ISOLATED DC/DC CONVERTERS

36 Vdc - 75 Vdc Input, 12 Vdc/33 A Output

May 23, 2011

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

0RQ1-Q0T12x RoHS Compliant PRELIMINARY Rev.A

Features

- Isolated
- High Efficiency
- Fixed Frequency (300 KHz)
- High Power Density
- Low Cost
- Input Under-voltage Protection
- Output Over-voltage Protection
- OCP/SCP
- Over Temperature Protection
- Remote ON/OFF
- Class 2, Category 2, Isolated DC/DC Converter (refer to IPC-9592)

Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The 0RQ1-Q0T12x is an isolated dc/dc converter that operates from a nominal 48 Vdc source. This converter is intended to provide isolation and step down to generate a regulated intermediate bus for the purpose of powering non-isolated Point-of-Load (POL) converters. This unit will provide up to 400 W of output power from a nominal 48 Vdc input.

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	33 A	400 W	95.5%	0RQ1-Q0T12L	0RQ1-Q0T120

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

Part Number Explanation

0	R	Q1	–	Q0	T	12	x
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 (12V)
7---Option, “x” of the model part number to be 0-9, A-Z, which will represent the special request of customer.

Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Continuous non-operating Input Voltage	-0.3	-	100	V	
Remote On/Off	-0.3	-	10	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)	-	-	12	A	
Input Current (no load)	-	140	200	mA	
Remote Off Input Current	-	4	8	mA	
Input Reflected Ripple Current (rms)	-	50	-	mA	12μH source impedance; VIN= 48V,Io= Iomax
Input Reflected Ripple Current (pk-pk)	-	80	-	mA	
I^2t Inrush Current Transient	-	-	1	A^2s	
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.

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

Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point	11.8	12	12.2	V	Vin＞40V, Io=50% load
	11	-	-	V	Vin≤40V, TBD
Load Regulation	-30	-	30	mV	Vin=48V, Io=0~100% load
Line Regulation	-	20	30	mV	Vin=40~75V,Io=100% load
Output Ripple and Noise (pk-pk)	-	100	150	mV	0-20MHz BW, with a 1μF ceramic capacitor and a 10uF tantalum at output.
Output Ripple and Noise (rms)	-	10	20	mV	
Ripple and Noise (pk-pk) under worst case	-	-	200	mV	Over all operating input voltage, load and ambient temperature condition.
Output Current Range	0	-	33	A	
Output DC Current Limit	-	40	-	A	
Rise time	-	-	15	mS	

Output Specifications (continued)

Parameter			Min	Typ	Max	Unit	Notes
Turn on Time			-	30	35	mS	Enable from Vin
			-	30	35	mS	Enable from ON/OFF
Overshoot at Turn on			-	0	3	%	
Output Capacitance			0	-	5000	uF	
Transient Response							
△V 50%~75% of Max Load	Overshoot	Vo= 12 V	-	300	-	mV	di/dt=0.1A/us, Vin=48Vdc, Ta=25°C, Tested with a 1.0μF ceramic, a 10μF tantalum, and 470μF capacitor and across the load.).
	Settling Time		-	500	-	uS	
△V 75%~50% of Max Load	Overshoot		-	300	-	mV	
	Settling Time		-	500	-	uS	

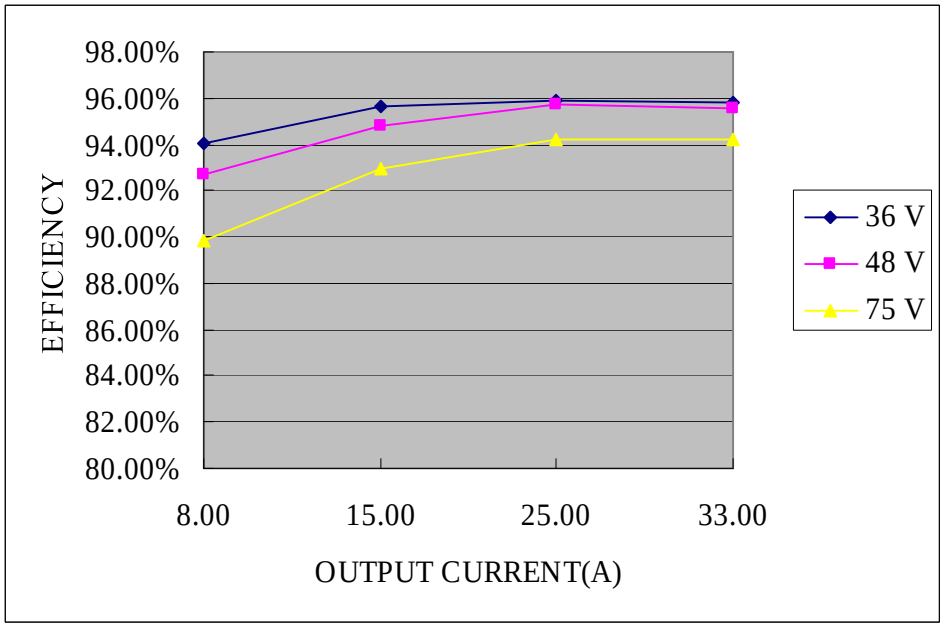
Note: All specifications are typical at nominal input, full load at 25°C unless otherwise stated.

