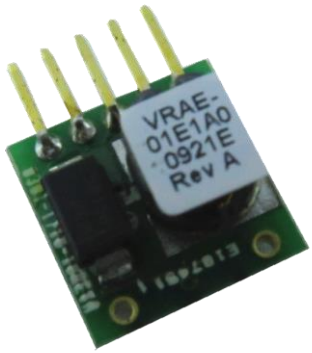
VRAE-01E1A0

Non-Isolated DC-DC Converter

The Bel VRAE-01E1A0 is a non-isolated DC/DC converter power module with an adjustable output voltage. This converter can provide a wide range of output voltage from 0.6 VDC to 5.1 VDC over a wide range of input voltage (VIN = 5.5 - 13.8 VDC) with the use of an external resistor.



RoHS Compliant

Key Features & Benefits

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

Applications

- Networking
- Computers and Peripherals
- Telecommunications

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
VRAE-01E1A0G	0.6 - 5.1 VDC	5.5 - 13.8 VDC	1.5 A	7.65 W	84%

PART NUMBER EXPLANATION

V	R	AE	-	01	E	1A	0	G
Mounting Type	RoHS Status	Series Name		Output Current	Input Range	Output Voltage	Active Logic	Package Type
Vertical Mount	RoHS	SIP		1.5 A	5.5 - 13.8 V	0.6 - 5.1 V	Active High	Tray Package

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
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.

3. INPUT SPECIFICATIONS

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

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
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)	With simulated source impedance of 1000 nH, 5 Hz to 20 MHz. Use a 1000 µF/25 V AL-Cap with ESR = 0.03 ohm max and 2*100 µF/ 25 V Tan-Cap with ESR = 0.013 ohm max at 100 kHz @ 25°C	-	10	20	mA
Input Reflected Ripple Current (pk-pk)		-	30	50	mA
I^2t Inrush Current Transient		-	-	1	A^2s
Turn-on Voltage Threshold		4.0	4.15	4.3	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.

4. OUTPUT SPECIFICATIONS

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

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Output Voltage Set Point		Vin = 12 V, Iout = full load	-2	-	2	%Vo,set
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
Output Ripple and Noise (pk-pk)		0-20 MHz BW, with a 10 µF tantalum capacitor and 1 µF ceramic capacitor at the output.	-	10	20	mV
Output Ripple and Noise (rms)			-	3	6	mV
Ripple and Noise (pk-pk) under worst case		Over entire operating input voltage range, load and temperature conditions.	-	15	30	mV
Output Current Range			0	-	1.5	A
Output DC Current Limit			2.17	3.2	3.6	A
Short Circuit Surge Transient		Vo ⩽ 20 mV, Hiccup Mode	-	-	1	A^2s
Turn on Time			-	3	5	ms
Overshoot at Turn on			-	-	1	%
Output Capacitance			100	-	1000	µF
Transient Response						
△V 50%~100% of Max Load	Overshoot	di/dt = 0.25 A/µs; Vin = 12 V; with a 10 µF tantalum capacitor and a 1 µF ceramic capacitor at the output.	-	40	80	mV
	Settling Time		-	50	100	µs
△V 100%~50% of Max Load	Overshoot		-	40	80	mV
	Settling Time		-	50	100	µs

5. GENERAL SPECIFICATIONS

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

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vo = 5.0 V	Vin = 12 V	85	88	-	%
	Vo = 3.3 V		81	84	-	%
	Vo = 0.6 V		45	50	-	%
Switching Frequency			-	500	-	kHz
Output Voltage Trim Range			0.6	-	5.1	V
FIT		Calculated Per Bell Core SR-332 (Vin = 12 V, Vo = 5.0 V, Io = 80% load, 0 LFM, Ta = 25°C, FIT = 10^9/MTBF)	-	100	-	-
Weight			-	2	-	g
Dimensions (L × W × H)			0.41 x 0.299 x 0.40			inch
			10.41 x 7.59 x 10.16			mm

