

ISOLATED DC/DC CONVERTERS

36 Vdc - 75 Vdc Input,

3.3 Vdc/25 A Output



Sep. 22, 2009

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

0REB-C0T03x RoHS Compliant PRELIMINARY Rev.A

Features

- Isolated
- High Efficiency
- Fixed Frequency (310 KHz)
- High Power Density
- Low Cost
- Remote On/Off
- Class 1, Category 2, Isolated DC/DC Converter (refer to IPC-9592)
- TUV EN60950-1 Recognized (Pending)
- UL60950-1 Recognized (UL/cUL) (Pending)
- Input Under Voltage Protection
- Output Voltage Trim
- Output Over-Voltage Protection
- OCP/SCP
- Over Temperature Protection

Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The 0REB-C0T03x is an isolated dc/dc converter that operates from a nominal 48 Vdc source. This converter provides up to 82 W of output power. Features include remote on/off, short circuit protection, over current protection, over-temperature protection, output over-voltage protection, input under-voltage protection.

Part Selection

| Output Voltage | Input Voltage | Max. Output Current | Max. Output Power | Typical Efficiency | Model Number Active Low | Model Number Active High |
|----------------|-----------------|---------------------|-------------------|--------------------|-------------------------|--------------------------|
| 3.3 Vdc | 36 Vdc - 75 Vdc | 25 A | 82 W | 92% | 0REB-C0T03L | 0REB-C0T033 |

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

Part Number Explanation

0 R EB - C0 T 03 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
- 4---Series code
- 5---Input range (36-75V)
- 6---Output voltage (3.3V)
- 7---Enable, active low, change "L" to "3" means active high

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Absolute Maximum Ratings

| Parameter | Min | Typ | Max | Unit | Notes |
|--|------|-----|------|------|---------------|
| Continuous non-operating Input Voltage | -0.3 | - | 75 | 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) | - | - | 2.56 | A | |
| Input Current (no load) | - | 50 | 100 | mA | |
| Remote Off Input Current | - | 10 | 15 | mA | |
| Input Reflected Ripple Current (rms) | - | 2 | 5 | mA | With simulated source impedance of 10uH, 5Hz to 20MHz. Use a 100uF/100V electrolytic capacitor with ESR=1 ohm max, at 200KHz@25°C. |
| Input Reflected Ripple Current (pk-pk) | - | 20 | 40 | mA | |
| I ² t Inrush Current Transient | - | - | 1 | A ² s | |
| Turn-on Voltage Threshold | 32 | 34 | 35 | V | |
| Turn-off Voltage Threshold | 30 | 32 | 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 3.5A on system board. Refer to the fuse manufacturer's datasheet for further information.

- Notes:** 1. This converter has internal C-L-C (0.47uF-2.2uH-3.2uF) filter.
2. All specifications are typical at 25 °C unless otherwise stated.

Output Specifications

| Parameter | Min | Typ | Max | Unit | Notes |
|--|------|-----|------|------------|---|
| Output Voltage Set Point | 3.25 | 3.3 | 3.35 | V | Vin=48V, Io=50% load |
| Load Regulation | - | 0.2 | 0.5 | % Vo,set | Vin=48V, Io=0~100% load |
| Line Regulation | - | 0.2 | 0.5 | % Vo,set | Vin=36~75V, Io=100% load |
| Regulation Over Temperature (-40deg.C-85deg.C) | - | - | 0.02 | % Vo,set/C | |
| Ripple and Noise (pk-pk) | - | 90 | 120 | mV | Vin=48V, Io=100%load at 25oC ambient, 0-20MHz BW, with a 1µF ceramic capacitor and a 10uF Tantalum cap at output. |
| Ripple and Noise (rms) | - | 25 | 40 | mV | |
| Ripple and Noise (pk-pk) under worst case | - | - | 160 | mV | over all operating input voltage, load and ambient temperature condition |

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Output Specifications (continued)

| Parameter | Min | Typ | Max | Unit | Notes | | |
|--------------------------------------|---------------|--------------|-------|------------------|-------|----|--|
| Output Current Range | 0 | - | 25 | A | | | |
| Output DC Current Limit | 28 | 31 | 36 | A | | | |
| Short Circuit Surge Transient | - | - | TBD | A ² s | | | |
| Rise time | - | - | 10 | mS | | | |
| Turn on Time | - | 10 | 20 | mS | | | |
| | - | 10 | 20 | mS | | | |
| Overshoot at Turn on | - | 0 | 3 | % | | | |
| Output Capacitance | 0 | - | 10000 | uF | | | |
| Transient Response | | | | | | | |
| ΔV 50%~75% of Max Load | Overshoot | Vo= 3.3 V | - | 100 | 150 | mV | di/dt=0.1A/us, Vin=48Vdc, Ta=25°C, with a 1μF ceramic capacitor and a 10uF Tantalum cap at output. |
| | Settling Time | | - | 200 | 400 | uS | |
| ΔV 75%~50% of Max Load | Overshoot | | - | 100 | 150 | mV | |
| | Settling Time | | - | 200 | 400 | 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 | 90 | 92 | - | % | Vin=48V, full load | |
| Switching Frequency | 290 | 310 | 330 | kHz | | |
| Over Temperature Protection | - | 110 | 120 | °C | | |
| Output Voltage Trim Range | 80 | - | 110 | % | | |
| Over Voltage Protection (Static) | 3.8 | - | 5 | V | This voltage is achieved by trimming up output slowly. | |
| Over Voltage Protection (Dynamic) | - | - | 5 | V | The transient over voltage is achieved by connecting the Trim pin to Vout+ pin through a 1K resistor. | |
| Input to Output | - | - | 1500 | V | | |
| Isolation Resistance | 10M | - | - | Ohm | | |
| Isolation Capacitance | - | 2200 | - | pF | | |
| Weight | - | 23 | - | g | | |
| FIT | 350 | | | - | Calculated Per Bell Core SR-332 (Vin=48V, Vo=3.3V, Io=20A, Ta = 25 °C, FIT=10 ⁹ /MTBF) | |
| Dimensions | Inches (L x W x H) | | | - | | |
| | 2.30 x 0.90 x 0.334 | | | | | |
| | | Millimeters (L x W x H) | | | 58.42 x 22.86 x 8.50 | |

