

VRAE-10E1A0 Series

Non-Isolated DC-DC Converter

MicroSIP Series

The Bel VRAE-10E1A Series is a part of the non-isolated DC/DC converter Power Module series. The modules use a SIP package. These converters are available in a range of output voltages from 0.59 VDC to 5.1 VDC over a wide range of input voltage 4.5 VDC -13.8 VDC. The efficiency is typically 91% at 3.3 Vout (Vin = 12 VDC) at full load.



Key Features & Benefits

- Wide Input Voltage Range 4.5 VDC – 13.8 VDC
- 0.59 VDC – 5.1 VDC / 10 A Output
- Non-Isolated
- High Efficiency
- Fixed Frequency
- Low Cost
- Under-Voltage Lockout
- OCP/SCP
- Remote On/Off
- Class II, Category 2, Non-Isolated DC/DC Converter (refer to IPC-9592B)
- UL60950-1-2 2nd Edition Recognized (UL/cUL)

Applications

- Networking
- Computers and Peripherals
- Telecommunications

1. MODEL SELECTION

PART NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
VRAE-10E1A0	0.59 VDC - 5.1 VDC	4.5 VDC - 13.8 VDC	10 A	50 W	91%

PART NUMBER EXPLANATION

V	R	AE	-	10	E	1A	x	x
Mount Type	RoHS	Series Name		Output Current	Input Range	Output Voltage	Suffix	Package
Vertical Mount	RoHS 6 Compliant	SIP		10 A	4.5 - 13.8 V	0.59 - 5.1 V	0 – Active High	G – Tray Packaging

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Input Supply Voltage		-0.3	-	15	V
Ambient Temperature		-40	-	85	°C
Storage Temperature		-55	-	125	°C
Altitude		-	-	2000	m

NOTE: All specifications are typical at 25 °C unless otherwise stated.

3. INPUT SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Input Voltage	$V_o \leq 3.63$ V	4.5	-	13.8	V
	$V_o > 3.63$ V	7.0	-	13.8	
Input Current (Full load)	An input line fuse must always be used.	-	-	9.5	A
Input Current (No load)		-	-	120	mA
Remote Off Input Current		-	10	25	mA
Input Reflected Ripple Current (pk-pk)	With simulated source impedance of 1000 nH, 5 Hz to 20 MHz Use a 1000 μ F / 25 V AL-Cap with ESR = 0.03 ohm max and 2*100 μ F/25V Tan-Cap with ESR = 0.013 ohm max at 100 kHz @ 25°C.	-	30	100	mA
Input Reflected Ripple Current (rms)		-	15	30	mA
I ² t Inrush Current Transient		-	-	1	A ² s
Turn-on Voltage Threshold	A 30.1K resistor is connected from Enable to Vin	4.15	4.3	4.45	V
Turn-off Voltage Threshold		3.7	4.1	4.3	V

NOTE: All specifications are typical at 25 °C unless otherwise stated.

4. OUTPUT SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Output Voltage Set Point Accuracy	$V_{in} = 12\text{ V}$, $I_{out} = \text{full load}$	-2	-	+2	% V_o , set
Load Regulation		-	± 0.3	± 1	% V_o , set
Line Regulation		-	± 0.3	± 1	% V_o , set
Regulation Over Temperature		-	0.3	-	% V_o , set
Output Current		0	-	10	A
Output DC Current Limit		10.2	13	15	A
Output Ripple and Noise (pk-pk)	0 – 20 MHz BW, with a 1 μF ceramic capacitor and a 10 μF tantalum cap at output.	-	70	100	mV
Output Ripple and Noise (rms)		-	20	30	mV
Short Circuit Surge Transient		-	-	5	A ² s
Turn-on Time		-	-	7	ms
Overshoot at Turn-on		-	-	1	%
Output Capacitance		0	-	1000	μF
TRANSIENT RESPONSE					
50% ~ 100% Max Load	$di/dt = 2.5\text{ A}/\mu\text{S}$; $V_{in} = 12\text{ V}$; with 10 μF tantalum cap and 1 μF ceramic at the output, $T_a = 25^\circ\text{C}$	-	120	200	mV
Settling Time		-	30	50	μs
100% ~ 50% Max Load		-	120	200	mV
Settling Time		-	20	50	μs

NOTE: All specifications are typical at normal input, full load at $T_a = 25^\circ\text{C}$ unless otherwise stated.

