

## ISOLATED DC/DC CONVERTERS

36 Vdc - 75 Vdc Input, 12 Vdc/25 A Output



Jan. 14, 2010

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

0RQ1-T0T12x

RoHS Compliant

Rev.C

### Features

- Isolated
- High Efficiency
- Fixed Frequency (270 kHz)
- High Power Density
- Input Under Voltage Lockout
- Input Over Voltage Lockout
- Positive/Negative Remote Sense
- Class 1, Category 2, Isolated DC/DC Converter (refer to IPC-9592)
- TUV EN60950-1 Recognized (Pending)
- UL60950-1 Recognized (UL/cUL) (Pending)
- Output Over Voltage Shutdown
- Output Voltage Trim
- Over Temperature Protection
- SCP/OCP
- Low Cost
- Basic Insulation
- Remote On/Off



### Applications

- Networking
- Computers and peripherals
- Telecommunications

### Description

The 0RQ1-T0T12x are isolated dc/dc converters that operate from a nominal 48 Vdc source. These units will provide up to 300 W output power from a nominal 48 Vdc input. These units are designed to be highly efficient and low cost. Features include remote on/off, over current protection and under-voltage lockout. These converters are provided in an industry standard quarter brick package.

### Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active Low	Model Number Active High
12 Vdc	36 Vdc - 75 Vdc	25 A	300 W	95%	0RQ1-T0T12L	0RQ1-T0T120

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

### Part Number Explanation

0 R Q1 - T0 T 12 L  
1 2 3 4 5 6 7

- 1---Through hole mount
- 2---RoHS 6, change "R" to "7" means RoHS 5
- 3---Series name, 1/4 brick
- 4---Series code
- 5---Input range (36-75V)
- 6---Output voltage (12V)
- 7---Enable, active low, change "L" to "0" means active high

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## Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Continuous non-operating Input Voltage	-0.3	-	80	V	
Remote On/Off	-0.3	-	18	V	
I/O Isolation Voltage	-	-	2250	V	
Ambient Temperature	-40	-	85	°C	
Storage Temperature	-55	-	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
Operating Input Voltage	36	48	75	V	
Input Current (full load)	-	-	10	A	
Input Current (no load)	-	90	-	mA	
Remote Off Input Current	-	10	-	mA	
Input Reflected Ripple Current (rms)	-	15	-	mA	With simulated source impedance of 10 uH, 5 Hz to 20 MHz; use a 100 uF/100 V electrolytic capacitor with ESR = 1 ohm max, at 200 kHz.
Input Reflected Ripple Current (pk-pk)	-	50	-	mA	
I <sup>2</sup> t Inrush Current Transient	-	TBD	-	A <sup>2</sup> s	
Turn-on Voltage Threshold	-	34.5	35.5	V	
Turn-off Voltage Threshold	32.5	34	-	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 14A 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	11.76	12	12.24	V	V <sub>in</sub> =48 V, I <sub>o</sub> =50%Load
Load Regulation	-	±30	±60	mV	
Line Regulation	-	±12	±24	mV	
Regulation Over Temperature (-40deg.C-85deg.C)	-	±60	±100	mV	
Ripple and Noise (pk-pk)	-	50	100	mV	0 - 20 MHz BW, with 1 uF ceramic load capacitor and a 10 uF tantalum capacitor at the output.
Ripple and Noise (rms)	-	20	50	mV	
Output Current Range	0	-	25	A	
Output DC Current Limit	26	32	38	A	

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## Output Specifications (continued)

Parameter	Min	Typ	Max	Unit	Notes	
Short Circuit Surge Transient	-	TBD	-	A <sup>2</sup> s		
Turn on Time	-	80	120	mS		
Overshoot at Turn on	-	0	3	%		
Output Capacitance	0	-	5600	uF		
<b>Transient Response</b>						
$\Delta V$ 50%~75% of Max Load	Overshoot	-	-	600	mV	di/dt=0.1A/us, Vin=48Vdc, Ta=25 °C, with 1 uF ceramic capacitor and a 10 uF tantalum capacitor at the output.
	Settling Time	-	-	300	uS	
$\Delta V$ 75%~50% of Max Load	Overshoot	-	-	600	mV	
	Settling Time	-	-	300	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	94	95	-	%	Vin=48 V, full load.
Switching Frequency	-	270	-	kHz	
Isolation Capacitance	-	2200	-	pF	
Over Temperature Protection	-	125	-	°C	
Over Voltage Protection	-	14	-	V	
Output Voltage Trim Range	80	-	105	%Vo,set	The total voltage increased by trim and remote sense should not exceed 5%Vo.
Remote Sense Compensation	-	-	5	%Vo,set	
Weight	-	71	-	g	
FIT	TBD			-	Calculated Per Bell Core SR-332 (Vin=48 V, Vo=12 V, Io=20 A, Ta = 25 °C, FIT=10 <sup>9</sup> /MTBF)
Dimensions				-	
Inches (L x W x H)	2.30 x 1.45 x 0.50				
Millimeters (L x W x H)	58.42 x 36.83 x 12.70				

