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	Vo ≤ 3.63 V	4.5	-	13.8	V
	Vo > 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 µF / 25 V AL-Cap with ESR = 0.03 ohm max and 2*100 µF/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^2t Inrush Current Transient		-	-	1	A^2s
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	Vin = 12 V, Iout = full load	-2	-	+2	% Vo, set
Load Regulation		-	±0.3	±1	% Vo, set
Line Regulation		-	±0.3	±1	% Vo, set
Regulation Over Temperature		-	0.3	-	% Vo, 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^2s
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 A/µS; Vin =12 V; with 10 µF tantalum cap and 1 µF ceramic at the output, Ta=25 °C, Vo = All	-	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 Ta= 25°C unless otherwise stated.

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION		MIN	TYP	MAX	UNIT
Efficiency	Vo = 5.0 V	Vin = 12 V	91	93	-	%
	Vo = 3.3 V		89	91	-	
	Vo = 2.5 V		87	89	-	
	Vo = 1.8 V		84	86	-	
	Vo = 1.5 V		83	85	-	
	Vo = 1.2 V		80	82	-	
	Vo = 0.9 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 (Io = 80% load; Vin = 12 V; Vo = 5 V; 200 LFM; Ta = 25 °C)			7 677 401		h
Weight			-	3.5	-	g
Dimensions (L × W ×H)				0.65 x 0.41 x 0.32 16.51 x 10.41 x 8.13		in mm

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

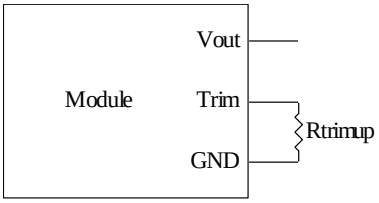
6. CONTROL SPECIFICATIONS

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

7. 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.

$$Rtrim = \frac{1.182}{Vo - 0.591} k\Omega$$



8. RIPPLE AND NOISE WAVEFORM

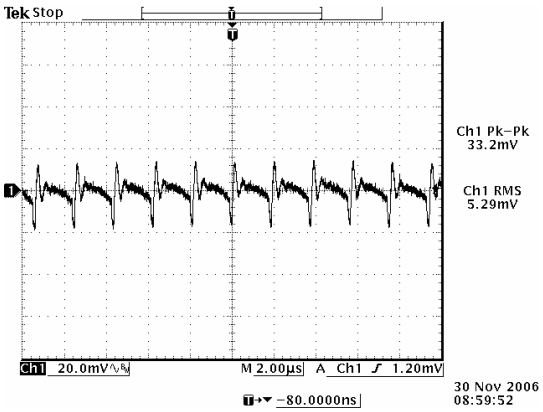


Figure 6. 12 V input, 0.591 V output

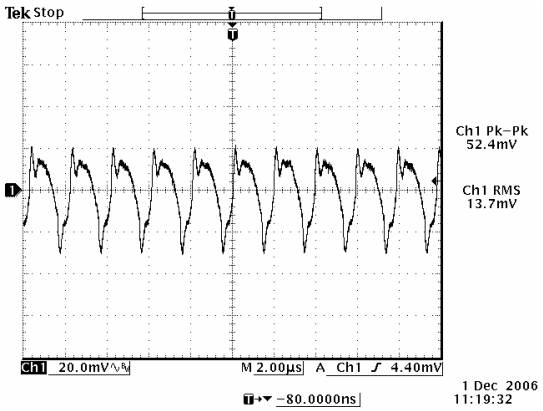


Figure 7. 12 V input, 3.3 V output.

