

ISOLATED DC/DC CONVERTERS

36 Vdc - 75 Vdc Input 14 Vdc /10A Output, 1/4 Brick Converter



Oct. 07, 2011

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

0RQB-C5T14x

RoHS Compliant

Preliminary

- Isolated
- Fixed Frequency (250 kHz)
- High Efficiency
- High Power Density
- Input Under-Voltage Lockout
- Input Over-Voltage Lockout
- Output Over-Voltage Shutdown
- Class 2, Category 2, Isolated DC/DC Converter (refer to IPC-9592)
- Over Temperature Protection
- SCP/OCF
- Low Cost
- Remote On/Off
- Basic Isolation
- Positive/Negative Remote Sense
- Output Voltage Trim

Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The 0RQB-C5T14x is an isolated DC/DC converter that operate from a nominal 48V source. This unit will provide up to 140W of output power from a nominal 48V input. This unit is designed to be highly efficient and low cost. Features include remote on/off, over current protection and overvoltage protection. The converter is 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 High	Model Number Active Low
14 Vdc	36 Vdc - 75Vdc	10 A	140 W	93.5%	0RQB-C5T140	0RQB-C5T14L

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

Part Number Explanation

$\frac{0}{1} \frac{R}{2} \frac{QB}{3} - \frac{C5}{4} \frac{T}{5} \frac{14}{6} \frac{x}{7}$

1---Through hole

2---RoHS 6, change "R" to "7" means RoHS 5

3---Series name

4---Series code

5---Input range (36-75V)

6---Output voltage (14V)

7---Suffix

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Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Continuous non-operating Input Voltage	-0.3	-	80	V	
Input Transient Voltage	-	-	100	V	100mS maximum
Remote On/Off	-0.3	-	18	V	
I/O Isolation Voltage	-	-	1500	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)	-	-	5.0	A	Vin=36 V
Input Current (no load)	-	80	120	mA	
Remote Off Input Current	-	10	20	mA	
Input Reflected Ripple Current (pk-pk)	-	35	50	mA	With simulated source impedance of 10 uH, 5 Hz to 20 MHz; Use a 1uF/100V ceramic capacitor and a 100uF/100V electrolytic capacitor with ESR=1 ohm max, at 200KHz@25°C.
Input Reflected Ripple Current (rms)	-	10	15	mA	
I ² t Inrush Current Transient	-	-	1	A ² s	
Turn-on Voltage Threshold		34.5	35.5	V	
Turn-off Voltage Threshold	32.5	33.5		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 7A on system board. Refer to the fuse manufacture's datasheet for further information.

- Notes:** 1. This converter has internal C-L-C (0.47uF-0.47uH-8.8uF) filter.
2. All specifications are typical at 25 °C unless otherwise stated.

Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point	13.72	14	14.28	V	Vin=48V, Io=50% load at 25C ambient.
Load Regulation	-	±14	±28	mV	
Line Regulation	-	±14	±28	mV	
Regulation Over Temperature (-40deg.C-85deg.C)	-	±70	±140	mV	
Ripple and Noise (pk-pk)	-	120	180	mV	0 - 20 MHz BW, with 1 uF ceramic load capacitor and a 10 uF tantalum capacitor at output
Ripple and Noise (rms)	-	25	50	mV	

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Output Specifications (continued)

Parameter	Min	Typ	Max	Unit	Notes	
Output Ripple and Noise(pk-pk) under worst case			220	mV	over all operating input voltage, load and ambient temperature condition	
Output Current Range	0		10	A		
Output DC Current Limit	10.5	12	14	A		
Short Circuit Surge Transient			5	A ² s		
Rise Time	6		12	mS		
Turn on Time		30	60	mS	Enable from Vin	
		25	50	mS	Enable from on/off	
Overshoot at Turn on		0	3	%		
Output Capacitance	0		680	uF		
Transient Response						
△V25%~50% of Max Load	Overshoot	-	400	600	mV	di/dt=0.1A/us, Vin=48 Vdc, with a 1 μF ceramic capacitor and a 10 uF Tantalum capacitor at output, Ta=25 °C.
	Settling Time	-	200	300	uS	
△V50%~25% of Max Load	Overshoot	-	400	600	mV	
	Settling Time	-	200	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	91.5	93.5	-	%	Vin=48V, full load, Ta=25°C
Switching Frequency	-	250	-	kHz	
Over Temperature Protection	-	125	-	°C	
Over Voltage Protection(Static)	-	17	-	V	This voltage is achieved by trimming up output slowly
Weight	-	48	-	g	
FIT	TBD			-	Calculated Per Bell Core SR-332 (Vin=48V, Vo=12V, Io=9.6A, Ta = 25 °C, FIT=10 ⁹ /MTBF)
Dimensions Inches (L × W × H) Millimeters (L × W × H)	2.30 x 1.45 x 0.50 58.42 x 36.83 x 12.69			-	
Isolation characteristics					
Input to Output	-	-	1500	V	
Input to Case	-	-	1500	V	
Output to Case	-	-	500	V	
Isolation Resistance	10M	-	-	ohm	
Isolation Capacitance	-	3900	-	pF	

