

# Features

- 4:1 wide input voltage range
- Compact size 1"x1" package
- Efficiency up to 90%
- Wide operating temperature from -40°C to +75°C without derating
- Continuous short circuit protection

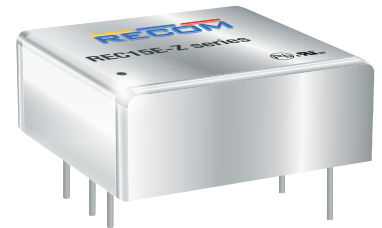
# Regulated Converters

## REC15E-Z

15 Watt

1" x 1"

Single and Dual Output



UL62368-  
CAN/CSA-C22.2 No. 62368-1-14  
UL60950-1  
CAN/CSA-C22.2 No. 60950-1-0  
IEC/EN62368-1 certified  
CB report  
EN55032 compliant

### Description

The REC15E-Z series are 4:1 wide input voltage range 15W power DC/DC converters in a 1"x1" case. Despite their low cost, the converters are fully specified devices with output currents up to 4 Amps, no minimum load, 1.6kVDC isolation, high efficiency and low ripple/noise figures. The inputs are protected against transients of up to 100V and feature UVLO to allow the primary supply to start up safely. The single or dual outputs are continuously protected against short circuits and overload and can drive high capacitive loads. The REC15E-Z series will find many uses in cost sensitive applications where board space is at a premium.

### Selection Guide

Part Number	nom. Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [mA]	Efficiency typ. <sup>(1)</sup> [%]	max. Capacitive Load <sup>(2)</sup> [µF]
REC15E-243.3SZ <sup>(3)</sup>	9 - 36	3.3	4000	85	12000
REC15E-2405SZ <sup>(3)</sup>	9 - 36	5	3000	88	6400
REC15E-2412SZ <sup>(3)</sup>	9 - 36	12	1250	88.5	1200
REC15E-2415SZ <sup>(3)</sup>	9 - 36	15	1000	89	900
REC15E-2424SZ <sup>(3)</sup>	9 - 36	24	625	89.5	240
REC15E-2412DZ <sup>(3)</sup>	9 - 36	±12	±625	87	±520
REC15E-2415DZ <sup>(3)</sup>	9 - 36	±15	±500	89	±330
REC15E-483.3SZ <sup>(3)</sup>	18 - 75	3.3	4000	85	12000
REC15E-4805SZ <sup>(3)</sup>	18 - 75	5	3000	88	6400
REC15E-4812SZ <sup>(3)</sup>	18 - 75	12	1250	89	1200
REC15E-4815SZ <sup>(3)</sup>	18 - 75	15	1000	89.5	900
REC15E-4824SZ <sup>(3)</sup>	18 - 75	24	625	90	240
REC15E-4812DZ <sup>(3)</sup>	18 - 75	±12	±625	89.5	±520
REC15E-4815DZ <sup>(3)</sup>	18 - 75	±15	±500	89.5	±330

#### Notes:

- Note1: Efficiency is tested at nominal input and full load at +25°C ambient  
 Note2: Max Cap Load is tested at nominal input and full resistive load

### Model Numbering



#### Notes:

Note3: "/X2" is without ON/OFF CTRL and without Output Voltage Trimming

#### Ordering Examples:

- REC15E-2405SZ      9-36Vin, 5Vout, Single output, 4:1 input  
 REC15E-4812DZ    18-75Vin, ±12Vout, Dual output, 4:1 input  
 REC15E-2412SZ/X2    9-36Vin, 12Vout, Single output, 4:1 input, without ON/OFF CTRL and without Output Voltage Trimming