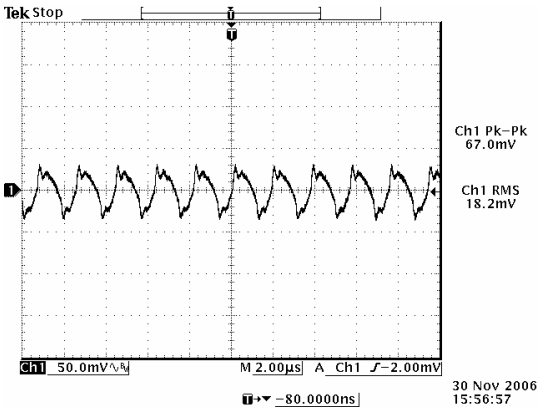
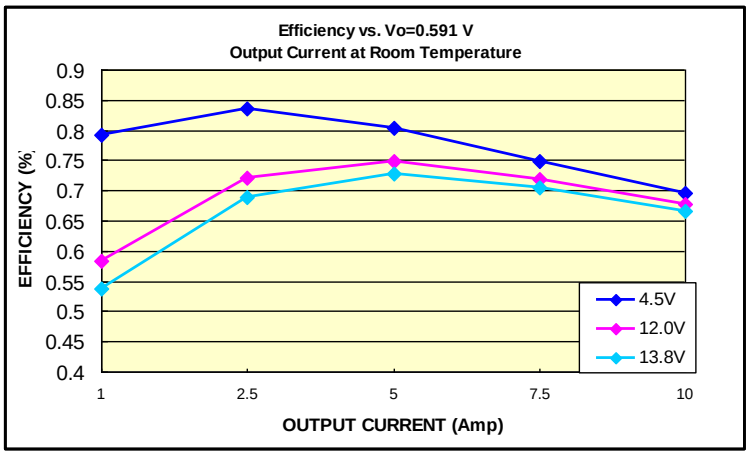
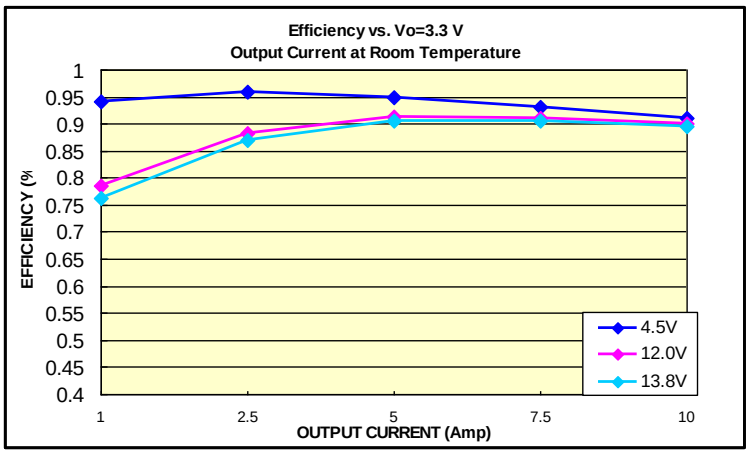


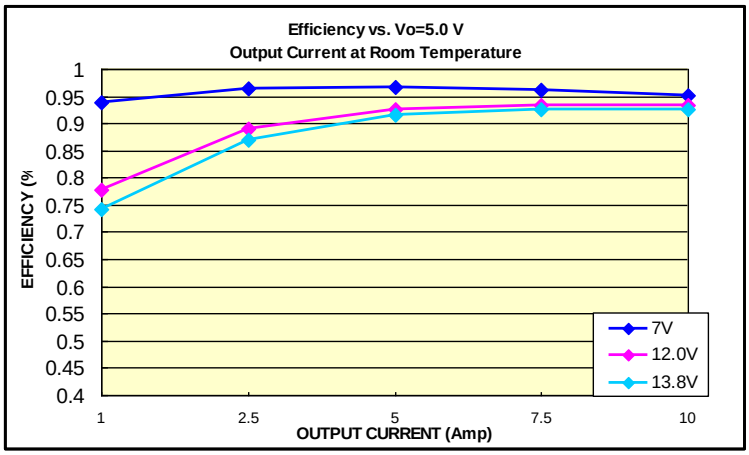
Figure 8. 12 V input, 5.0 V output.

NOTE: Ripple and noise at full load, 0-20 MHz BW, with a 1 µF ceramic cap and a 10 µF tantalum cap, and Ta=25 ˚C.

