

## ISOLATED DC/DC CONVERTERS

36 Vdc - 75 Vdc Input 9.6 Vdc /40 A Output, 1/4 Brick



Jun. 02, 2011

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

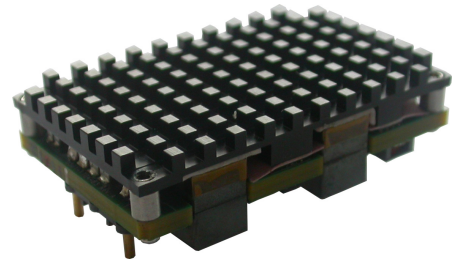
0RQB-Q2T09x

RoHS Compliant

Rev.F

### Features

- Isolated
- High Efficiency
- High Power Density
- Fixed Frequency (300 kHz)
- Low Cost
- Input Under-Voltage Lockout
- Input Over-Voltage Lockout
- Class 1, Category 2, Isolated DC/DC Converter (refer to IPC-9592)
- UL60950-1 2<sup>nd</sup> Edition Recognized (UL/cUL)
- Output Over-Voltage Protection
- Over Temperature Protection
- OCP/SCP
- Remote On/Off
- Basic Insulation
- Baseplate



### Applications

- Networking
- Computers and peripherals
- Telecommunications

### Description

The 0RQB-Q2T09x is an isolated dc/dc converter that operates from a nominal 48 Vdc source. This unit will provide up to 385 W of output power from a nominal 48 Vdc 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
9.6 Vdc	36 Vdc - 75 Vdc	40 A	385 W	95%	0RQB-Q2T096	0RQB-Q2T09L

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

### Part Number Explanation

0 R QB - Q2 T 09 x  
1 2 3 4 5 6 7

1---Through hole

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

3---Series name, 1/4 Brick

4---Series code

5---Input range 48V wide (36-75V)

6---Output voltage (9.6V)

7---Option, "x" of the model part number to be 0-9, A-Z, which will represent the special request of customer.

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### Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Continuous Input Voltage	-0.3	-	75	V	
Input Transient Voltage	-	-	100	V	100 mS 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)	-	-	15	A	
Input Current (no load)	-	120	180	mA	
Remote Off Input Current	-	10	20	mA	
Input Reflected Ripple Current (rms)	-	5	-	mA	Tested with simulated source impedance of 12uH, 5Hz to 20MHz; use a 100uF/100 V electrolytic capacitor with ESR=1ohm max, at 200 kHz at 25°C.
Input Reflected Ripple Current (pk-pk)	-	20	-	mA	
I <sup>2</sup> t Inrush Current Transient	-	-	1	A <sup>2</sup> s	
Turn-on Voltage Threshold	34	35	36	V	
Turn-off Voltage Threshold	32	34	34.8	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 20A on system board. Refer to the fuse manufacture's datasheet for further information.

- Notes:** 1. This converter has internal C-L-C (0.94uF-1uH-7.8uF) filter.  
2. All specifications are typical at 25 °C unless otherwise stated.

### Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point	9.43	9.63	9.82	V	Vin=48V, Io=50% load
Load Regulation	-	0.2	0.5	%Vo	Vin=48V, Io=Io,min to Io,max
Line Regulation	-	0.5	1	%Vo	Vin=36V~75V, Io=50% load
Regulation Over Temperature	-	0.5	1	%Vo	-40deg.C-85deg.C
Total Regulation	-	-	2	%Vo	Including set point, load/line/temperature regulation
Ripple and Noise (pk-pk)	-	-	150	mV	5 Hz-20 MHz bandwidth, Vin=48V
Ripple and Noise (rms)	-	-	60	mV	

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## Output Specifications (continued)

Parameter	Min	Typ	Max	Unit	Notes	
Output Current Range	0	-	40	A		
Output DC Current Limit	42	48	54	A		
Short Circuit Surge Transient	-	-	5	A <sup>2</sup> s		
Rise time	-	20	-	ms		
Turn on Time		60	-	mS	Enable from Vin	
	-	40	-	mS	Enable from ON/OFF	
Overshoot at Turn on	-	0	-	%		
Output Capacitance	0	-	20000	uF		
Back Bias Start-up	-	-	90	%Vo		
Back Drive Current Limit	-	-	2	A	50% of nominal output voltage	
	-	-	50	mA		
<b>Transient Response</b>						
ΔV50%~75% of Max Load	Overshoot	-	400	600	mV	di/dt=0.1A/us, Vin=48Vdc, Ta=25°C, with a 1μF ceramic capacitor and a 10uF Tantalum cap at the output.
	Settling Time	-	0.5	-	mS	
ΔV75%~50% of Max Load	Overshoot	-	400	600	mV	
	Settling Time	-	0.5	-	mS	

