NON-ISOLATED DC/DC CONVERTERS

5.5 Vdc - 13.8 Vdc Input 0.6 Vdc - 5.1 Vdc/1.5 A Output

Dec 28, 2015

Bel Power, Inc. , a subsidiary of Bel Fuse, Inc.

xRAE-01E1A0 RoHS Compliant Rev.H

Features

- Non-Isolated
- High Efficiency
- Fixed Frequency
- Low Cost
- Wide Input
- Input Under-Voltage Lockout
- Wide Trim
- OCP/SCP
- Remote On/Off
- Class 2, Category 2, Non-Isolated DC/DC Converter (refer to IPC-9592B)
- TUV EN60950-1 Recognized (Pending)

Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The Bel xRAE-01E1A0 is a non-isolated dc/dc converter power module with an adjustable output voltage. This converter is capable of providing a wide range of output voltages from 0.6 Vdc to 5.1 Vdc over a wide range of input voltages (VIN = 5.5 Vdc - 13.8 Vdc) with the use of an external resistor.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number	
					Vertical Thru Hole Mount	Horizontal Surface Mount
0.6 Vdc -5.1 Vdc	5.5 Vdc-13.8 Vdc	1.5 A	7.65 W	84%	VRAE-01E1A0	SRAE-01E1A1

Notes: Add “G” suffix at the end of the model number to indicate Tray Packaging.

Part Number Explanation

V	R	AE	–	01	E	1A	0	x
1	2	3		4	5	6	7	8

1 --- Vertical mount, change “V” to “S” means Surface mount
2 --- RoHS 6, change “R” to “7” means RoHS 5
3 --- Series name
4 --- Series code
5 --- Wide input range (5.5-13.8V)
6 --- Wide output range (0.6-5.1V)
7 --- Mount option
8 --- Package

Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Input Supply Voltage	-0.3	-	15	V	
Ambient Temperature	0	-	70	°C	
Storage Temperature	-55	-	125	°C	
Altitude	-	-	2000	m	

Note: Ratings used beyond the maximum ratings may cause a reliability degradation of the converter or may permanently damage the device.

Input Specifications

Parameter	Min	Typ	Max	Unit	Notes
Operating Input Voltage	5.5	12	13.8	V	
Input Current (full load)	-	-	1.4	A	
Input Current (no load)	-	40	100	mA	
Remote Off Input Current	-	10	25	mA	
Input Reflected Ripple Current (rms)		10	20	mA	With simulated source impedance of 1000 nH, 5 Hz to 20 MHz. Use a 1000 uF/25 V AL-Cap with ESR=0.03 ohm max and 2*100 Uf/25V Tan-Cap with ESR=0.013 ohm max at 100 kHz@25°C.
Input Reflected Ripple Current (pk-pk)	-	30	50	mA	
I^2t Inrush Current Transient	-	-	1	A^2s	
Turn-on Voltage Threshold	4.00	4.15	4.30	V	

CAUTION: This converter is not internally fused. An input line fuse must be used in application.
Recommend a fast-acting fuse with maximum rating of 3A on system board. Refer to the fuse manufacture's datasheet for further information.

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

Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point	-2	-	2	%Vo,set	Vin= 12 V, Iout=full load
Load Regulation	-	±0.2	±0.5	%Vo,set	
Line Regulation	-	±0.2	±0.5	%Vo,set	
Regulation Over Temperature (0°C to 70°C)	-	0.3	-	%Vo,set	
Ripple and Noise (pk-pk)	-	10	20	mV	0-20 MHz BW, with a 10 uF tantalum capacitor and 1 uF ceramic capacitor at the output.
Ripple and Noise (rms)	-	3	6	mV	
Ripple and Noise (pk-pk) under worst case	-	15	30	mV	over all operating input voltage, load and temperature conditions.
Output Current Range	0	-	1.5	A	
Output DC Current Limit	2.17	3.2	3.6	A	

Output Specifications (continued)

Parameter		Min	Typ	Max	Unit	Notes
Short Circuit Surge Transient		-	-	1	A^2s	Vo≤20 mV, Hiccup Mode
Turn on Time		-	3	5	mS	
Overshoot at Turn on		-	-	1	%	
Output Capacitance		100	-	1000	uF	
Transient Response						
△V50%~100% of Max Load	Overshoot	-	40	80	mV	di/dt=0.25 A/uS; Vin=12 V; with a 10 uF tantalum capacitor and a 1 uF ceramic capacitor at the output.
	Settling Time	-	50	100	uS	
△V100%~50% of Max Load	Overshoot	-	40	80	mV	
	Settling Time	-	50	100	uS	