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

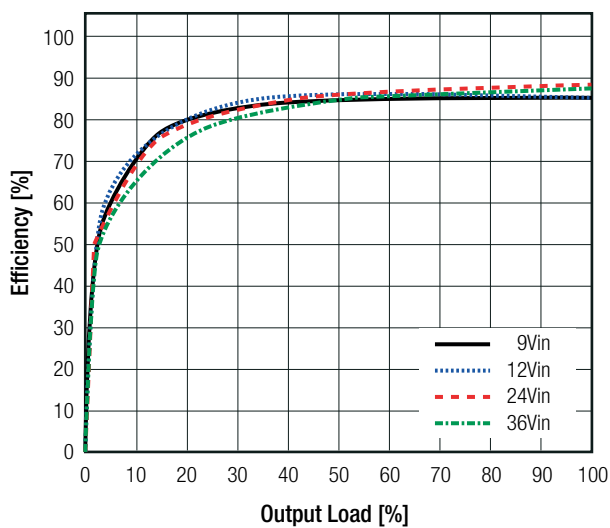
BASIC CHARACTERISTICS					
Parameter	Condition		Min.	Typ.	Max.
Internal Input Filter					Pi type
Input Voltage Range	nom. Vin= 24VDC nom. Vin= 48VDC		9VDC 18VDC	24VDC 48VDC	36VDC 75VDC
Input Surge Voltage	100ms max.	nom. Vin= 24VDC nom. Vin= 48VDC			50VDC 100VDC
Under Voltage Lockout (UVLO)	nom. Vin= 24VDC	DC-DC ON DC-DC OFF		7.5VDC	9VDC
	nom. Vin= 48VDC	DC-DC ON DC-DC OFF		16VDC	18VDC
Input Current	nom. Vin= 24VDC nom. Vin= 48VDC			700mA 350mA	
Quiescent Current	nom. Vin= 24VDC nom. Vin= 48VDC				7mA 5mA
Output Voltage Trimming	refer to calculation on page ECO-3 to ECO-4				±10%
Minimum Load			0%		
Start-up Time				20ms	25ms
ON/OFF CTRL	DC-DC ON DC-DC OFF		Open or 3.5V <sub>CTRL</sub> - 15VDC Short or 0V <sub>CTRL</sub> - 1.2VDC		
Standby Current	DC-DC OFF			2mA	
Internal Operating Frequency				350kHz	
Output Ripple and Noise <sup>(4)</sup>	20MHz BW	nom. Vin= 24VDC nom. Vin= 48VDC			60mVp-p 100mVp-p

**Notes:**

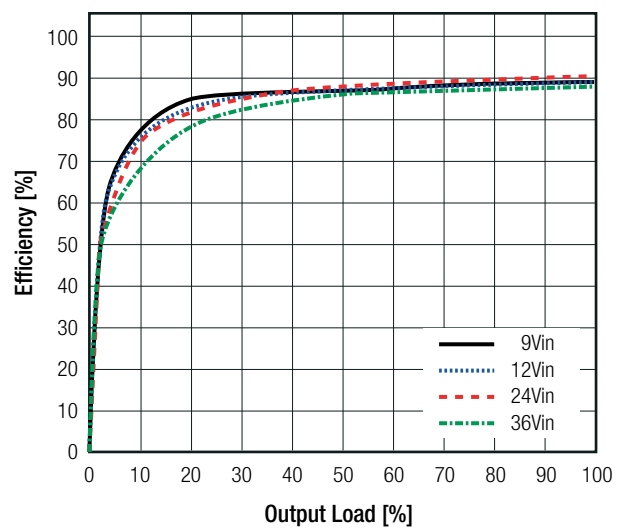
Note4: Measurements are made with a 1µF MLCC across output. (low ESR)

