ISOLATED DC/DC CONVERTERS

48 Vdc Input, 12 Vdc/50A Output

Jul.12, 2016

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

0RQ1-H0T12x RoHS Compliant Rev.G

Features

- Basic Isolation
- High Efficiency
- Fixed Frequency (300 KHz)
- High Power Density
- Low Cost
- Remote ON/OFF
- Input Under-voltage lockout
- Input over voltage lockout
- Output Over-voltage Protection
- OCP/SCP
- Over Temperature Protection
- Class 2, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)
- Approved to UL/CSA60950-1, 2nd +A2 version

Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

0RQ1-H0T12x is an isolated DC/DC converter that operates from a nominal 48 Vdc source. This unit provides up to 600 W output power from a nominal 48 Vdc input. This unit is designed to be highly efficiency and low cost. Features include remote on/off, short circuit protection, over current protection, under voltage lockout and over-temperature 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 Low	Model Number Active High
12 Vdc	48 Vdc	50 A	600 W	96%	0RQ1-H0T12B	0RQ1-H0T12A
12 Vdc	48 Vdc	50 A	600 W	96%	0RQ1-H0T12D	0RQ1-H0T12C

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

Ordering Part Number

0	R	Q1	–	H0	T	12	x	y
1	2	3		4	5	6	7	8

1---Mounting type, **0 – Through hole mount**
2---RoHS Status, **R – RoHS 6**
3---Series name, **Q1 – 1/4 brick**
4---Output power, **H0 – 600W output**
5---Input range, **T – 48V input**
6---Output voltage, **12 – 12V output**
7---Active logic and HSK feature, **B – active low, with HSK plate, A – active High, with HSK plate, D –active low, with HSK with Fins, C – active High, with HSK with Fins**
8---Package type, **G – Tray packaging**

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	-	-	1500	V	0RQ1-H0T12A/B
	-	-	2250	V	0RQ1-H0T12C/D
Ambient Temperature	-40	-	85	°C	
Storage Temperature	-55	-	125	°C	
Altitude	-	-	4000	m	

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)	-	-	17	A	
Input Current (no load)	-	110	150	mA	
Remote Off Input Current	-	15	20	mA	
Input Reflected Ripple Current (rms)	-	50	-	mA	10uH source impedance; Vin=48V, Io=Iomax
Input Reflected Ripple Current (pk-pk)	-	160	-	mA	
I^2t Inrush Current Transient	-	-	1	A^2s	
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 25 A 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

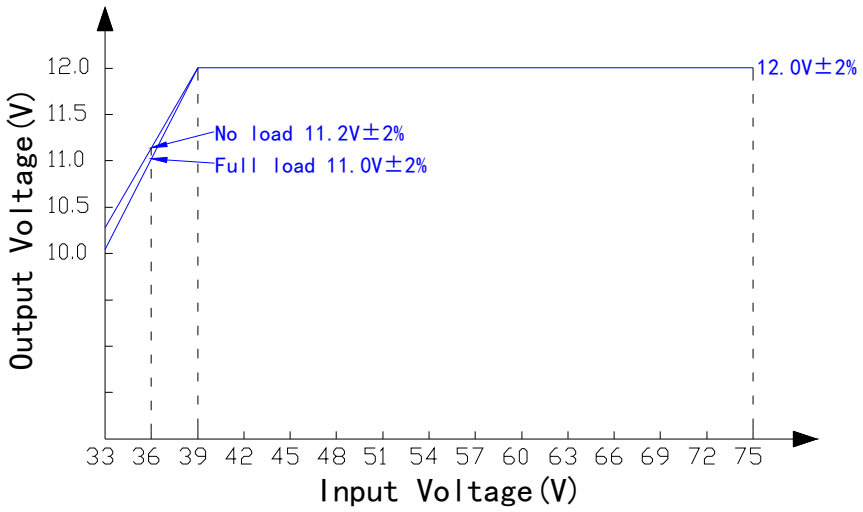
Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point	11.76	12.00	12.24	V	Vin=48V, Io=50% load
Output Voltage	10.80	-	12.24	V	Over all operating input voltage, resistive load and temperature conditions until end of life
Load Regulation	-	200	350	mV	Vin=36~40V, Io=0~100% load
	-	20	70	mV	Vin=40~75V, Io=0~100% load
Line Regulation	-	1000	1440	mV	Vin=36~40V,Io=100% load
	-	20	80	mV	Vin=40~75V,Io=100% load
Regulation Over Temperature	-	100	200	mV	Vin=40~75V, Io=100%load over all ambient temperature condition
Output Ripple and Noise (pk-pk)	-	50	150	mV	Vin=48V, Io=100%load, 0-20MHz BW, with a 1μF ceramic capacitor and a 270uF AL. cap at output.
Output Ripple and Noise (rms)	-	10	20	mV	