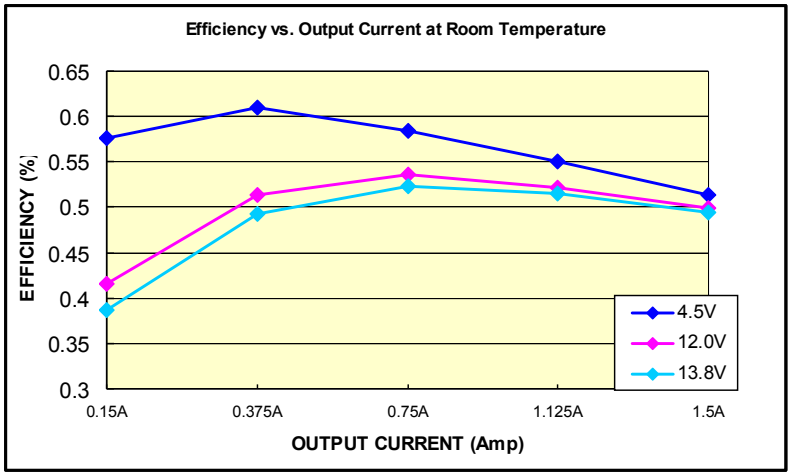
Note: All specifications are typical at nominal input, full load at 25°C unless otherwise stated.

General Specifications

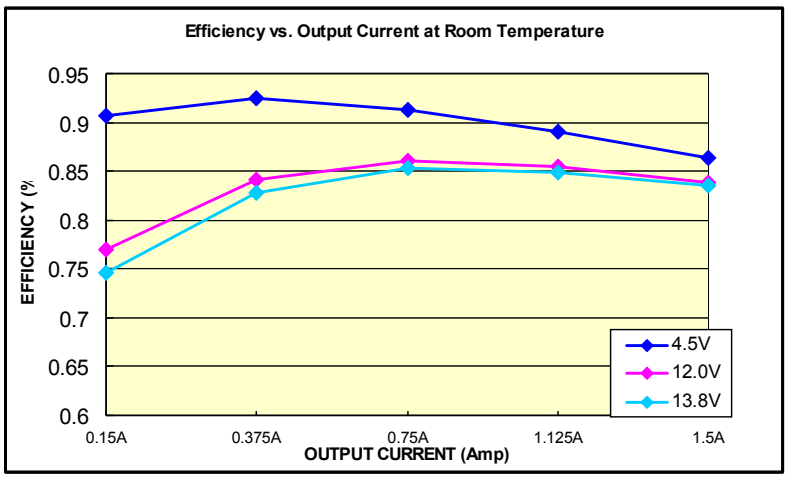
Parameter	Min	Typ	Max	Unit	Notes
Efficiency Vo=5.0 V Vo=3.3 V Vo=0.6 V	 85 81 45	 88 84 50	 - - -	 % % %	Vin=12 V
Switching Frequency	-	500	-	kHz	
Output Voltage Trim Range	0.6	-	5.1	V	
Weight	-	2	-	g	
FIT	100			-	Calculated Per Bell Core SR-332 (Vin=12 V, Vo=5.0 V, Io=80% load, 0 LFM, T_a = 25 °C, FIT=10^9/MTBF)
Dimensions Inches (L × W × H) Millimeters (L × W × H)	 0.40 x 0.41 x 0.299 10.16 x 10.41 x 7.59			-	VRAE-01E1A0
Dimensions Inches (L × W × H) Millimeters (L × W × H)	 0.40 x 0.41 x 0.309 10.16 x 10.41 x 7.85			-	SRAE-01E1A1

