Features

Regulated Converters

- 4:1 Wide Input Voltage Range
- 1.5kVDC / 1 min. Isolation
- UL/IEC/EN60950 and EN50155 Certified
- Efficiency Up To 93.3%
- OVP, OCP & OTP
- +105°C max Case Temperature

RECOM

DC/DC Converter

RPA60-FW

60 Watt 2“x1“ Single Output

3 YEAR Warranty

RoHS 2+ compliant 10 from 10

REACH compliant

c UL us E224736

UL60950-1 Certified
IEC/EN60950 Certified
EN50155 Certified

Description

The RPA60-FW series are high power density, wide input voltage range 60W DC/DC converters in an industry standard 2”x1” case size. Despite their small size, the RPA60-FW converters are fully specified devices with output currents up to 12Amps, up to 93% efficiency, no minimum load, UVLO, 1500VDC / 1 minute isolation, tight regulation and low ripple/noise figures. The trimmable outputs are also fully protected against over-temperature, short circuits, overcurrent and overvoltage. The converters are UL/IEC/EN60950 and EN50155 certified and will find many uses in railway and industrial applications where board space is at a premium.

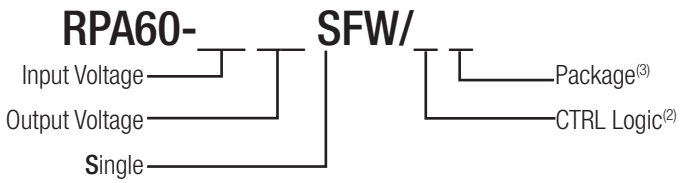
Selection Guide

Part Number	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [mA]	Input[1] Current [mA]	Efficiency[1] typ. [%]	Max. Capacitive Load [µF]
RPA60-2405SFW[2,3]	9-36	05	12000	2706	92.4	20000
RPA60-2412SFW[2,3]	9-36	12	5000	2694	92.8	6000
RPA60-2415SFW[2,3]	9-36	15	4000	2662	93.3	4000
RPA60-2424SFW[2,3]	9-36	24	2500	2688	93	2000

Notes:

Note1: Tested at nominal Vin, full load and at +25°C ambient

Model Numbering



Ordering Examples

RPA60-2405SFW = 24V Input, 5V Output, Single, no CTRL pin
RPA60-2405SFW/P = 24V Input, 5V Output, Single, Pos. CTRL function
RPA60-2415SFW/N-HC = 24V Input, 15V Output, Single, Neg. CTRL function, Heat-sink assembled

Notes:

Note2: part without suffixes is without CTRL pin, trim pin fitted
add suffix “P” for positive CTRL function (1=ON, 0=OFF), trim pin fitted
add suffix “N” for negative CTRL function (0=ON, 1=OFF), trim pin fitted
Note3: add suffix “-HC” for glued Heat-sink (compatible with all other suffixes)

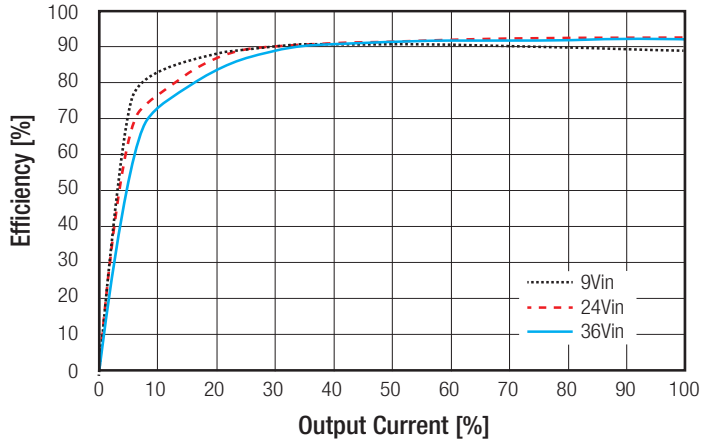
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