General Specifications

Parameter	Min	Typ	Max	Unit	Notes
Efficiency	-	95.5	-	%	Vin=48V, full load
Switching Frequency	280	300	320	kHz	
Over Temperature Protection	-	125	-	℃	
Over Voltage Protection	-	-	14	V	
Weight	-	TBD	-	g	
FIT	TBD			-	Calculated Per Bell Core SR-332 (Vin=48 V, Vo=12 V, Io=33 A, Ta = 25°C, FIT=10^9/MTBF)
Dimensions Inches (L × W × H) Millimeters (L × W × H)	2.28 x 1.45 x 0.50 57.91 x 36.83 x 12.70			-	
Isolation characteristics					
Input to Output	1500	-	-	V	
Isolation Resistance	10M	-	-	Ohm	
Isolation Capacitance	-	2700	-	pF	

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

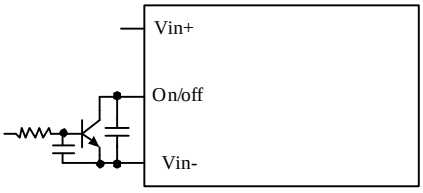
Efficiency Data



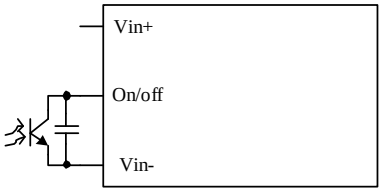
Remote On/Off

Parameter		Min	Typ	Max	Unit	Notes
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V	0RQ1-Q0T12L The remote on/off pin open, Unit off.
Signal High (Unit Off)		2.4	-	10	V	
Signal Low (Unit Off)	Active High	-0.3	-	0.8	V	0RQ1-Q0T120 The remote on/off pin open, Unit on.
Signal High (Unit On)		2.4	-	10	V	
Current Sink		0	-	0.3	mA	

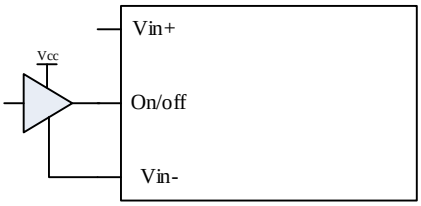
Recommended remote on/off circuit for active low



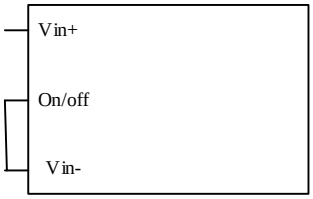
Control with open collector/drain circuit



Control with photocoupler circuit

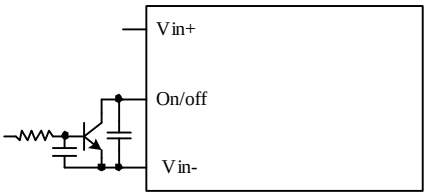


Control with logic circuit

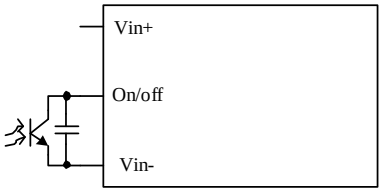


Permanently on

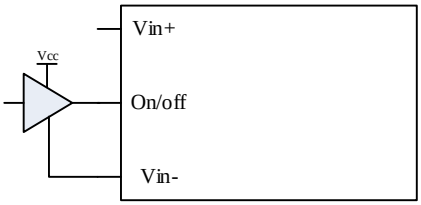
Recommended remote on/off circuit for active high



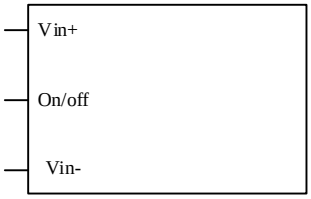
Control with open collector/drain circuit