Output Specifications (continued)

Parameter	Min	Typ	Max	Unit	Notes
Ripple and Noise (pk-pk) under worst case	-	-	200	mV	Over all operating input voltage, load and ambient temperature condition.
Output Current Range	0	-	50	A	
Output DC Current Limit	54	58	62	A	
Short Circuit Surge Transient	-	-	6	A^2s	
Rise time	-	12	-	ms	
Turn on Time	-	28	50	ms	Enable from Vin
	-	28	50	ms	Enable from ON/OFF
Overshoot at Turn on	-	0	3	%	
Output Capacitance	0	-	10000	μF	
Transient Response					
△V 50%~75% of Max Load	-	200	-	mV	di/dt=0.1A/μs, Vin=48Vdc, with a 1μF ceramic capacitor and a 270uF AL. cap at output.
Settling Time	-	200	-	μs	
△V 75%~50% of Max Load	-	200	-	mV	
Settling Time	-	200	-	μs	

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

Output Plot VS Input



Note:

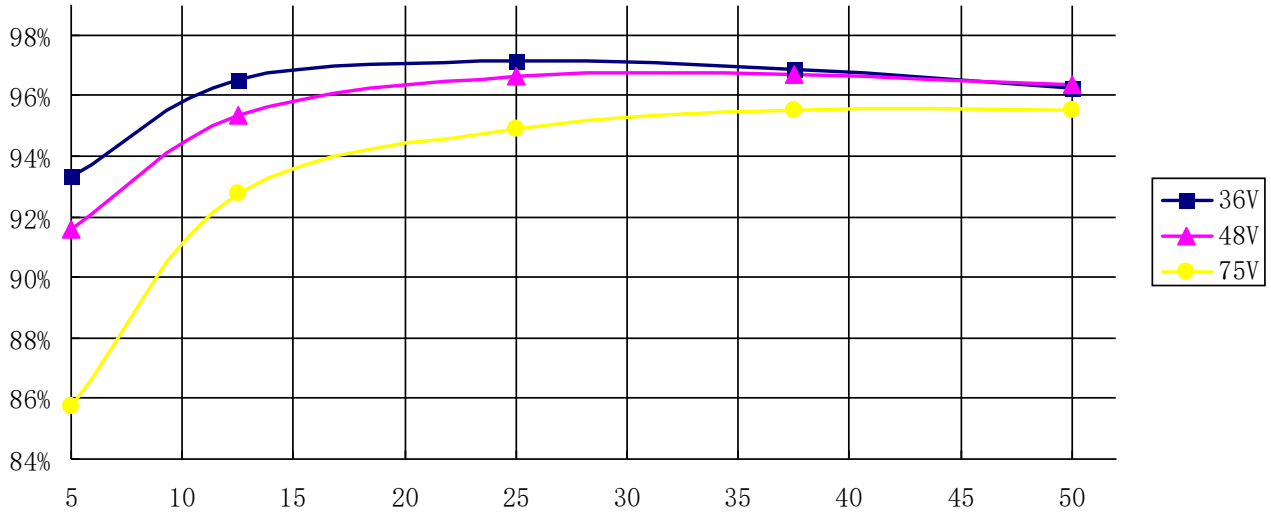
Parameter	Min	Typ	Max	Unit
Turn-on Voltage Threshold	-	34.5	35.5	V
Turn-off Voltage Threshold	32.5	33.5	-	V