**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	-	95	-	%	Vin=48V, full load
Switching Frequency	-	300	-	kHz	
Over Temperature Protection	-	125	-	°C	
Over Voltage Protection(Static)	11.2	-	11.8	V	This voltage is achieved by trimming up output slowly
Weight	-	75	100	g	
FIT		357		-	Calculated Per Bell Core SR-332 (Vin=48V, Vo=9.6V, Io=40A, Ta = 25 °C, FIT=10 <sup>9</sup> /MTBF)
Dimensions Inches (L x W x H) Millimeters (L x W x H)		2.30 x 1.45 x 0.67 58.42 x 36.83 x 17.00		-	
<b>Isolation characteristics</b>					
Input to Output	-	-	1500	V	
Isolation Resistance	10M	-		ohm	
Isolation Capacitance	-	2200	-	pF	

- Notes:**
1. It is important to maintain symmetric layout of all converters' input and output power traces to achieve good current sharing. Oring diodes or Mosfets may be needed in parallel operation.
  2. All specifications are typical at 25 °C unless otherwise stated.

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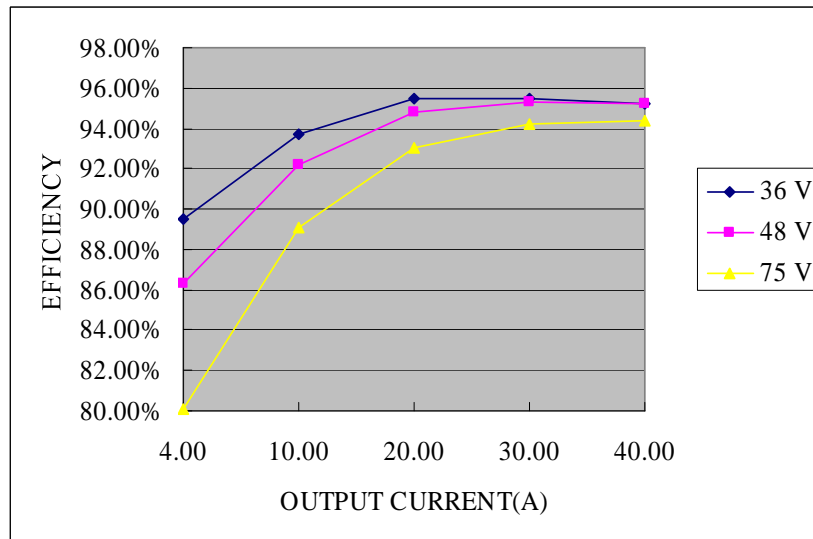
36 Vdc - 75 Vdc Input 9.6 Vdc /40 A Output, 1/4 Brick



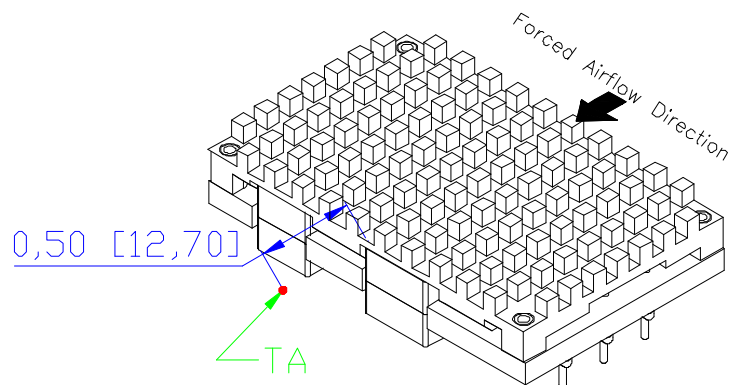
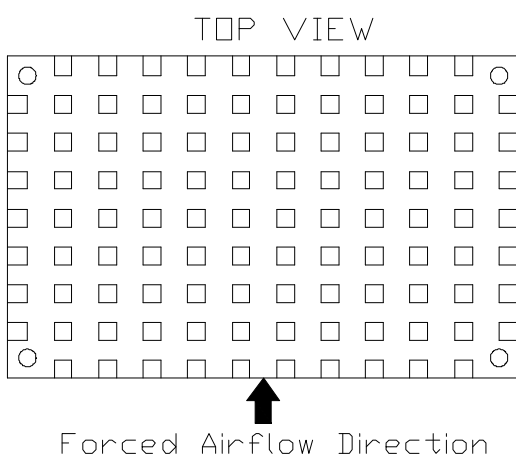
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## Efficiency Data



## Thermal Derating Curve



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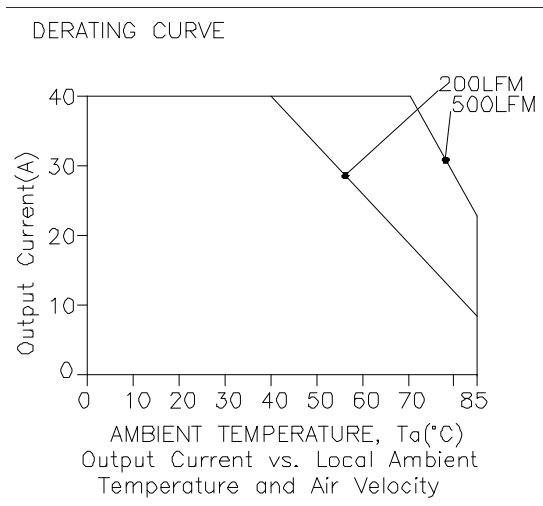
36 Vdc - 75 Vdc Input 9.6 Vdc /40 A Output, 1/4 Brick