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

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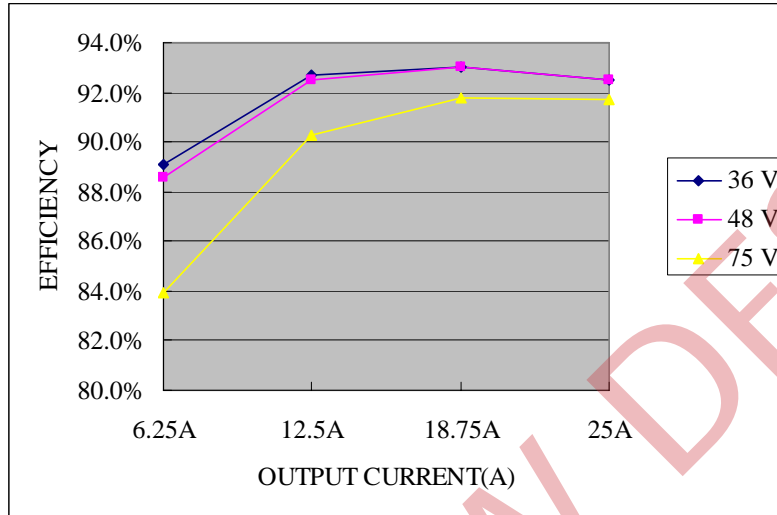
36 Vdc - 75 Vdc Input, 3.3 Vdc/25 A Output



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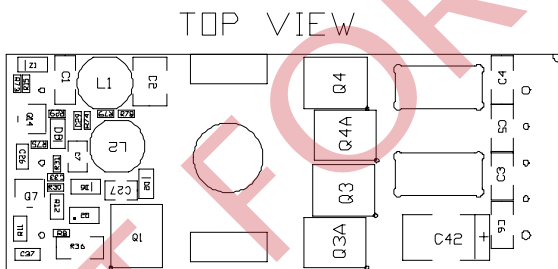
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Efficiency Data

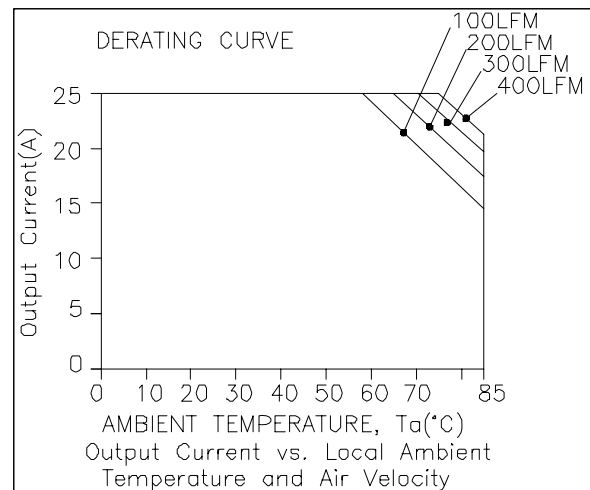


Thermal Derating Curve

Maximum junction temperature of semiconductors derated to 120 degree C.



↑
Forced Airflow Direction



Derating curve under normal input

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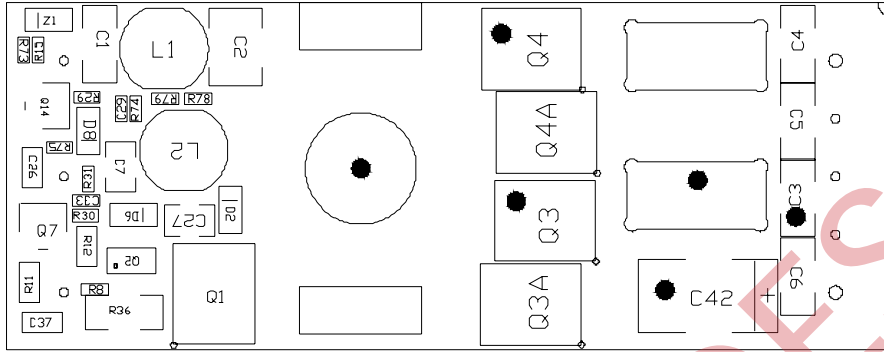
36 Vdc - 75 Vdc Input, 3.3 Vdc/25 A Output



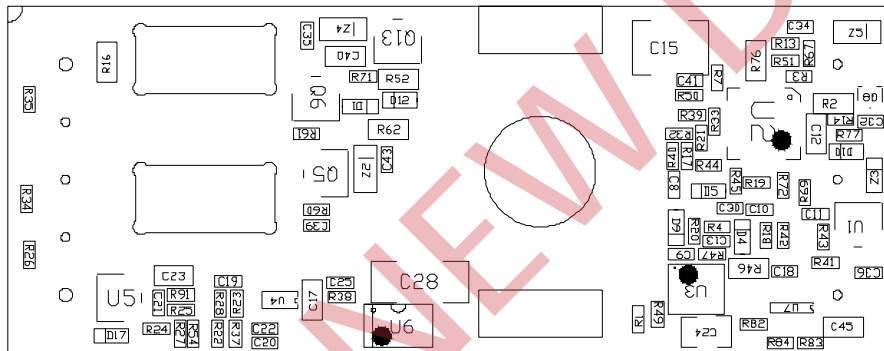
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Thermal Derating Curve (continued)

