Features

Regulated Converter

- 4:1 wide input voltage range
- 1.5kVDC / 1 minute 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“ x 1“ Single Output

3 YEAR warranty

Description

The RPA60-FW series are high power density, wide input voltage range 60W DC/DC converters in an industry standard 2” x 1” 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	nom. 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	5	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

C UL US
E224736

UL60950-1 certified
IEC/EN60950 certified
EN50155 certified

Model Numbering

RPA60-__ __ SFW/__ __

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

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)

Ordering Examples

RPA60-2405SFW = 24VDC input, 5VDC output, single, no CTRL pin
RPA60-2405SFW/P = 24VDC input, 5VDC output, single, positive CTRL function
RPA60-2415SFW/N-HC = 24VDC input, 15VDC output, single, negative CTRL function, glued Heat-sink

REF DESIGN available

https://recom-power.com/rec-s-R-REF04-RIA12.html

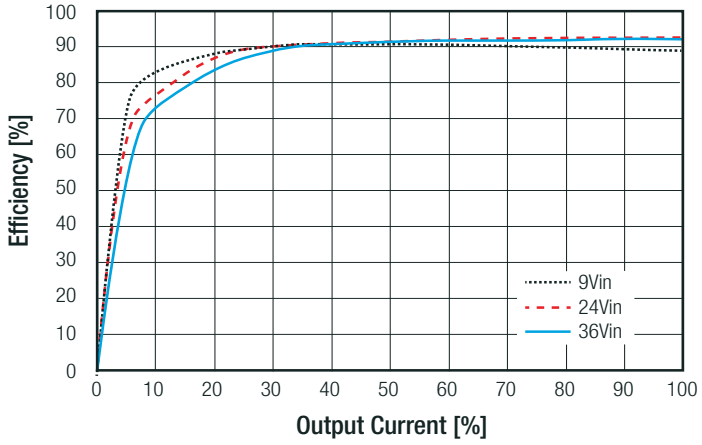
Specifications (masured @Ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted)

BASIC CHARACTERISTICS

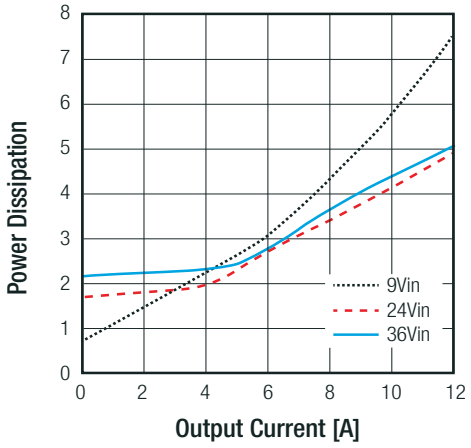
Parameter	Condition		Min.	Typ.	Max.
Internal Input Filter					LC Filter
Input Voltage Range	nom. Vin = 24VDC		9VDC	24VDC	36VDC
Input Surge Voltage	100ms max.				50VDC
Under Voltage Lockout (UVLO)	DC-DC ON DC-DC OFF		8VDC 7VDC	8.5VDC 7.5VDC	9VDC 8VDC
Quiescent Current	5Vout 12Vout & 15 Vout 24Vout			70mA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

