

## NON-ISOLATED DC/DC CONVERTERS

4.5 Vdc - 13.8 Vdc Input    0.591 Vdc - 5.1 Vdc/20 A Output



Apr. 14, 2011

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

**VRP1-20E2AC    RoHS Compliant    PRELIMINARY    Rev.A**

### Features

- Non-Isolated
- High Efficiency
- Fixed Switching Frequency
- Low Cost
- Excellent Thermal Performance
- Wide Input Voltage Range
- Class 1, Category 2, Non-Isolated DC/DC Converter (refer to IPC-9592)
- Wide Output Trim Range
- Output Over-Voltage Shutdown
- OCP/SCP
- Low Output Ripple
- Power Good Signal
- Remote On/Off

### Applications

- Networking
- Computers and peripherals
- Telecommunications

### Description

The VRP1-20E2AC is a non-isolated dc/dc converter that operates over a wide range of input voltage ( $V_{in} = 4.5$  Vdc - 13.8 Vdc). This unit can provide a precisely regulated output voltage from 0.591 Vdc to 5.1 Vdc and can deliver up to 20 A of output current. This unit is designed to be highly efficient and low cost. The converter is provided in an industry standard package.

### Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active High
0.591 Vdc - 5.1Vdc	4.5 Vdc - 13.8 Vdc	20 A	100 W	94%	VRP1-20E2AC

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

### Part Number Explanation

$\frac{V}{1} \frac{R}{2} \frac{P1}{3} - \frac{20}{4} \frac{E}{5} \frac{2A}{6} \frac{C}{7}$

- 1---Vertical mount
- 2---RoHS 6, change "R" to "7" means RoHS 5
- 3---Series name, SIP
- 4---Series code, 20A output
- 5--- Wide input range (4.5-13.8V)
- 6---Wide output range (0.591-5.1V)
- 7---Suffix

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### Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Input Voltage (continuous)	-0.3	-	15	V	
Output Enable Terminal Voltage	-0.3	-	15	V	
Ambient Temperature	0	-	70	°C	
Storage Temperature	-40	-	125	°C	

**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
Input Voltage					
$V_o < 3.45V$	4.5	12	13.8	V	
$V_o \geq 3.45V$	$1.3 \cdot V_o$	12	13.8	V	
Input Current (full load)	-	-	20	A	An input line fuse must always be used.
Input Current (no load)	-	150	300	mA	
Remote Off Input Current	-	50	-	mA	
Input Reflected Ripple Current (pk-pk)	-	50	100	mA	Use a 1000uF AL-Cap on the input.
Input Reflected Ripple Current (rms)	-	20	40	mA	
$I^2t$ Inrush Current Transient	-	-	1	A <sup>2</sup> s	
Turn-on Voltage Threshold	-	4.2	-	V	A 30.1K resistor is connected from Enable to Vin.
Turn-off Voltage Threshold	-	3.9	-	V	

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

### Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point Accuracy	-1.5	-	1.5	% $V_{o,set}$	$V_{in}=12V$ , $I_{out}$ =half load
Load regulation	-	-	1	% $V_{o,set}$	
Line Regulation	-	-	0.5	% $V_{o,set}$	
Regulation Over Temperature (0 °C to +70 °C)	-	-	1	% $V_{o,set}$	
Output Current	0	-	20	A	
Current Limit Threshold	-	150	-	% $I_{omax}$	
Output Ripple and Noise (pk-pk)	-	40	80	mV	0-20MHz BW, with a 1μF ceramic capacitor and a 10uF Tantalum cap at output.
Output Ripple and Noise (rms)	-	20	40	mV	
Short Circuit Surge Transient	-	1	3	A <sup>2</sup> s	

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### Output Specifications (continued)

Parameter	Min	Typ	Max	Unit	Notes		
Turn On Time	-	2	10	mS			
Overshoot at Turn on and off	-	-	5	%			
Output Capacitance	0	-	1000	uF			
<b>Transient Response</b>							
ΔV50%~75% of Max Load	Overshoot	Vo=All	-	200	300	mV	di/dt = 2.5 A/uS; Vin =12 V; with 10 uF tantalum cap and 1 uF ceramic at the output, Ta=25 °C
	Settling Time		-	-	50	uS	
ΔV75%~50% of Max Load	Overshoot		-	200	300	mV	
	Settling Time		-	-	50	uS	