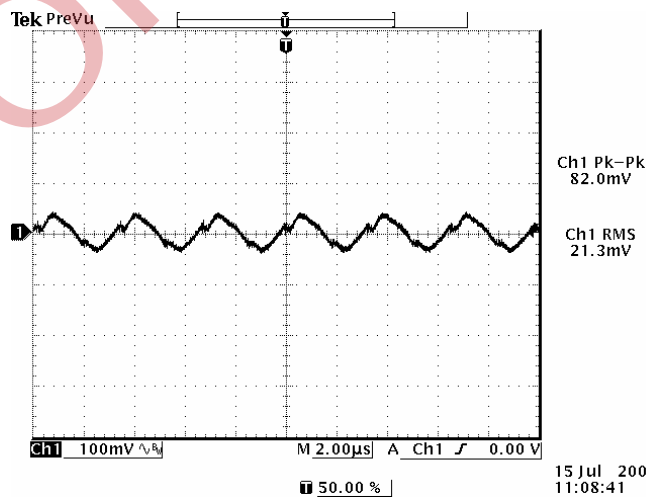


Temperature reference points on top side



Temperature reference points on bottom side

Ripple and Noise Waveform



48Vdc input, 3.3Vdc/25A output

Note: Ripple and noise at full load, with a 1uF ceramic cap and a 10 uF Tantalum cap at output, $T_a=25$ deg C.

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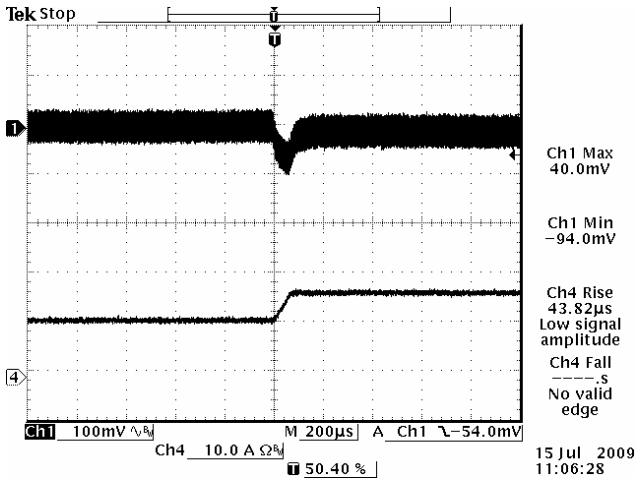
36 Vdc - 75 Vdc Input, 3.3 Vdc/25 A Output



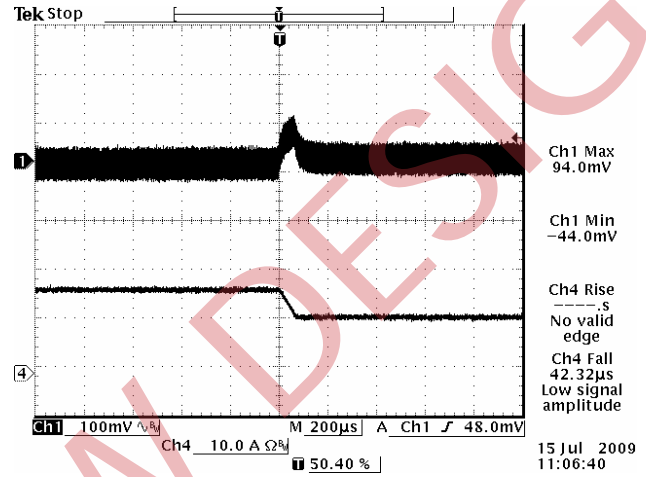
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Transient Response Waveforms



Vout= 3.3V 50%-75% Load Transients

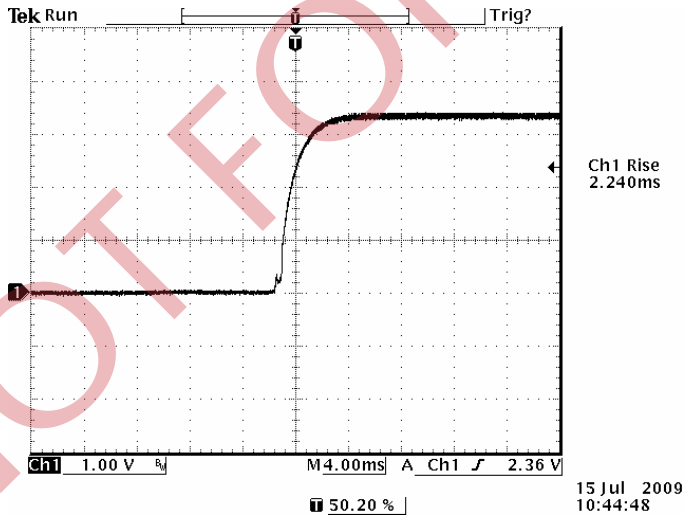


Vout= 3.3V 75%-50% Load Transients

Note: Transient Response at Vin=48V, di/dt=0.1A/µs, with a 1µF ceramic cap and a 10µF aluminum cap at the output.

