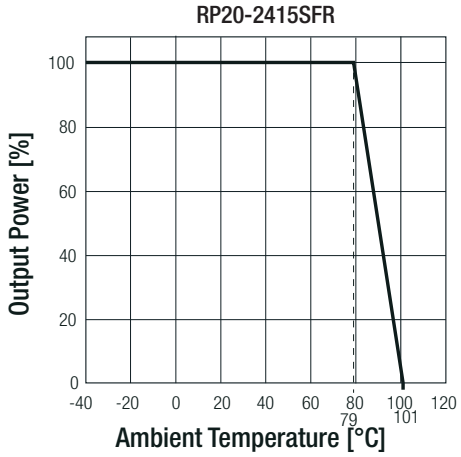
Note6: Refer to local safety regulations if input over-current protection is also required. Recommended fuse: slow blow type

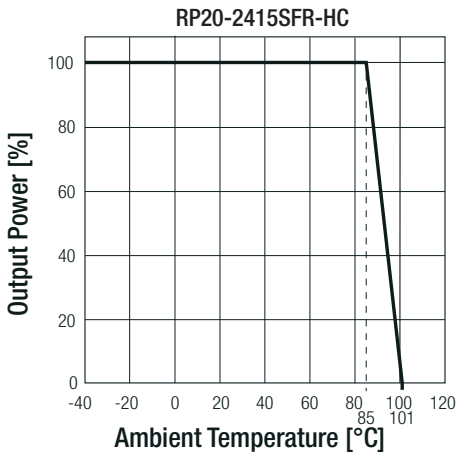
ENVIRONMENTAL			
Parameter	**Condition**		**Value**
Operating Temperature Range	without derating		-40°C to +79°C
	with derating		-40°C to +101°C
Maximum Case Temperature			+105°C
Temperature Coefficient			±0.02%/K max.
Thermal Impedance	@ natural convection 0.1m/s	without heat-sink	12K/W
		with heat-sink	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/s² (0.103Grms), Y-Axis, X-Axis 0.70m/s² (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 OI
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: 0.04g²/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 Tempearture/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 10^3 hours

continued on next page

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

Derating Graph [7]





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
Audio/Video, information and communication technology equipment - Part1: Safety requirements 2nd Edition	E196683	UL62368-1:2014 2nd Edition
		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 [8]	DC Power Port: ±2kV	EN61000-4-4, Criteria A
Surge Immunity [8]	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

continued on next page

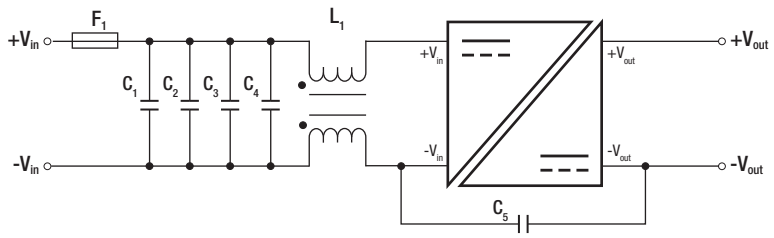
Specifications (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

EMC Compliance (Multimedia)	Condition	Standard / Criterion
Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement	without external filter without external filter	EN55011, Class A EN55011, Class B
Electromagnetic compatibility of multimedia equipment - Emission requirements (24Vin and 48Vin)	without external filter without external filter	EN55032, Class A 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

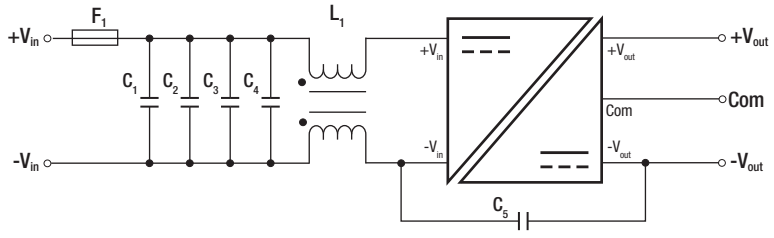
Notes:

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

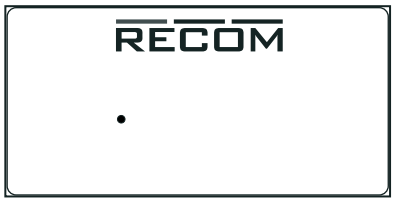
MODEL	C1	C2/C3/C4	C5	L1
RP20-110xxSFR RP20-110xxDFR	39µF/250V Al Cap. (lie down) Rubycon BX	0.47µF/250V 1812 MLCC	1000pF/3kV 1808 MLCC	CMC: 470µH ref.: WE-SL5 744272471

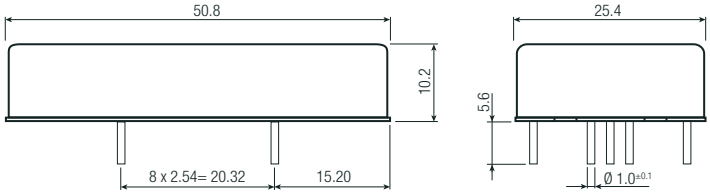
Specifications (measured @ Ta= 25°C, nom. Vin, full load unless otherwise stated)

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

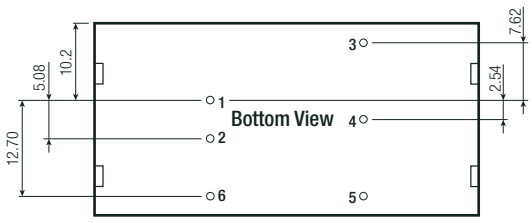
Dimension Drawing (mm)



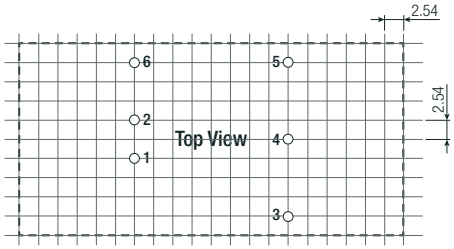


Pinning Information

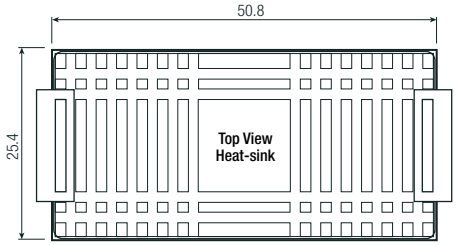
Pin #	Single	Dual
1	+Vin	+Vin
2	-Vin	-Vin
3	+Vout	+Vout
4	Trim (4)	Com
5	-Vout	-Vout
6	CTRL(2)	CTRL(2)

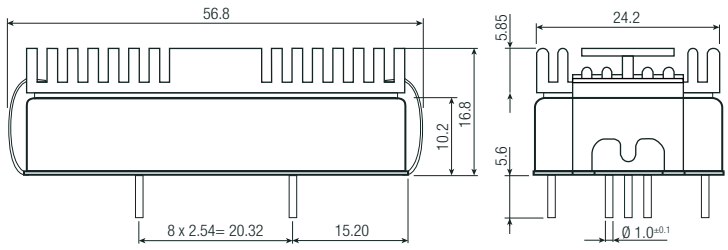


Recommended Footprint Details



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.