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

### General Specifications

Parameter	Min	Typ	Max	Unit	Notes
Efficiency					
Vo=5.0 V	-	94	-	%	Vin=12V, full load
Vo=3.3 V	-	92	-	%	
Vo=2.5 V	-	90	-	%	
Vo=1.5 V	-	85	-	%	
Vo=0.591 V	-	70	-	%	
Switching Frequency	-	500	-	kHz	
Output Voltage Trim Range	0.591	-	5.1	V	
Remote Sense Compensation	-	-	0.2	V	Vin=12 V, Io=full load
Weight	-	9.7	-	g	
MTBF	TBD			-	Calculated Per Bell Core SR-332 (Io = 80%Iomax; Vin=12 V; Ta = 25 °C)
Dimensions					
Inches (L x W x H)	1.45 x 0.61 x 0.40			-	
Millimeters (L x W x H)	36.83 x 15.49 x 10.15				

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

### Control Specifications

Parameter	Min	Typ	Max	Unit	Notes
<b>Remote On/Off (Active High)</b>					
Signal Low (Unit Off)	-0.3	-	0.4	V	Remote On/Off pin is open, unit is on.
Signal High (Unit On)	2	-	5.5	V	
<b>PwGood (PowerGood)</b>					
PwGood = High = Power Good	2.4	-	6	V	
	-	-	2	mA	
PwGood = Low = Power Not Good	0	-	0.35	V	
	-	-	5	mA	

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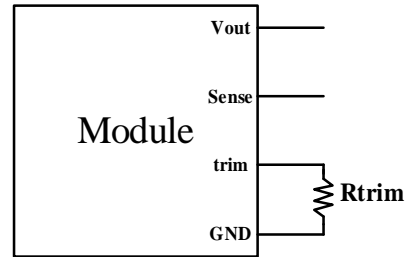
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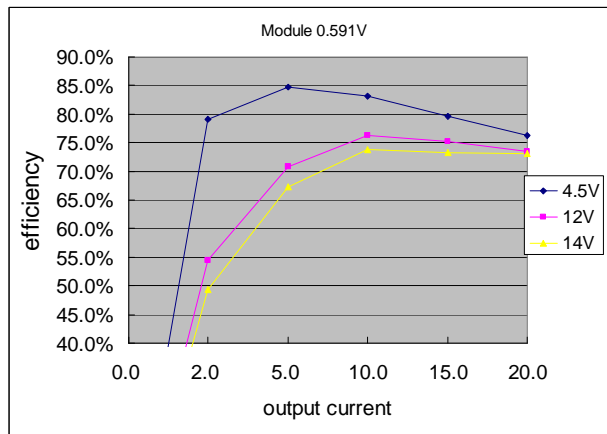
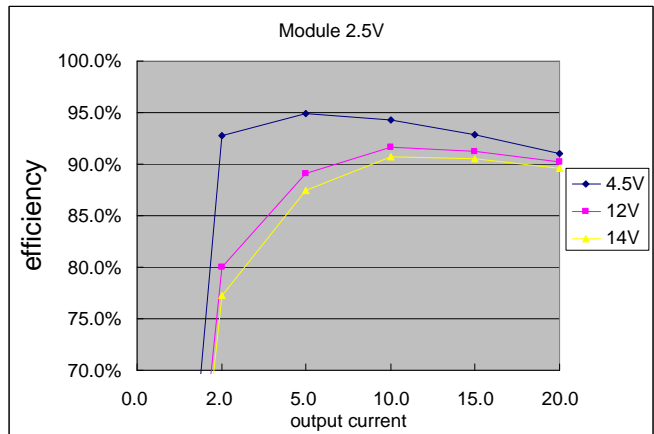
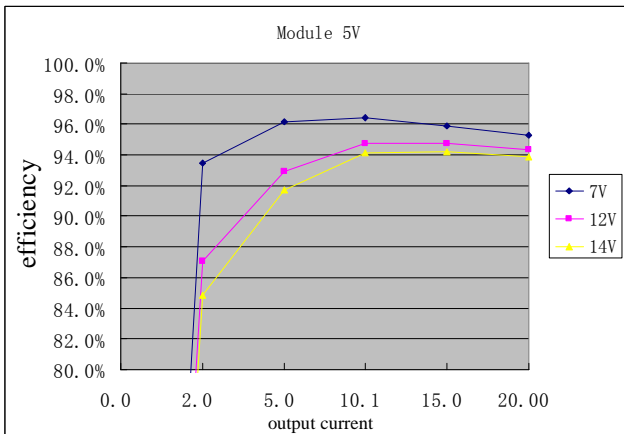
## Output Trim Equation