Startup & Shutdown

Rise Time



Vin=48V, Vo=3.3V, Io=25A

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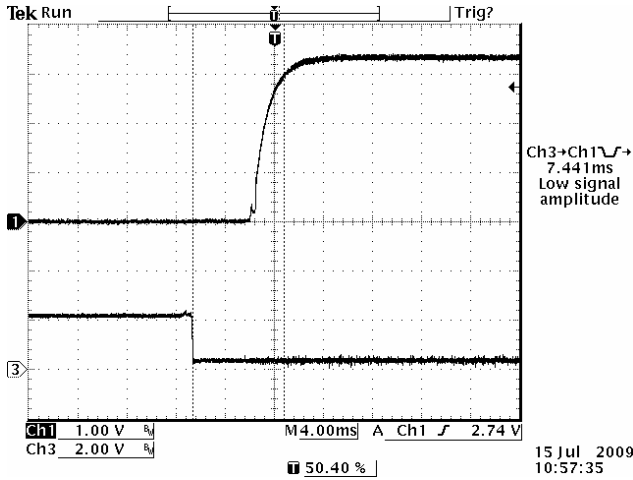


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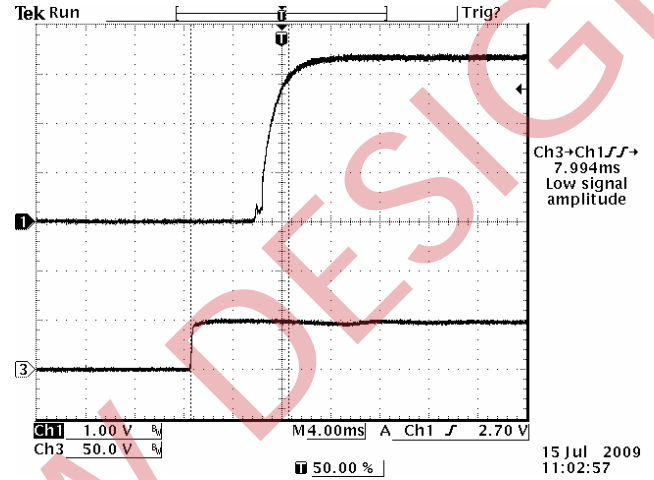
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Startup & Shutdown (continued)

Startup time

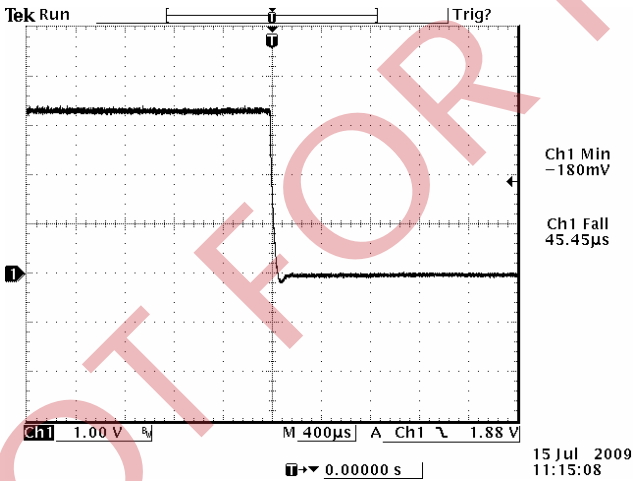


Startup from Vin
Ch1: Vo
Ch3: Vin
Vin=48V, Vo=3.3V, Io=25A



Startup from on/off
Ch1: Vo
Ch3: on/off
Vin=48V, Vo=3.3V, Io=25A

Shutdown



Vin=48V, Vo=3.3V, Io=25A

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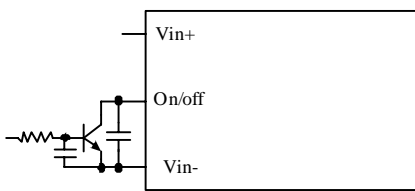
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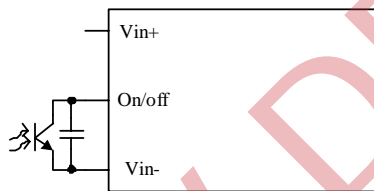
Remote On/Off

| 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 | - | 1 | mA | |

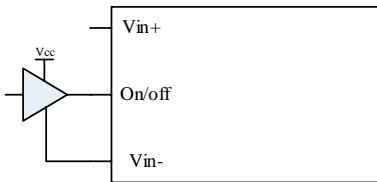
Recommended remote on/off circuit for active low



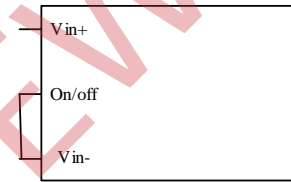
Control with open collector/drain circuit



Control with photocoupler circuit

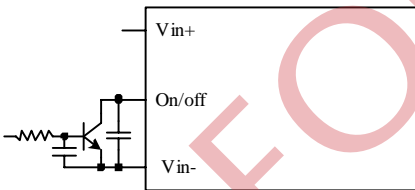


Control with logic circuit

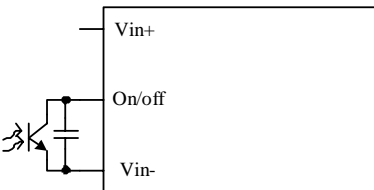


Permanently on

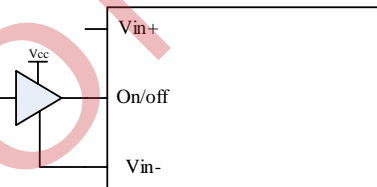
Recommended remote on/off circuit for active high



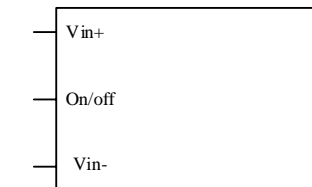
Control with open collector/drain circuit



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 2.64V

Maximum trim up voltage is 3.63V.

The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.