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

ISOLATED DC/DC CONVERTERS

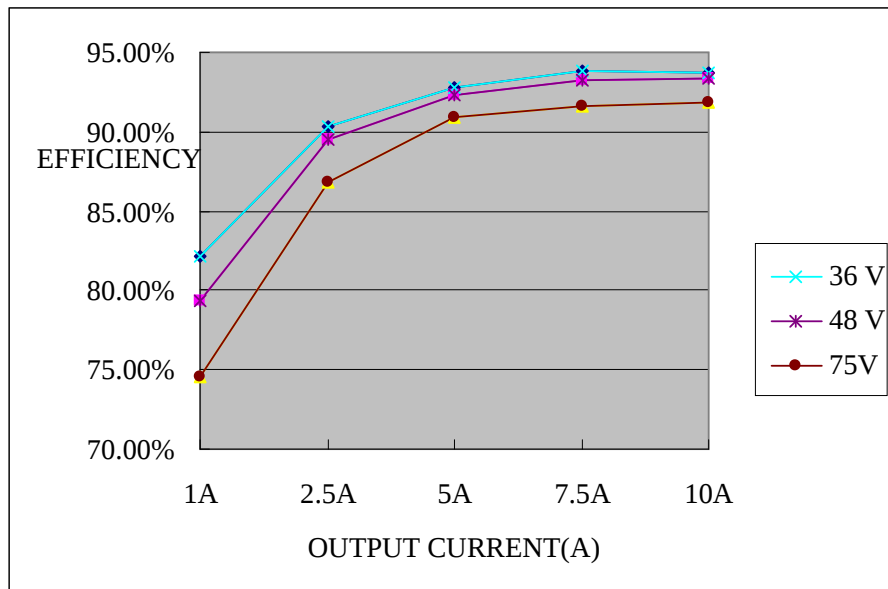
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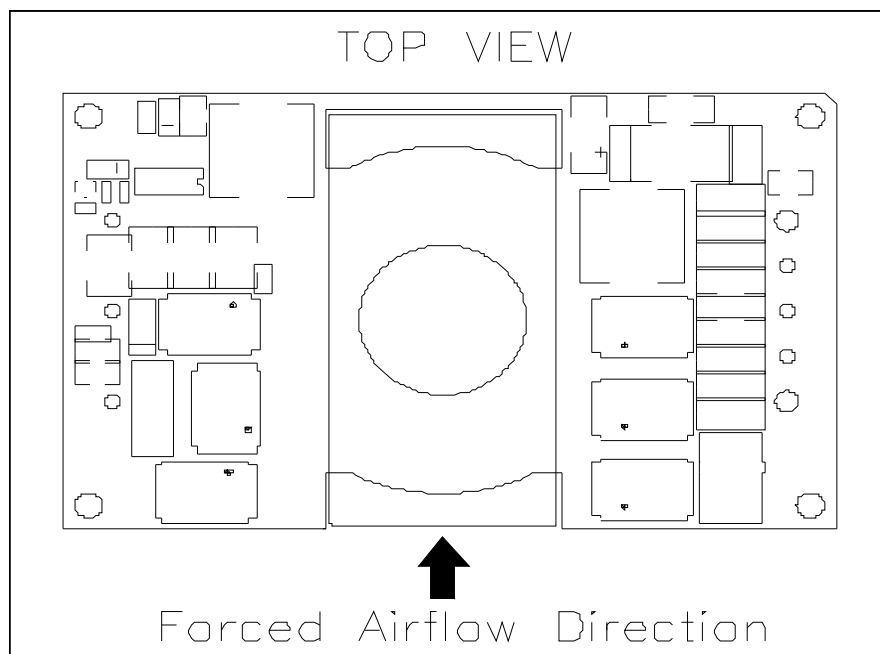
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Efficiency Data



Thermal Derating Curve

Maximum junction temperature of semiconductors derated to 120 degree C.