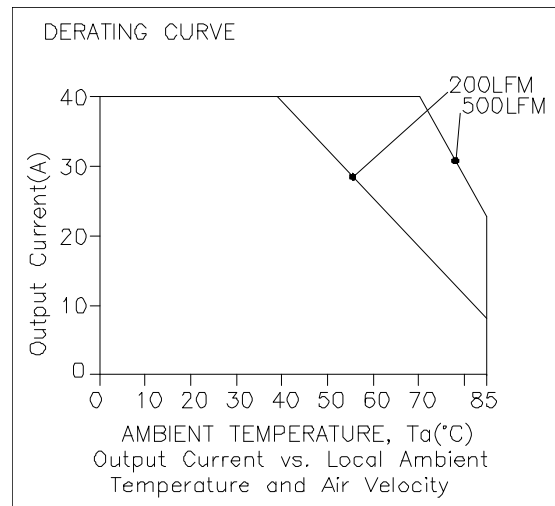
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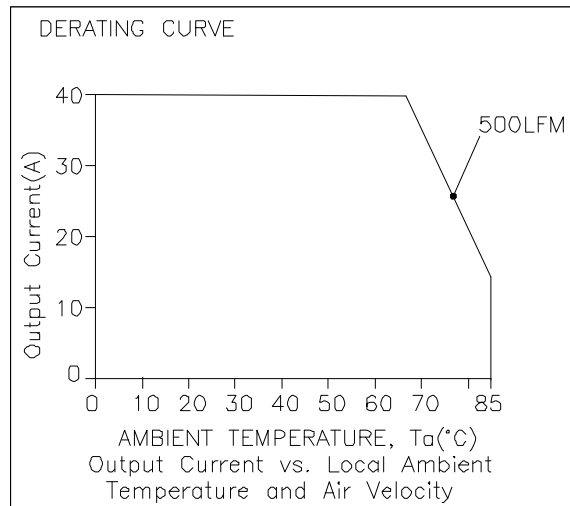
## Thermal Derating Curve (continued)



Vin=36V



Vin=48V



Vin=75V

# ISOLATED DC/DC CONVERTERS

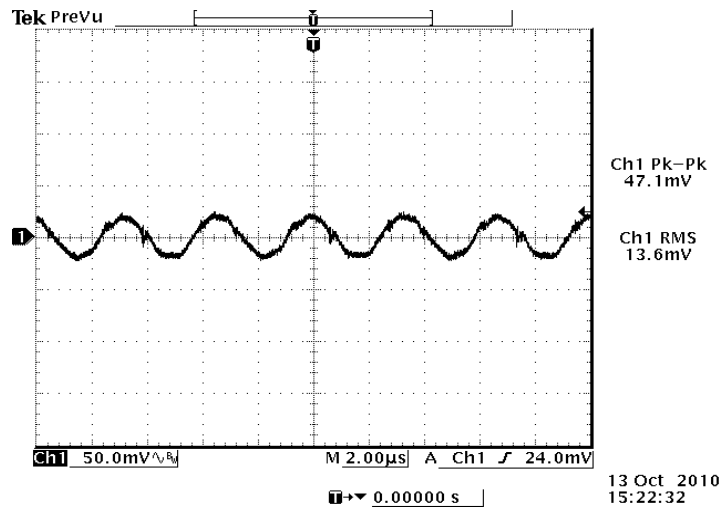
36 Vdc - 75 Vdc Input 9.6 Vdc /40 A Output, 1/4 Brick



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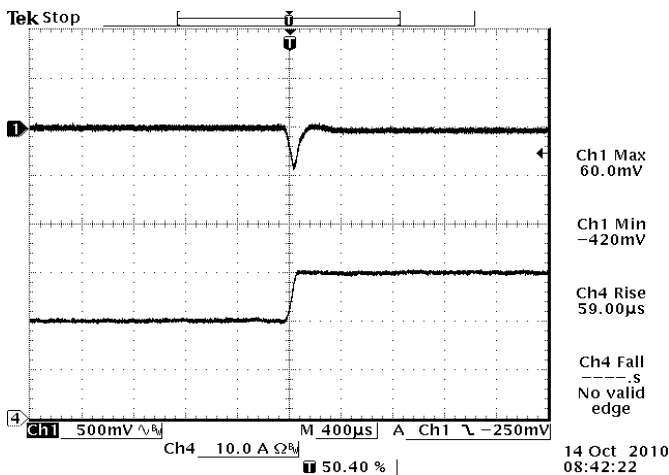
## Ripple and Noise Waveform