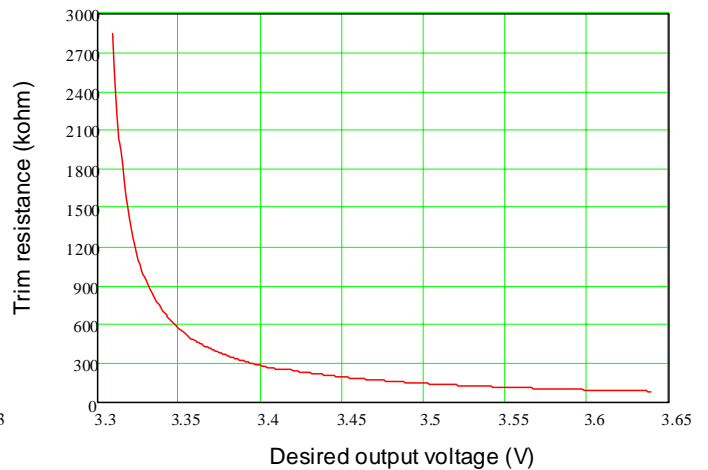
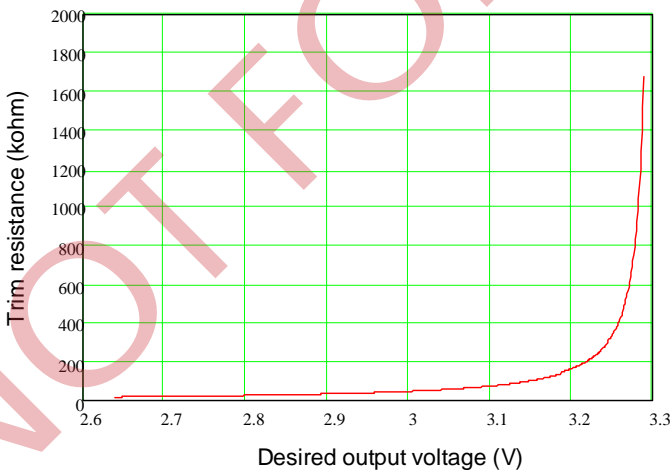
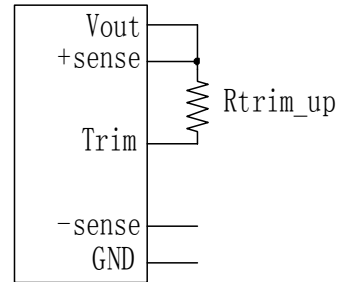
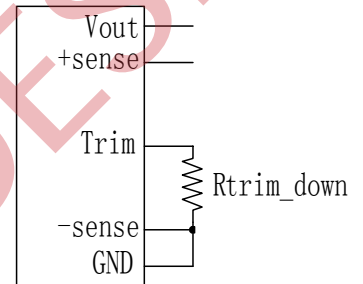
$$R_{trimdown} = \frac{511}{\Delta\%} - 10.22 [k\Omega]$$

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

Note:
$$\Delta\% = \left| \frac{V_{DES} - V_o}{V_o} \right| \times 100$$

V_{o_req} = Desired (trimmed) output voltage [V]

Output voltage V_o = 3.3 V



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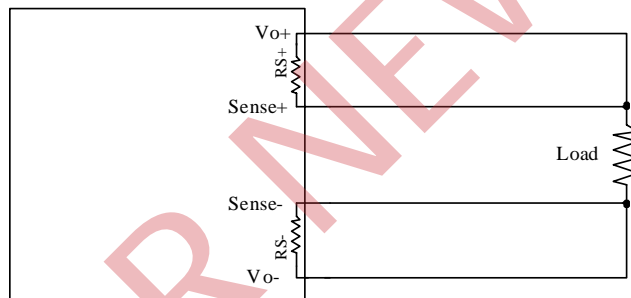
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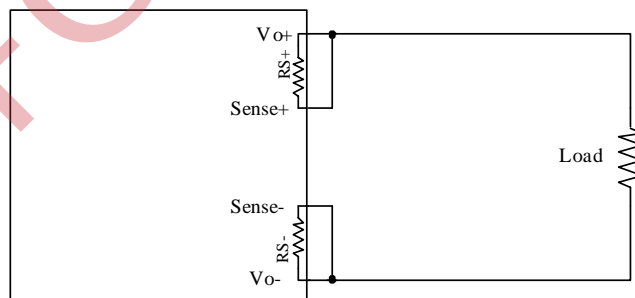
Remote Sense

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 0.1 μ F 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+ (10 ohm) from Vo+ to Sense+ and a resistor RS- (10 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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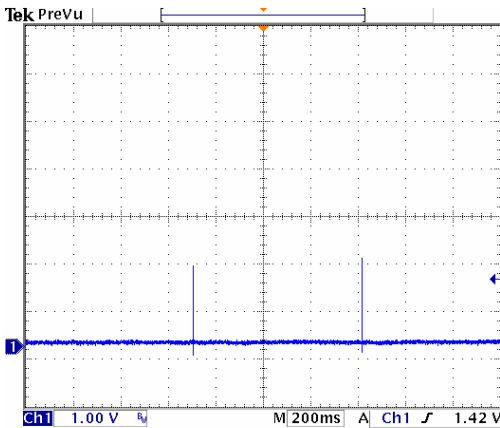


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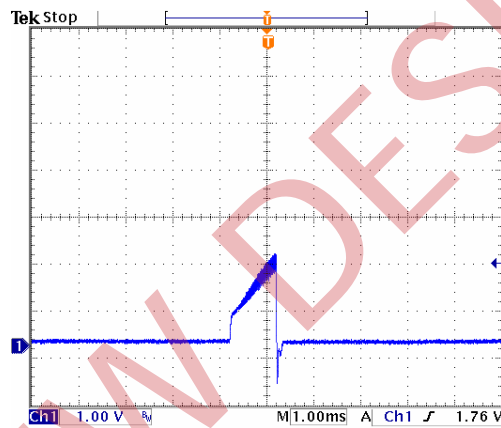
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Over Current Protection

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 700mS. The module operates normally when the output current goes into specified range. The typical average output current is 2A during hiccup.