General Specifications

Parameter	Min	Typ	Max	Unit	Notes
Efficiency	-	96	-	%	Vin=48V, full load,
Switching Frequency	-	300	-	kHz	
Over Temperature Protection	-	130	-	℃	
Over Voltage Protection	-	-	14	V	
Weight	-	85	-	g	0RQ1-H0T12A/B
	-	96	-		0RQ1-H0T12C/D
FIT[2]	277			-	Calculated Per Bell Core SR-332 (Vin=48 V, Vo=12 V, Io=40 A, FIT=10^9/MTBF)
Dimensions Inches (L × W × H)	2.30×1.45×0.57			-	0RQ1-H0T12A/B
Millimeters (L × W × H)	58.42×36.83×14.48				
	2.30×1.45×1.1			-	0RQ1-H0T12C/D
	58.42×36.83×28				
Isolation characteristics					
Input to Output	-	-	1500	V	0RQ1-H0T12A/B
	-	-	2250	V	0RQ1-H0T12C/D
Input to Case	-	-	1500	V	0RQ1-H0T12A/B
	-	-	2250	V	0RQ1-H0T12C/D
Output to Case	-	-	500	V	
Isolation Resistance	10M	-	-	Ohm	
Isolation Capacitance	-	2700	-	pF	

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

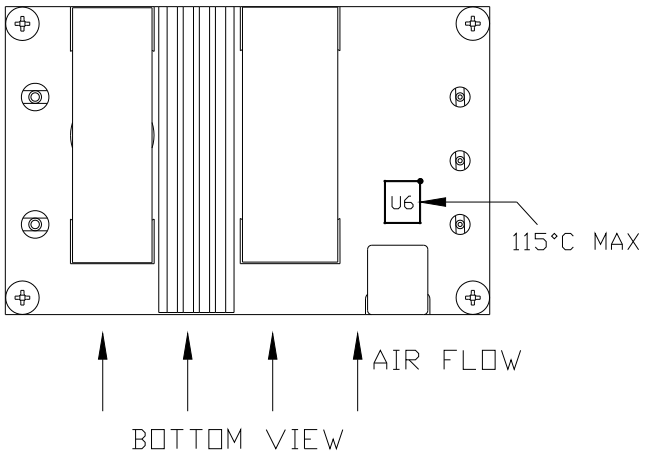
Efficiency Data



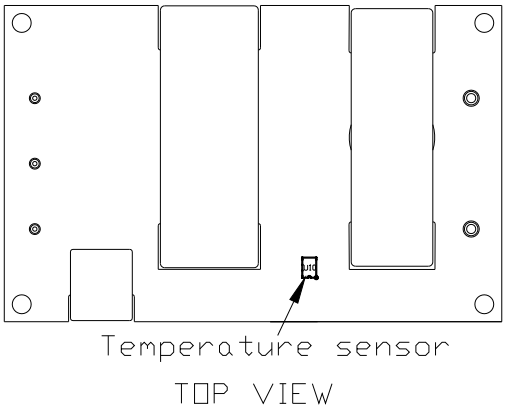
Efficiency vs. load current and input voltage at Ta=+25℃

Thermal Derating Curve

The OTP is achieved by temperature sensor U10 and it's in non-latch mode when the hottest component U5 reaches 115℃ with 200LFM air flow correspondingly. It will restart automatically when the temperature falls down to 105℃. The protecting point will be varied a little under different conditions (air flow, ambient temperature, input voltage, load...).