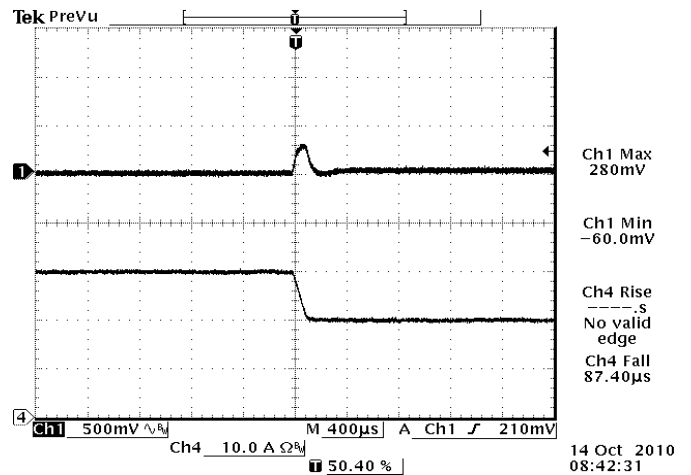
48Vdc input, 9.6Vdc/40A output

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

## Transient Response Waveforms



Vout=9.6V, 50% to 75% Load Transients



Vout=9.6V, 75% to 50% Load Transients

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

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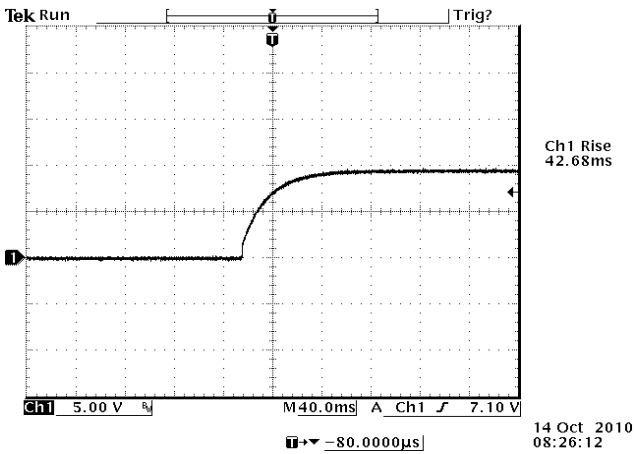


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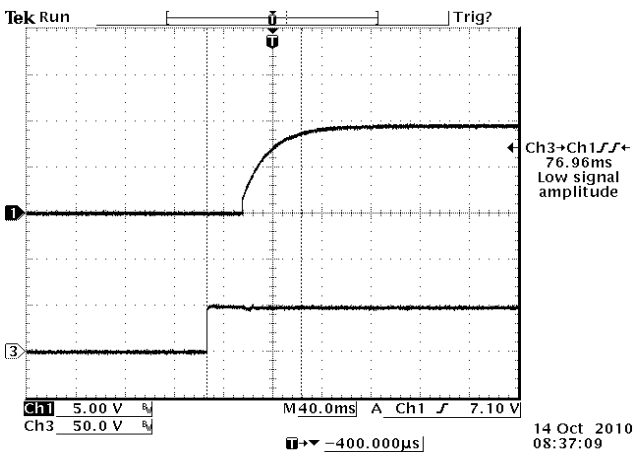
## Startup & Shutdown

### Rise Time



Test Condition: Vin=48V, Io=40A

### Startup time

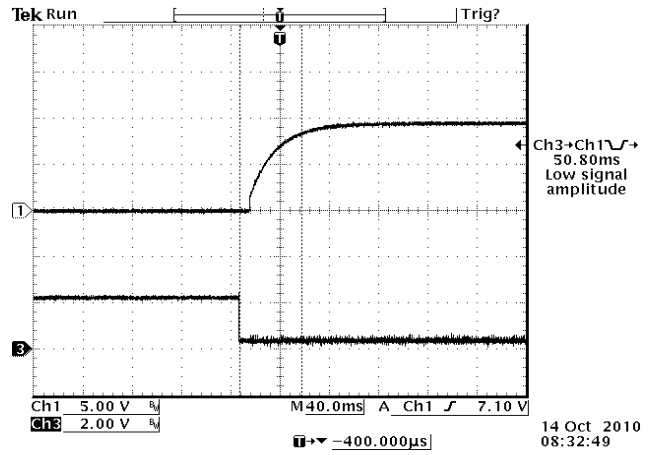


Startup from Vin

Ch1: Vo

Ch3: Vin

Test Condition: Vin=48V, Io=40A



Startup from on/off

Ch1: Vo

Ch3: on/off

Test Condition: Vin=48V, Io=40A

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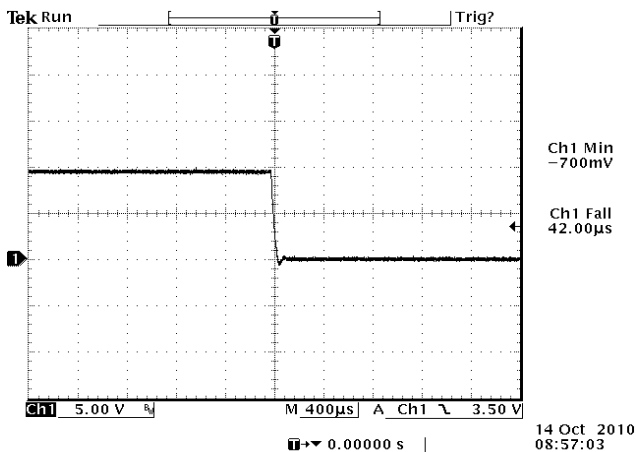