Vin=48V

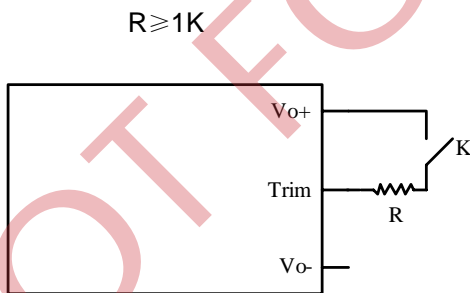


Expansion of on time portion

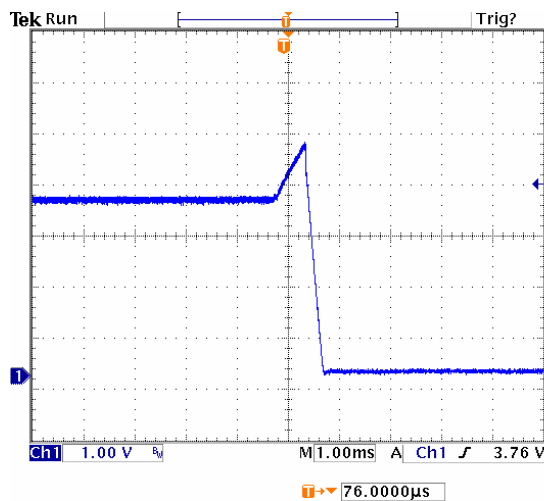
Over Voltage Protection

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 700mS. The module operates normally when the fault is cleared.

Test setup:



Waveform:



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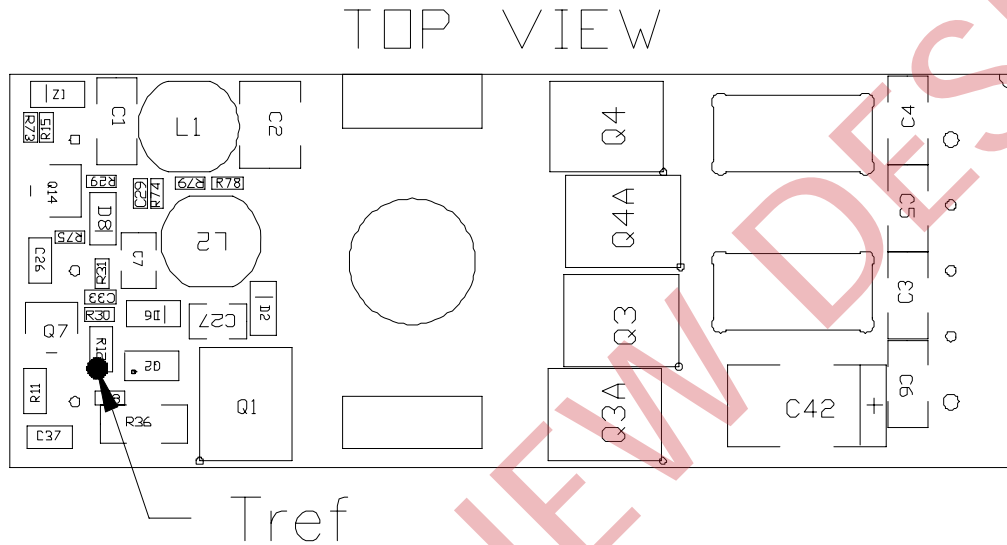


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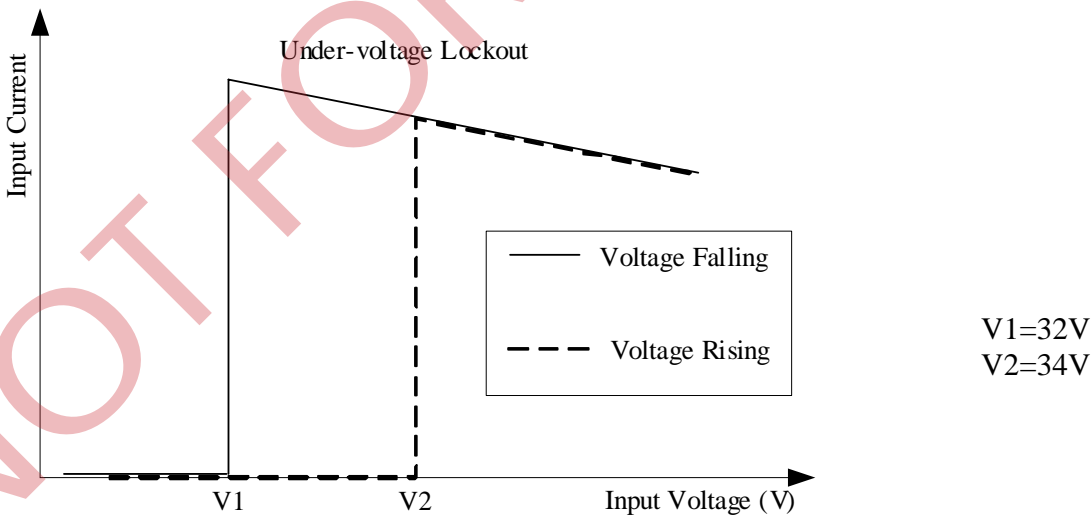
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Over Temperature Protection

The OTP is achieved by thermistor R12 and the threshold is set at 110C in non-latch mode; the hottest component Q1 reaches 112C with 100LFM air flow correspondingly. It will restart automatically when the temperature falls down to 100C. The protecting point will be varied a little under different conditions (air flow, ambient temperature, input voltage, load...).