Control with photocoupler circuit



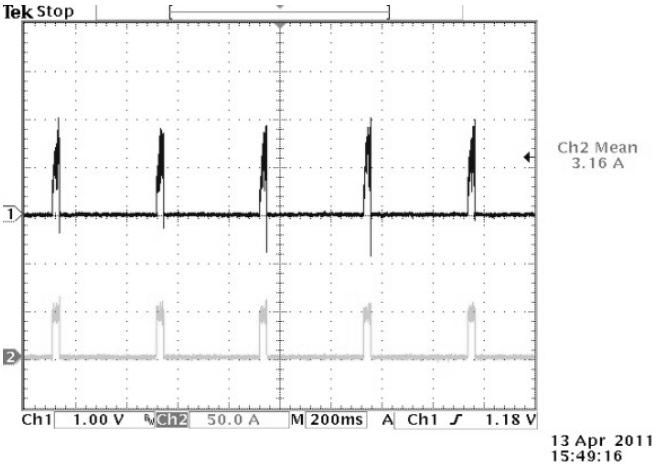
Control with logic circuit



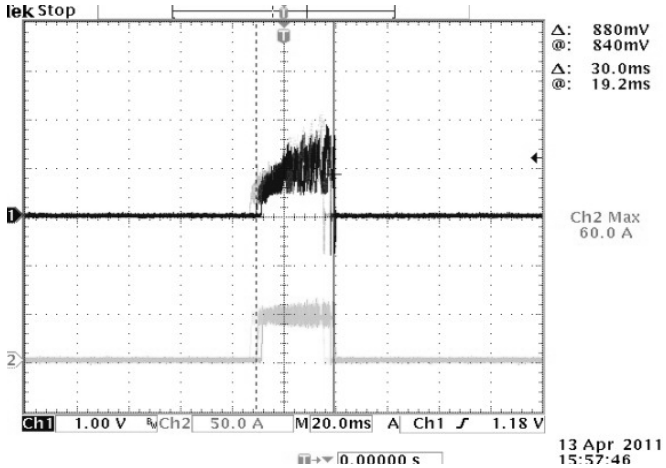
Permanently on

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 mili-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 3.2A during hiccup.

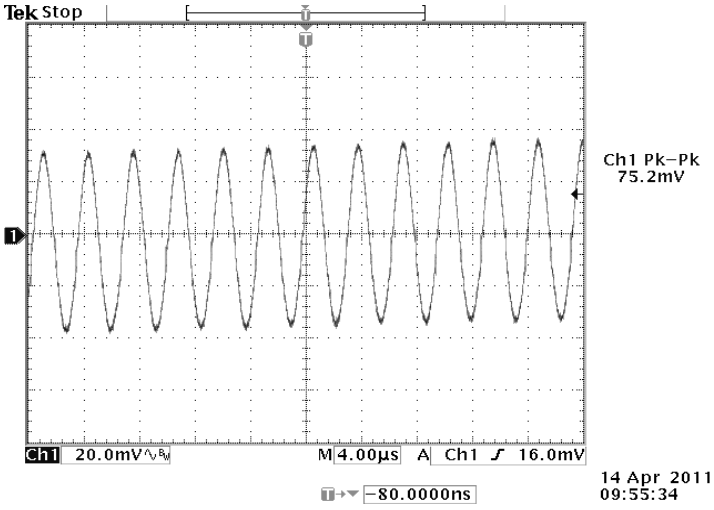


CH1: Output Voltage
CH2: Output current waveform
Test condition: Vin=48V



CH1: Output Voltage
CH2: Output current waveform
Expansion of on time portion of above figure