6. EFFICIENCY DATA

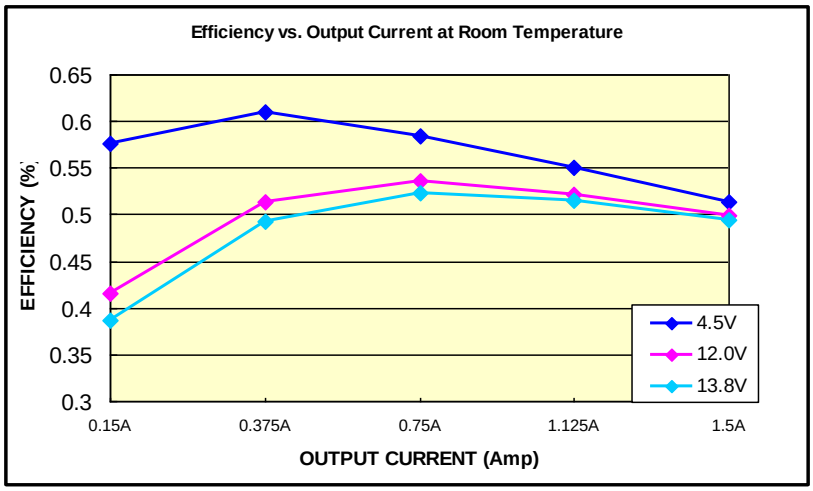


Figure 1. Efficiency data at Vo = 0.6 V

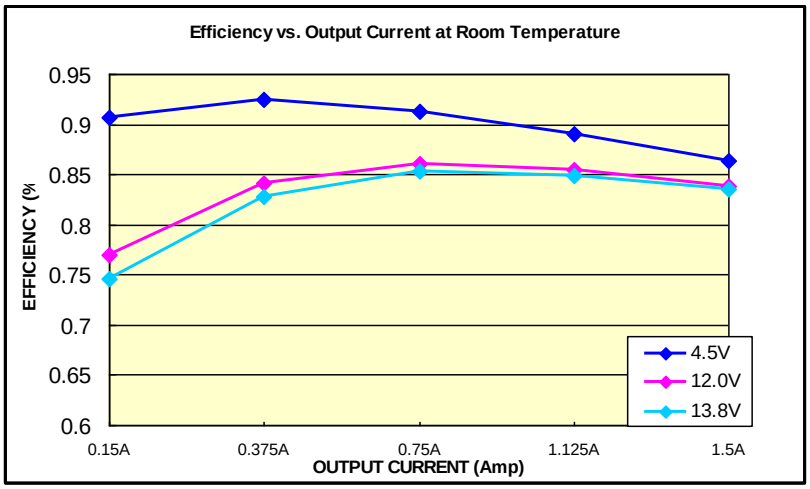


Figure 2. Efficiency data at Vo = 3.3 V

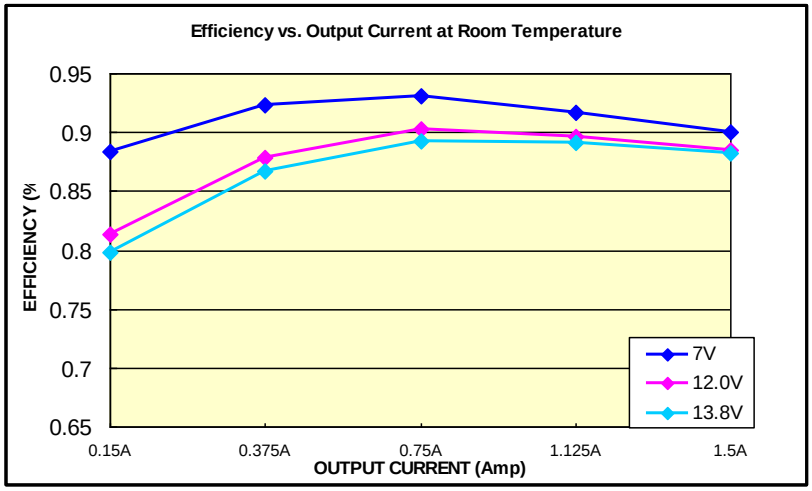


Figure 3. Efficiency data at Vo = 5.0 V

7. REMOTE ON/OFF

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit Off)	Active High	Remote On/Off Pin is open, the unit is off.	-0.3	-	0.8	V
Signal High (Unit On)			2.7	-	6.0	V

Recommended remote on/off circuit for active high:

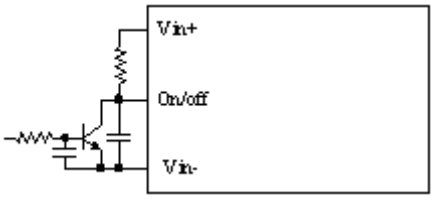


Figure 4. Control with open collector/drain circuit

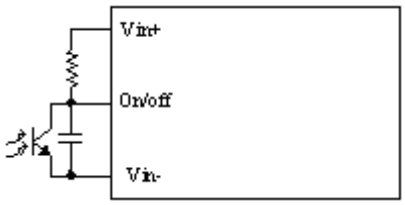


Figure 5. Control with photocoupler circuit

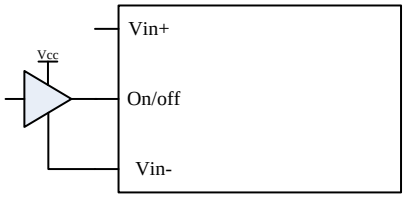


Figure 6. Control with logic circuit

8. RIPPLE AND NOISE WAVEFORMS

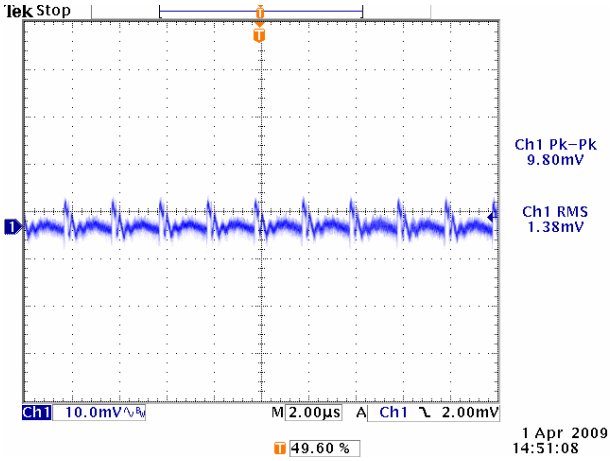


Figure 7. 12 V input, 0.6 V output

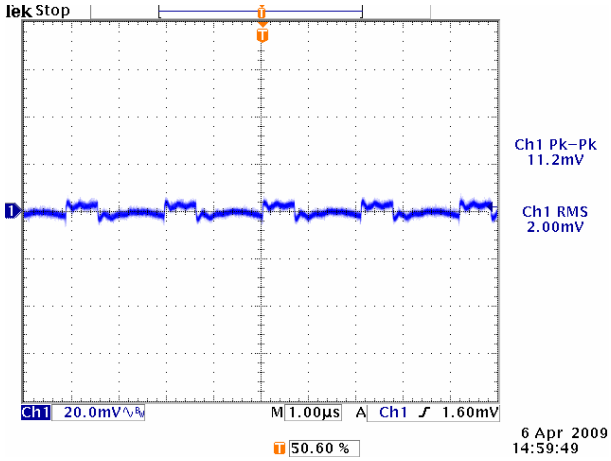


Figure 8. 12 V input, 3.3 V output

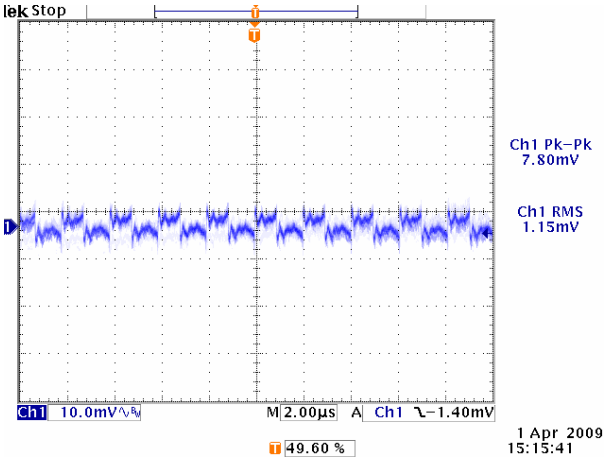


Figure 9. 12 V input, 5 V output

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

9. TRANSIENT RESPONSE WAVEFORMS