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

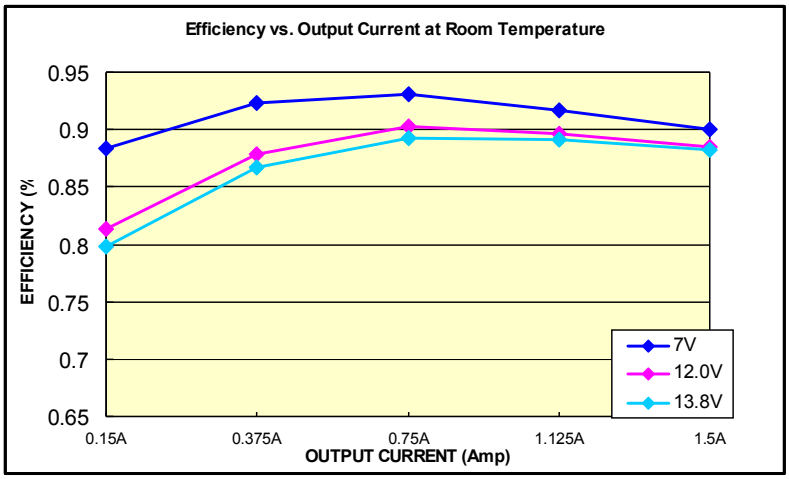
Efficiency Data



Vo=0.6V

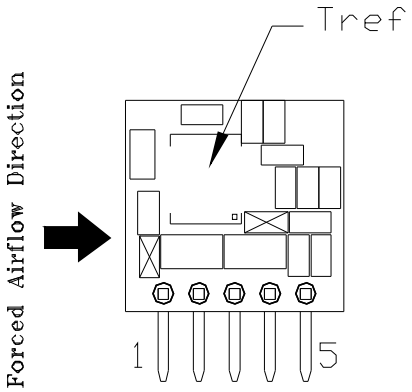


Vo=3.3V

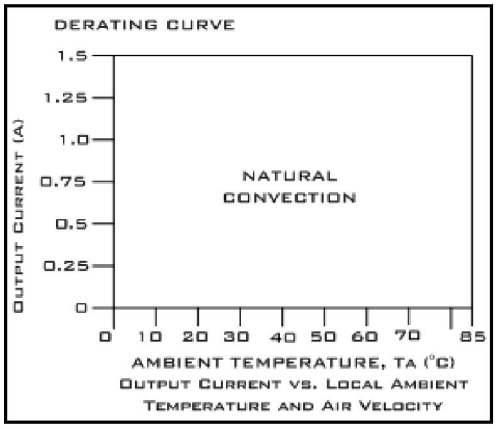


Vo=5.0V

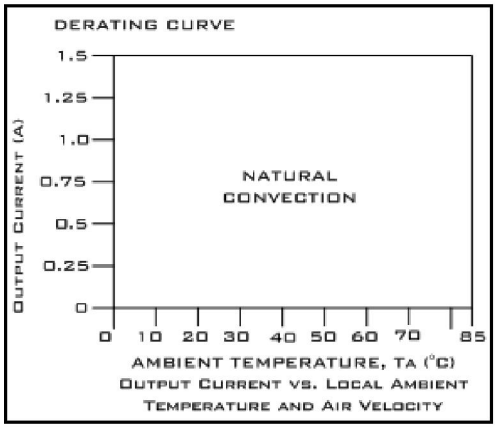
Thermal Derating Curves



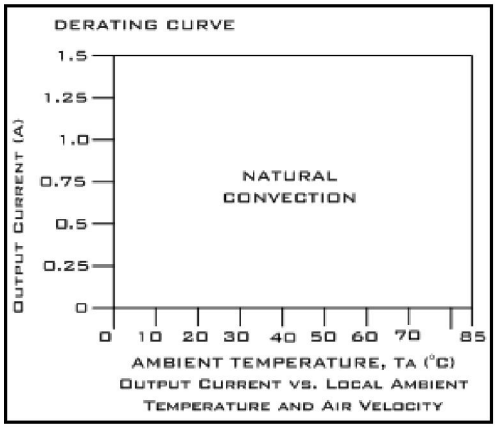
The thermal reference point Tref is shown above. For reliable operation this temperature should not exceed 115°C. The output power of the module should not exceed the rated power for the module.



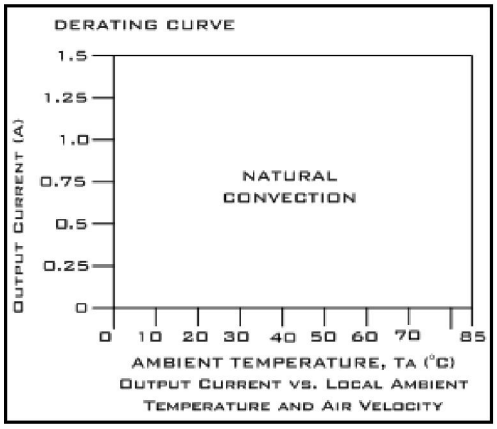
Vin=12 V, Vout=5 V



Vin=12 V, Vout=3.3 V

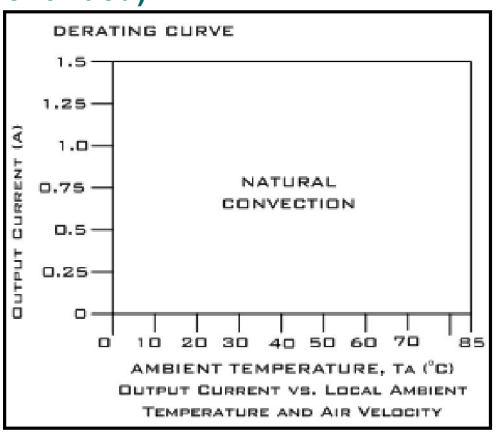


Vin=12 V, Vout=2.5 V



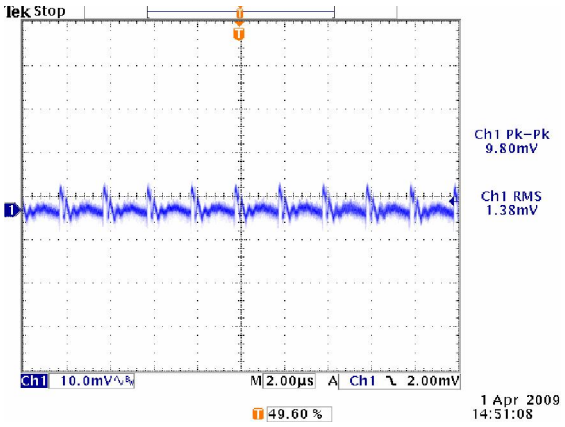
Vin=12 V, Vout=1.2 V

Thermal Derating Curves (continued)