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## Startup & Shutdown (continued)

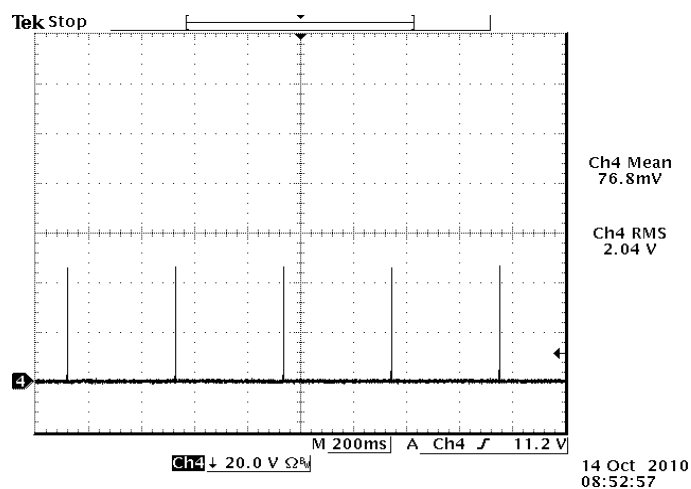
### Shutdown



Test Condition:  $V_{in}=48V$ ,  $I_o=40A$

## 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 5A during hiccup.



Test condition:  $V_{in}=48V$



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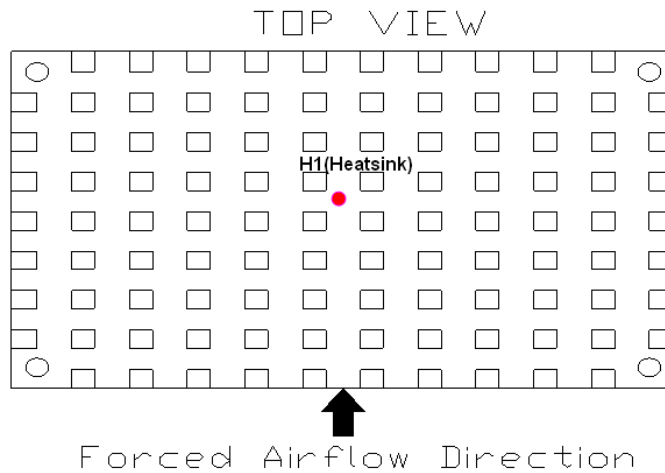


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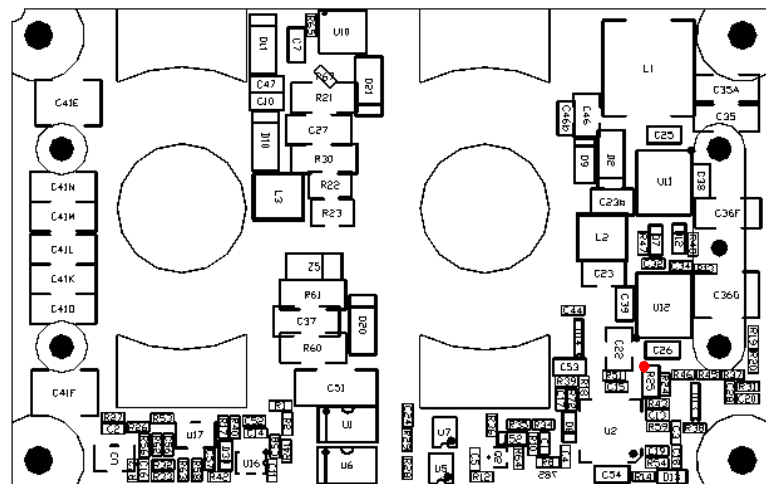
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## Over Temperature Protection

The OTP is achieved by thermistor R25 over the threshold is set at 125C in non-latch mode; the hottest component Q13 reaches 130C with 100LFM air flow correspondingly (In fact, the hottest component H1 reaches 100C 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...).