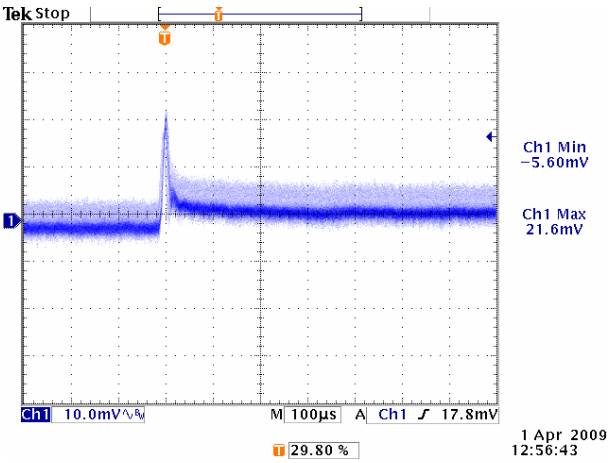


Figure 10. 100%-50% Load Transients at Vin = 12 V, Vout = 0.6 V

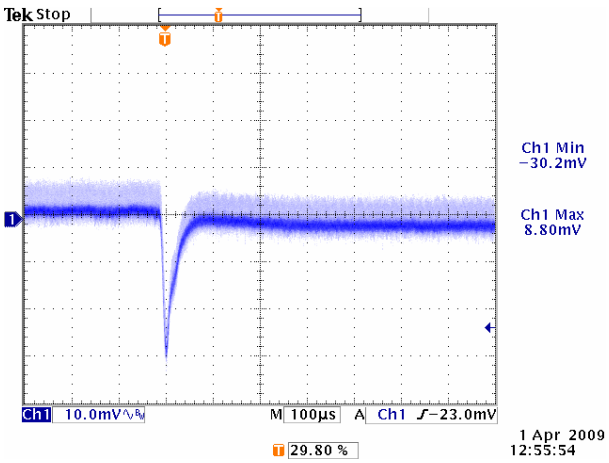


Figure 11. 50%-100% Load Transients at Vin = 12 V, Vout = 0.6 V

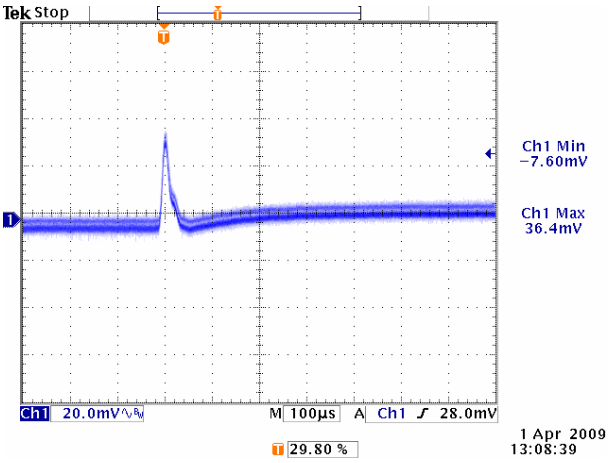


Figure 12. 100%-50% Load Transients at Vin = 12 V, Vout = 3.3 V

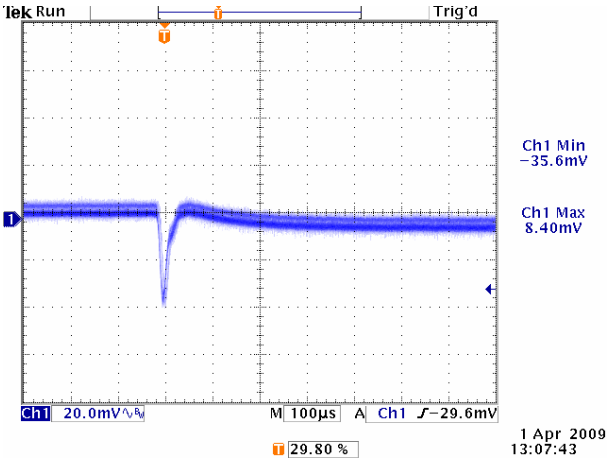


Figure 13. 50%-100% Load Transients at Vin = 12 V, Vout = 3.3 V

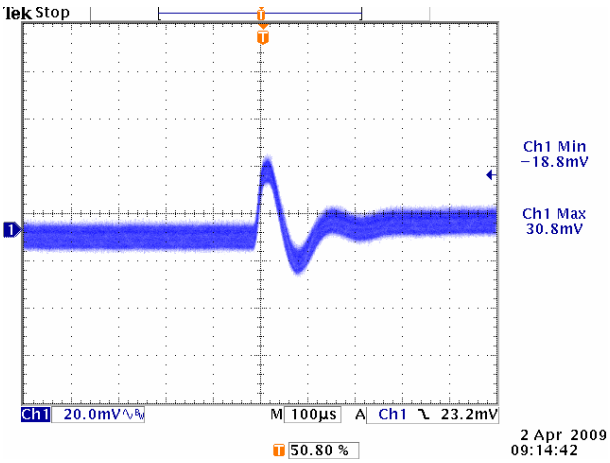


Figure 14. 100%-50% Load Transients at Vin = 12 V, Vout = 5.0 V

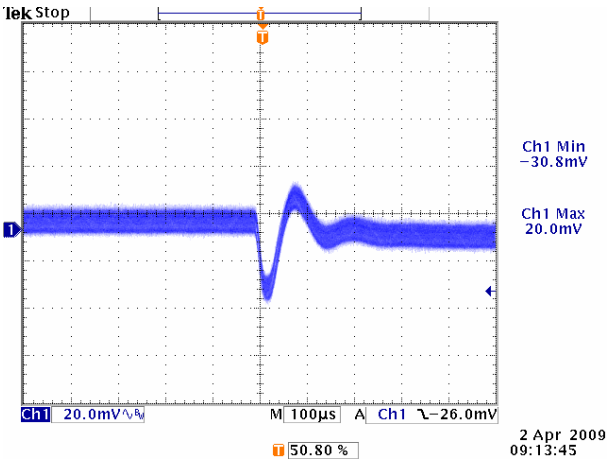


Figure 15. 50%-100% Load Transients at Vin = 12 V, Vout = 5.0 V