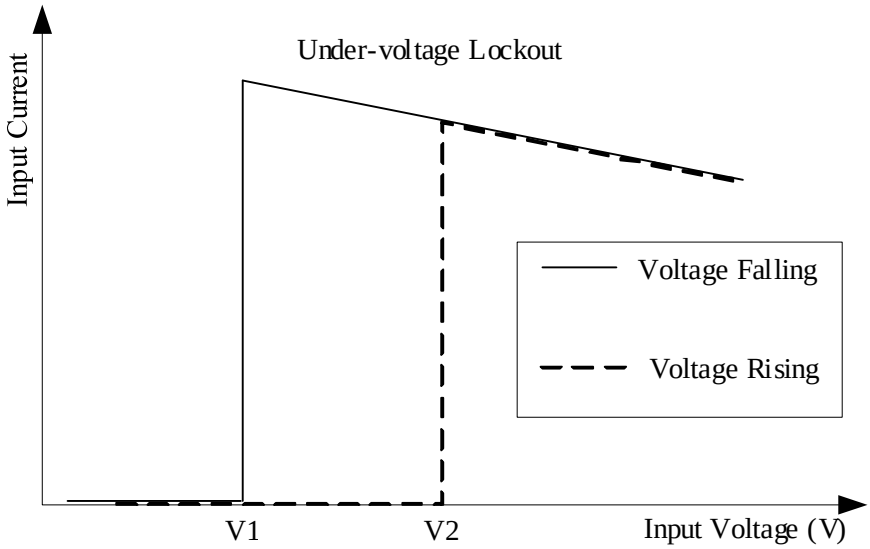
Ripple and Noise Waveform



48Vdc input, 12Vdc/33A output

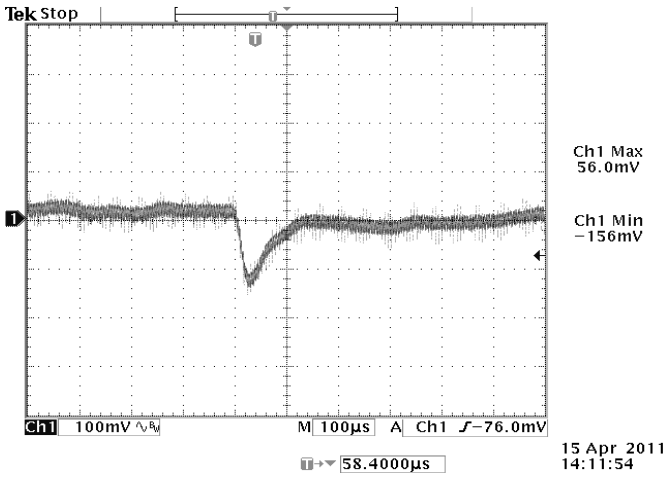
Note: Ripple and noise at full load, 0-20MHz BW, with a 1uF ceramic cap and a 10 uF Tantalum cap at output, Ta=25 deg C.

Input Under-voltage Lockout

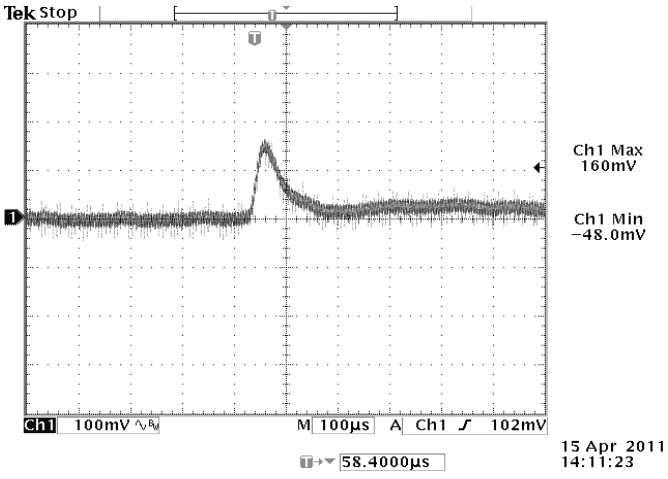


V1=35V
V2=34V

Transient Response Waveforms



Vin= 48V 50%-75% Load Transients

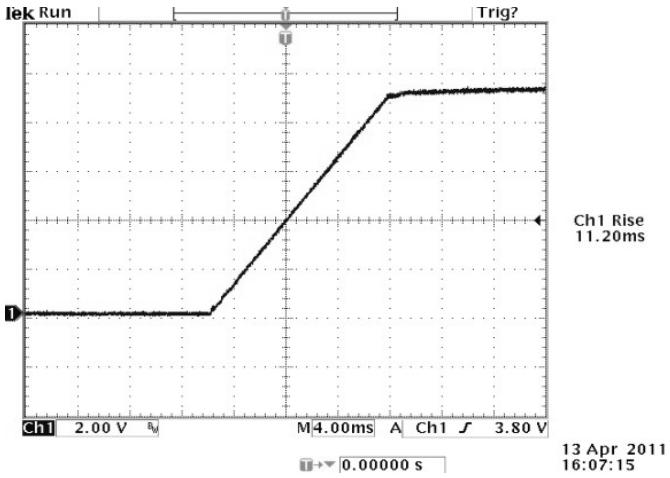


Vin= 48V 75%-50% Load Transients

Note: Transient Response at di/dt=0.1A/uS, Vin=48Vdc, Ta=25°C, Tested with a 1.0µF ceramic, a 10µF tantalum, and 470µF capacitor and across the load.