Input Under-voltage Lockout



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Safety & EMC

Safety

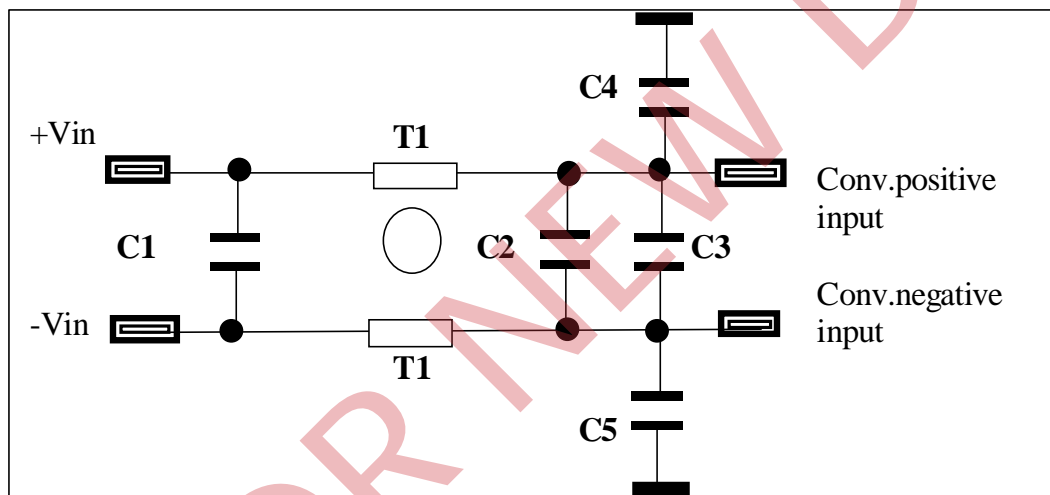
1. Material flammability UL94V-0
2. TUV Certification EN60950-1
3. UL Certification UL60950-1

EMC

1. Surge IEC61000-4-5
2. DC-DIP IEC61000-4-29
3. Conductive EMI EN55022 class A

Compliance to EN55022 class A (both q.peak and average) with the following inductive and capacitive filter

Setup:



| Item | Designator | Parameter | Vendor | Vendor P/N |
|------|------------|---------------------|----------|--------------------|
| 1 | C1 | 1uF/100V,ceramic | Murata | GRM32ER72A105KA01L |
| 2 | C2 | 0.1uF/100V, ceramic | TDK | C3216X7R2A104K |
| 3 | C3 | 100uF/100V, AL cap | Nichicon | UVZ2A101MPD |
| 4 | C4 | 22nF/1000V,ceramic | Johanson | 631S41W223KV4E |
| 5 | C5 | 22nF/1000V,ceramic | Johanson | 631S41W223KV4E |
| 6 | T1 | 1.3mH, common mode | Pulse | P0402NL |

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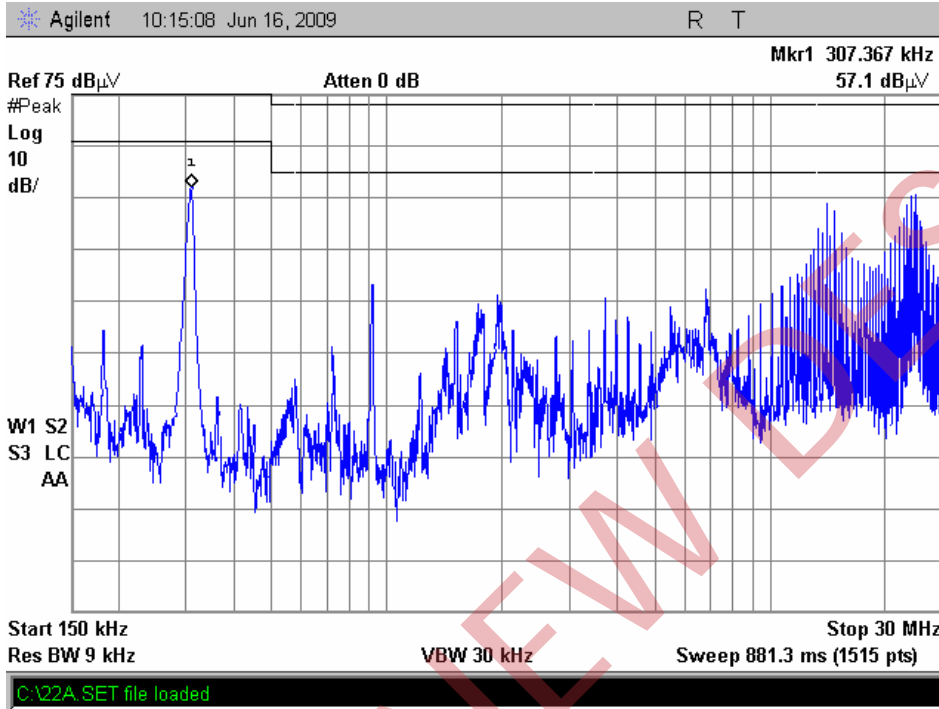