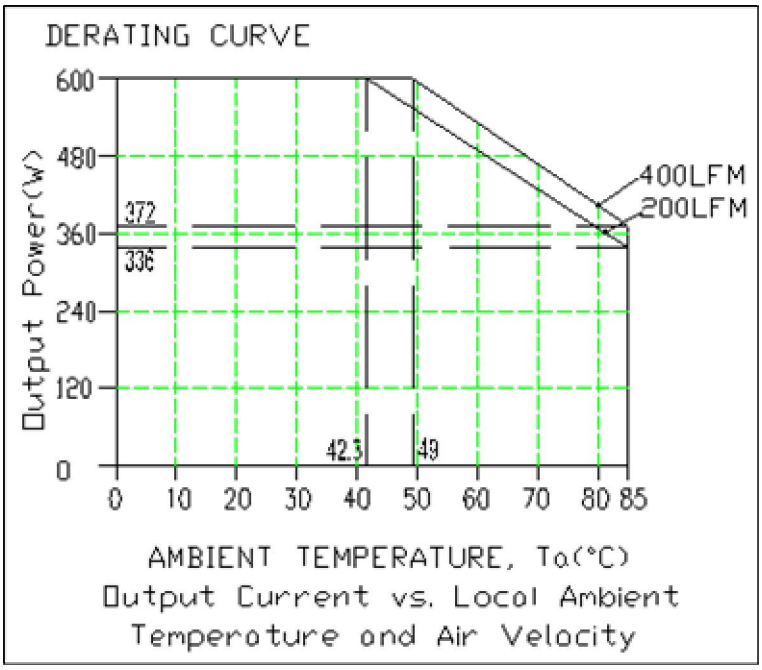


Temperature reference points on bottom side



Temperature reference points on top side

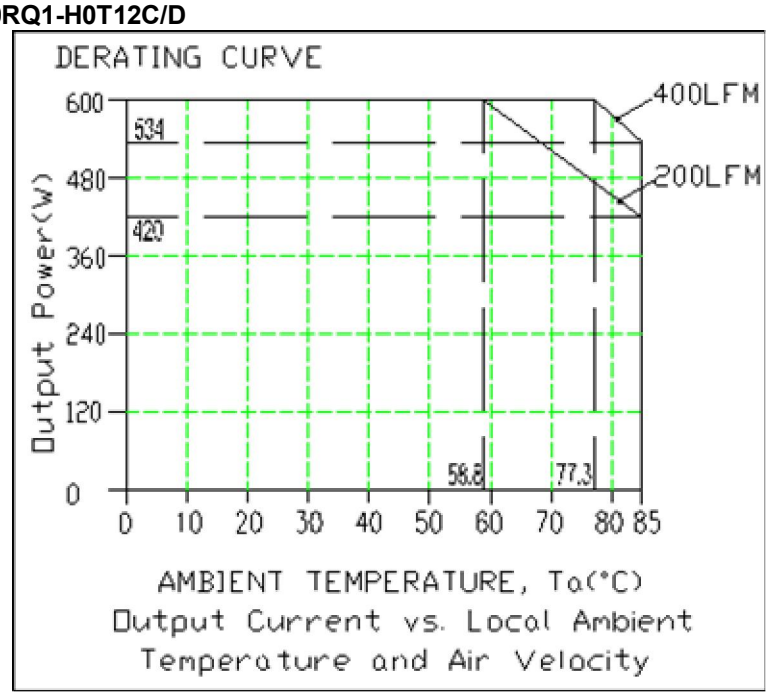
Derating Curves for 0RQ1-H0T12A/B



Note: Output power vs. ambient temperature and air velocity @Vin=48V (Transverse Orientation, airflow from Vin- to Vin+)

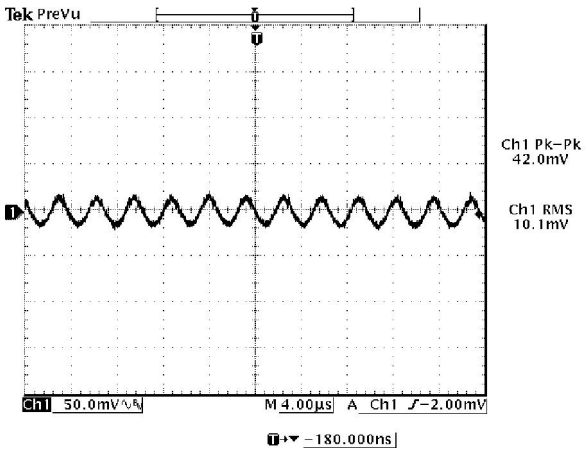
Thermal Derating Curve (continued)

Derating Curves for 0RQ1-H0T12C/D



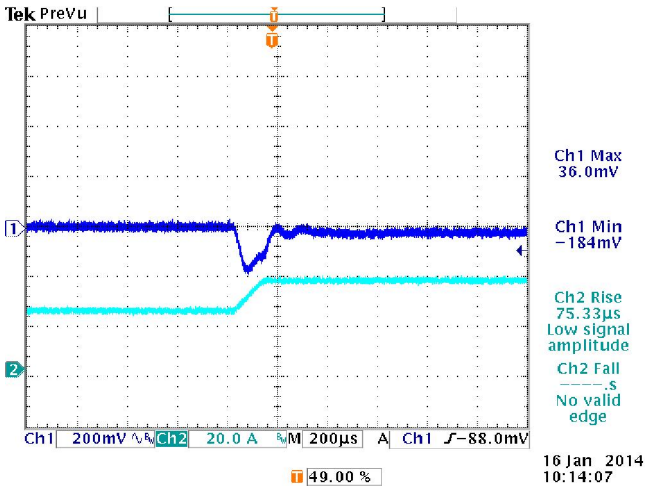
Note: Output power vs. ambient temperature and air velocity @Vin=48V (Transverse Orientation, airflow from Vin- to Vin+)