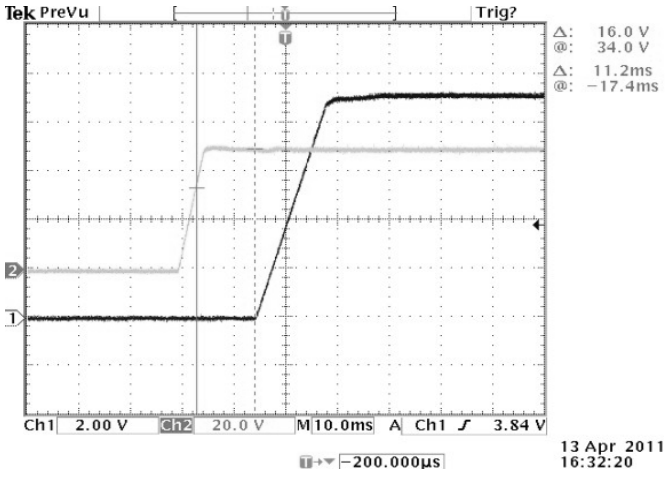
Startup & Shutdown

Turn on rise time

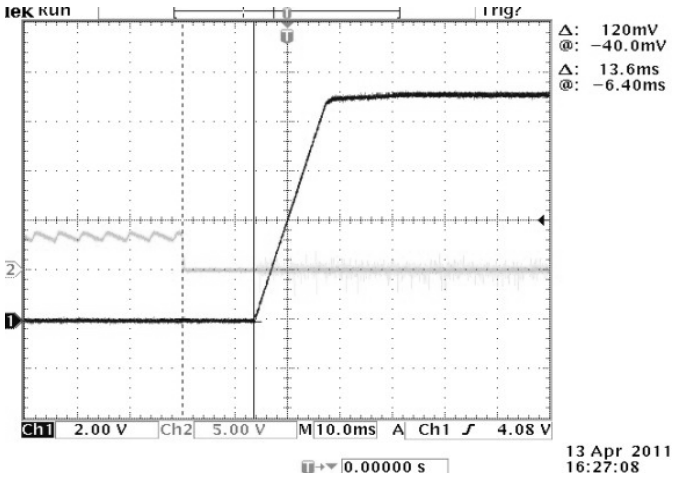


Vin=48V, Vo=12V, Io=33A

Turn on delay time



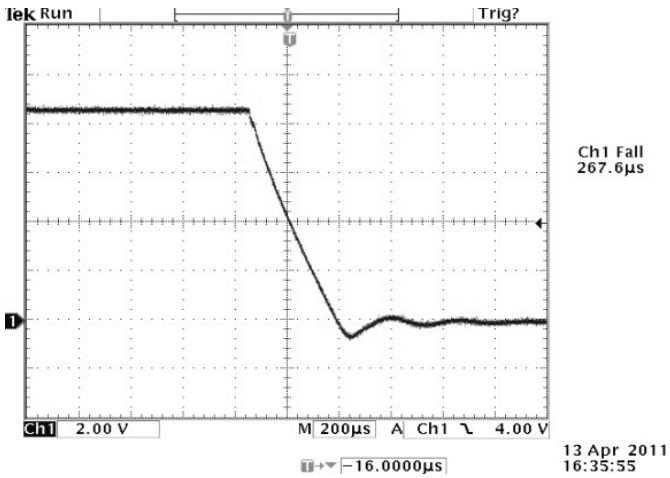
Startup from Vin
Ch1: Vo
Ch2: Vin
Vin=48V, Vo=12V, Io=33A



Startup from on/off
Ch1: Vo
Ch2: on/off
Vin=48V, Vo=12V, Io=33A

Startup & Shutdown (continued)

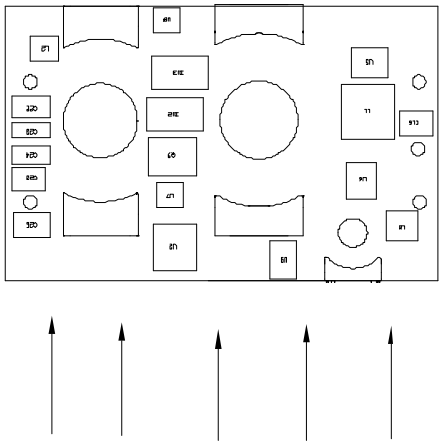
Shutdown



Vin=48V, Vo=12V, Io=33A

Thermal Derating Curve

Maximum junction temperature of semiconductors derated to 120 degree C.