**Efficiency vs. Load**

REC15E-2405SZ



REC15E-2412SZ

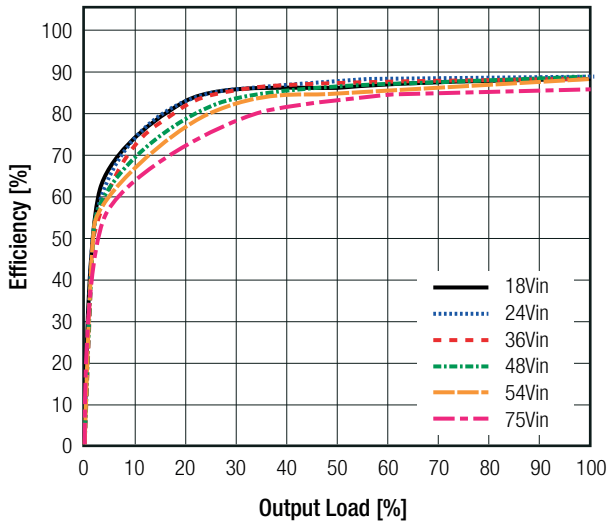


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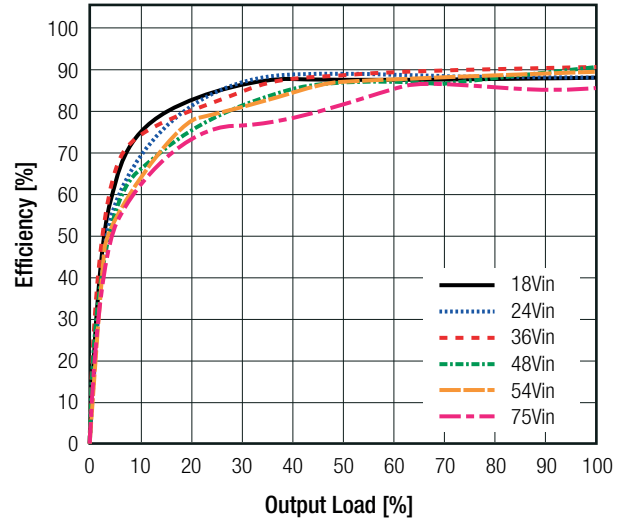
Specifications (measured @  $T_a = 25^\circ\text{C}$ , nom.  $V_{in}$ , full load and after warm-up unless otherwise stated)

### Efficiency vs. Load

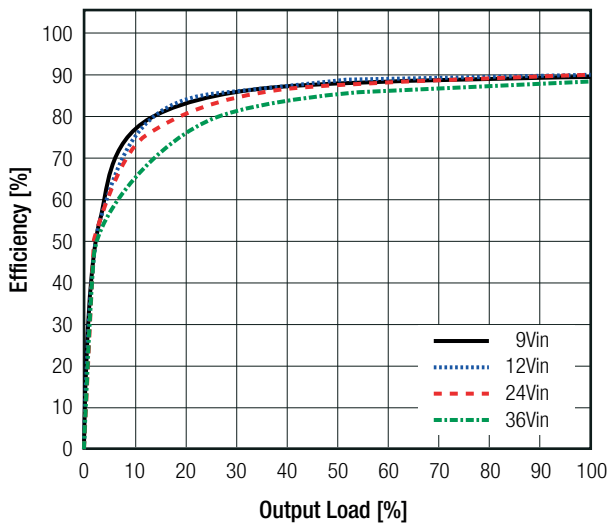
REC15E-4805SZ



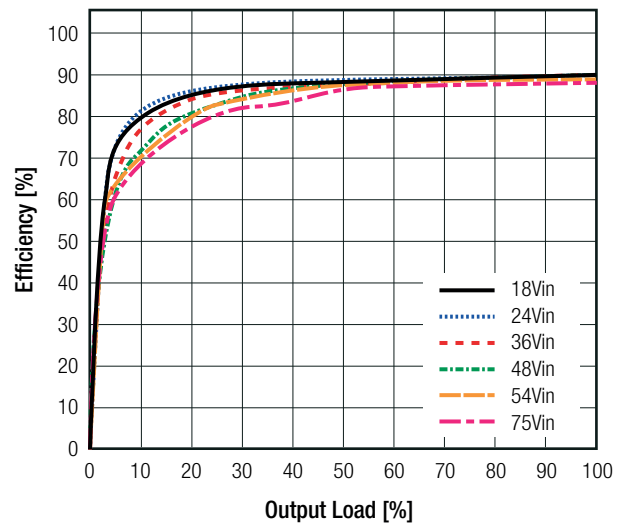
REC15E-4824SZ



REC15E-2415DZ



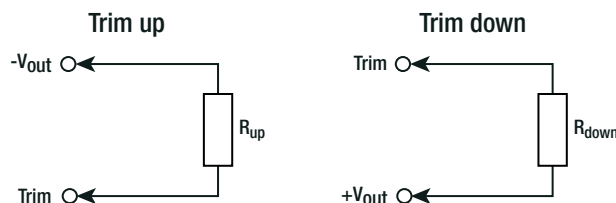
REC15E-4812DZ



### OUTPUT TRIM

#### Output Voltage Trimming

It allows the user to increase or decrease the output voltage of the module. This is accomplished by connecting an external resistor between the Trim pin and either the +Vout or -Vout pins. With an external resistor between the -Vout and Trim pin, the output voltage increases. With an external resistor between the Trim and +Vout pin, the output voltage decreases. The values for trim resistors shown in trim tables below are according to standard E96 values; therefore, the specified voltage may slightly vary.