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

10. 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.

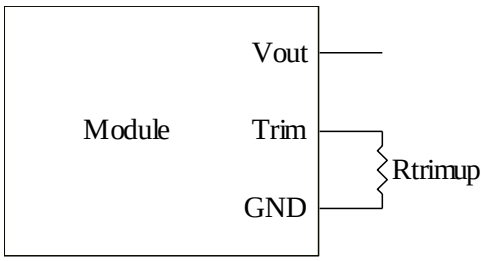


Figure 16. Trim circuit

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

11. 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.

12. INPUT UNDER VOLTAGE LOCKOUT

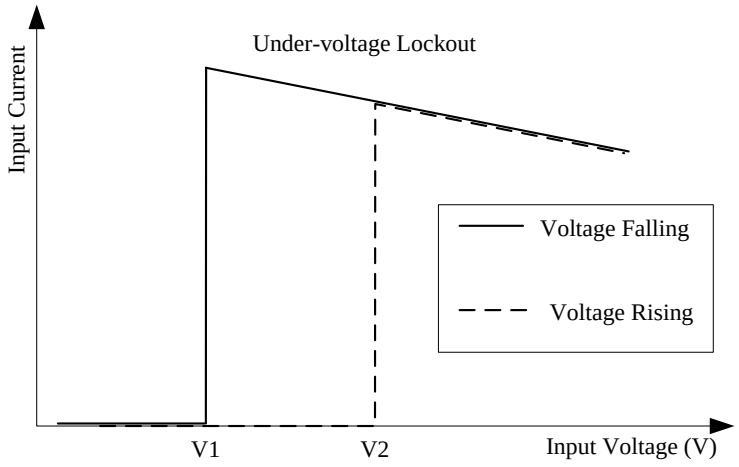


Figure 17. Input under voltage lockout
V1 = 4.0 V
V2 = 4.3 V

13. 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.

14. THERMAL DERATING CURVE

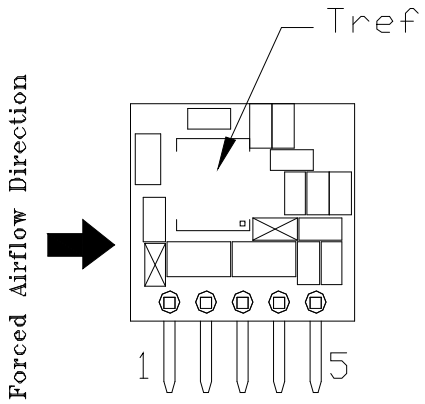


Figure 18. Airflow direction

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.