The hottest component on the top side: Q13



The thermistor on the bottom side: R25

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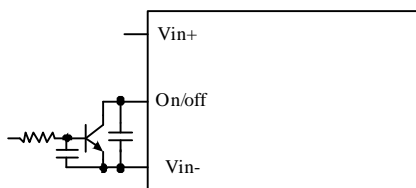
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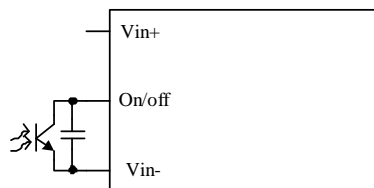
## Remote On/Off

Parameter		Min	Typ	Max	Unit	Notes
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V	0RQB-Q2T09L. 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-Q2T096. The remote on/off pin open, Unit on.
Signal High (Unit On)		2.4	-	18	V	
Current Sink		0	-	1	mA	

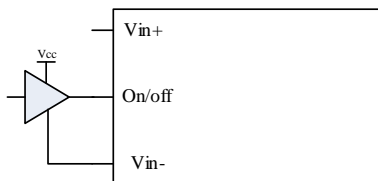
### Recommended remote on/off circuit for active low



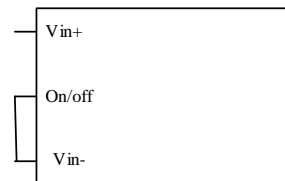
Control with open collector/drain circuit



Control with photocoupler circuit

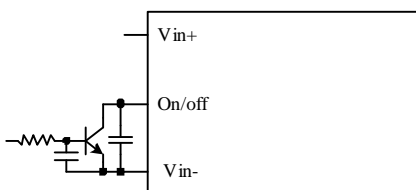


Control with logic circuit

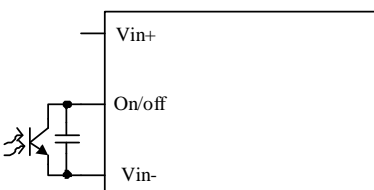


Permanently on

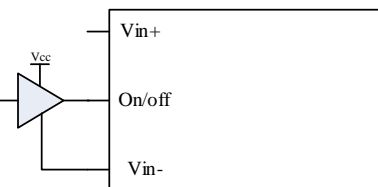
### Recommended remote on/off circuit for active high



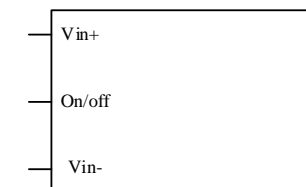
Control with open collector/drain circuit



Control with photocoupler circuit



Control with logic circuit



Permanently on

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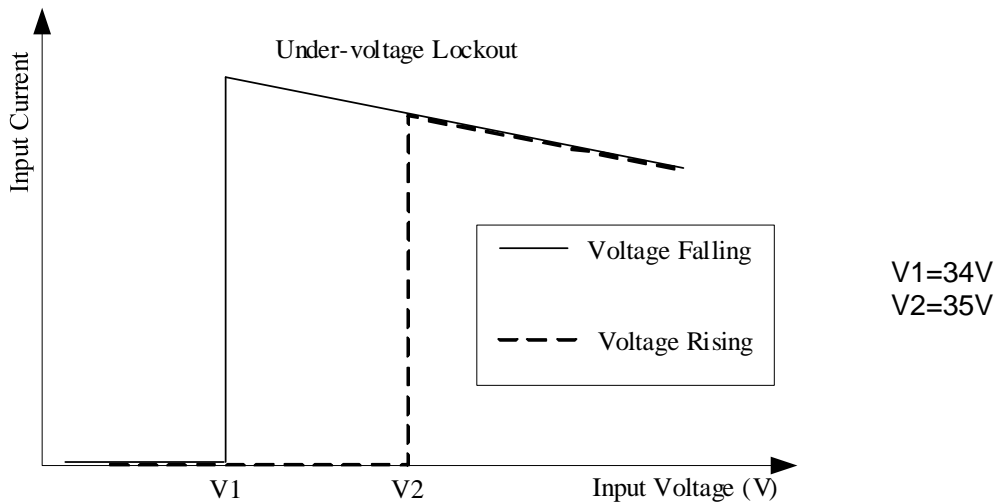
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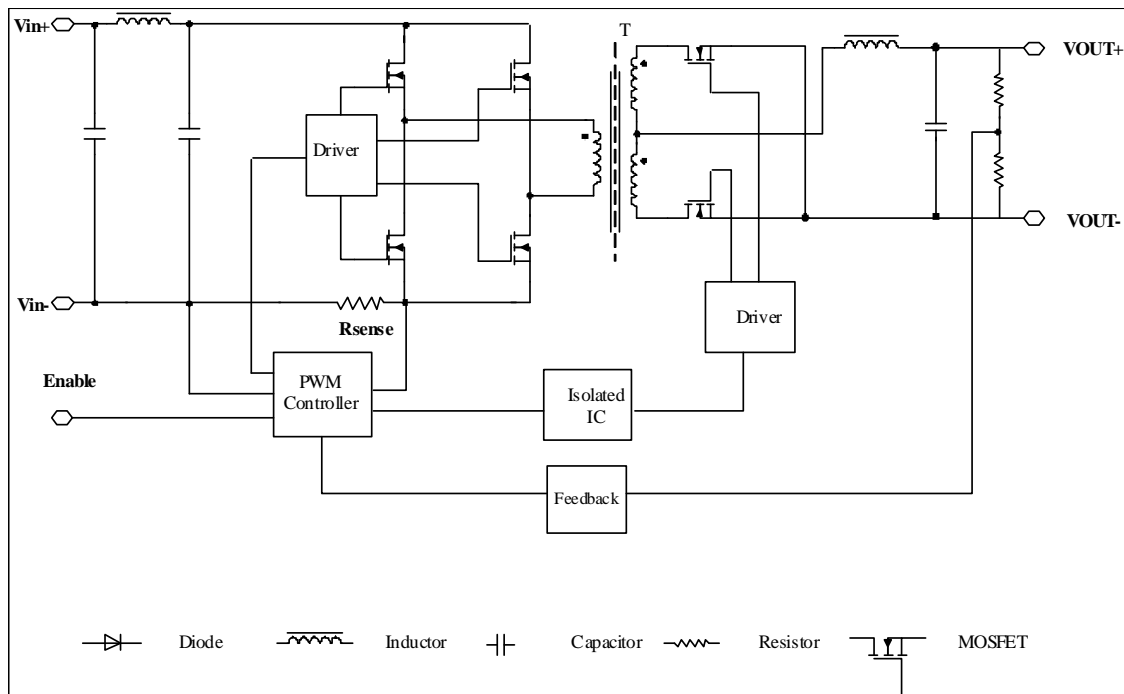
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## Input Under-voltage Lockout