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	$V_o = 5.0\text{ V}$	91	93	-	%
	$V_o = 3.3\text{ V}$	89	91	-	
	$V_o = 2.5\text{ V}$	87	89	-	
	$V_o = 1.8\text{ V}$	84	86	-	
	$V_o = 1.5\text{ V}$	83	85	-	
	$V_o = 1.2\text{ V}$	80	82	-	
	$V_o = 0.9\text{ V}$	73	75	-	
Switching Frequency		-	500	-	kHz
Output Voltage Trim Range	Wide Trim	0.591	-	5.1	V
MTBF	Calculated Per Bell Core SR-332 ($I_o = 80\%$ load; $V_{in} = 12\text{ V}$; $V_o = 5\text{ V}$; 200 LFM; $T_a = 25^\circ\text{C}$)	7 677 401			h
Weight		-	3.5	-	g
Dimensions (L x W x H)		0.65 x 0.41 x 0.32			in
		16.51 x 10.41 x 8.13			mm

NOTE: All specifications are typical at 25°C unless otherwise stated.

6. CONTROL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Remote On/Off (Active High)					
Signal Low (Unit Off)	Remote On/Off Pin is open, the unit is off	-0.3	-	0.4	V
Signal High (Unit On)		2.0	-	5.5	V



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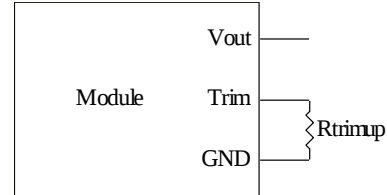
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Rev. K_12.17

7. OUTPUT TRIM EQUATIONS

Equation for calculating the trim resistor given the desired output voltage (V_o) is shown below. The R_{trim} resistor should be connected between the trim pin and GND pin.

$$R_{trim} = \frac{1.182}{V_o - 0.591} k\Omega$$



8. RIPPLE AND NOISE WAVEFORM

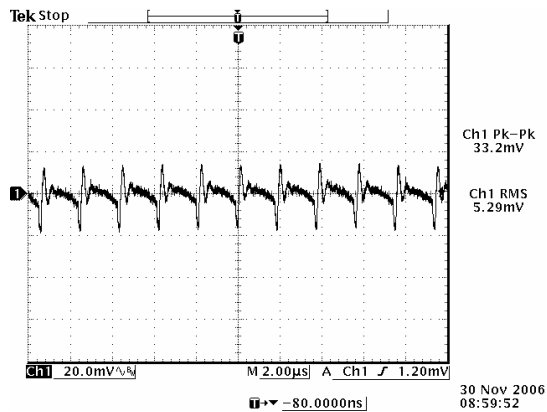


Figure 6. 12 V input, 0.591 V output

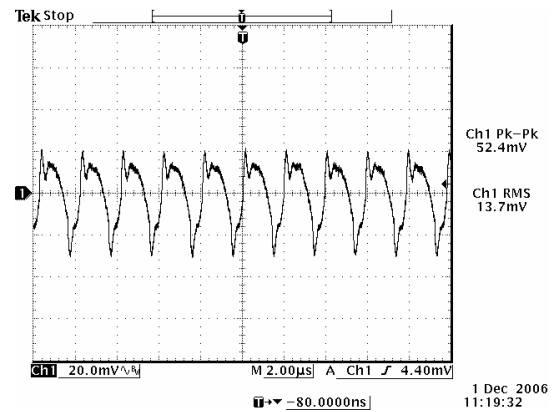


Figure 7. 12 V input, 3.3 V output.