9. EFFICIENCY DATA

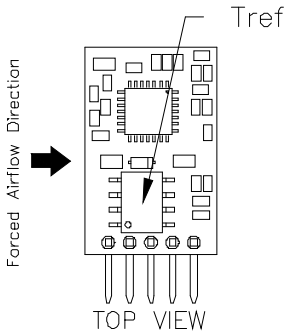






10. THERMAL DERATING CURVES

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



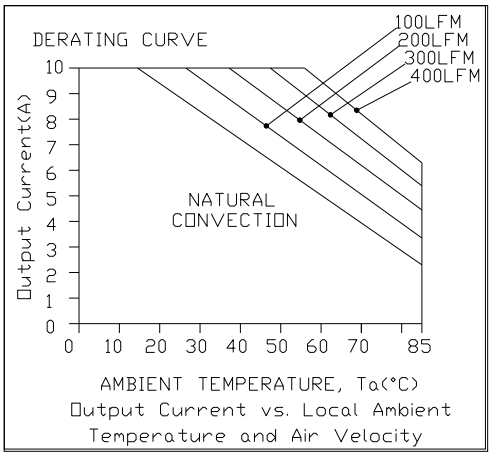


Figure 1. Vin=12 V, Vout = 5 V

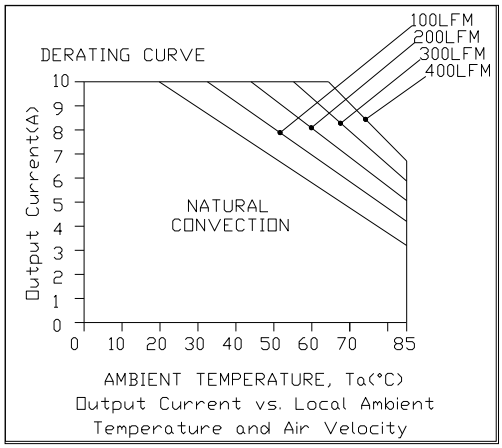


Figure 2. Vin=12 V, Vout =3.3 V

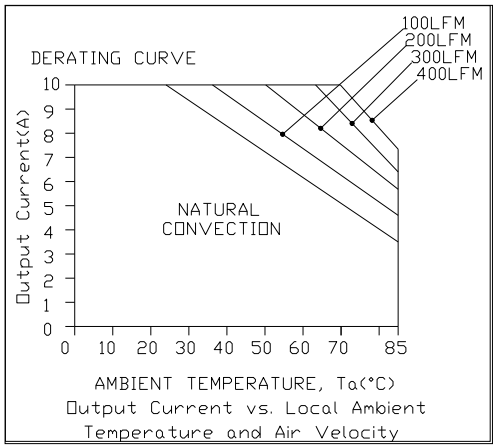


Figure 3. Vin=12 V, Vout = 2.5 V

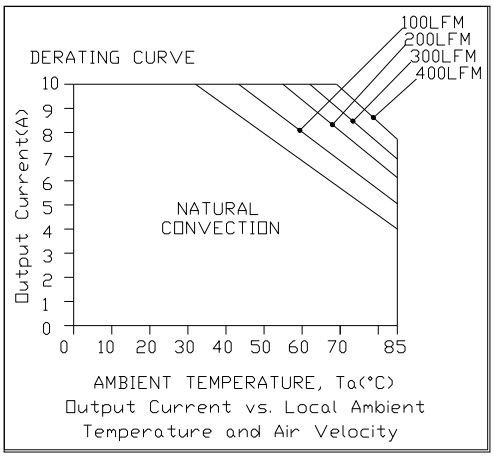


Figure 4. Vin=12 V, Vout = 1.2 V

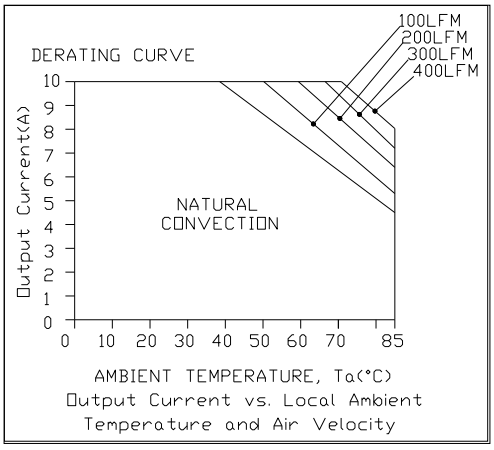


Figure 5. Vin=12 V, Vout = 0.59 V

11. TRANSIENT RESPONSE WAVEFORMS