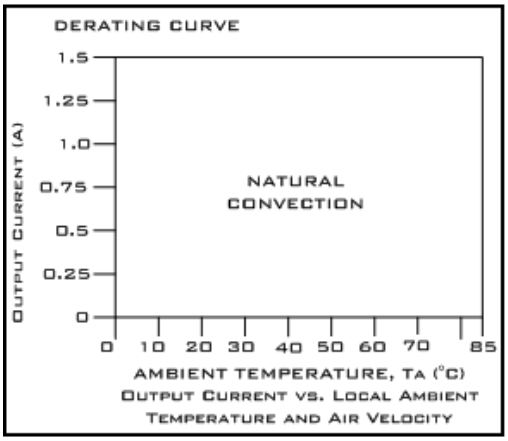


Figure 19. Vin = 12 V, Vout = 5 V

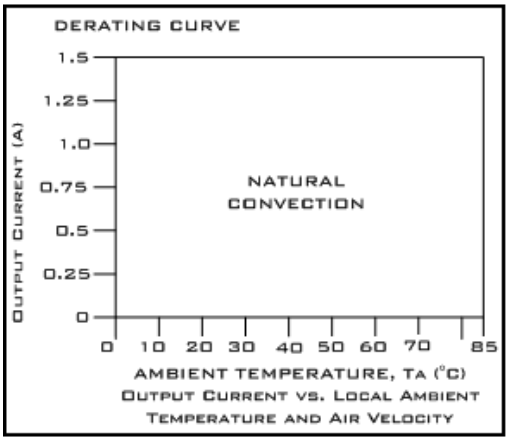


Figure 20. Vin = 12 V, Vout = 3.3 V

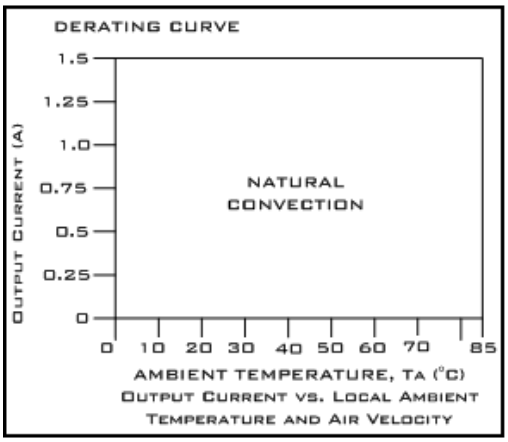


Figure 21. Vin = 12 V, Vout = 2.5 V

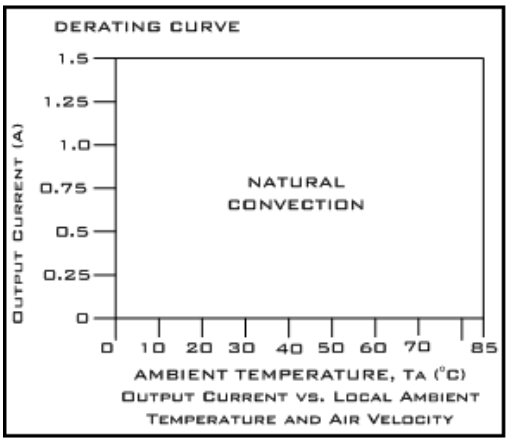


Figure 22. Vin = 12 V, Vout = 1.2 V

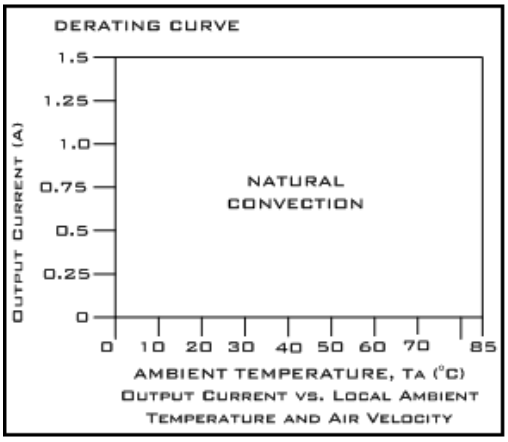


Figure 23. Vin = 12 V, Vout = 0.6 V

15. MECHANICAL DIMENSIONS

OUTLINE

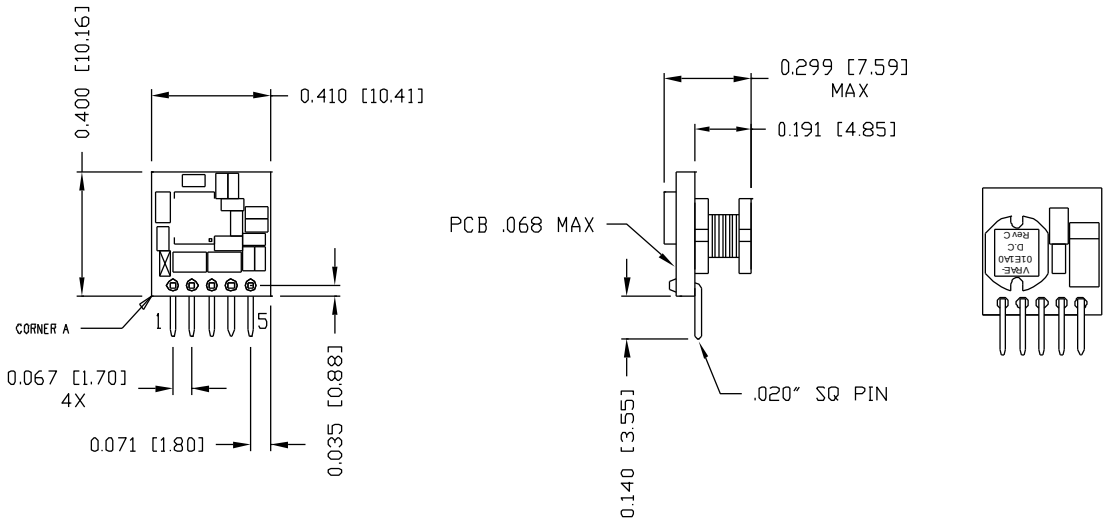


Figure 24. Outline

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 - Gold plated.
2) Un-dimensioned components are shown for visual reference only.
3) All dimensions in inch [mm]; Tolerances: x.xx +/-0.02 inch [0.51 mm]. x.xxx +/-0.005 inch [0.13 mm].

PIN DEFINITIONS

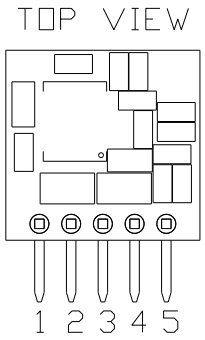