The Rtrim resistor should be connected between the Trim pin and GND pin.

$$R_{trim} = \left[ \frac{1.182}{V_o - 0.591} \right] \text{ k}\Omega$$



## Efficiency Data



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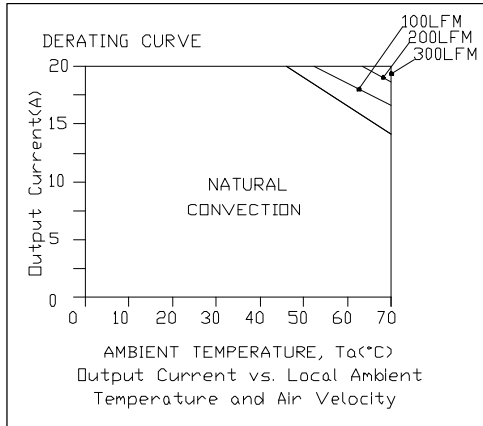
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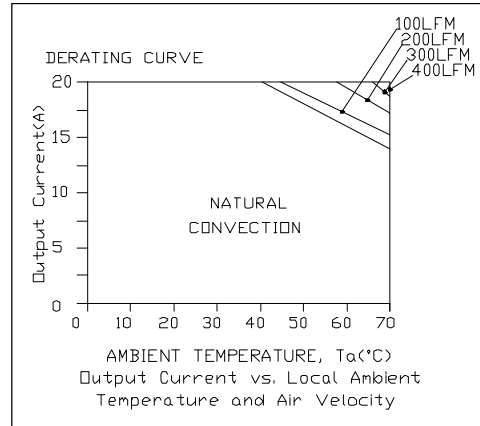
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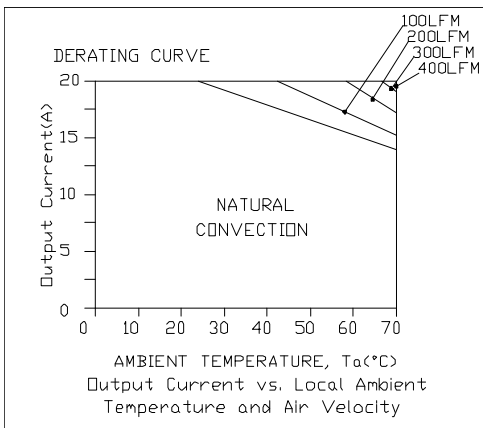
## Thermal Derating Curves