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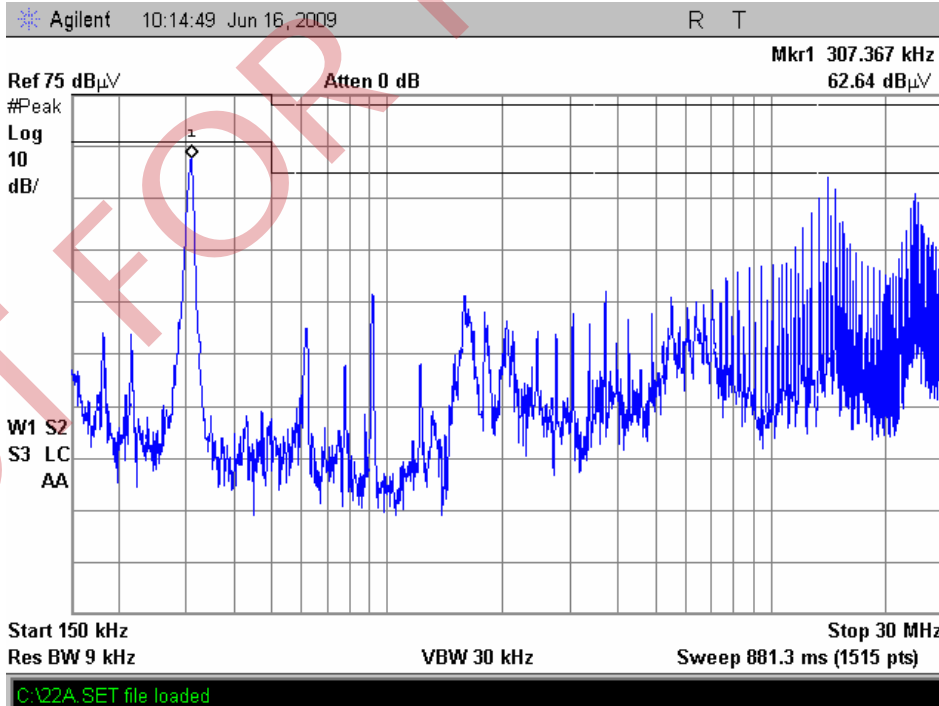
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Safety & EMC (continued)

Positive



Negative



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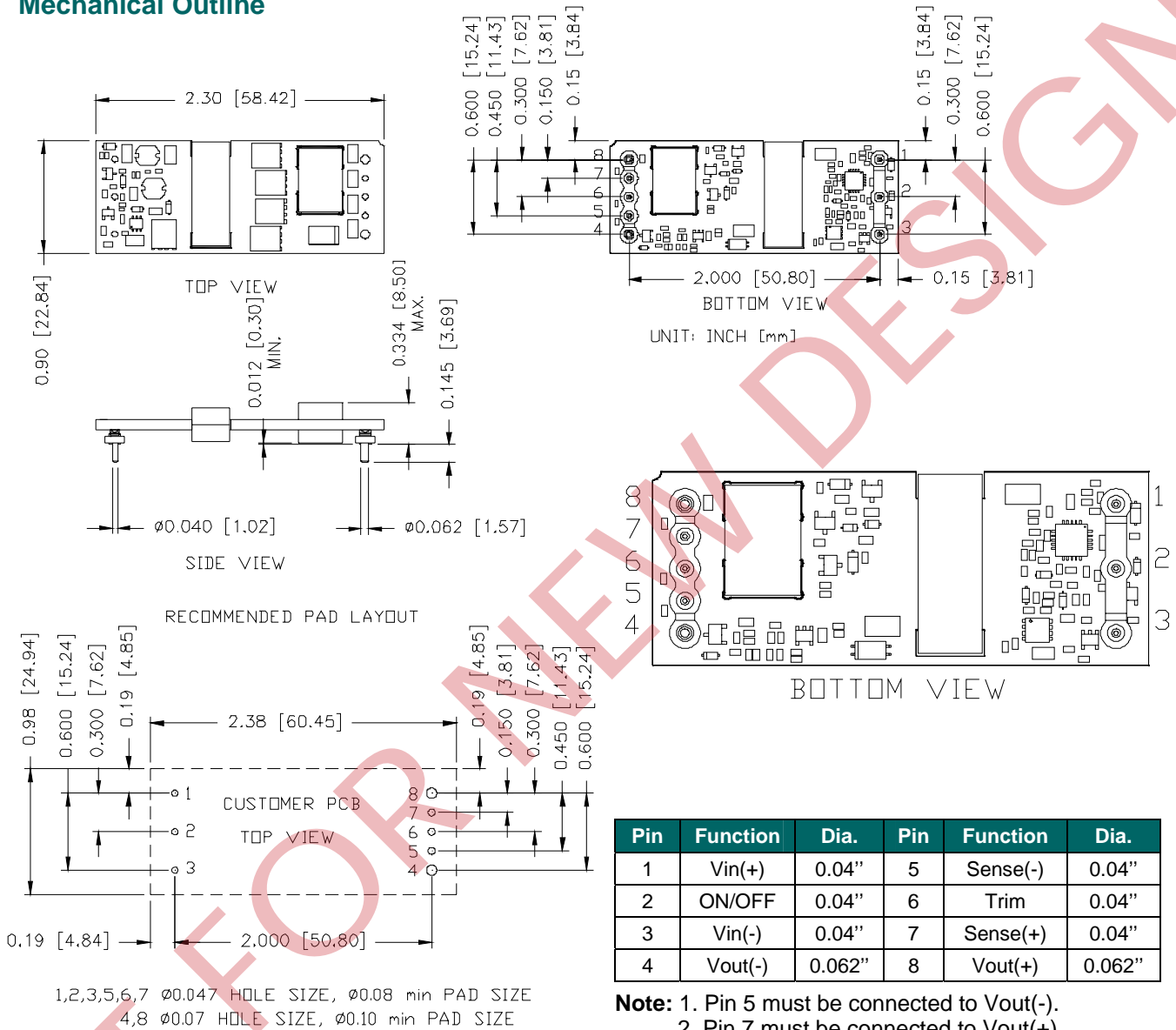
3.3 Vdc/25 A Output



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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 | Revision | Changes Detail | Approval |
|-----------|----------|----------------|----------|
| 2009-9-22 | A | First release | YP Zhou |

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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