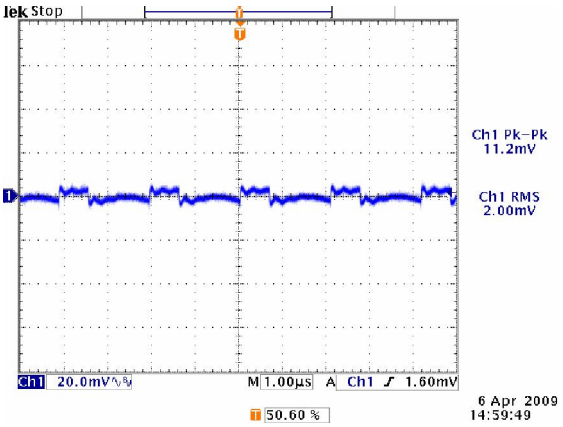


Vin=12 V, Vout=0.6 V

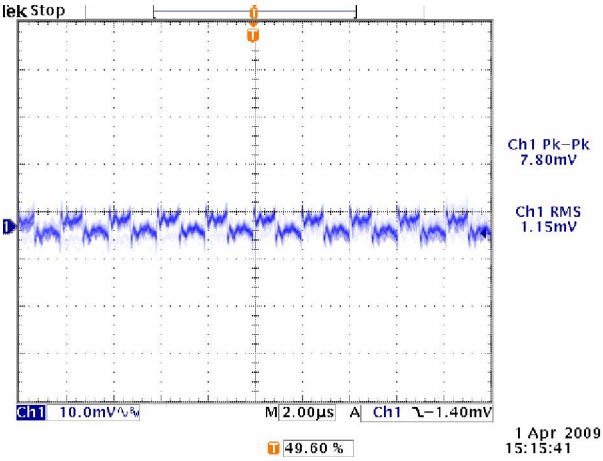
Ripple and Noise Waveforms



12V input, 0.6V output



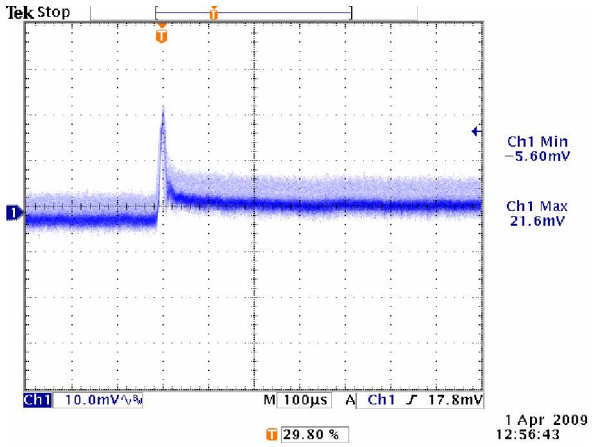
12V input, 3.3V output



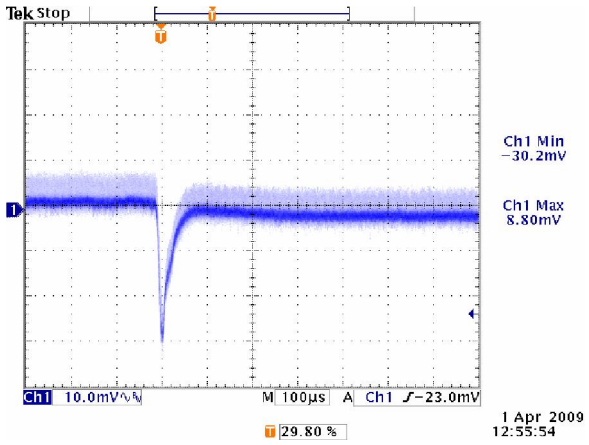
12V input, 5V output

Note: Ripple and Noise at 0-20 MHz BW, with a 10 uF tantalum capacitor and 1 uF ceramic capacitor at the output