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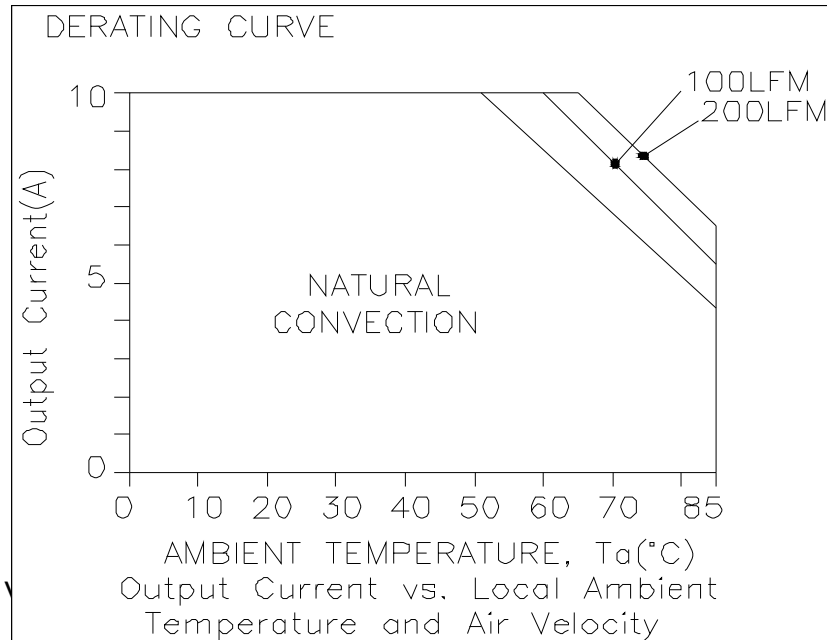


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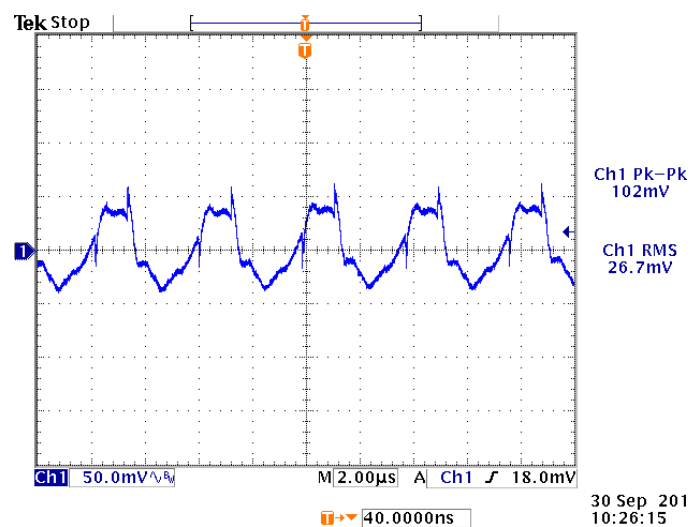
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Thermal Derating Curve (continued)

Derating curve under 48V input



Ripple and Noise Waveform



Note: Ripple and noise at full load, 48Vdc input, 14Vdc/10A output and Ta=25 deg C, and with a 1uF ceramic cap and a 10 uF Tantalum cap at output. .