BASIC CHARACTERISTICS

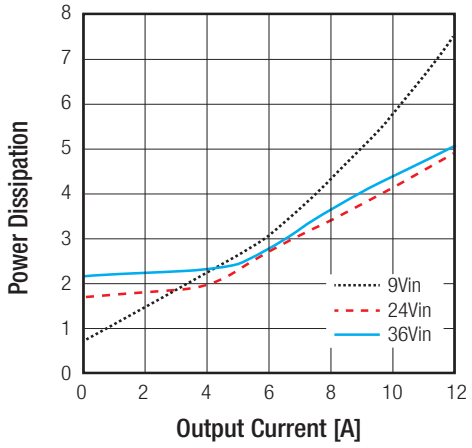
Parameter	Condition		Min.	Typ.	Max.
Internal Input Filter					LC Filter
Input Voltage Range			9VDC	24VDC	36VDC
Input Surge Voltage	100ms max.				50VDC
Quiescent Current	5Vout 12Vout & 15 Vout 24Vout			70mA 60mA 40mA	
Start-up time	Power up Remote ON/OFF			60ms	
Internal Operating Frequency				330kHz	
Minimum Load			0%		
Ripple and Noise	20MHz bw, 10µF tantalum capacitor and 1µF ceramic capacitor			100mVp-p	
Under Voltage Lockout (UVLO)	DC-DC ON DC-DC OFF		8VDC 7VDC	8.5VDC 7.5VDC	9VDC 8VDC
ON/OFF Control[2]	Positive Logic	DC-DC ON DC-DC OFF			Open or 2.4 < Vr < 10VDC Short or 0 < Vr < 0.8VDC
	Negative Logic	DC-DC ON DC-DC OFF			Short or 0 < Vr < 0.8VDC Open or 2.4 < Vr < 10VDC
Input current of CTRL pin	DC-DC OFF			10mA	
Output Voltage Trimming			-10%		+10%

