

**PART NUMBER:** VBT1-SMT

**DESCRIPTION:** dc-dc converter

**description**

Designed to convert fixed voltages into an isolated voltage, the VBT1-SMT series is well suited for providing board-mount local supplies in a wide range of applications, including mixed analog/digital circuits, test & measurement equip., process/machine controls, datacom/telecom fields, etc...

The semi-regulated output can be followed by 3-terminal regulators to provide output protection, in addition to output regulation.

**features**

- isolated 1 W output
- temperature range: -40°C~+85°C
- unregulated
- high efficiency to 80%
- single voltage output
- small footprint
- SMD package style
- industry standard pinout
- UL94-V0 package
- no heatsink required
- 1K Vdc isolation
- power density 0.85 W/cm<sup>3</sup>
- no external component required
- low cost



model number	input voltage		output voltage	output current		efficiency	package	
	nominal	range		max.	min.		style	UL60950-1
VBT1-S3.3-S3.3-SMT	3.3 Vdc	3.0~3.63 Vdc	3.3 Vdc	303 mA	30 mA	73%	SMD	YES
VBT1-S3.3-S5-SMT	3.3 Vdc	3.0~3.63 Vdc	5 Vdc	200 mA	20 mA	74%	SMD	YES
VBT1-S5-S3.3-SMT	5 Vdc	4.5~5.5 Vdc	3.3 Vdc	303 mA	30 mA	72%	SMD	NO
VBT1-S5-S5-SMT	5 Vdc	4.5~5.5 Vdc	5 Vdc	200 mA	20 mA	77%	SMD	YES
VBT1-S5-S9-SMT	5 Vdc	4.5~5.5 Vdc	9 Vdc	111 mA	12 mA	76%	SMD	YES
VBT1-S5-S12-SMT	5 Vdc	4.5~5.5 Vdc	12 Vdc	84 mA	9 mA	79%	SMD	YES
VBT1-S5-S15-SMT	5 Vdc	4.5~5.5 Vdc	15 Vdc	67 mA	7 mA	78%	SMD	YES
VBT1-S5-S24-SMT	5 Vdc	4.5~5.5 Vdc	24 Vdc	42 mA	5 mA	78%	SMD	NO
VBT1-S12-S3.3-SMT	12 Vdc	10.8~13.2 Vdc	3.3 Vdc	300 mA	30 mA	75%	SMD	NO
VBT1-S12-S5-SMT	12 Vdc	10.8~13.2 Vdc	5 Vdc	200 mA	20 mA	69%	SMD	YES
VBT1-S12-S9-SMT	12 Vdc	10.8~13.2 Vdc	9 Vdc	111 mA	12 mA	73%	SMD	YES
VBT1-S12-S12-SMT	12 Vdc	10.8~13.2 Vdc	12 Vdc	84 mA	9 mA	73%	SMD	YES
VBT1-S12-S15-SMT	12 Vdc	10.8~13.2 Vdc	15 Vdc	67 mA	7 mA	74%	SMD	YES
VBT1-S12-S24-SMT	12 Vdc	10.8~13.2 Vdc	24 Vdc	42 mA	5 mA	79%	SMD	NO
VBT1-S15-S5-SMT	15 Vdc	13.5~16.5 Vdc	5 Vdc	200 mA	20 mA	74%	SMD	NO
VBT1-S15-S15-SMT	15 Vdc	13.5~16.5 Vdc	15 Vdc	67 mA	7 mA	79%	SMD	NO
VBT1-S24-S3.3-SMT	24 Vdc	21.6~26.4 Vdc	3.3 Vdc	300 mA	30 mA	69%	SMD	NO
VBT1-S24-S5-SMT	24 Vdc	21.6~26.4 Vdc	5 Vdc	200 mA	20 mA	70%	SMD	NO
VBT1-S24-S9-SMT	24 Vdc	21.6~26.4 Vdc	9 Vdc	110 mA	11 mA	72%	SMD	NO
VBT1-S24-S12-SMT	24 Vdc	21.6~26.4 Vdc	12 Vdc	83 mA	8 mA	75%	SMD	NO
VBT1-S24-S15-SMT	24 Vdc	21.6~26.4 Vdc	15 Vdc	67 mA	7 mA	76%	SMD	NO
VBT1-S24-S24-SMT	24Vdc	21.6~26.4 Vdc	24 Vdc	42 mA	5 mA	77%	SMD	NO