RPA60-2405SFW

Efficiency vs. Output Current

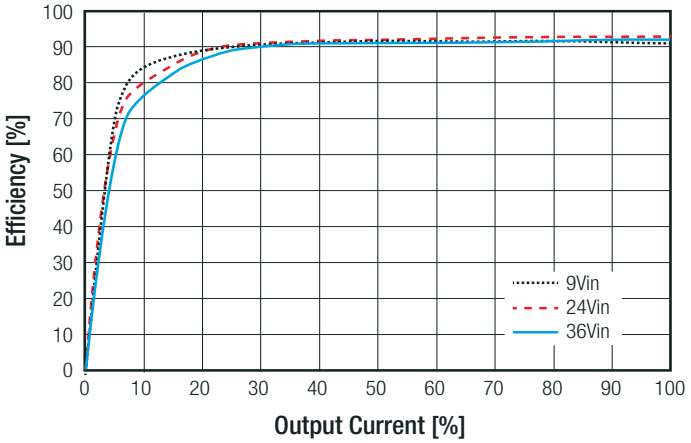


Power Dissipation vs. Output Current

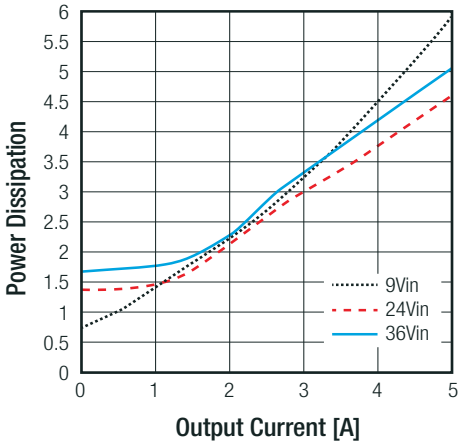


RPA60-2412SFW

Efficiency vs. Output Current



Power Dissipation vs. Output Current



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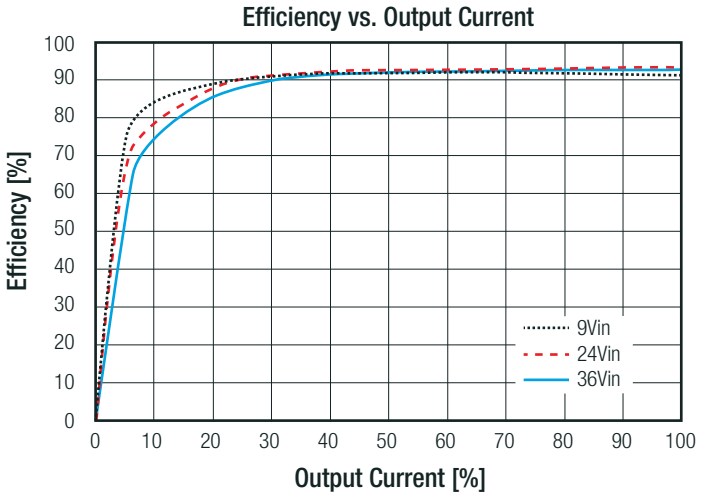
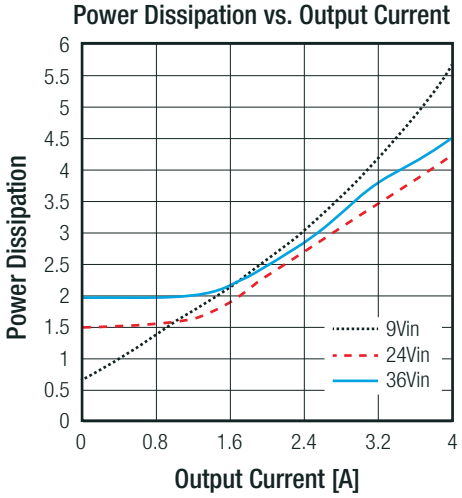
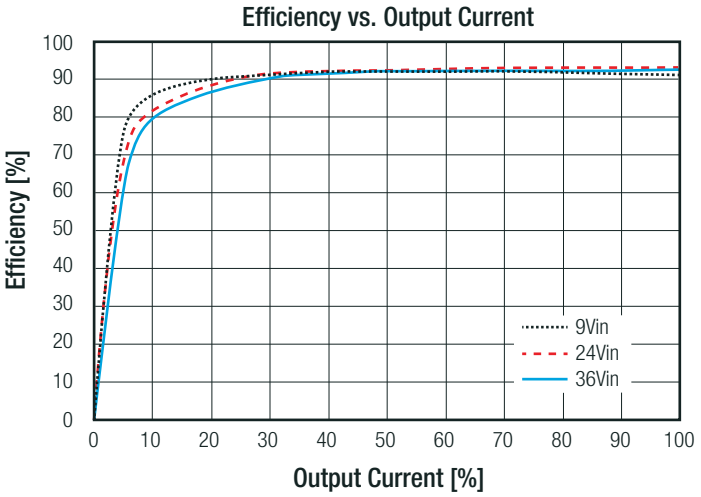
Specifications (masured @Ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted)