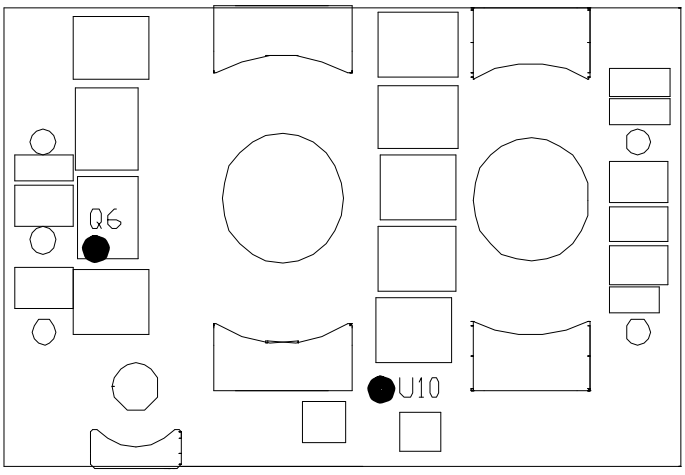
AIR FLOW

Bottom view

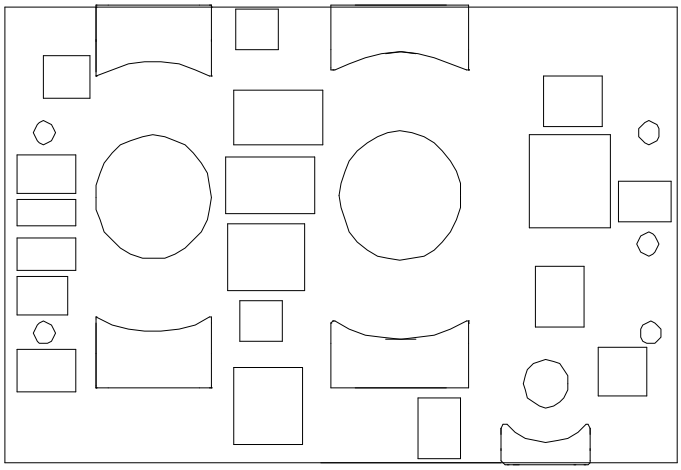
T.B.D.

Derating curve under 55V input

The OTP is achieved by temperature sensor U10 and it's in non-latch mode when the hottest component Q6 reaches 125°C with 200LFM air flow correspondingly. It will restart automatically when the temperature falls down to 105°C. The protecting point will be varied a little under different conditions (air flow, ambient temperature, input voltage, load...).



Temperature reference points on top side



Temperature reference points on bottom side

Safety & EMC

Safety

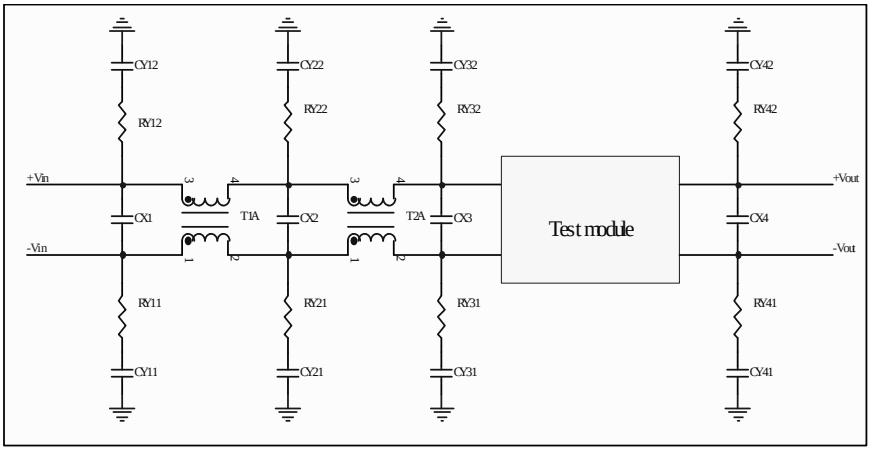
1. Material flammability UL94V-0
2. UL Certification UL60950-1