RPA60-2405SFW

Efficiency vs. Output Current

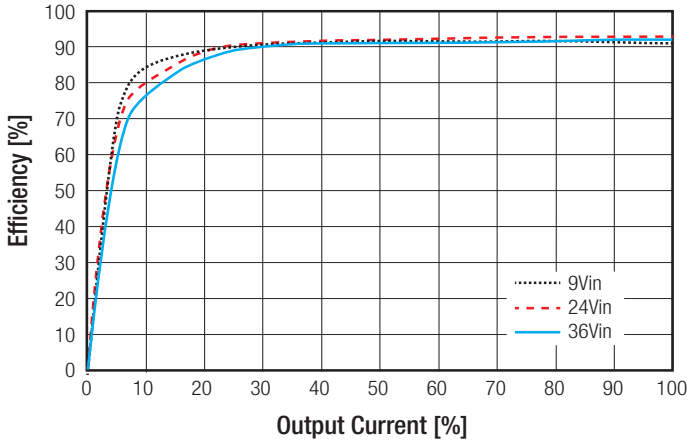


Power Dissipation vs Output Current

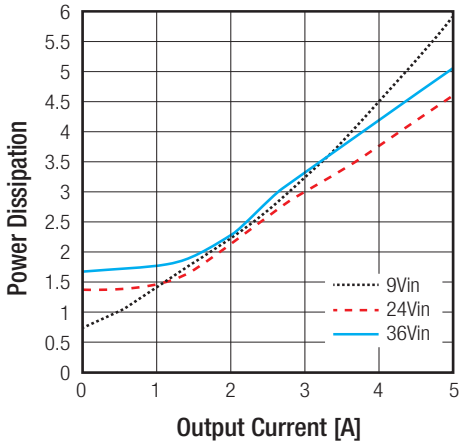


RPA60-2412SFW

Efficiency vs. Output Current



Power Dissipation vs Output Current



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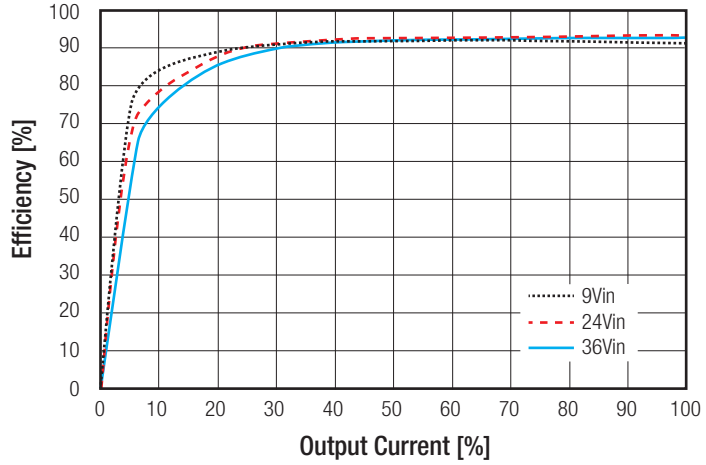
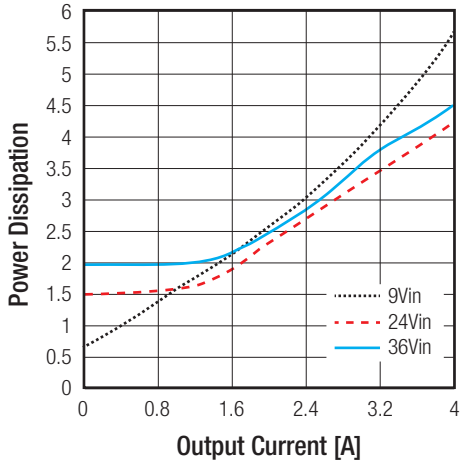
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

RPA60-2415SFW

Efficiency vs. Output Current

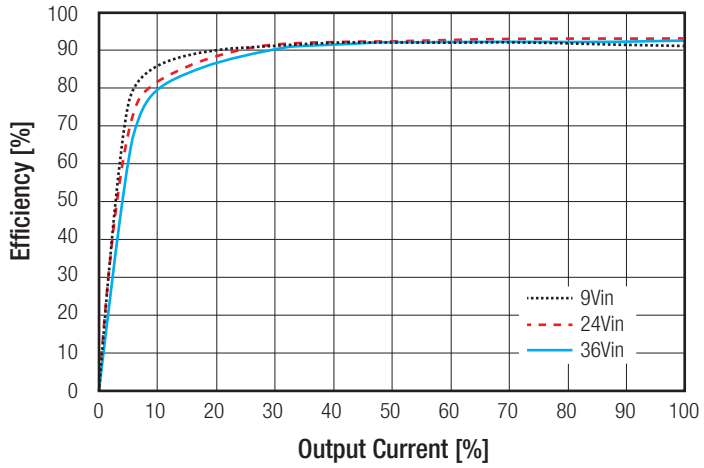


Power Dissipation vs Output Current

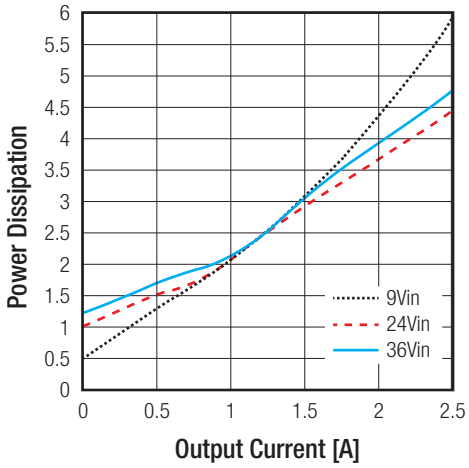


RPA60-2424SFW

Efficiency vs. Output Current



Power Dissipation vs Output Current

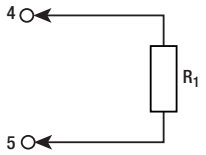


OUTPUT TRIM

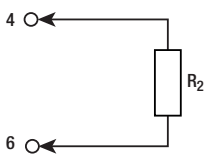
Output Voltage Trimming

RPA60-FW converters offer the feature of trimming the output voltage over a certain range around the nominal value by using external trim resistors. The values for trim resistors shown in trim tables below are according to standard E96 values; therefore, the specified voltage may slightly vary.