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

$V_{out\_nom}$  = nominal output voltage [VDC]  
 $V_{out\_set}$  = trimmed output voltage [VDC]  
 $V_{ref}$  = reference voltage [VDC]  
 $R_{up}$  = trim up resistor [ $\Omega$ ]  
 $R_{down}$  = trim down resistor [ $\Omega$ ]  
 $R_1, R_2, R_3$  = internal resistors [ $\Omega$ ]  
 $k_u$  = trim up factor [ ]  
 $k_d$  = trim down factor [ ]

$V_{out\_nom}$	$R_1$	$R_2$	$R_3$	$V_{ref}$
3.3VDC	16k6 $\Omega$	10k $\Omega$	52k3 $\Omega$	1.24VDC
5VDC	10k $\Omega$		35k7 $\Omega$	
12VDC	38k1 $\Omega$		48k7 $\Omega$	
15VDC	50k1 $\Omega$		51k $\Omega$	
24VDC	86k32 $\Omega$		73k2 $\Omega$	

### Calculation:

$$k_u = \left[ \frac{V_{ref}}{V_{out\_set} - V_{ref}} \right] \times R_1$$

$$k_d = \left[ \frac{V_{out\_set} - V_{ref}}{V_{ref}} \right] \times R_2$$

$$R_{up} = \left[ \frac{k_u \times R_2}{R_2 - k_u} \right] - R_3$$

$$R_{down} = \left[ \frac{k_d \times R_1}{R_1 - k_d} \right] - R_3$$

### Practical Example REC15-0505SZ trim up 10%

$$k_u = \left[ \frac{2.5}{5.5 - 2.5} \right] \times 10k = 8k33$$

$$R_{up} = \left[ \frac{8k33 \times 10k}{10k - 8k33} \right] - 35k7 = 14k2\Omega$$

$R_{up}$  according to E96  $\approx$  **14k3 $\Omega$**

### Practical Example REC15-0505SZ trim down 10%

$$k_d = \left[ \frac{4.5 - 2.5}{2.5} \right] \times 10k = 8k$$

$$R_{down} = \left[ \frac{8k \times 10k}{10k - 8k} \right] - 35k7 = 4k3\Omega$$

$R_{down}$  according to E96  $\approx$  **4k32 $\Omega$**

## REGULATIONS

Parameter	Condition		Value
Output Accuracy			$\pm$ 1.0% max.
Line Regulation	low line to high line, full load	Single	$\pm$ 0.2% max.
		Dual	$\pm$ 0.5% max.
Load Regulation <sup>(5)</sup>	10% to 100% load	Single	0.5% max.
		Dual	1.0% max.
Cross Regulation	dual output only		$\pm$ 5.0% max.

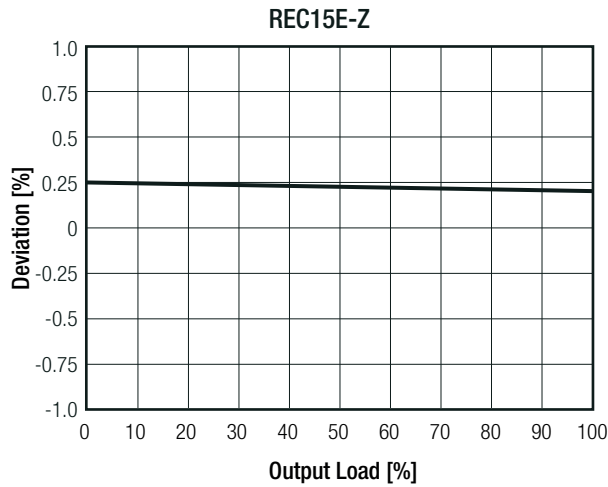
### Notes:

Note5: Operation below 10% load will not harm the converter, but specifications may not be met