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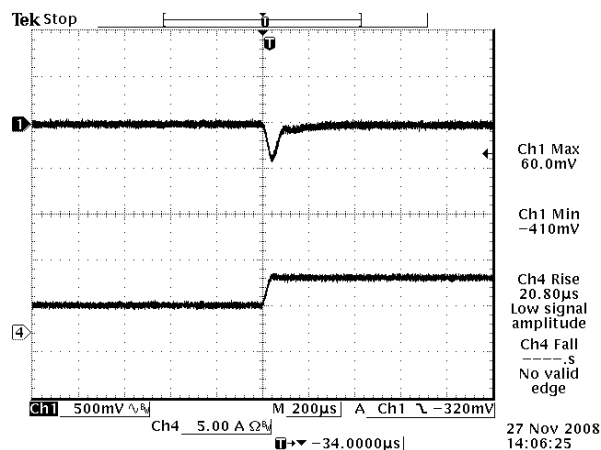
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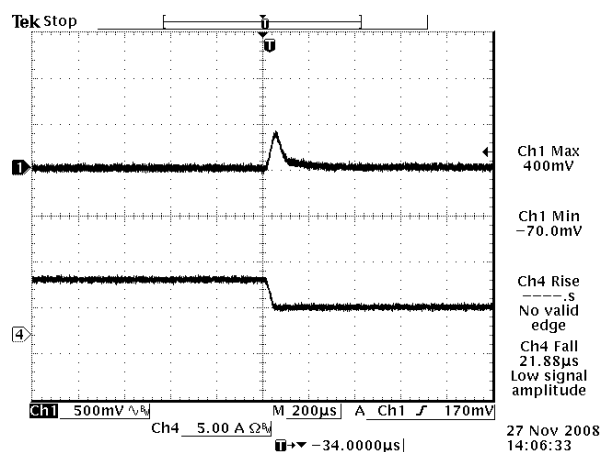
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Transients Responses Waveforms



Vout= 14V 25%-50% Load Transients at Vin=48V@Ta=25°C



Vout= 14V 50%-25% Load Transients at Vin=48V@Ta=25°C

Note: Transients response at $di/dt=0.1$ A/ μ s, with a 1 μ F ceramic capacitor and a 10 μ F tantalum capacitor at the output, Ta=25 deg C.

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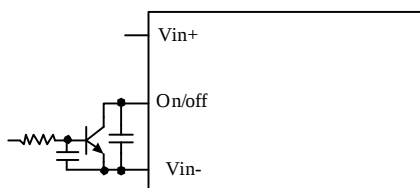
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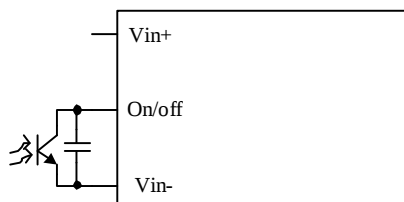
Remote On/Off

Parameter		Min	Typ	Max	Unit	Notes
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V	0RQB-C5T14L. 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	0RQB-C5T140. The remote on/off pin open, Unit on.
Signal High (Unit On)		2.4	-	18	V	
Current Sink		0	-	1	mA	

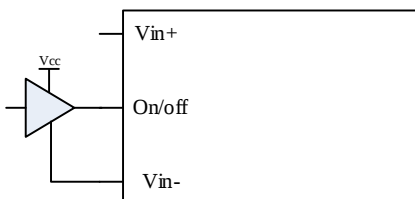
Recommended remote on/off circuit for active low



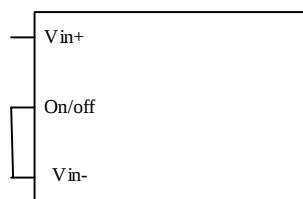
Control with open collector/drain circuit



Control with photocoupler circuit



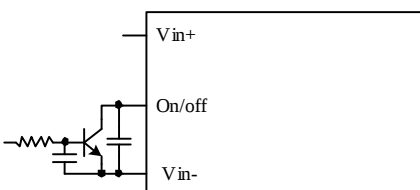
Control with logic circuit



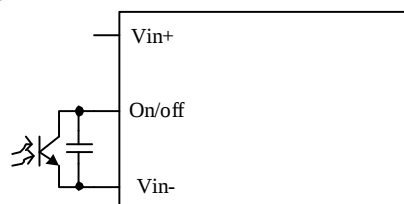
Permanently on

Remote On/Off(continued)

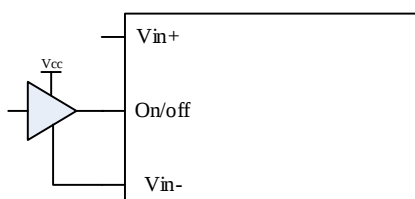
Recommended remote on/off circuit for active high



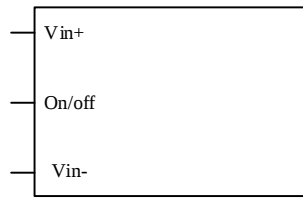
Control with open collector/drain circuit



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 Sense (-) pin. The Trim Up resistor should be connected between the Trim pin and the Sense (+). Only one of the resistors should be used for any given application.