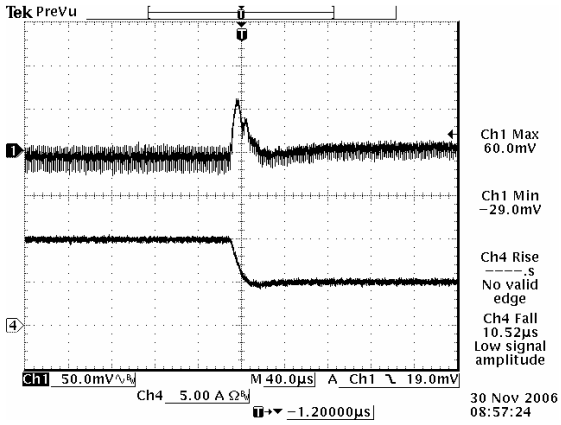


Figure 9. 100% to 50% load step at 12 V input, 0.591 V output

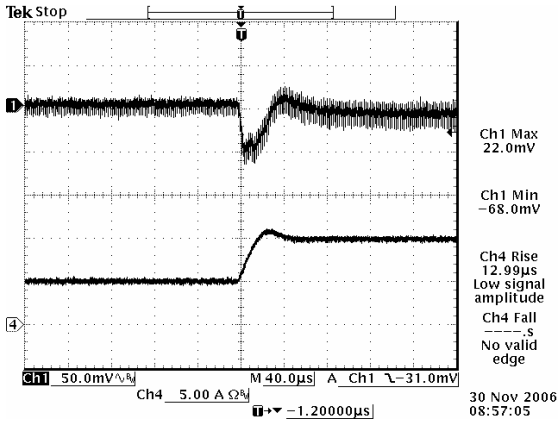


Figure 10. 50% to 100% load step at 12 V input, 0.591 V output

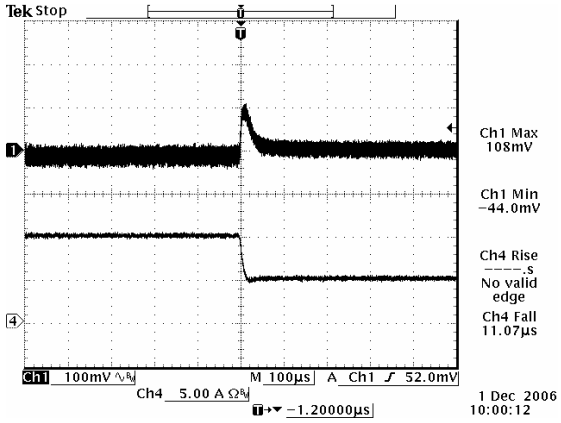


Figure 11. 100% to 50% load step at 12 V input, 3.3 V output

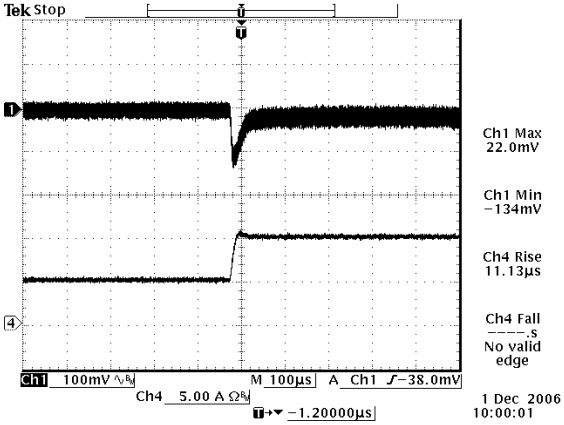


Figure 12. 50% to 100% load step at 12 V input, 3.3 V output

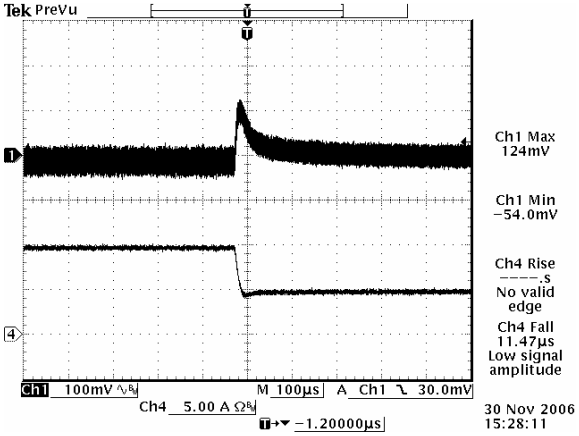


Figure 13. 100% to 50% load step at 12 V input, 5.0 V output

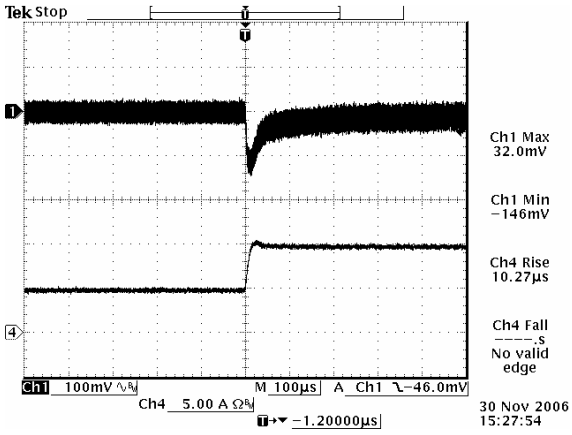