TRIM UP



TRIM DOWN



RPA60-2405SFW

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	5.40	5.45	5.50	Volts
R_1 =	604	243	147	95.3	68.1	39.2	34.8	22.1	15	8.06	kOhms
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	Volts
R_2 =	604	301	169	115	80.6	56.2	40.2	28	15	8.06	kOhms

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

RPA60-2412SFW

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 =	604	255	154	105	75	49.9	38.3	24.9	18.2	10	kOhms
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	Volts
R_2 =	698	301	187	121	84.5	60.4	45.3	30.1	20	10	kOhms

RPA60-2415SFW

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	Volts
R_1 =	750	309	191	124	71.5	59	40.2	28	15	8.06	kOhms
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	Volts
R_2 =	698	374	226	150	105	71.5	59	32.4	20	8.06	kOhms

RPA60-2424SFW

Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout =	24.24	24.48	24.72	24.96	25.2	25.44	25.68	25.92	26.16	26.4	Volts
R_1 =	1000	511	324	221	162	121	90.9	68.1	48.7	34.8	kOhms
Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout =	23.76	23.52	23.38	23.04	22.8	22.56	22.32	22.08	21.84	21.6	Volts
R_2 =	1500	909	499	324	232	169	124	93.1	64.9	45.3	kOhms

REGULATION

Parameter	Condition		Value
Output Accuracy			±1.0% max.
Line Regulation	low line to high line		±0.2% max.
Load Regulation			±0.5%
Transient Response	5Vout others	50%-75% full load	±5.0% Vout typ. ±2.5% Vout typ.
	25% load step change		250µs typ.

PROTECTION

Parameter	Condition		Value
Short Circuit Protection (SCP)	below 100mΩ		continuous, auto recovery
Over Voltage Protection (OVP)			115%-140% Output Voltage
Over Current Protection (OCP)			110%-150% Output Current, Hiccup
Over Temperature Protection (OTP)			115°C ±5°C
Isolation Voltage (5)	I/P to O/P	tested for 1 minute	1.5kVDC
Isolation Resistance			10MΩ min.
Isolation Capacitance			2200pF typ.
Insulation Grade			basic

Notes:

Note4: An input fuse is required if the mains supply is not over-current protected. Recommended fuse: 10A slow blow type.

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

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

ENVIRONMENTAL

Parameter	Condition	Value
Operating Temperature Range (6)		-40°C to [refer to thermal calculation]
Maximum Case Temperature		+105°C
Temperature Coefficient		0.02%/°C
Thermal Impedance		please refer to table 1
Operating Altitude		4500m
Operating Humidity		95% RH
Shock		5G, 30ms, 6 times along X,Y and Z axis
Vibration		10-500Hz, 2.4G, 30mins along X,Y and Z axis
MTBF	according to Telcordia SR332 3, +25°C	5997 x 10^3 hours

Table 1: Thermal Impedance

	without Heatsink		with Heatsink	
airflow [m/s]	Rth without PCB [°C/W]	Rth with PCB (6) [°C/W]	Rth without PCB [°C/W]	Rth with PCB (6) [°C/W]
0.1	11.5	7.5	9.6	6.8
0.2	8.9	5.6	7.4	5.1
0.5	6.6	4.1	5.5	3.8
1.0	4.8	3.0	4.0	2.7
1.5	3.9	2.5	3.3	2.2
2.0	3.0	1.9	2.5	1.7

Notes:

Note6: Test PCB:160x100mm105µm (Eurocard), double layer

Thermal Calculation

choose your model:

RPA60-2405SFW (with PCB (6))

- Load conditions in application (e.g. 50%)
- Airflow conditions in application (e.g. 0.5m/s)
- use Rth from Table1 (4.1°C/W)

Calculation:

Iout = 50%
R_{th} = 4.1°C/W
P_{DISS} = 2.75W
$T_{CASEmax}$ = 105°C

$T_{OVER} = R_{th} \times P_{Dis} = 4.1°C/W \times 2.75W = \mathbf{11.3°C}$

$T_{AMBmax} = T_{CASEmax} - T_{OVER} = 105°C - 11.3°C = \mathbf{93.7°C}$

choose your model:

RPA60-2405SFW-HC (with PCB (6))

- Load conditions in application (e.g. 50%)
- Airflow conditions in application (e.g. 0.5m/s)
- use Rth from Table1 (3.8°C/W)