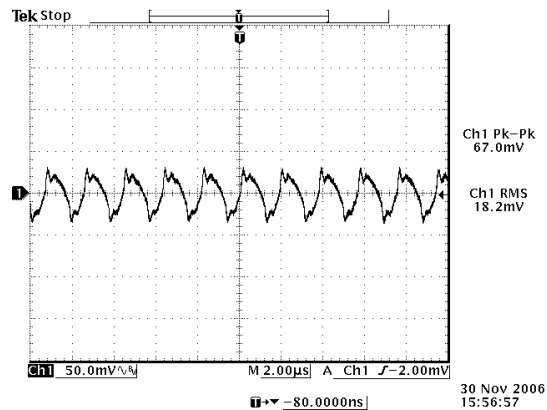
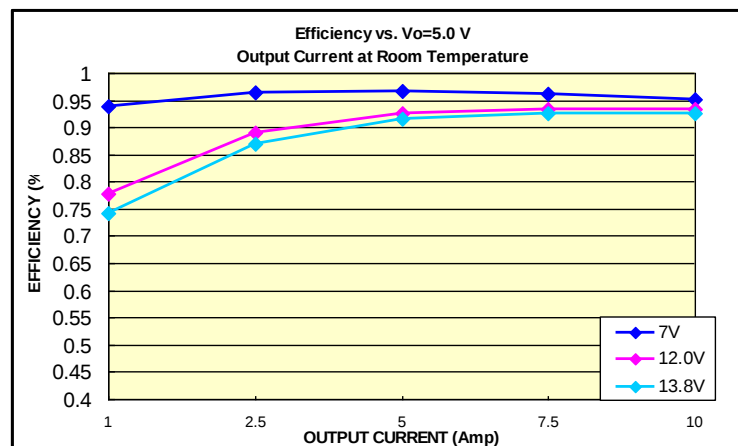
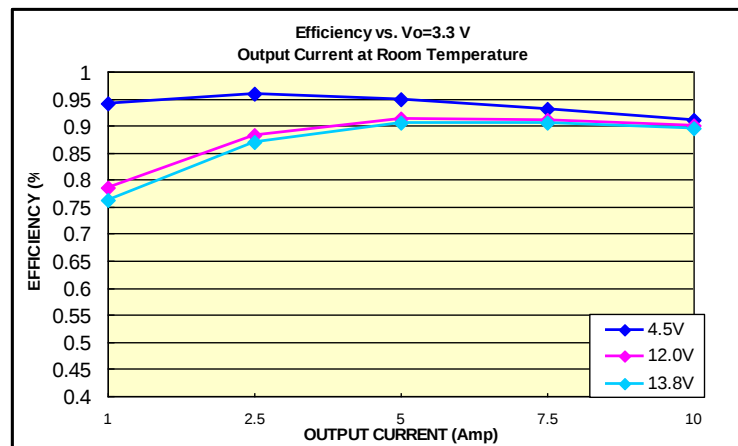
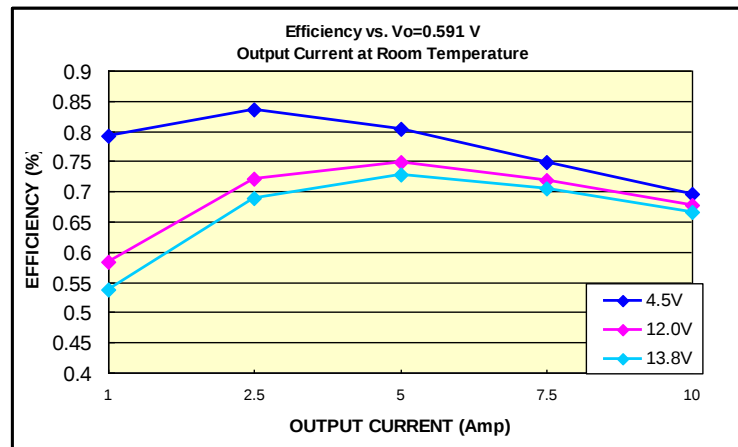


Figure 8. 12 V input, 5.0 V output.