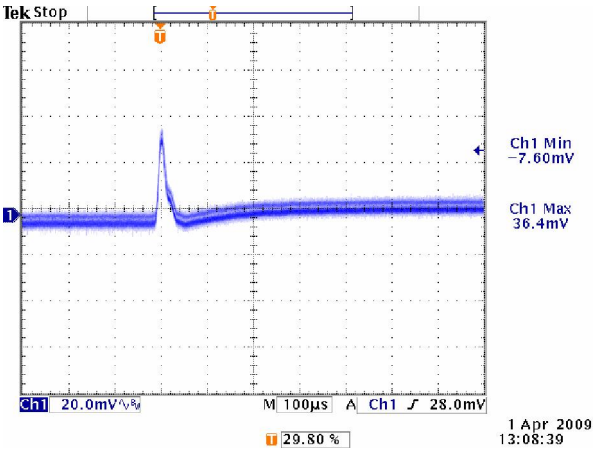
Transient Response Waveforms



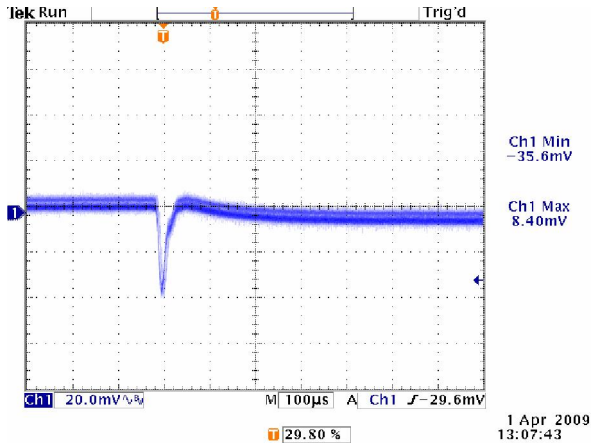
100%-50% Load Transients at Vin=12V,Vout=0.6V



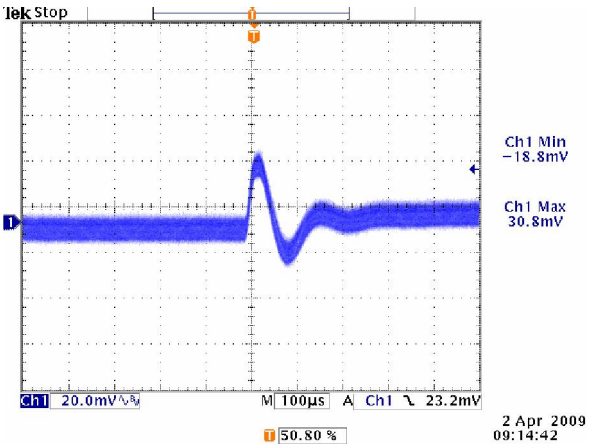
50%-100% Load Transients at Vin=12V,Vout=0.6V



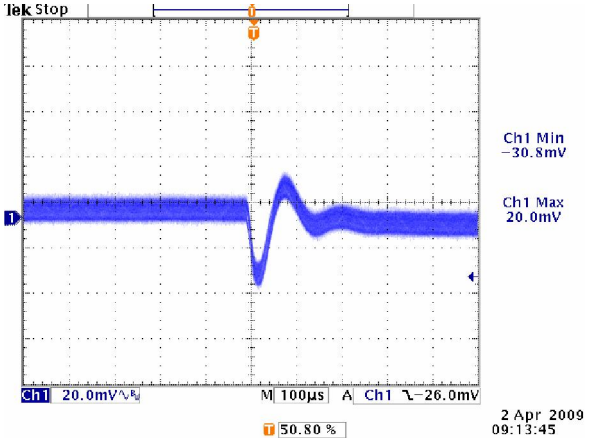
100%-50% Load Transients at Vin=12V,Vout=3.3V



50%-100% Load Transients at Vin=12V,Vout=3.3V



100%-50% Load Transients at Vin=12V,Vout=5.0V



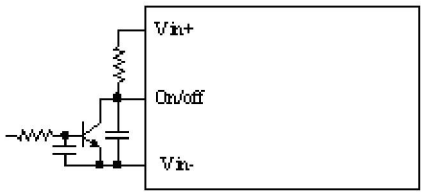
50%-100% Load Transients at Vin=12V,Vout=5.0V

Note: Transients at di/dt=0.25 A/uS; Vin=12 V; with a 10 uF tantalum capacitor and a 1 uF ceramic capacitor at the output.