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

# ISOLATED DC/DC CONVERTERS

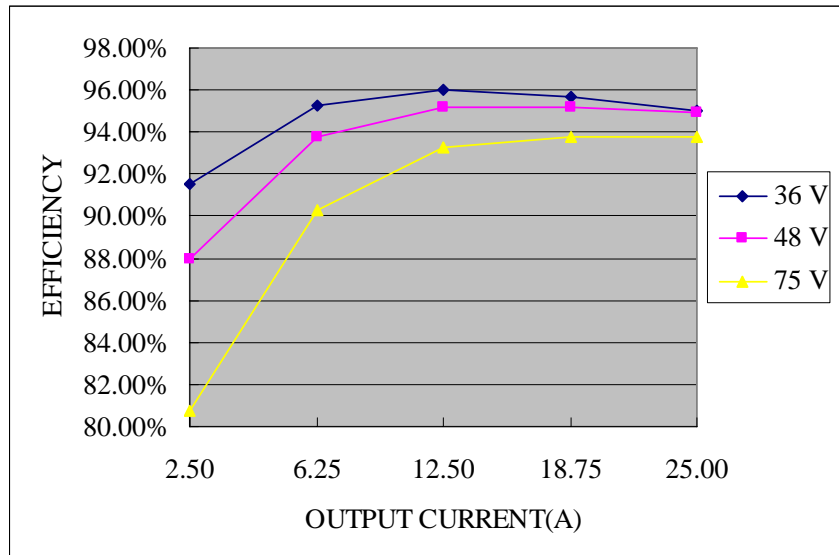
36 Vdc - 75 Vdc Input, 12 Vdc/25 A Output



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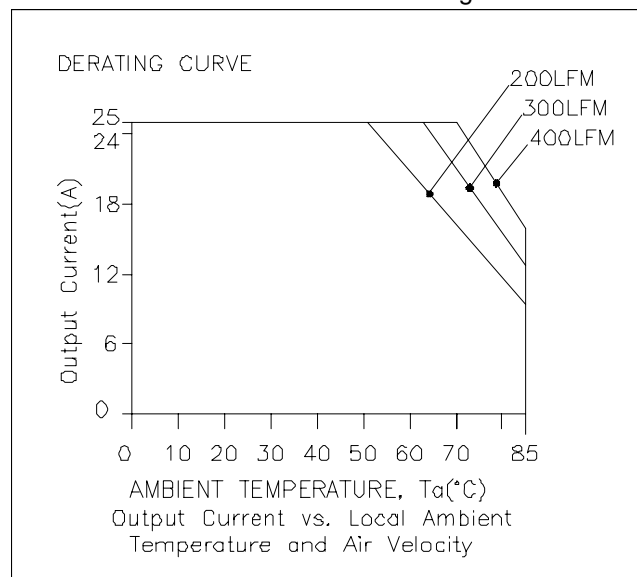
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## Efficiency Data

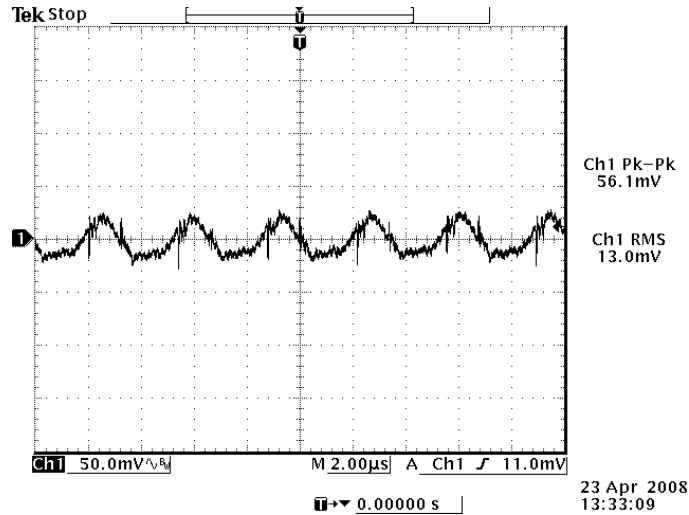


## Thermal Derating Curve

Maximum junction temperature of semiconductors derated to 120 degree C.