NOTE: Ripple and noise at full load, 0-20 MHz BW, with a 1 μ F ceramic cap and a 10 μ F tantalum cap, and $T_a=25^\circ\text{C}$.

9. EFFICIENCY DATA



10. THERMAL DERATING CURVES

The thermal reference point T_{ref} is shown below. For reliable operation this temperature should not exceed 115 °C. The output power of the module should not exceed the rated power for the module.

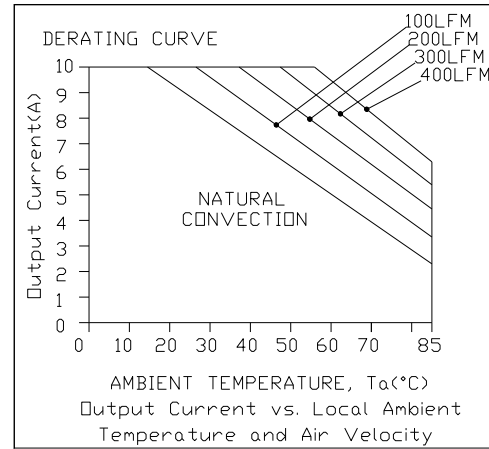
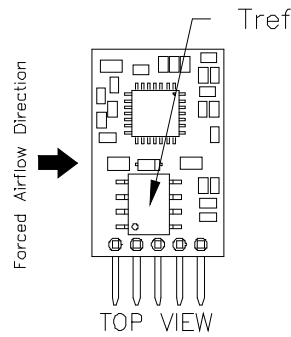