## Fundamental Circuit Diagram



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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:

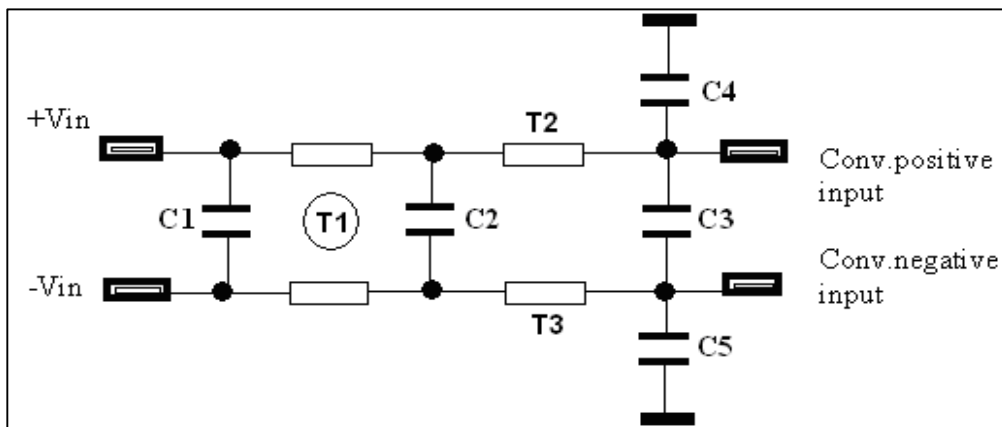


Figure -Recommended Filter

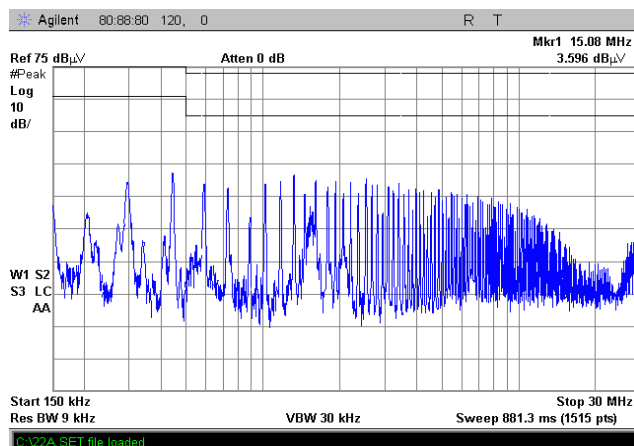
C1 = C2 = C3 = 68uF/100 V (1AB012230187)

C4=C5=1nF

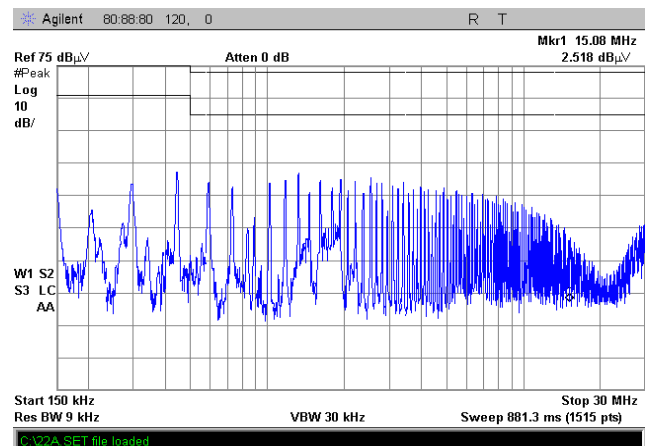
T1 = 180uH common mode choke type T50277 Falco