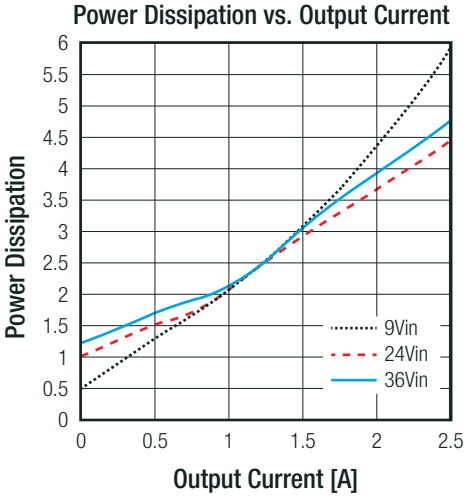
RPA60-2415SFW





RPA60-2424SFW

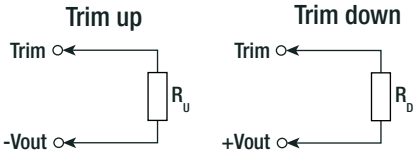




OUTPUT VOLTAGE TRIMMING

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.



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	[VDC]
R_U =	604	243	147	95.3	68.1	39.2	34.8	22.1	15	8.06	[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 =	604	301	169	115	80.6	56.2	40.2	28	15	8.06	[kΩ]

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Specifications (masured @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	[VDC]
R_U =	604	255	154	105	75	49.9	38.3	24.9	18.2	10	[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 =	698	301	187	121	84.5	60.4	45.3	30.1	20	10	[kΩ]
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	[VDC]
R_U =	750	309	191	124	71.5	59	40.2	28	15	8.06	[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 =	698	374	226	150	105	71.5	59	32.4	20	8.06	[kΩ]
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	[VDC]
R_U =	1000	511	324	221	162	121	90.9	68.1	48.7	34.8	[kΩ]
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	[VDC]
R_D =	1500	909	499	324	232	169	124	93.1	64.9	45.3	[kΩ]

REGULATION

Parameter	Condition		Value
Output Accuracy			±1.0% max.
Line Regulation	low line to high line, full load		±0.2% max.
Load Regulation			±0.5%
Transient Response	50%-75% full load	5Vout	±5.0% Vout typ.
		others	±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 mode
Over Temperature Protection (OTP)			115°C ±5°C
Isolation Voltage (4)	I/P to O/P	tested for 1 minute	1.5kVDC
Isolation Resistance			10MΩ min.
Isolation Capacitance			2200pF typ.
Insulation Grade			basic

Notes:

Note4: For repeat Hi-Pot testing, reduce the time and/or the test voltage

Note5: An input fuse is required if the mains supply is not over-current protected. Recommended fuse: 10A slow blow type

Specifications (masured @Ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted)

ENVIRONMENTAL			
Parameter	**Condition**		**Value**
Operating Temperature Range [6]	with derating		-40°C to refer to ***"Thermal Calculation"***
Maximum Case Temperature			+105°C
Temperature Coefficient			0.02%/K
Thermal Impedance			refer to ***"Table 1: Thermal Impedance"***
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** [K/W]	**Rth with PCB** [6] [K/W]	**Rth without PCB** [K/W]	**Rth with PCB** [6] [K/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: 160x100mm 105µm (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 (4.1K/W)

Calculation:

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

$T_{OVER} = R_{th} \times P_{Dis} = 4.1K/W \times 2.75W =$ **11.3K**

$T_{AMBmax} = T_{CASEmax} - T_{OVER} = 105°C - 11.3K =$ **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 (3.8K/W)