Figure 1. $V_{in}=12\text{ V}$, $V_{out}=5\text{ V}$

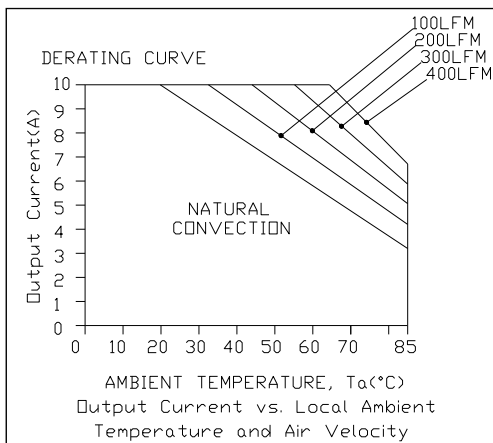


Figure 2. $V_{in}=12\text{ V}$, $V_{out}=3.3\text{ V}$

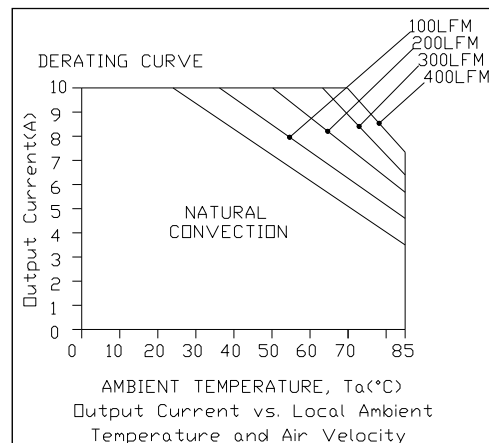


Figure 3. $V_{in}=12\text{ V}$, $V_{out}=2.5\text{ V}$

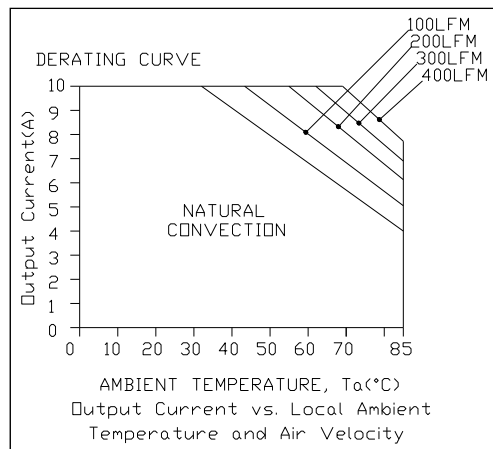


Figure 4. $V_{in}=12\text{ V}$, $V_{out}=1.2\text{ V}$

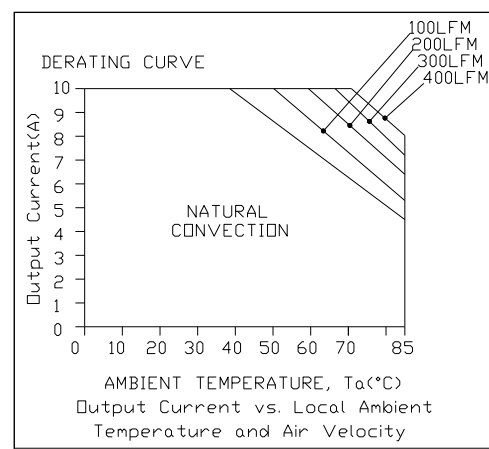


Figure 5. $V_{in}=12\text{ V}$, $V_{out}=0.59\text{ V}$

11. TRANSIENT RESPONSE WAVEFORMS

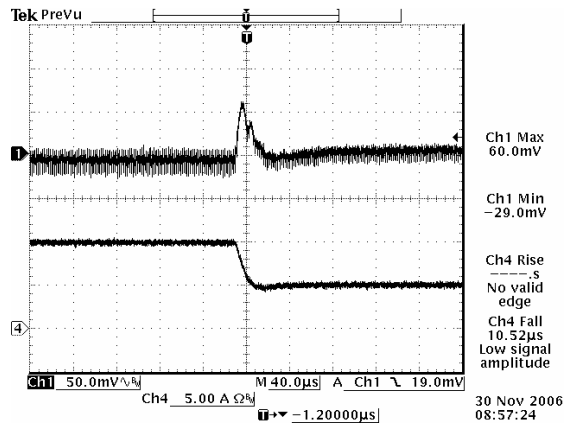