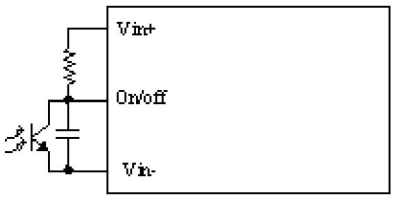
Remote On/Off

Parameter		Min	Typ	Max	Unit	Notes
Signal Low (Unit Off)	True Active High	-0.3	-	0.8	V	Remote On/Off Pin is open, the unit is off.
Signal High (Unit On)		2.7	-	6.0	V	

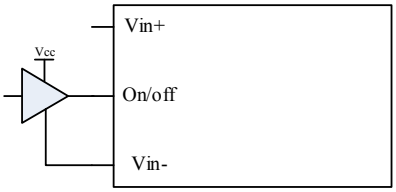
Recommended remote on/off circuit for true active high



Control with open collector/drain circuit



Control with photocoupler circuit

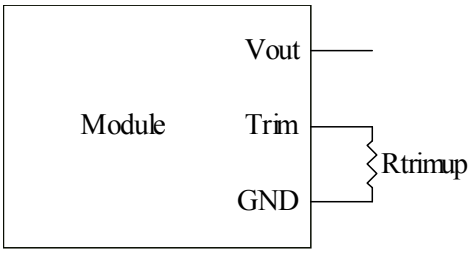


Control with logic circuit

Output Trim Equations

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

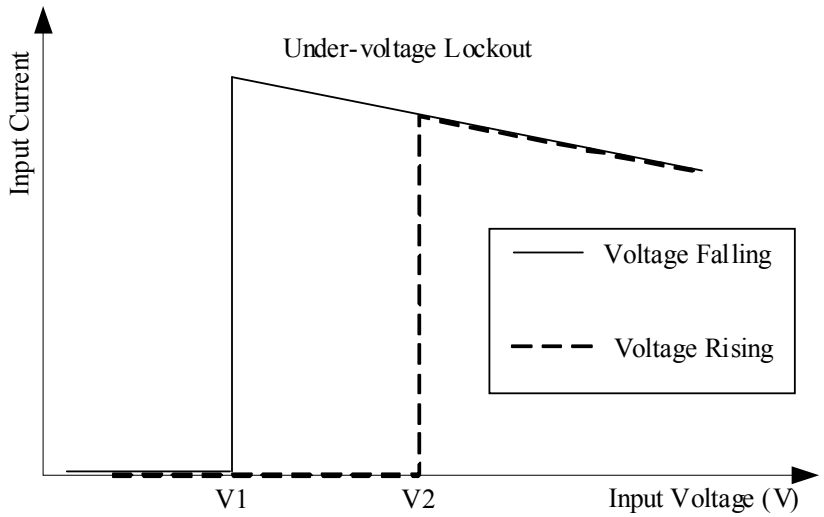
$$Rtrim = \frac{1.176}{Vo - 0.6} \quad k\Omega$$



Over Current Protection

The module is equipped with internal current-limiting circuitry in order to provide protection in a fault output overload condition. The module will be in hiccup mode when the output current exceeds the current limit.

Input Under-voltage Lockout



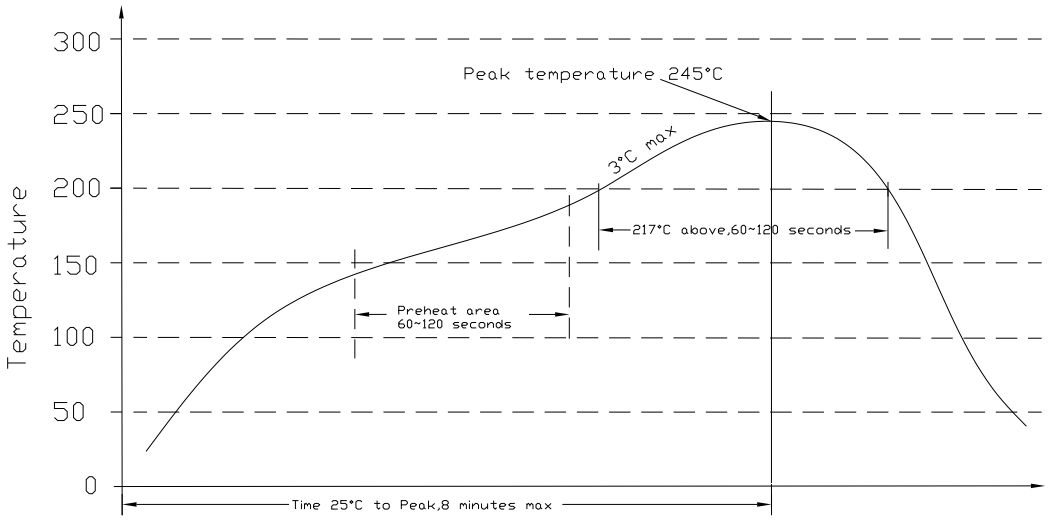
V1=4.0V
V2=4.3V

Assembly Note

Modules for VRAE-01E1A0 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

Soldering Information

The SRAE-01E1A1G modules are designed to be compatible with a Paste-In-Hole assembly process. The suggested Pb-free solder paste is Sn/Ag/Cu(SAC). The recommended reflow profile using Sn/Ag/Cu solder is shown in the following. Recommended reflow peak temperature is 245℃ while the part can withstand peak temperature of 260℃ maximum for 10seconds. This profile should be used only as a guideline. Many other factors influence the success of SMT reflow soldering. Since your production environment may differ, please thoroughly review these guidelines with your process engineers.