EMC

Conductive EMI EN55022 class A

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

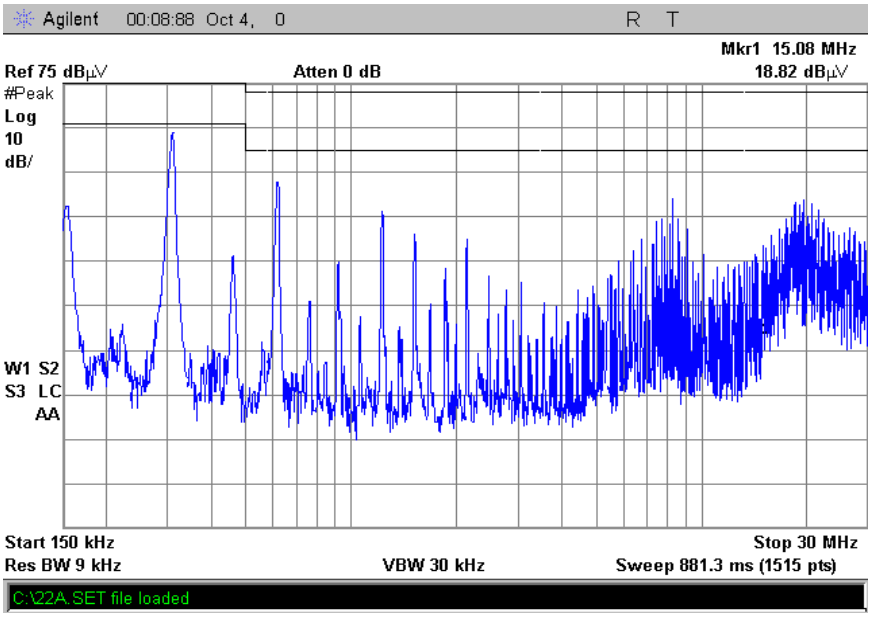
Setup:



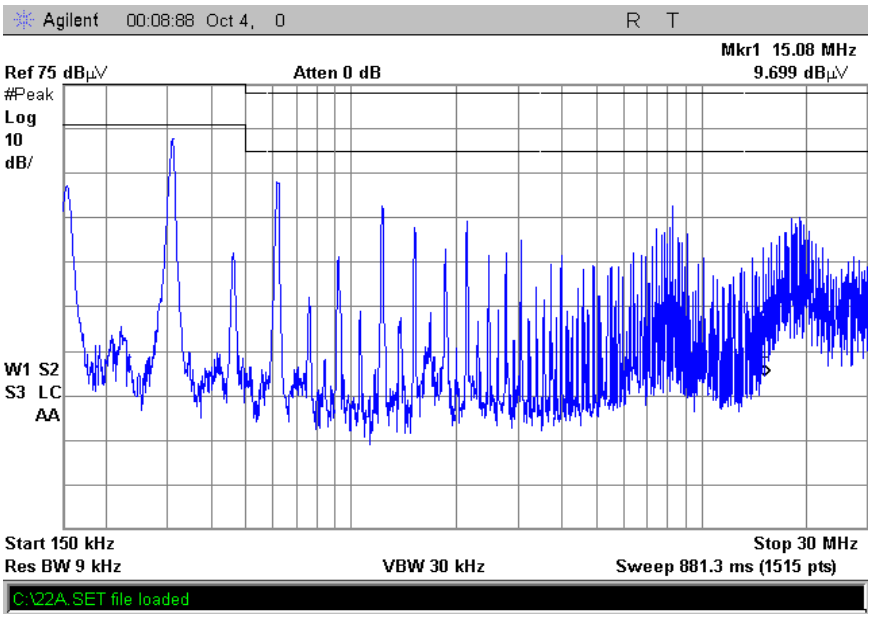
Item	Designator	Parameter	Vendor	Vendor P/N
1	CX2	220uF/100V, AL cap		
2	CX3	330uF/100V, AL cap		
3	CY31	2*6.8nF/1000V,ceramic		
4	CY32	2*6.8nF/1000V,ceramic		
5	CY41	6.8nF/1000V,ceramic		
6	CY42	6.8nF/1000V,ceramic		
7	RY31	1206,0R,Resistor		
8	RY32	1206,0R,Resistor		
9	RY41	1206,0R,Resistor		
10	RY42	1206,0R,Resistor		
11	T2A	0.81mH, common mode		
12	T1A,CX1,CX2 RY11,RY21,RY12 RY22,CY11,CY21 CY12,CY22	NIL		

Safety & EMC (continued)