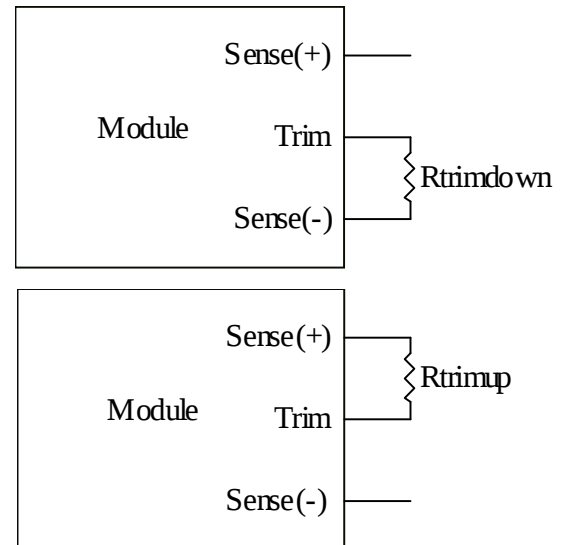
Minimum trim down voltage is 12.6V

Maximum trim up voltage is 15.4V.

The total voltage increased by trim and remote sense should not exceed 10% 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=14.000 V

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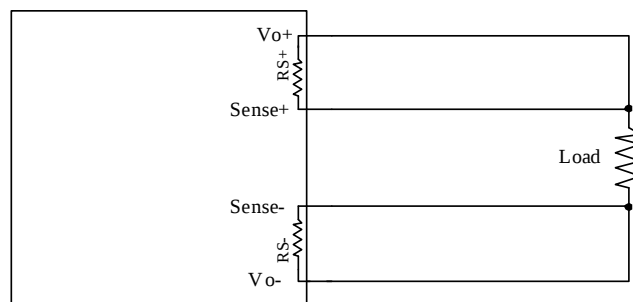
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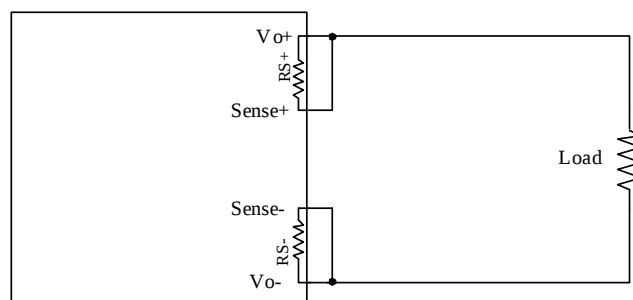
Remote Sense

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 10% 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 10% 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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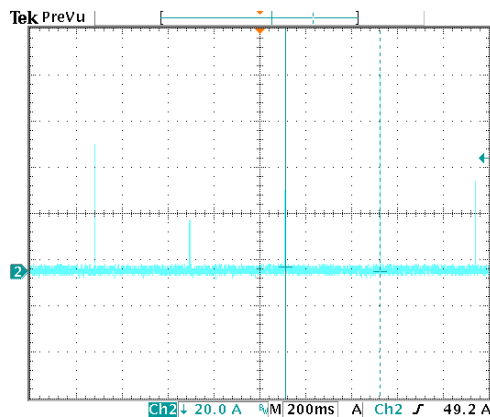


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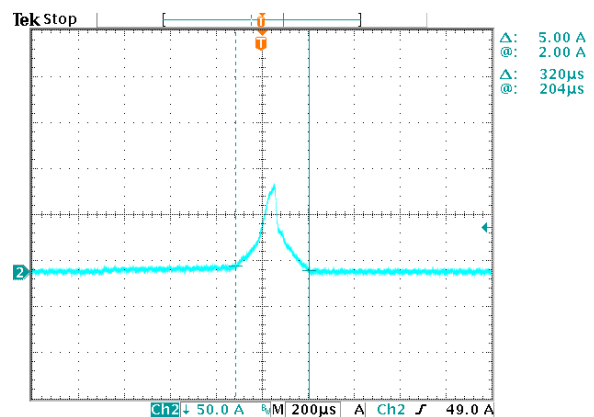
Over Current Protection

To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry and can endure current limiting for a few milli-seconds. If the over-current condition persists beyond a few milliseconds, the module will shut down into hiccup mode and restart once every 400mS. The module operates normally when the output current goes into specified range. The typical average output current is 0.5A during hiccup.