MSL Rating

The SRAE-01E1A1G modules have a MSL rating of 3.

Storage and Handling

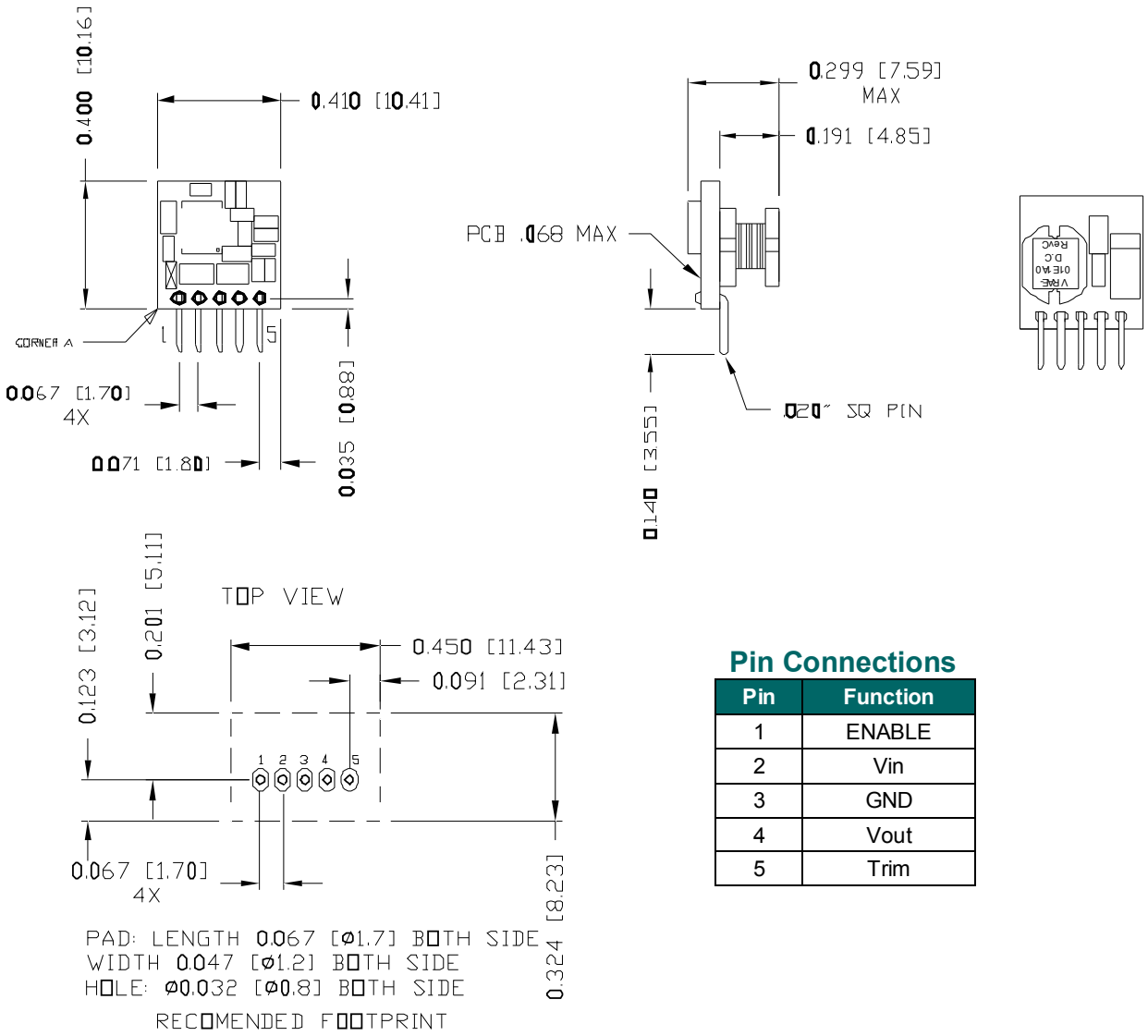
The SRAE-01E1A1G modules are designed to be compatible with J-STD-033 Rev:A (Handling, Packing, Shipping and Use of Moisture /Reflow Sensitive surface Mount devices). Moisture barrier bags (MBB) with desiccant are applied. The recommended storage environment and handling procedure is detailed in J-STD-033.