Figure 9. 100% to 50% load step at 12 V input, 0.591 V output

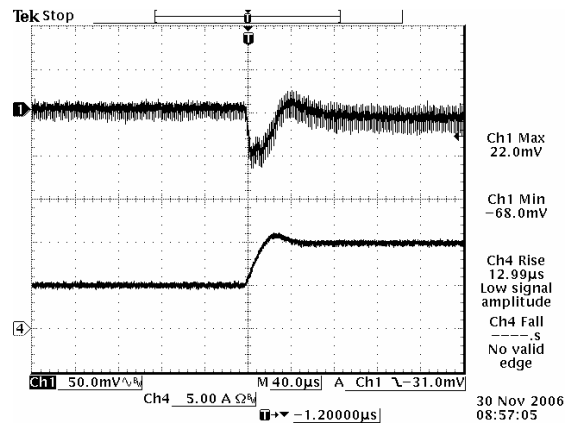


Figure 10. 50% to 100% load step at 12 V input, 0.591 V output

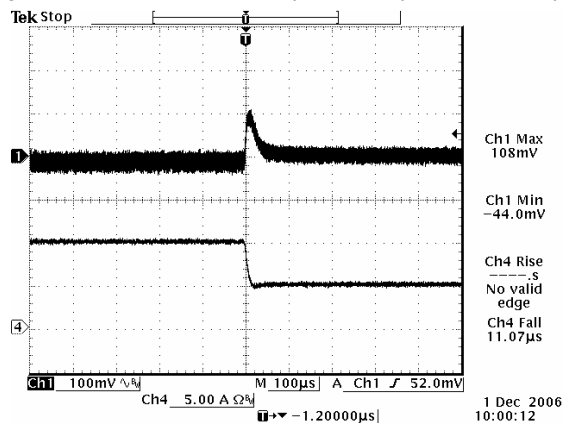


Figure 11. 100% to 50% load step at 12 V input, 3.3 V output

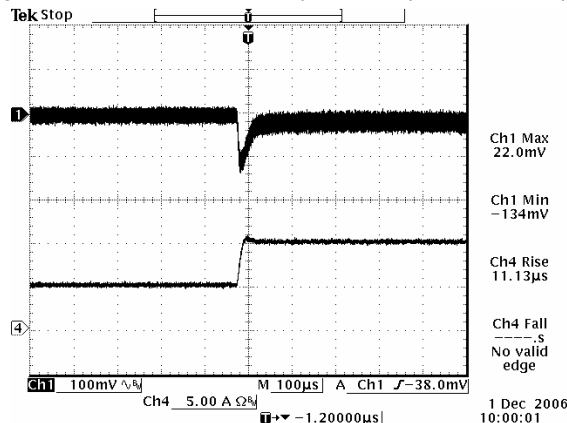


Figure 12. 50% to 100% load step at 12 V input, 3.3 V output

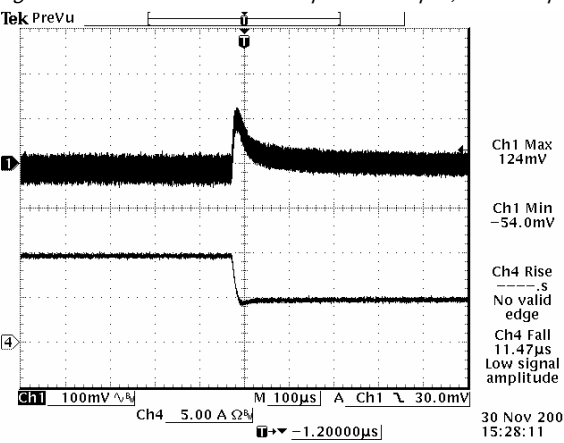


Figure 13. 100% to 50% load step at 12 V input, 5.0 V output

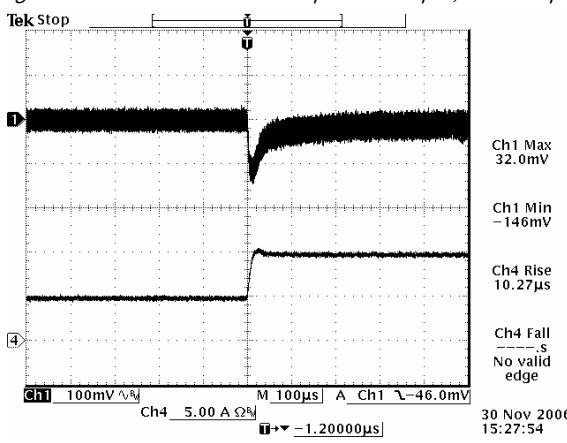
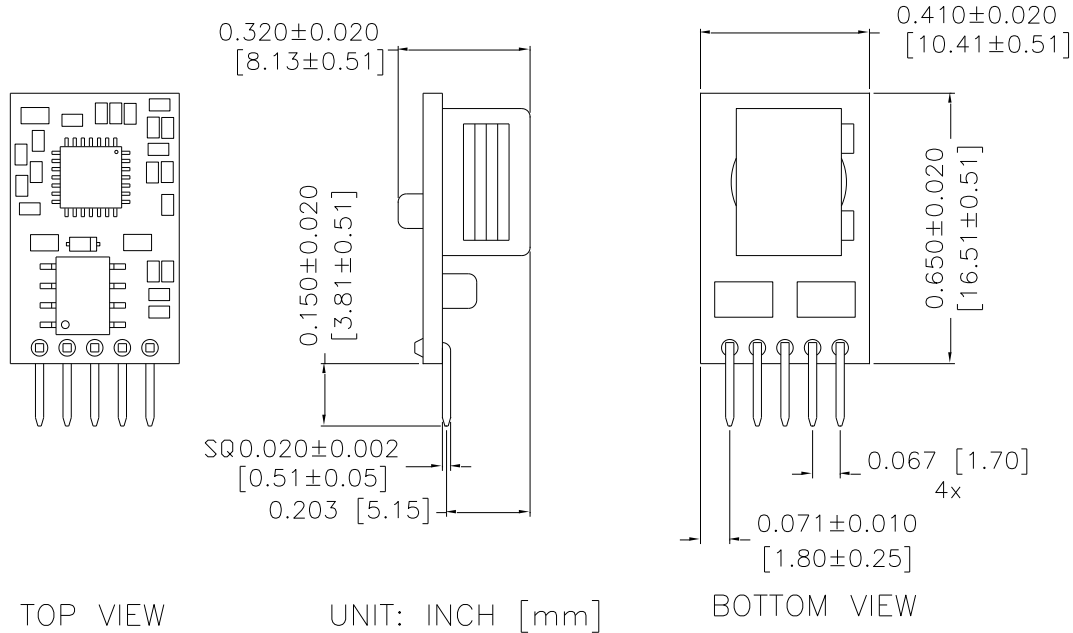