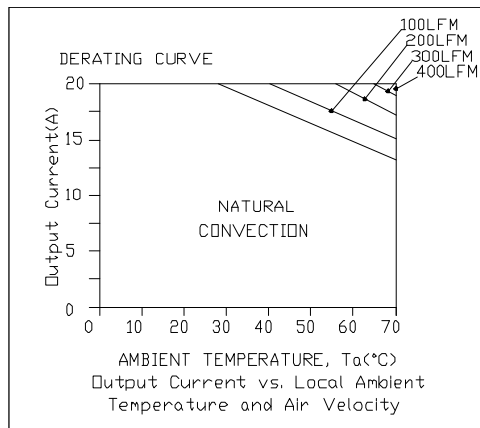
Vout=0.591V



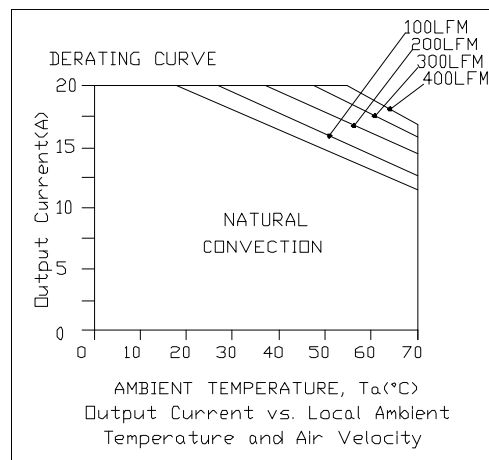
Vout=1.2 V



Vout=2.5 V



Vout=3.3 V



Vout=5 V

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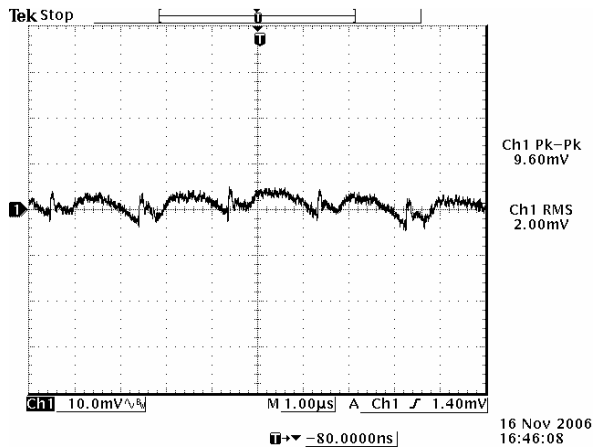
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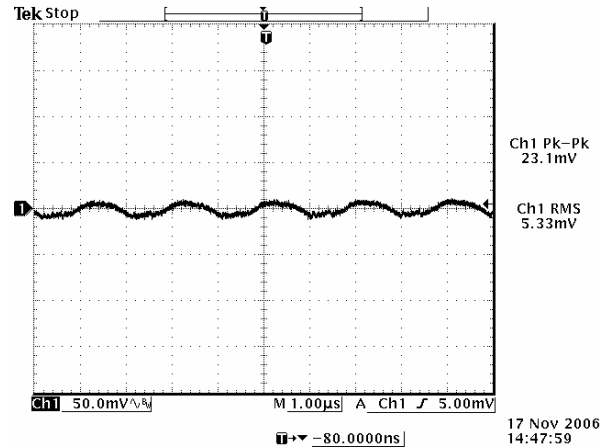
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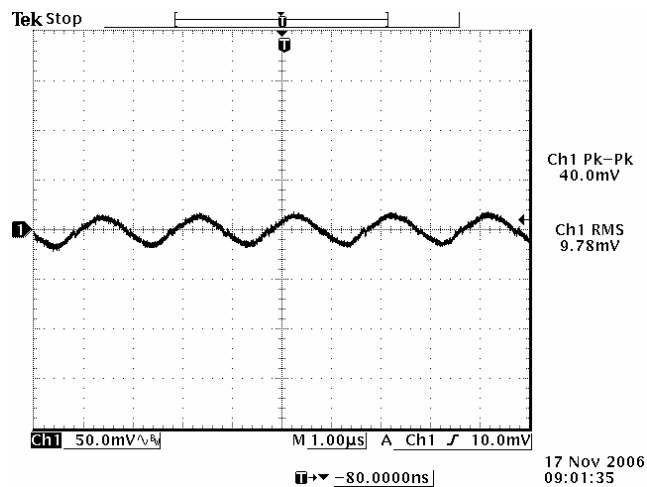
## Ripple and Noise Waveforms