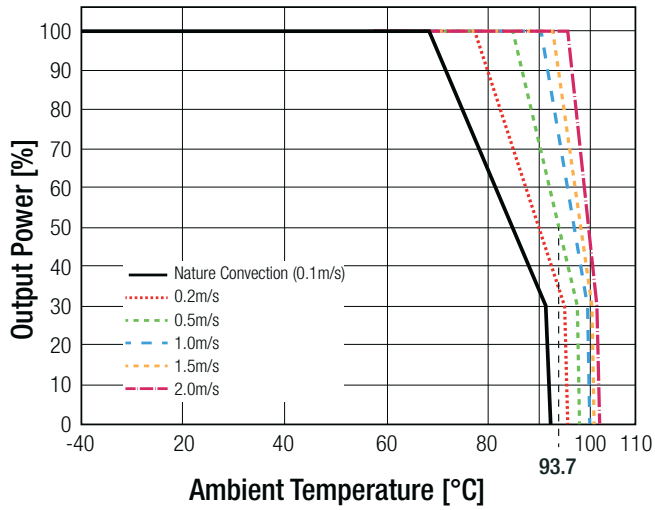
Calculation:

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

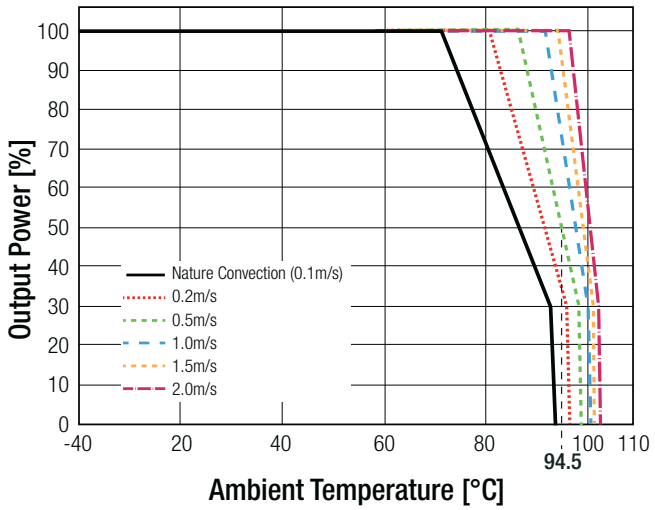
$T_{OVER} = R_{th} \times P_{Dis} = 3.8K/W \times 3.04W =$ **10.5K**

$T_{AMBmax} = T_{CASEmax} - T_{OVER} = 105°C - 10.5K =$ **94.5°C**

RPA60-2405SFW



RPA60-2405SFW-HC

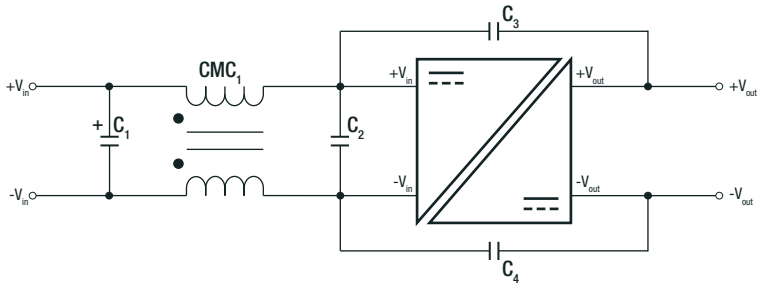


Specifications (masured @Ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted)

SAFETY AND CERTIFICATIONS		
Certificate Type (Safety)	**Report / File Number**	**Standard**
Information Technology Equipment, General Requirements for Safety	E224736-A41	UL60950-1:2014, 2nd Edition CSA C22.2 No. 60950-1-07: 2014, 2nd Edition
IEC/EN Information Technology Equipment - General Requirments for Safety (CB Scheme)	E224736-A41-CB-1	IEC60950-1: 2005, 2nd Edition + AM2, 2013
IEC/EN Information Technology Equipment - General Requirments for Safety		EN60950-1: 2006, + A2, 2013
Railway Applications - Electrical Equipment used on rolling stock	15100173 001	EN50155, 1st Edition, 2007, Clause 5.4 and 5.5
RoHS2		RoHS 10/10, 2011/65/EU + AM-2015/863