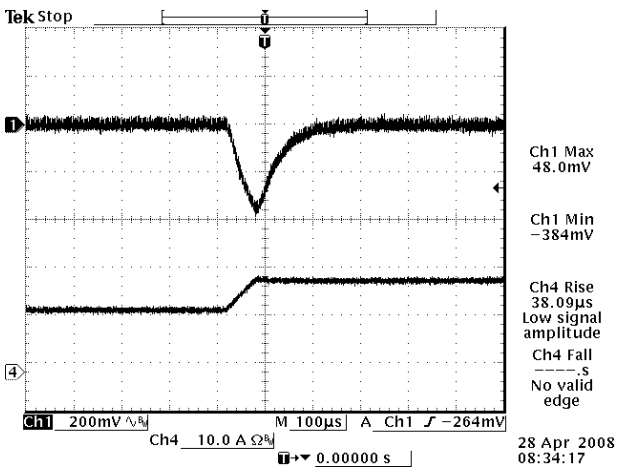
**Ripple and Noise Waveform**



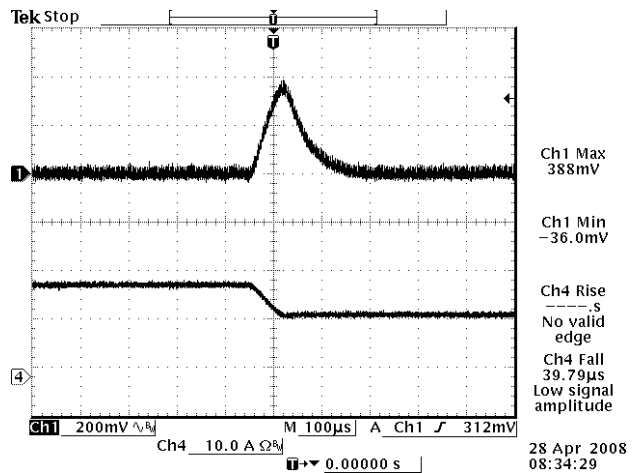
48 Vdc input, 12 Vdc/25 A output

**Note:** Ripple and noise at full load, with a 1µF ceramic cap and a 10 µF Tantalum cap at output, Ta=25 deg C.

**Transient Response Waveforms**



50%-75% Load Transients at Vin=48 V



75%-50% Load Transients at Vin=48 V

**Note:** Transient response at di/dt=0.1A/us, with a 1µF ceramic cap and a 10µF Tantalum cap at output, and Ta=25 deg C.

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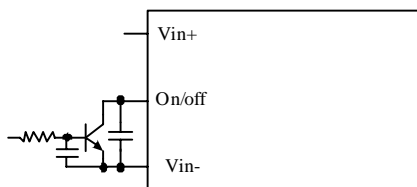
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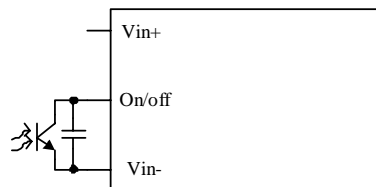
## Remote On/Off

Parameter		Min	Typ	Max	Unit	Notes
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V	The remote on/off pin open, Unit off.
Signal High (Unit Off)		2.4	-	18	V	
Signal Low (Unit Off)	Active High	-0.3	-	0.8	V	The remote on/off pin open, Unit on.
Signal High (Unit On)		2.4	-	18	V	
Current Sink		0	-	0.75	mA	

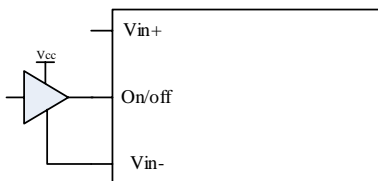
### Recommended remote on/off circuit for active low



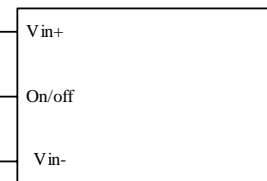
Control with open collector/drain circuit



Control with photocoupler circuit

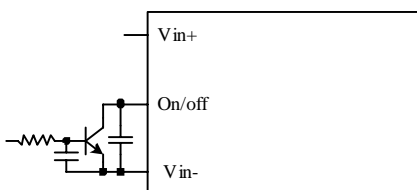


Control with logic circuit

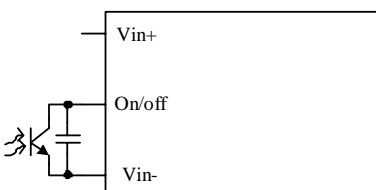


Permanently on

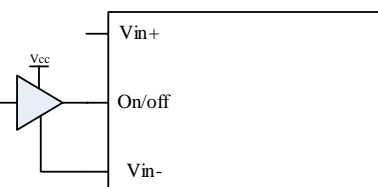
### Recommended remote on/off circuit for active high