12 Vdc input, 0.591 Vdc output



12 Vdc input, 2.5 Vdc output



12 Vdc input, 5 Vdc output

**Note:** Ripple and noise at full load, 0-20 MHz BW, with a 10 uF tantalum cap and a 1 uF ceramic cap, and Ta=25 deg C.

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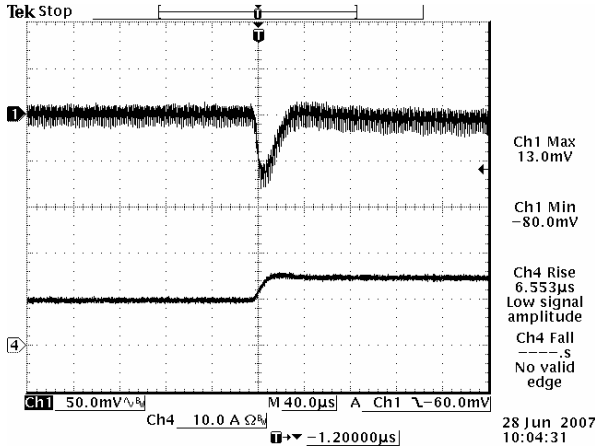
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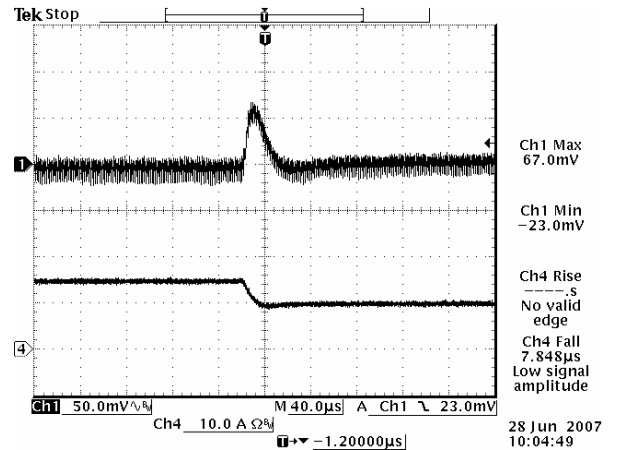
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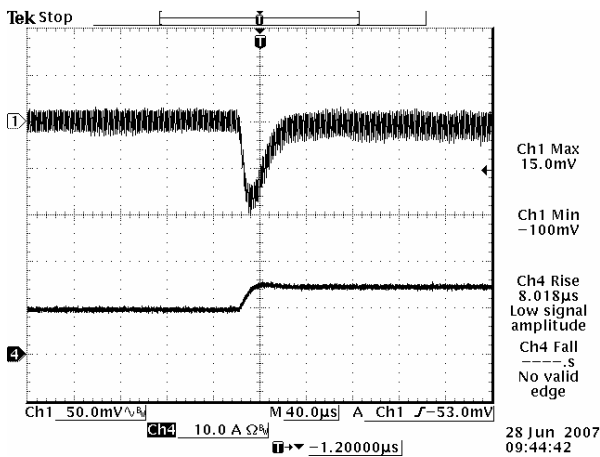
## Transient Response Waveforms



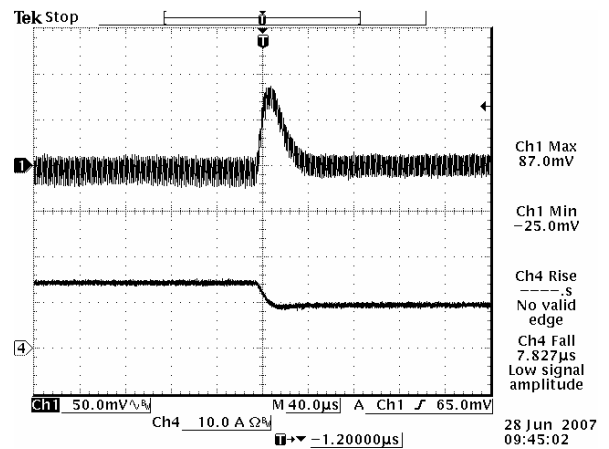
Vout= 2.5 V 50%-75% Load Transients



Vout=2.5 V 75%-50% Load Transients



Vout= 5 V 50%-75% Load Transients



Vout=5 V 75%-50% Load Transients

**Note:** Transient response at  $di/dt = 2.5 \text{ A}/\mu\text{S}$ , with  $1 \mu\text{F}$  ceramic capacitor at the output, and  $T_a=25 \text{ deg C}$ .