Figure 25. Pins

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

RECOMMENDED PAD LAYOUT

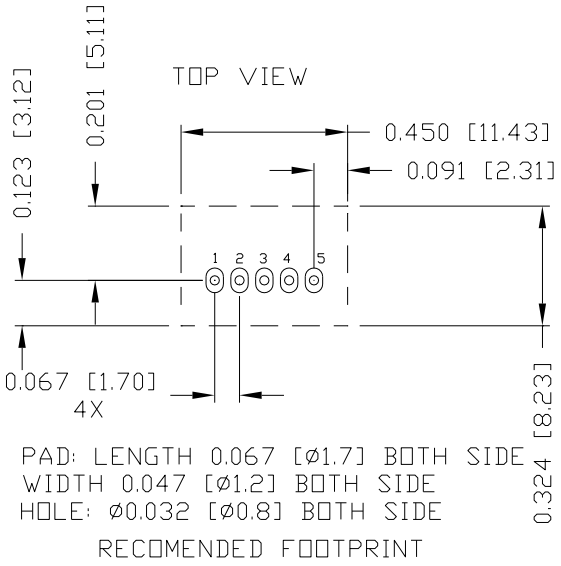


Figure 26. Recommended pad layout

16. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2009-03-16	A	First release	HAN
2009-04-02	B	Update mechanical drawing.	HAN
2009-04-21	C	1. Add thermal reference point; 2. Remove some “TBD” information.	HAN
2009-05-05	D	1. Replace the “TBD” in specification with data; 2. Add efficiency curve, NR and TR waveforms; 3. Update Trim.	HAN
2009-06-03	E	The maximum voltage for Signal High (Unit On) is changed from 18V to 6V.	T.Bubriski
2010-02-23	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.	F.Tao
2021-08-05	AI	Add object ID and module photo. Update to new format. Delete SRAE-01E1A1.	XF.Jiang