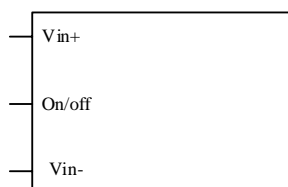
Control with open collector/drain circuit



Control with photocoupler circuit



Control with logic circuit



Permanently on

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### Output Trim Equations

Equations for calculating the trim resistor are shown below. The Trim Down resistor should be connected between the Trim pin and GND pin. The Trim Up resistor should be connected between the Trim pin and the Vout pin. Only one of the resistors should be used for any given application.

Minimum trim down voltage is 9.6V

Maximum trim up voltage is 12.6V.

The total voltage increased by trim and remote sense should not exceed 5% of the nominal output voltage.

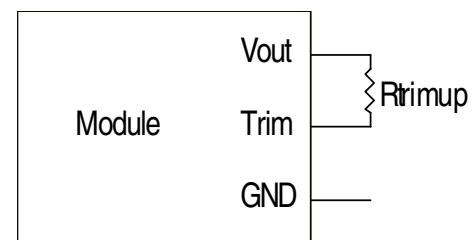
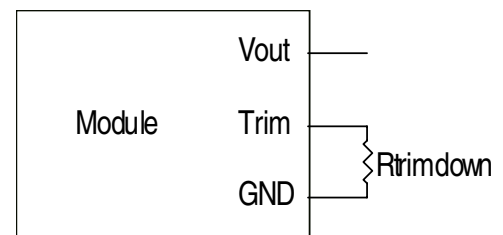
$$R_{trimdown} = \frac{511}{|\delta|} - 10.22 [k\Omega]$$

$$R_{trimup} = \frac{(100 + \delta) \cdot V_o \cdot 5.11 - 626}{1.225 \cdot \delta} - 10.22 [k\Omega]$$

**Note:**

$$\delta = \frac{(V_o_{req} - V_o)}{V_o} \times 100 [\%]$$

$V_o_{req}$  = Desired (trimmed) output voltage [V]  
Output voltage  $V_o$  = 12 V



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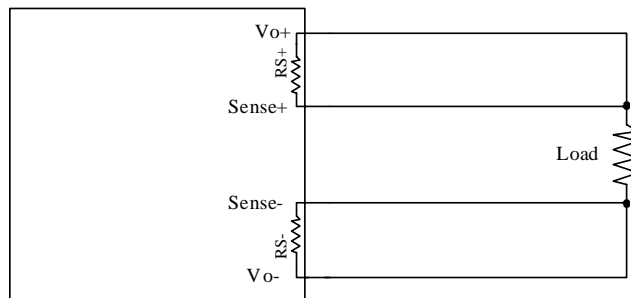
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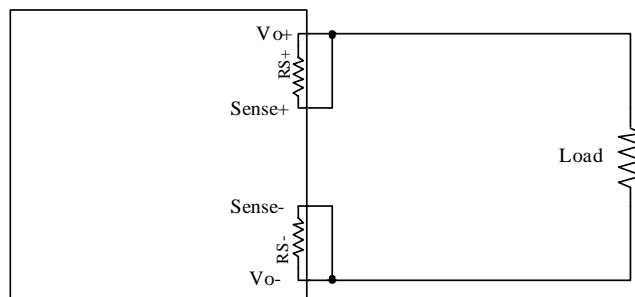
### Remote Sense

This module has remote sense compensation feature. It can minimize the effects of resistance between module's output and load in system layout and facilitates accurate voltage regulation at load terminals or other selected point.

1. The remote sense lines carries very little current and hence do not require a large cross-sectional area.
2. This module compensates for a maximum drop of 5% of the nominal output voltage.
3. If the unit is already trimmed up, the available remote sense compensation range should be correspondingly reduced. The total voltage increased by trim and remote sense should not exceed 5% of the nominal output voltage.
4. When using remote sense compensation, all the resistance, parasitic inductance and capacitance of the system are incorporated within the feedback loop of this module. It can make an effect on the module's compensation, affecting the stability and dynamic response. A 0.1uF ceramic capacitor can be connected at the point of load to de-couple noise on the sense wires.
5. Recommend the connection of remote sense compensation as below figure. There are a resistor RS+ (100 ohm) from Vo+ to Sense+ and a resistor RS- (51 ohm) from Vo- to Sense- inside of this module.