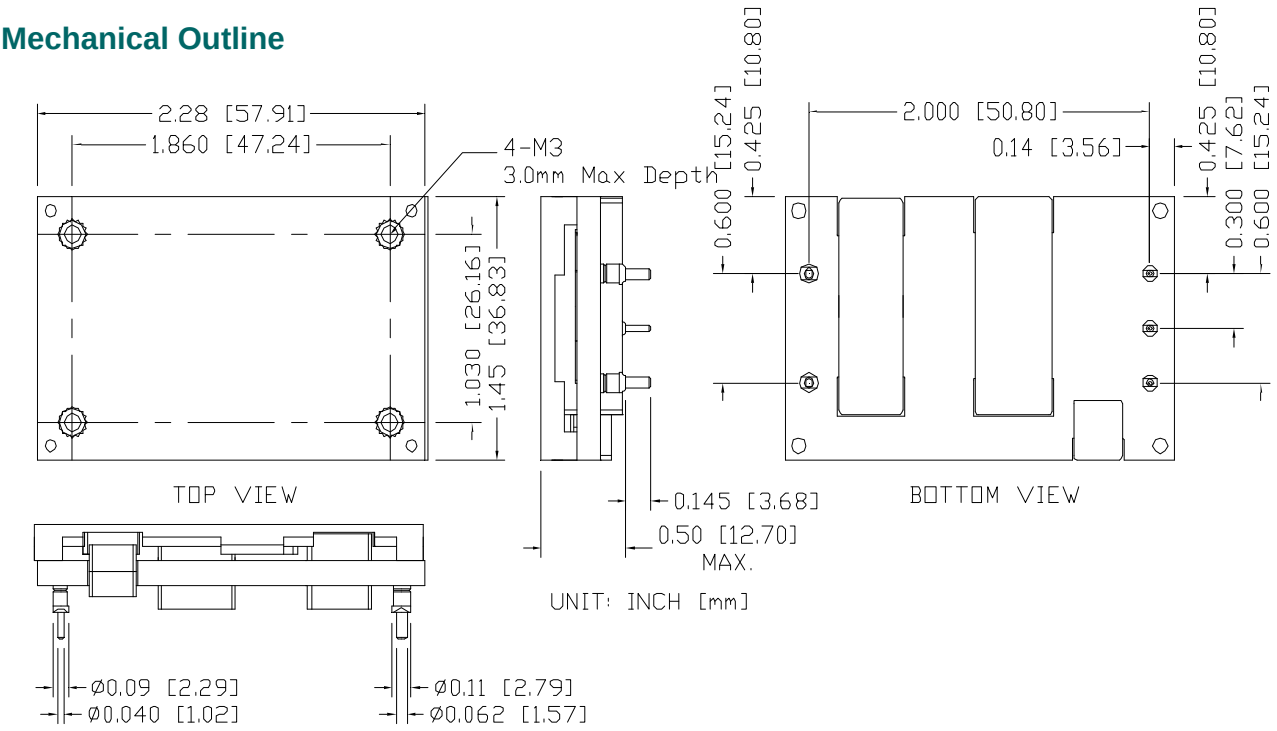
Positive Line



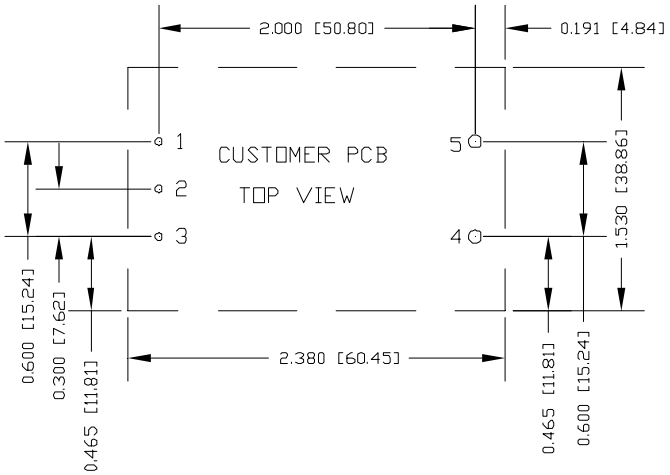
Negative Line



Mechanical Outline



RECOMMENDED PAD LAYOUT



1,2,3, Ø0.047 HOLE SIZE, Ø0.08 min PAD SIZE
4,5 Ø0.07 HOLE SIZE, Ø0.10 min PAD SIZE

Pin	Function	Dia.	Length
1	Vin(+)	0.04"	0.145"
2	Enable	0.04"	0.145"
3	Vin(-)	0.04"	0.145"
4	Vout(-)	0.06"	0.145"
5	Vout(+)	0.06"	0.145"

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 ºC 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).

Revision History

Date	Revision	Changes Detail	Approval
2011-05-23	PA	First release	YF Sun

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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