Vin=48V

18 Aug 2010
16:02:55



Expansion of on time portion

18 Aug 2010
16:05:31

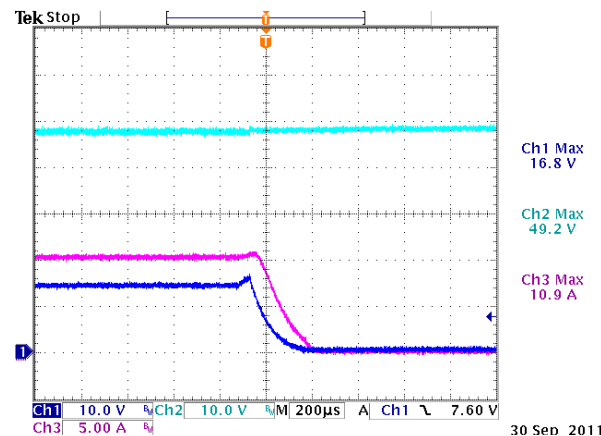
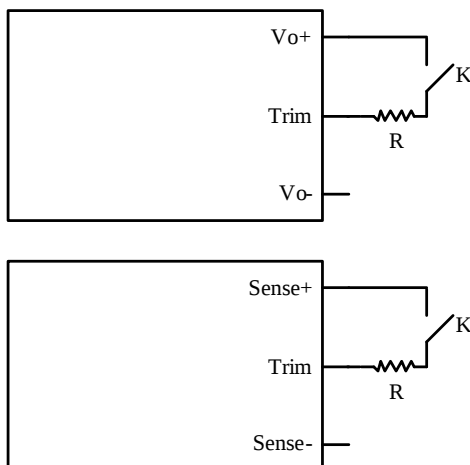
Over Voltage Protection

The output over voltage protection consists of circuitry that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over voltage protection threshold, the module will shutdown into hiccup mode and restart once every 800mS. The module operates normally when the fault is cleared.

Test setup:

Waveform:

R=10K



30 Sep 2011

48Vin,10A Load

CH1: Output voltage waveform

CH2: Input voltage waveform

CH3: Output Current waveform

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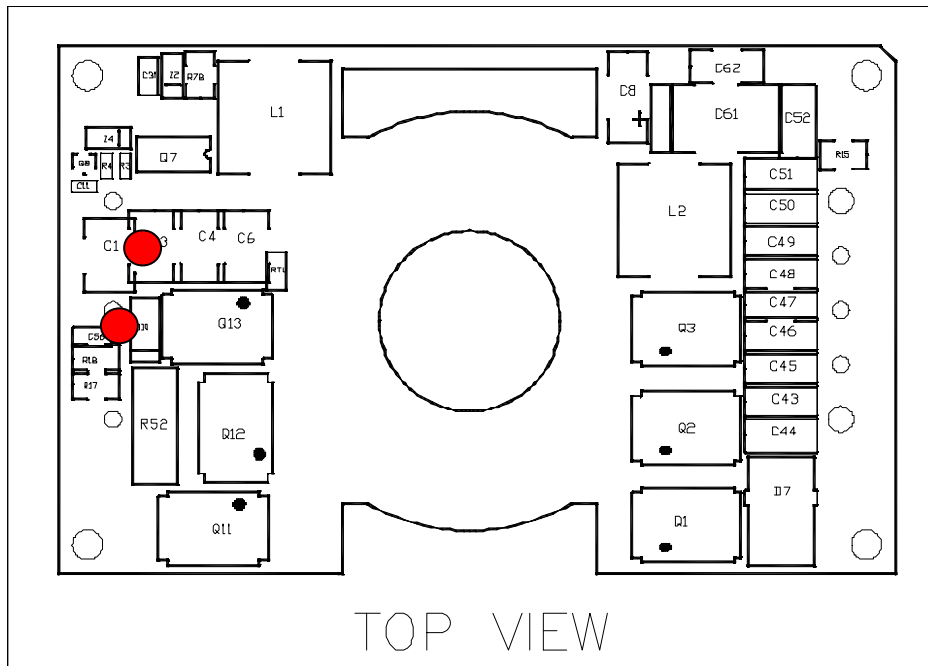


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Over Temperature Protection

The OTP is achieved by thermistor RT1 and the threshold is set at 120C in non-latch mode; the hottest component Q13 reaches 130C with 100LFM air flow correspondingly. It will restart automatically when the temperature falls down to 110C. The protecting point will be varied a little under different conditions (air flow, ambient temperature, input voltage, load...).