EMC Compliance (designed to meet)	**Condition**	**Standard / Criterion**
Electromagnetic compatibility of multimedia equipment - Emission requirements	with external filter (see filter suggestion below)	EN55032: 2015, Class A
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

EMC Filtering according to EN50121-3-2 and EN55032 Class A



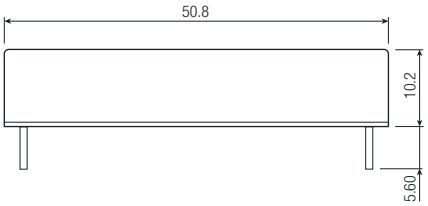
C1	C2	C3/C4	CMC_1
100µF/100V electrolytic	10µF/50V MLCC	6.8nF/2kV MLCC	350µH/8.5A

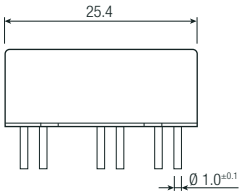
Specifications (masured @Ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted)

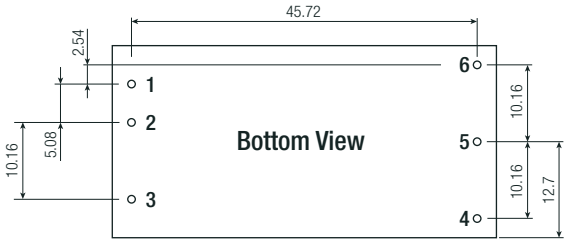
DIMENSIONS and PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	case baseplate potting	al alloy, anodize black non-conductive FR4 silicone (UL94-V0)
Dimensions (LxWxH)	without Heat-sink with Heat-sink	50.8 x 25.4 x 10.2mm 50.8 x 25.4 x 17.1mm
Weight	without Heat-sink with Heat-sink	35g typ. 46g typ.

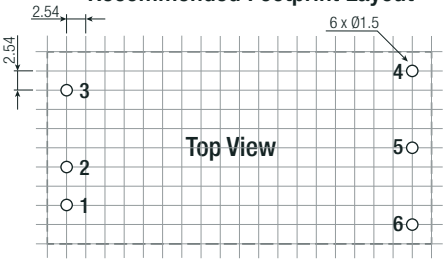
Dimension Drawing (mm)







Recommended Footprint Layout

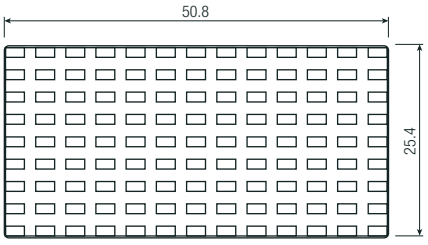


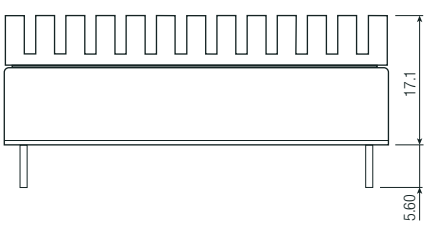
Pin Connections

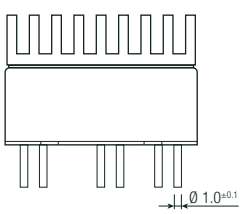
Pin #	Single
1	+Vin
2	-Vin
3	CTRL (2)
4	Trim
5	-Vout
6	+Vout

Pin Pitch Tolerance ±0.25mm
xx.x = ±0.5mm
xx.xx = ±0.25mm

Dimension Drawing (mm) with Heat-sink







Specifications (masured @Ta = 25°C, resistive load, nominal Vin and rated Iout unless otherwise noted)

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