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

Deviation vs. Load



**PROTECTIONS**

Parameter	Type		Value
Short Circuit Protection (SCP)			continuous, automatic recovery
Over Current Protection (OCP)	nom. Vin= 24VDC nom. Vin= 48VDC		170%, hiccup mode 190%, hiccup mode
Isolation Capacitance			1200pF typ.
Isolation Voltage <sup>(6)</sup>	I/P to O/P	tested for 1 second tested for 1 minute	2kVDC 1.6kVDC
Isolation Resistance			1GΩ min.
Isolation Grade			functional

**Notes:**

Note6: For repeat Hi-Pot testing, reduce the time and/or the test voltage

Note7: 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 <sup>(8)</sup>	full load @ free air convection (see graph) refer to derating graph		-40°C to +75°C -40°C to +105°C
Maximum Case Temperature			+110°C
Temperature Coefficient			± 0.02%/K
Thermal Impedance <sup>(8)</sup>	0.1m/s, horizontal		15.9K/W
Operating Altitude			5000m
Operating Humidity	non-condensing		5% - 95% RH max.
Pollution Degree			PD2
Vibration			according to MIL-STD-202G standard
MTBF	according to MIL-HDBK-217F, G.B.	+25°C +75°C	1400 x 10 <sup>3</sup> hours 354 x 10 <sup>3</sup> hours

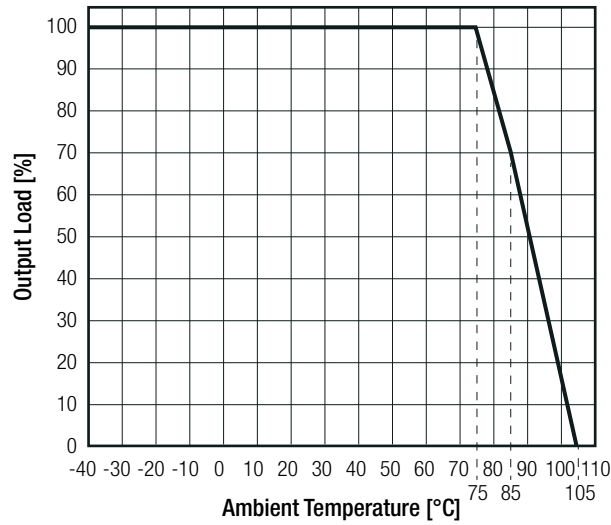
**Notes:**

Note8: Test PCB:160x100mm105µm (Eurocard), double layer

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

**Derating Graph**  
(@ free air convection)



**SAFETY AND CERTIFICATIONS**

Certificate Type (Safety)	Report / File Number	Standard
Audio/video, information and communication technology equipment - Safety requirements		UL62368-1, 2nd Edition, 2014 CAN/CSA -C22.2 No. 62368-1-14, 2nd Edition
Information Technology Equipment, General Requirements for Safety		UL60950-1, 2nd Edition, 2014 CAN/CSA C-22.2 No. 60950-1-07, 2nd Edition
Audio/video, information and communication technology equipment - Safety requirements (CB Scheme)	WD-ITAC-180737-A0	IEC62368-1:2014, 2nd Edition
Audio/video, information and communication technology equipment - Safety requirements		EN62368-1:2014 + A11:2017
RoHS2+		RoHS 2011/65/EU + AM2015/863

EMC Compliance (pending)	Condition	Standard / Criterion
Electromagnetic compatibility of multimedia equipment - Emission requirements	without external filter	EN55032, Class A
	with external filter	EN55032, Class B
ESD Electrostatic discharge immunity test		EN61000-4-2, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test <sup>(9)</sup>		EN61000-4-3, Criteria A
Fast Transient and Burst Immunity <sup>(9)</sup>		EN61000-4-4, Criteria A
Surge Immunity <sup>(9)</sup>		EN61000-4-5, Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields <sup>(9)</sup>		EN61000-4-6, Criteria A
Power Magnetic Field Immunity <sup>(9)</sup>		EN61000-4-8, Criteria A