\*VB(X)T1-Series with ALT PIN config. (see dimensions, page 3)

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## OUTPUT SPECIFICATIONS

item	test conditions	min.	typ.	max.	units
output power		0.1		1	W
line regulation	for Vin change of 1%			1.2	%
	for Vin change of 1% (3.3 V output)			1.5	%
load regulation	10% to 100% full load (3.3 V output)		15	20	%
	10% to 100% full load (5 V output)		12.8	15	%
	10% to 100% full load (9 V output)		8.3	10	%
	10% to 100% full load (12 V output)		6.8	10	%
	10% to 100% full load (15 V output)		6.3	10	%
	10% to 100% full load (24 V output)		5	10	%
output voltage accuracy	see tolerance envelope graph				
temperature drift	@ 100% load			0.03	%/°C
output ripple/noise	20 MHz bandwidth		50	75	mVp-p
switching frequency	full load, nominal input (5 V/12 V)		100		KHz
	full load, nominal input (24 V)		500		KHz

## GENERAL SPECIFICATIONS

short circuit protection	<1 second
temperature rise at full load	25°C Max, 15°C typ.
cooling	free air convection
operating temperature range	-40°C to +85°C
storage temperature range	-55°C to +125°C
soldering temperature	260°C (1.5mm from case for 10 sec.)
storage humidity range	<95%
case material	plastic (UL94-V0)
safety <sup>2</sup>	approved to UL60950-1 (E222736)
MTBF	>3,500,000 hrs.
burn-in	full load at +85°C, for 4 hours at no-load and 4 hours at full load.

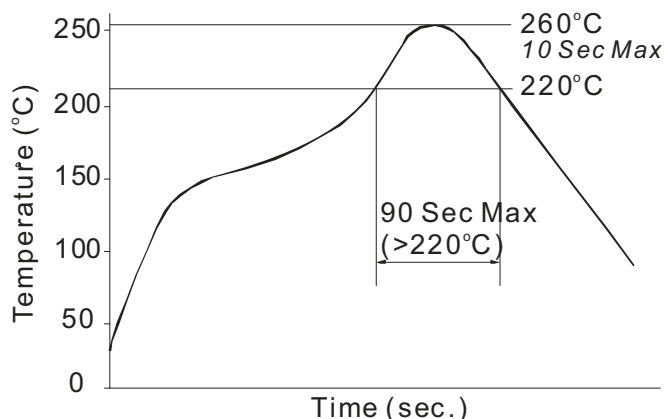
## ISOLATION SPECIFICATIONS

item	test conditions	min.	typ.	max	units
isolation voltage	tested for 1 min.	1000			Vdc
insulation resistance	test at 500 Vdc	1000			M Ω

**NOTE:**

1. All specifications measured at TA=25°C, humidity <75%, nominal input voltage and rated output load unless otherwise specified.
2. See table on page 1 for available models.

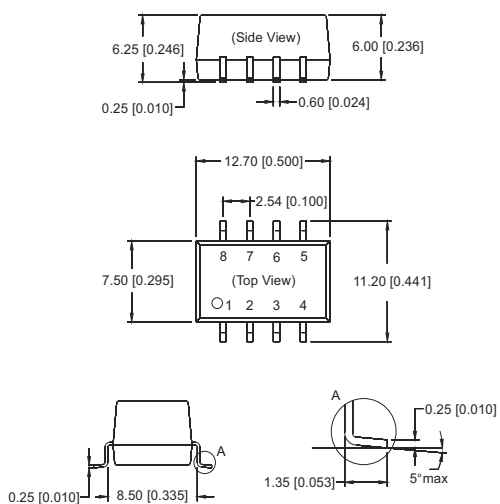
## REFLOW SOLDERING PROFILE



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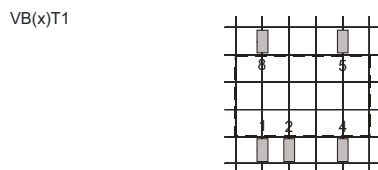
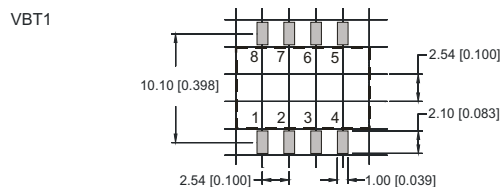
**DESCRIPTION:** dc-dc converter