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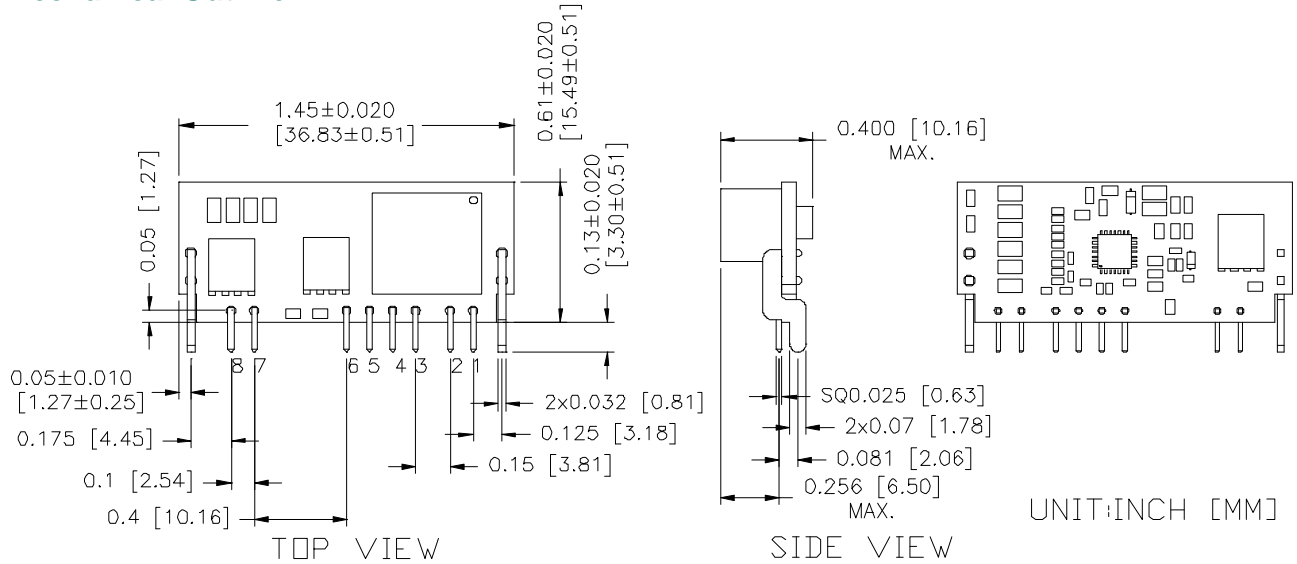
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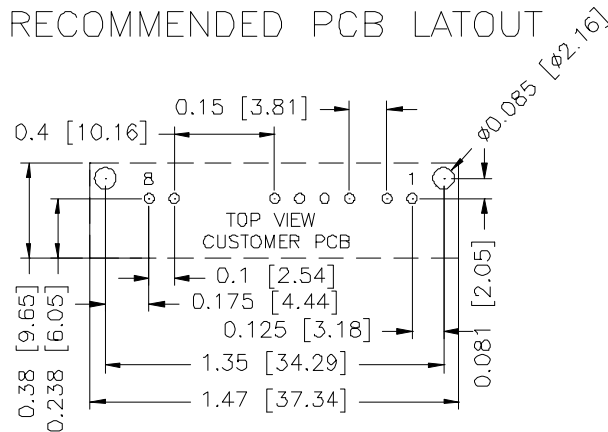
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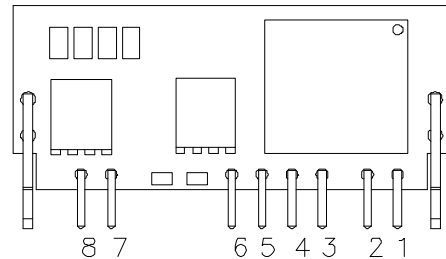
## Mechanical Outline



## RECOMMENDED PCB LAYOUT



- 2 SUPPORT PAD HOLES: ∅0.085 [2.16] BOTH SIDES
- 8 PIN PAD HOLES: ∅0.04 [1.00] BOTH SIDES



## Pin Connections

Pin	Function
1	Vout
2	Trim+
3	GND
4	PwGOOD
5	Enable
6	Vin
7	Sense+
8	Sense-

**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.

### Note:

- 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. (x.x +/-0.5mm) x.xxx +/-0.010 in. (x.xx +/-0.25mm).



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### Revision History

Date	Revision	Changes Detail	Approval
2011-04-14	PA	First release	JZ Wang

### RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products.



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