Ripple and Noise Waveform

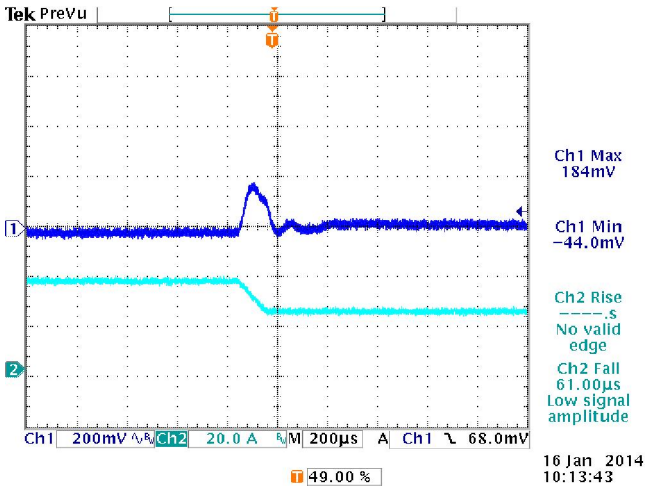


Note: Ripple and noise at full load, 48Vdc input, 12Vdc/50A output and Ta=25°C, and with a 1uF ceramic cap and a 270 uF AL. cap at output.

Transient Response Waveforms



50%-75% Load Transients at Vin=48V@Ta=25℃



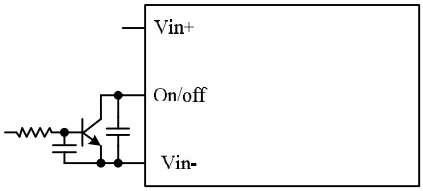
75%-50% Load Transients at Vin=48V@Ta=25℃

Note: Transient Response at Vin=48V, di/dt=0.1A/µS, 1µF ceramic cap and 270µF AL. cap at output, Ta=25℃.

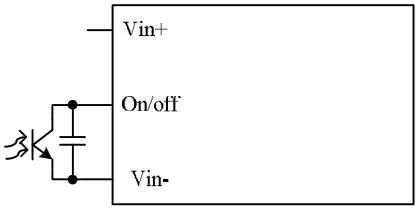
Remote On/Off

Parameter		Min	Typ.	Max	Unit	Notes
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V	Remote On/Off pin is open, the module is off.
Signal High (Unit Off)		2.4	-	18	V	
Signal Low (Unit Off)	Active High	-0.3	-	0.8	V	Remote On/Off pin is open, the module is on.
Signal High (Unit On)		2.4	-	18	V	
Current Sink		0	-	1	mA	

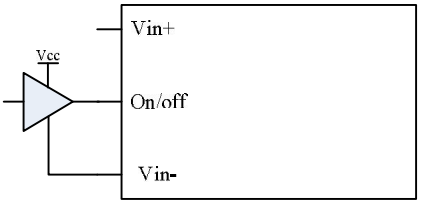
Recommended remote on/off circuit for active low



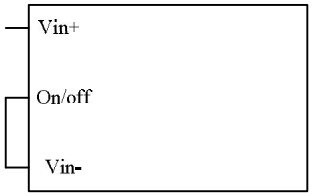
Control with open collector/drain circuit



Control with photo coupler circuit

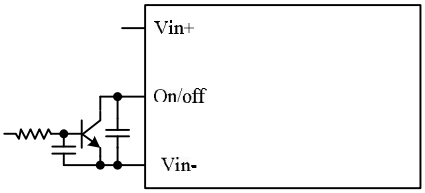


Control with logic circuit

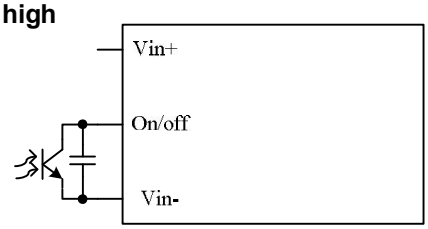


Permanently on

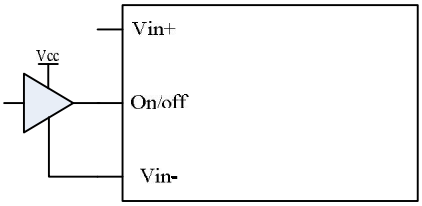
Recommended remote on/off circuit for active high