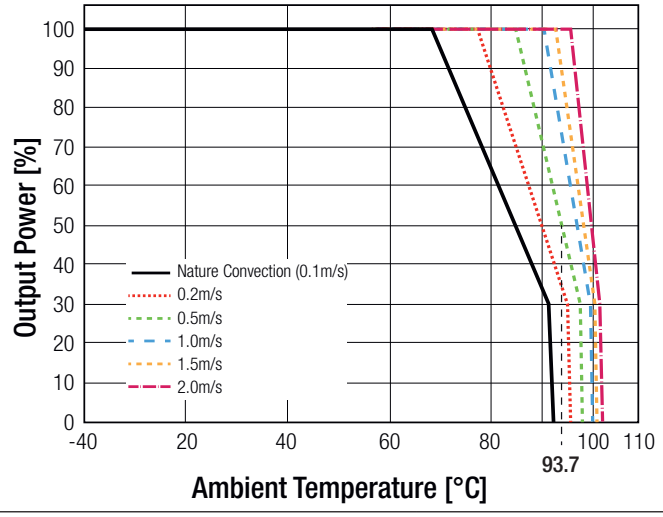
Calculation:

Iout = 50%
R_{th} = 3.8°C/W
P_{DISS} = 2.75W
$T_{CASEmax}$ = 105°C

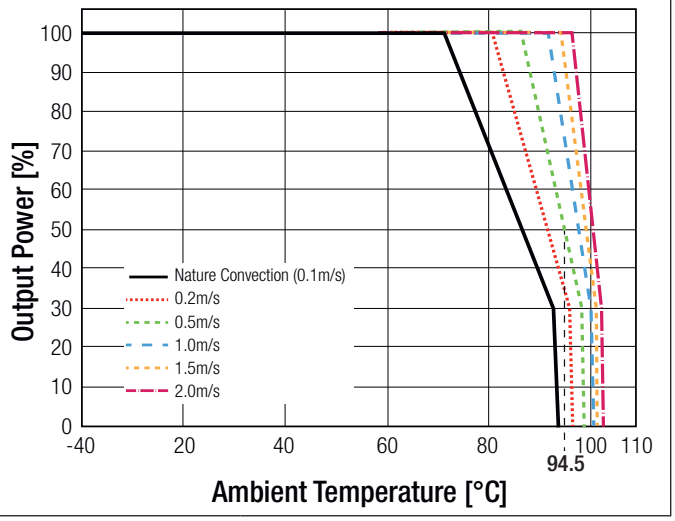
$T_{OVER} = R_{th} \times P_{Dis} = 3.8°C/W \times 3.04W = \mathbf{10.5°C}$

$T_{AMBmax} = T_{CASEmax} - T_{OVER} = 105°C - 10.5°C = \mathbf{94.5°C}$

RPA60-2405SFW



RPA60-2405SFW-HC

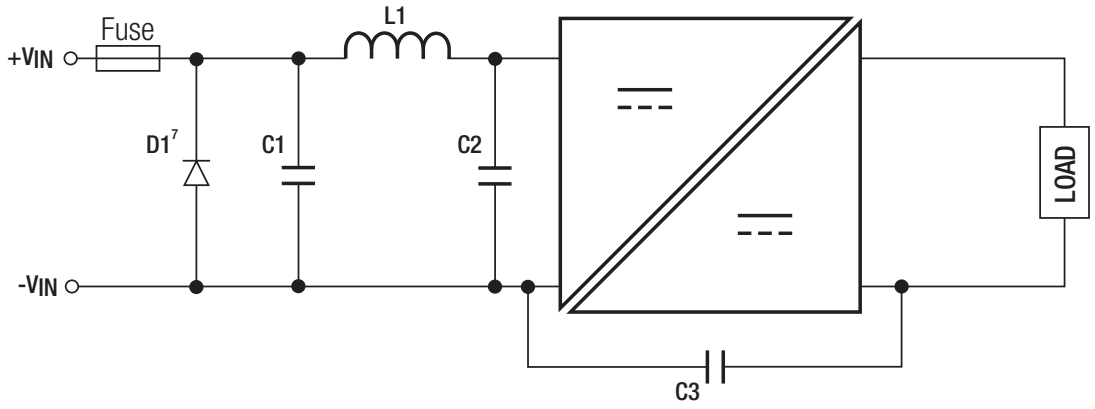


Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

SAFETY AND CERTIFICATIONS		
Certificate Type (Safety)	**Report / File Number**	**Standard**
Information Technology Equipment, General Requirements for Safety	E224736-A41	UL60950-1, 2nd Edition, 2014 CSA C22.2 No. 60950, 2nd Edition, 2014
IEC/EN Information Technology Equipment - General Requirments for Safety (CB Scheme)	E224736-A41-CB	IEC60950-1, 2nd Edition, 2005 + AM2, 2013 EN60950-1, 1st Edition, 2006 + AM2, 2013
Railway Applications - Electrical Equipment used on rolling stock	15100173 001	EN50155, 1st Edition, 2007, Clause 5.4 and 5.5
RoHs 2+		RoHS 10/10, 2011/65/EU + AM-2015/863