## DIMENSIONS (mm)



Note:  
Unit: mm[inch]  
Pin section: 0.60 x 0.25 mm (0.024 x 0.010 inch)  
Pin tolerances: ±0.10 mm (±0.004 inch)  
General tolerances: ±0.25mm [±0.06inch]

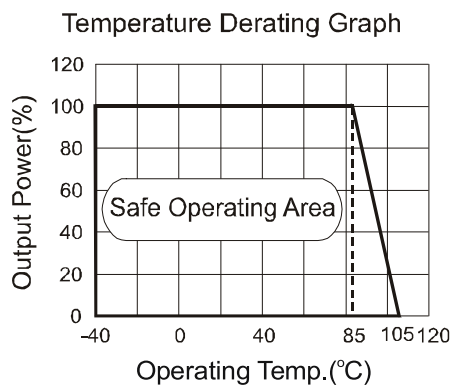
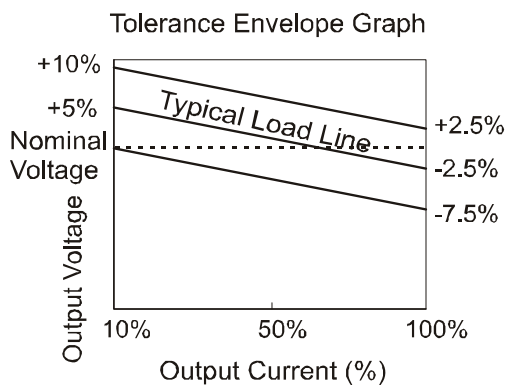
## RECOMMENDED FOOTPRINT



FOOTPRINT DETAILS		
Pin	SINGLE	ALT
1	-Vin	-Vin
2	+Vin	+Vin
4	-Vo	-Vo
5	+Vo	+Vo
3,6,7	NC	No Pin
8	NC	NC

NC:No Connection

## TYPICAL CHARACTERISTICS



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**APPLICATION NOTES:**

## - Input filtering

To reduce the reflected ripple current and minimize EMI, especially when the converter input is more than 2" away from the DC source, it is recommended to connect a low ESR electrolytic capacitor between Vin and Gnd. The values suggested are as shown in Table 1. If additional filtering is required, the capacitance may be increased, or expanded to an LC network as shown in Figure 1.

**TABLE 1**

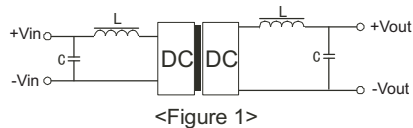
Input Voltage	External Input Capacitance
3.3, 5 V	4.7 $\mu$ F
12 V	2.2 $\mu$ F
15 V	2.2 $\mu$ F
24 V	1.0 $\mu$ F

## - Output filtering

An output capacitor is needed to meet output ripple requirements as shown in Table 2. Output capacitance may be increased for additional filtering, but should not exceed 10 $\mu$ F or expanded to an LC network as in Figure 1.

**TABLE 2**

Vout	External Output Capacitance
3.3, 5 V	4.7 $\mu$ F
9 V	2.2 $\mu$ F
12 V	1.0 $\mu$ F
15 V	0.47 $\mu$ F
24 V	0.33 $\mu$ F



## - Minimum loading

During operation, the minimum output load should not be less than 10% of the full load, and that this product should never be operated under no load. If the actual output power is very small, please connect a resistor with proper resistance at the output end in parallel to increase the load.

## - Input Regulation

This converter accepts a narrow input range. With a semi-regulated design, the converter's output voltage will also change proportionally with the input voltage. To accept a wider input range and to improve line regulation, an input regulator can be added as shown in Fig. 2



## - Protection

The converter has minimal protection against input over-voltage or output over-load, and may be permanently damaged if exposed to these conditions. An input clamping device can be used for input voltage limiting. An input fuse or an output fuse also be used to protect against over-loading.

## - Dual outputs used as a single output

The +Vout and -Vout can be used to obtain a single output that is the sum of the two outputs. In this case, the COM pin shouldn't be used.

## - Output Regulation

An external 3-terminal regulator can be connected to the output of the converter to achieve full regulation. Make sure the converter's output voltage provides sufficient head room for the regulator. An additional benefit is that the built-in protection features in the regulator, such as OCP, OTP, etc, will protect the converter also. In a complimentary supply, a negative output regulator must be used to achieve the negative regulated output.