6. If not using remote sense compensation, please connect sense directly to output at module's pin, that is, connect sense+ to Vo+ and sense- to Vo- at module's pin, the shorter the better. See below figure.



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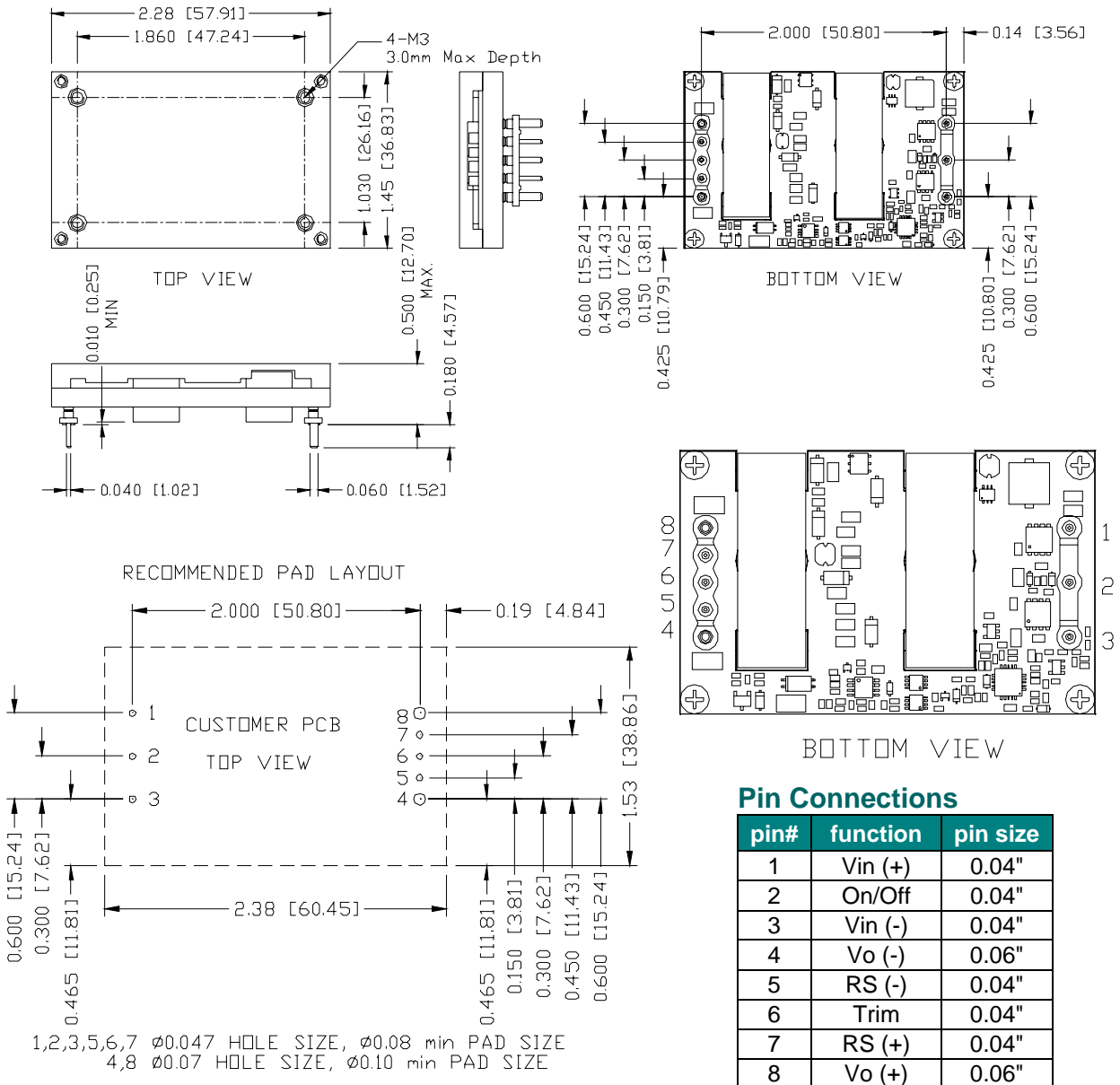
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## Mechanical Outline



**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.

**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	Version	Changes Detail	Approval
2008-10-17	A	First release	HL
2009-4-16	B	1. Change to new format; 2. Update the I/O isolation voltage, min efficiency and output DC current limit.	HL
2010-1-14	C	Remove "Preliminary"	Jack

### 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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10

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