Pre-baking

This component has been designed, handled, and packaged ready for pb-free reflow soldering. If the assembly shop follows J-STD-033 guidelines, no pre-bake of this component is required before being reflowed to a PCB. However, if the J-STD-033 guidelines are not followed by the assembler, Bel recommends that the modules should be pre-baked @ 120~125℃ for a minimum of 4 hours (preferably 24 hours) before reflow soldering.

Mechanical Outline

VRAE-01E1A0



Pin Connections

Pin	Function
1	ENABLE
2	Vin
3	GND
4	Vout
5	Trim

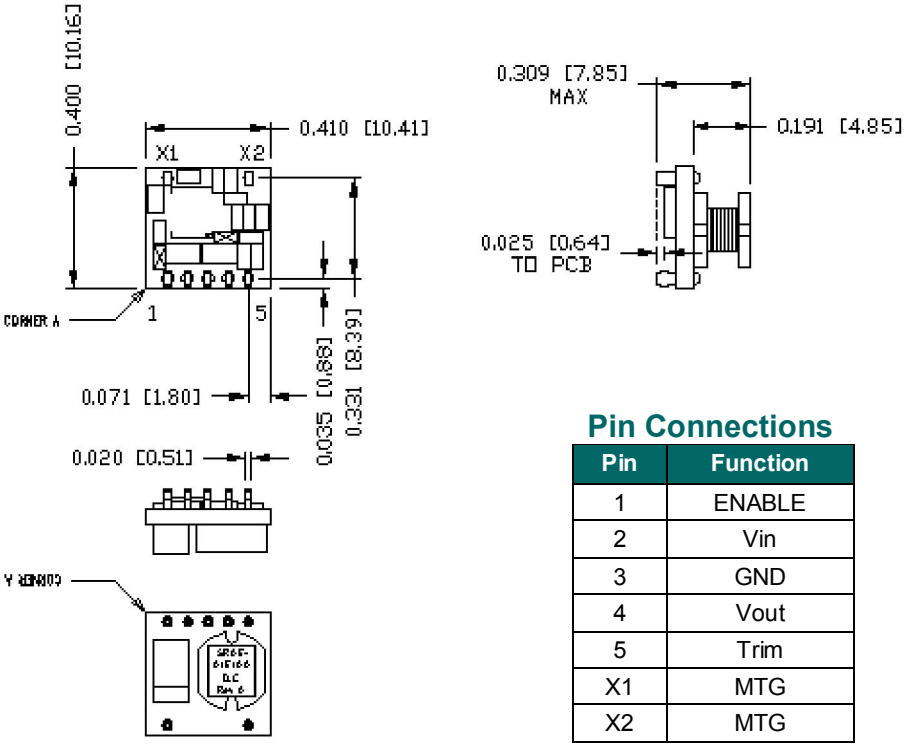
Note: This module is recommended and compatible with Pb-Free Wave Soldering and must be soldered using a peak solder temperature of no more than 260ºC for less than 5 seconds.

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[0.5mm]. x.xxx +/-0.005 in[0.13mm].

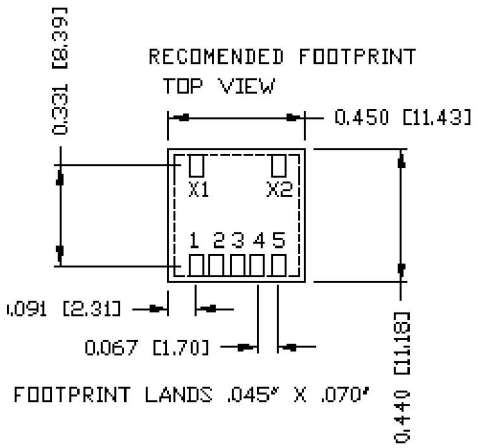
Mechanical Outline (continued)

SRAE-01E1A1



Pin Connections

Pin	Function
1	ENABLE
2	Vin
3	GND
4	Vout
5	Trim
X1	MTG
X2	MTG



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Revision History

Date	Version	Changes Detail	Approval
2009-3-16	A	First release	
2009-4-2	B	Update mechanical drawing	
2009-4-21	C	1. Add thermal reference point; 2. Remove some "TBD" information.	
2009-5-5	D	1. Replace the "TBD" in specification with data; 2. Add efficiency curve, NR and TR waveforms; 3. Update Trim	HAN
2009-6-3	E	The maximum voltage for Signal High (Unit On) is changed from 18V to 6V.	T. Bubriski
2010-2-23	F	Released to production.	T. Bubriski
2010-10-12	G	1. The minimum voltage for Signal High (Unit On) is changed from 2.4V to 2.7V; 2. Updated the mechanical outline drawing for the VRAE-01E1A0.	A.DeMarco
2015-12-28	H	Add Assembly Note. Update mechanical drawing	Falling Tao

RoHS Compliance

Complies with the European Directive 2011/65/EU, calling for the elimination of lead and other hazardous substances from electronic products.

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