T2 = T3 = 0.68uH Shielded power inductor type SRP7030-R68FM Bourns

### Positive



### Negative



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## Layout



Layout of components on top side



Layout of components on bottom side

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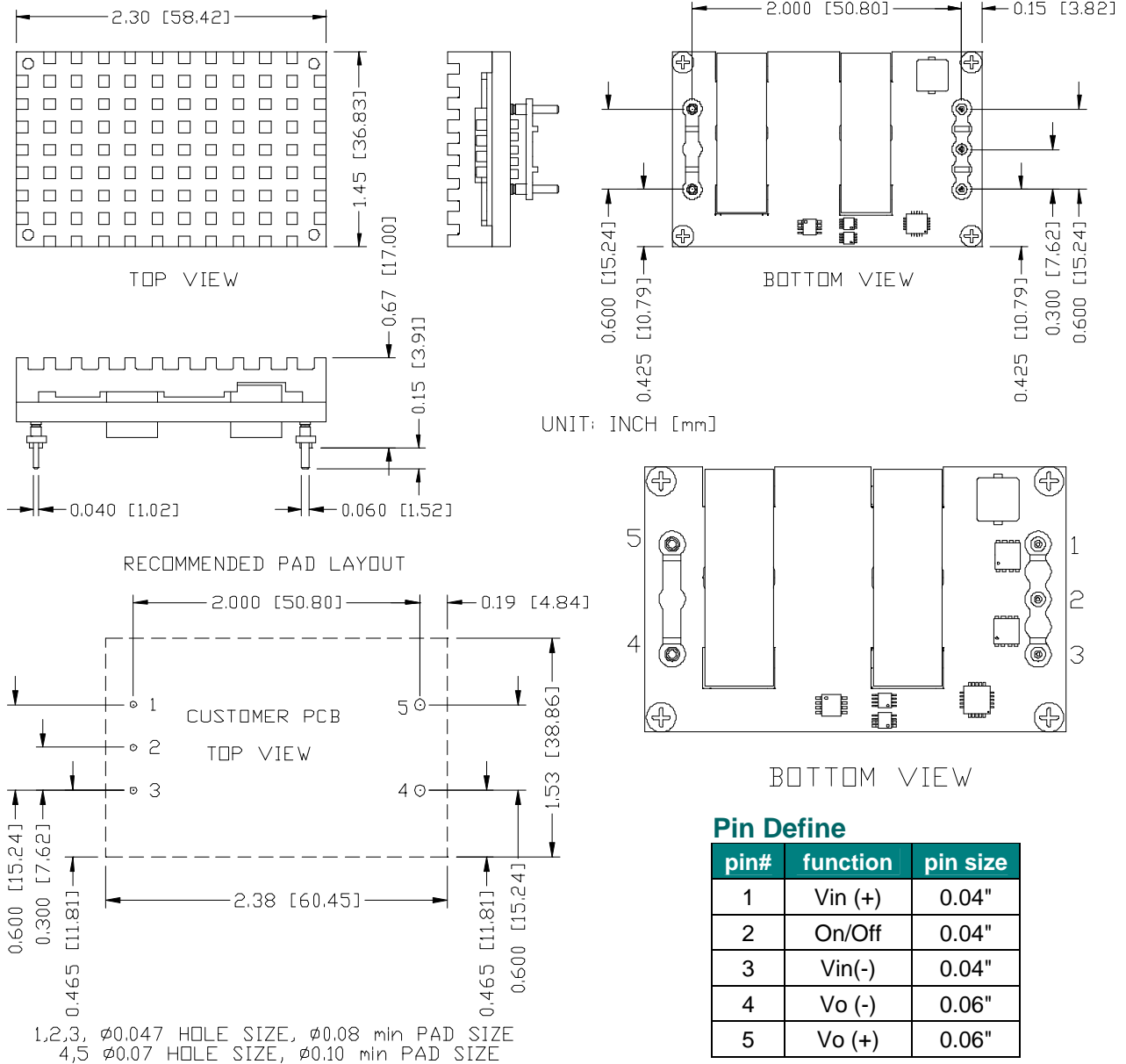
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## Mechanical Outline



**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	Revision	Changes Detail	Approval
2010-04-14	PA	First release.	XF Jiang
2010-04-28	PB	1. Delete part number 0RQB-Q2T09A/B. 2. Add back bias start, back drive current limit. 3. Delete TD, update mechanical outline(heatsink, pin).	XF Jiang
2010-11-23	C	1. Updated No load input current in Input specifications, Output voltage regulation, Output DC current limit, Transient response in Output specifications, Over temperature protection in General specifications, OCP, OTP, Efficiency data, MD. 2. Add TD, NR, TR, startup & shutdown, safety & EMC and Layout.	XF Jiang
2011-02-24	D	Updated TD.	XF Jiang
2011-04-29	E	1. Updated turn off voltage threshold in input specifications. 2. Updated output voltage setpoint, output current limit and transient response in output specifications. 3. Updated FIT and weight in general specifications. 4. Updated UVLO and TD.	XF Jiang
2011-06-02	F	Delete pending of UL60950-1 2 <sup>nd</sup> Edition Recognized (UL/cUL) in the first page.	XF Jiang

### 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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#### CORPORATE

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