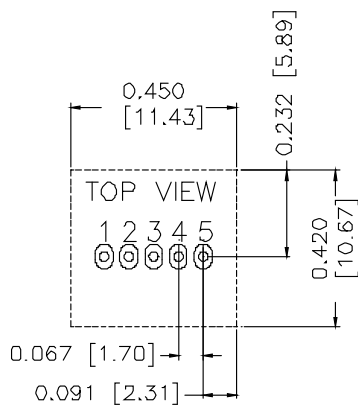
Figure 14. 50% to 100% load step at 12 V input, 5.0 V output

NOTE: Transient response at $di/dt=0.25 \text{ A}/\mu\text{s}$, with a $1\mu\text{F}$ ceramic cap and a $10\mu\text{F}$ tantalum cap at the output, and $T_a=25^\circ \text{C}$.

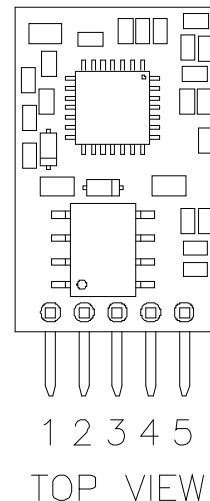
12. MECHANICAL OUTLINE



RECOMMENDED PAD LAYOUT



PAD: LENGTH 0.067 [Ø1.7] BOTH SIDE
 WIDTH 0.047 [Ø1.2] BOTH SIDE
 HOLE: Ø0.035 [Ø0.89] BOTH SIDE



PIN CONNECTIONS

PIN	NAME
1	ENABLE
2	Vin
3	GND
4	Vout
5	Trim

NOTE: This module is recommended and compatible with Pb-Free Wave Soldering and must be soldered using a peak solder temperature of no more than 260°C for less than 5 seconds.

NOTES:

- 1) All Pins: Material - Copper Alloy;
Finish – 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
- 2) Undimensioned components are shown for visual reference only.
- 3) All dimensions in inches (mm); Tolerances: x.xx +/-0.02 in [0.5 mm]. x.xxx +/-0.010 in [0.25 mm].

13. ASSEMBLY NOTE

Modules were designed for vertical insertion into host board. Experiments should be performed to make sure that the units meet the intended tilt specification. A fixture may be needed to make the module stand upright in assembly.

14. REVISION HISTORY

DATE	REVISION	CHANGE DESCRIPTION	APPROVAL
2010-04-22	G	Change operating temp range from 0~70°C to -40~85°C Add the data of full load input current	XF JIANG
2010-10-07	H	Update Thermal Derating Curves	XF JIANG
2014-3-24	I	Update MD	Shiyong Qian
2015-12-28	J	Add Assembly Note. Update mechanical drawing	Falling Tao
2017-12-15	K	Datasheet updated to the new Bel template	

For more information on these products consult: tech.support@psbel.com

NUCLEAR AND MEDICAL APPLICATIONS - Products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.

TECHNICAL REVISIONS - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.



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