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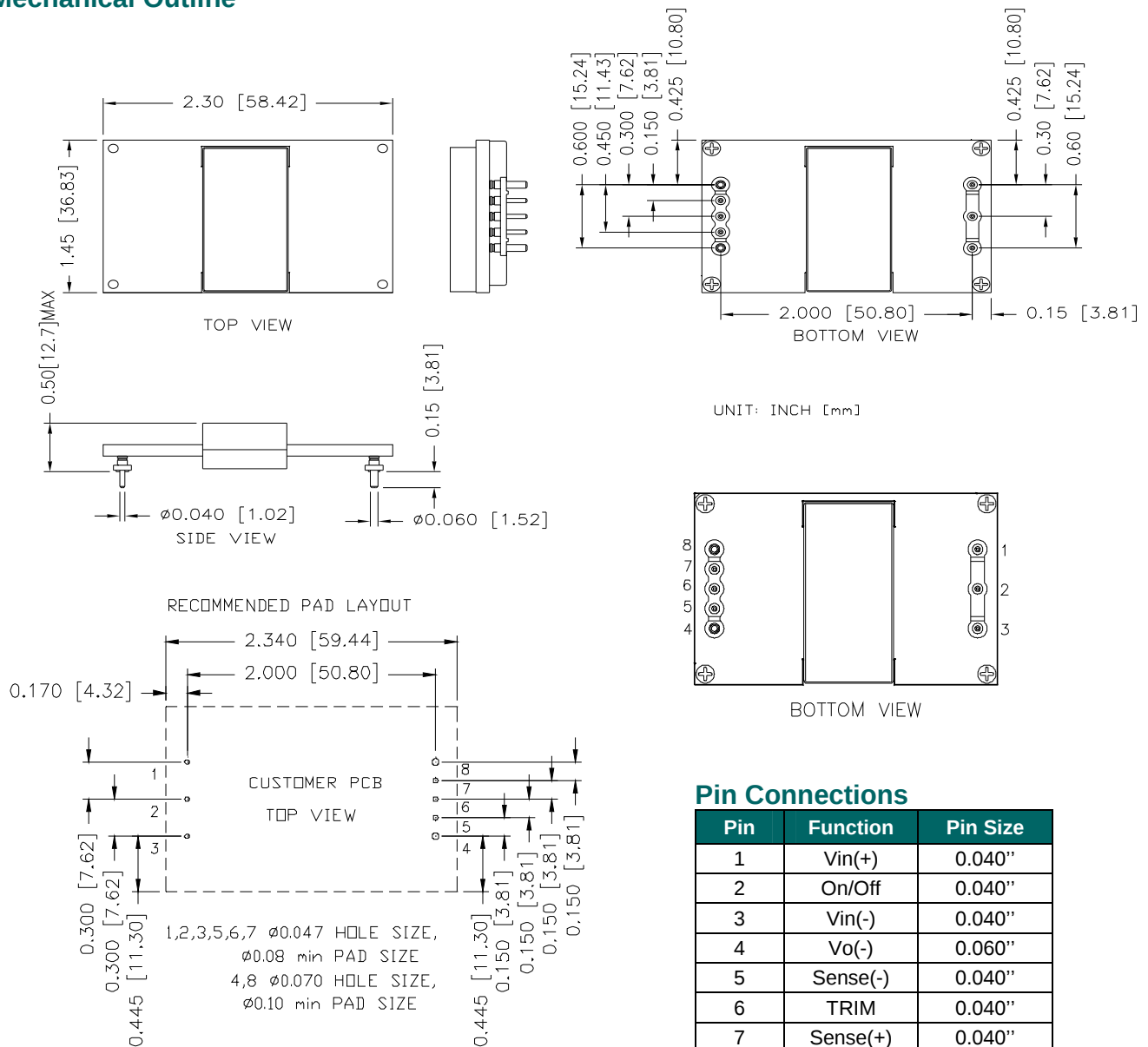
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Mechanical Outline

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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
2011-10-7	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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