EMC Compliance (designed to meet)	Condition	Standard / Criterion
Information technology equipment - Radio disturbance characteristics Limits and methods of measurement	with external filter	EN55022, Class A, 2010
Railway applications - Electromagnetic compatibility Part 3-2: Rolling stock - Apparatus		EN50121-3-2, 2015
Specification for radio disturbance and immunity measuring apparatus and methods Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements		EN55016-2-1, 2009
Specification for radio disturbance and immunity measuring apparatus and methods Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements		EN55016-2-3, 2010
ESD Electrostatic discharge immunity test	Air ±8kV, Contact ±6kV	EN61000-4-2, 2009; Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	20V/m, 80-1000MHz 10V/m, 1.4-2.0GHz 5V/m, 2.0-2.7GHz 3V/m, 5.1-6.0GHz	EN61000-4-3, 2006; Criteria A
Fast Transient and Burst Immunity	±2kV	IEC61000-4-4, 2004; Criteria A
Surge Immunity	±1kV	EN61000-4-5, 2006; Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields	10V	EN61000-4-6, 2009; Criteria A

EMI Filtering according to EN50121-3-2 (EN50155) and EN55022 Class A



Notes:

Note7: Diode is only needed for EN50155.

C1	C2	L1	C3
100µF/50V electrolytic	6.8µF/50V MLCC	4.7µH SMD Inductor	6.8nF/2kV MLCC

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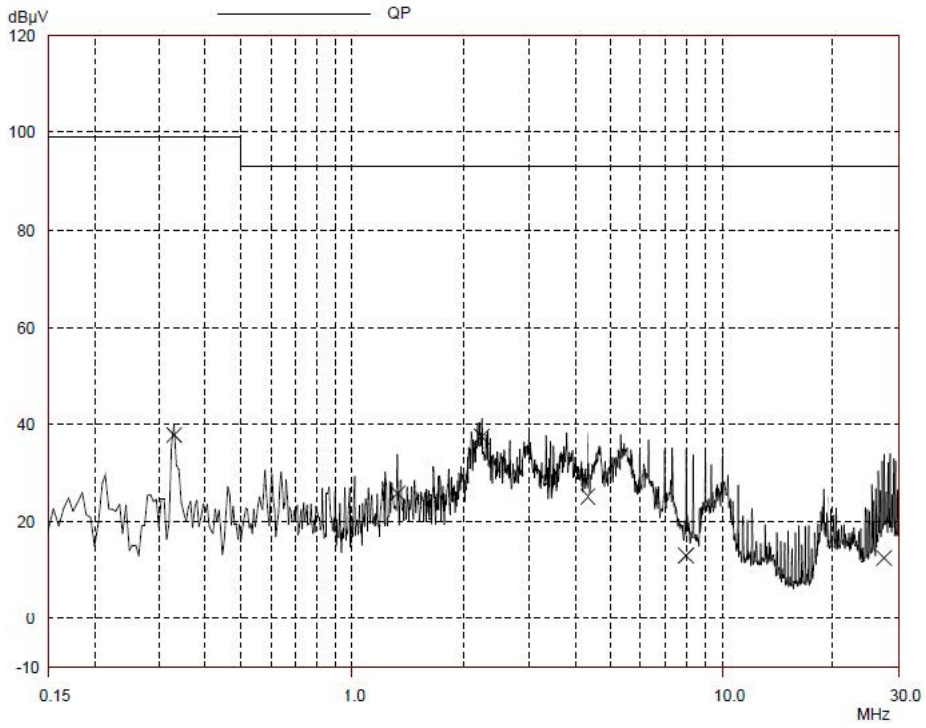
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

Conducted Emissions according to EN50121-3-2 (EN50155)



DIMENSIONS and PHYSICAL CHARACTERISTICS		
Parameter	**Type**	**Value**
Material	Case Baseplate Potting	Al Alloy, anodize black non-conductive FR4 Silicone (UL94-0)
Package Dimensions (LxWxH)	without Heat-sink with Heat-sink	50.8 x 25.4 x 10.2mm 50.8 x 25.4 x 17.1mm
Package Weight	without Heat-sink with Heat-sink	35g typ. 46g typ.