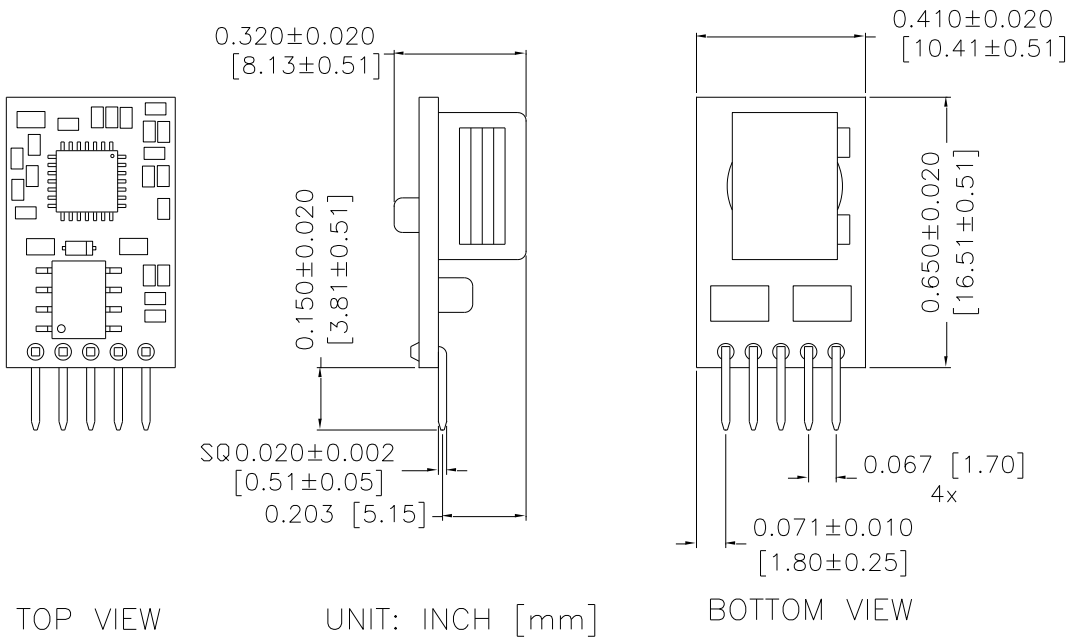


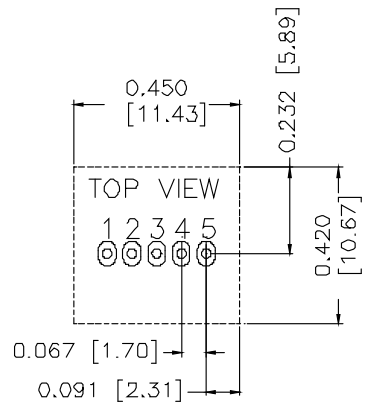
Figure 14. 50% to 100% load step at 12 V input, 5.0 V output

NOTE: Transient response at di/dt=0.25 A/µS, with a 1µF ceramic cap and a 10µF tantalum cap at the output, and Ta=25 ° C.

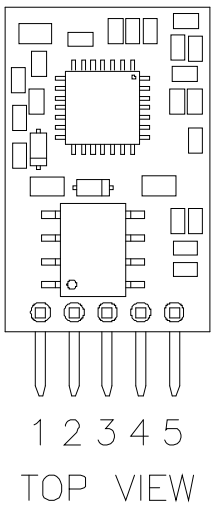
12. MECHANICAL OUTLINE



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 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 [0.5 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

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