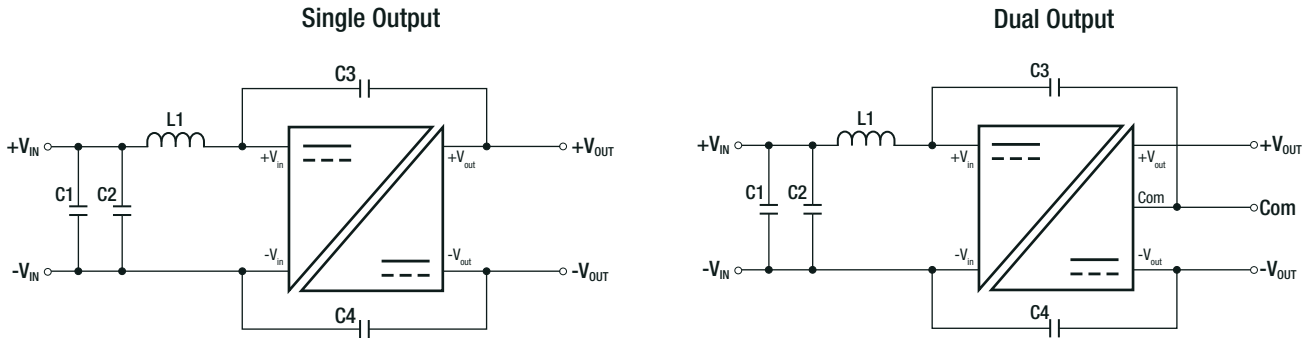
**Notes:**

Note9: measurements are made with E-Cap 220uF/100V at input terminal

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

### EMC Filtering Suggestions according to EN55032 Class B



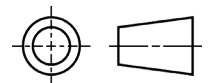
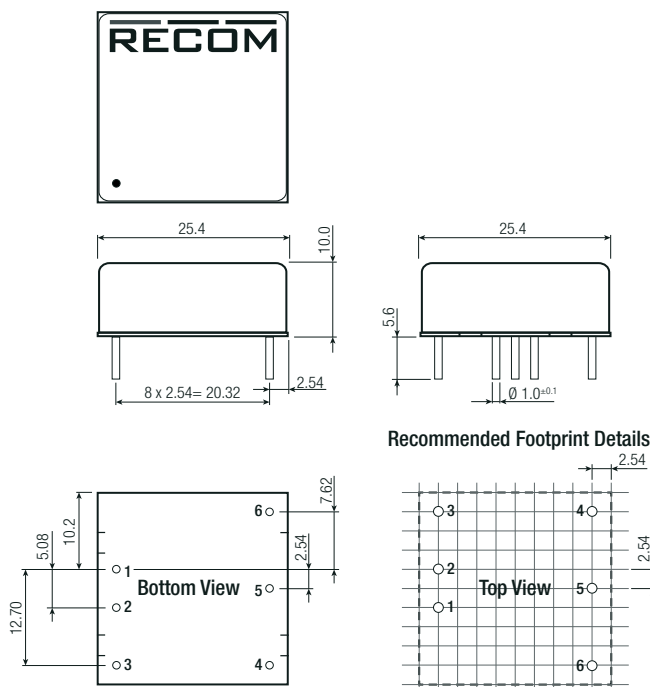
### Component List Class B

MODEL	C1	C2	C3	C4	L1
REC15E-24xxS(D)Z	2.2μF/100V	2.2μF/100V	1500pF/2kV	1500pF/2kV	4.7μH
REC15E-48xxS(D)Z					

### DIMENSION AND PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	case potting PCB	nickel plated metal silicone, (UL94V-0) FR4, (UL94V-0)
Dimension (LxWxH)		25.4 x 25.4 x 10.0mm
Weight		17g typ.

### Dimension Drawing (mm)



### Pinning information

Pin #	Single	Dual	Single/X2	Dual/X2
1	+Vin	+Vin	+Vin	+Vin
2	-Vin	-Vin	-Vin	-Vin
3	CTRL	CTRL	no pin	no pin
4	-Vout	-Vout	-Vout	-Vout
5	Trim	Com	no pin	Com
6	+Vout	+Vout	+Vout	+Vout

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

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

PACKAGING INFORMATION		
Parameter	Type	Value
Packaging Dimension (LxWxH)	tube	260.0 x 28.5 x 20.8mm
Packaging Quantity	tube	8pcs
Storage Temperature Range		-55°C to +125°C
Storage Humidity		95% RH max.

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