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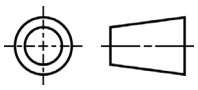
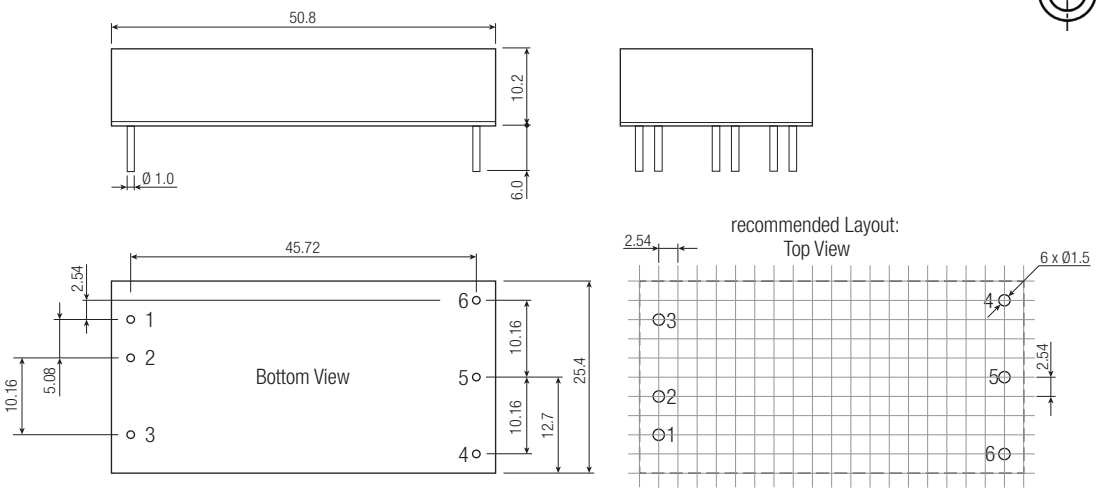
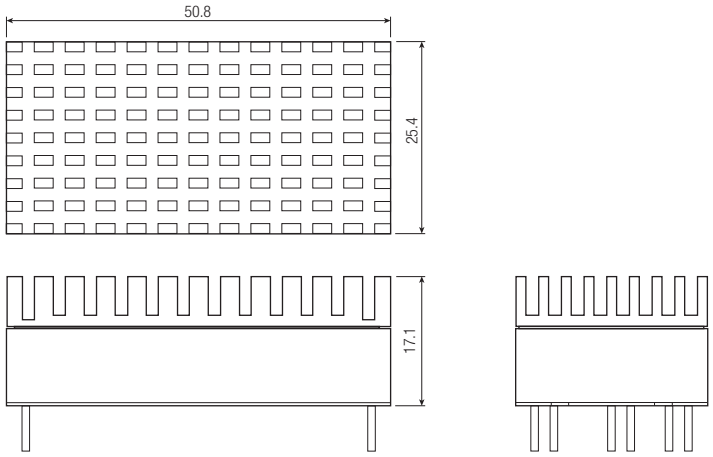
Specifications measured @ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted

Dimension Drawing (mm)





Heat-sink Dimension Drawing (mm)



Pin Connections

Pin #	Single
1	+Vin
2	-Vin
3	CTRL[2]
4	Trim
5	-Vout
6	+Vout

Pin Pitch Tolerance ±0.25mm
Pin dimension tolerance ±0.1mm
XX.X ± 0.5mm
XX.XX ± 0.25mm

PACKAGING INFORMATION			
Parameter	**Type**		**Value**
Packaging Dimensions (LxWxH)	without Heat-sink with Heat-sink	tube	285.0 x 27.6 x 19.0mm 285.0 x 27.6 x 25.8mm
Packaging Quantity			5pcs
Storage Temperature Range			-55°C to +125°C
Storage Humidity			5% - 95% RH