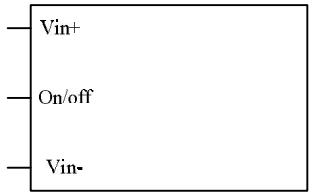
Control with open collector/drain circuit



Control with photo coupler circuit



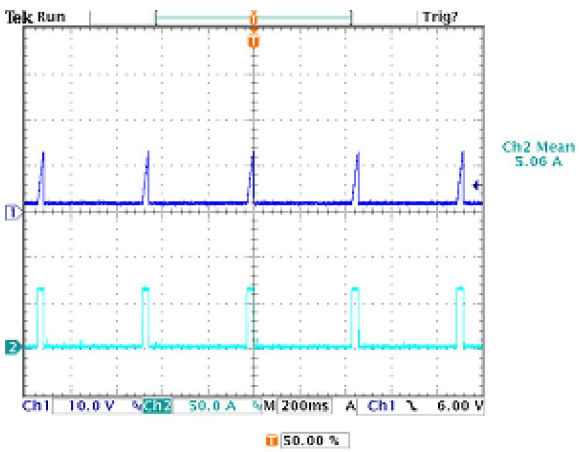
Control with logic circuit



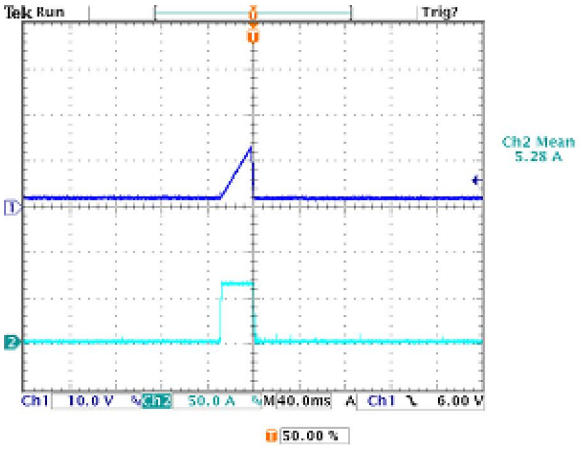
Permanently on

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 milliseconds. 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 5.05A during hiccup.

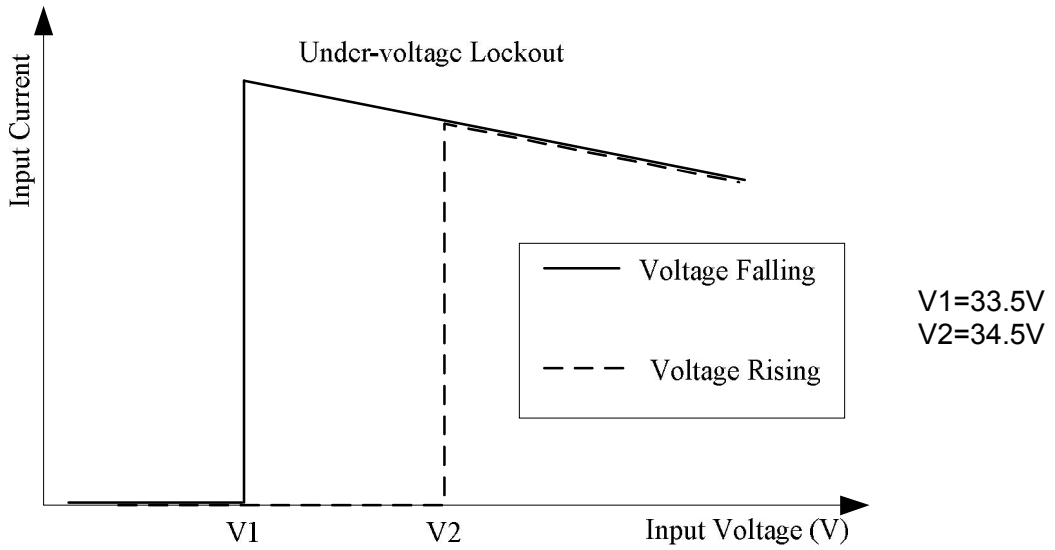


CH1: Output Voltage
CH2: Output Current Waveform
Test condition: Vin=48V@Ta=25℃



CH1: Output Voltage
CH2: Output Current Waveform
Expansion of on time portion of above figure

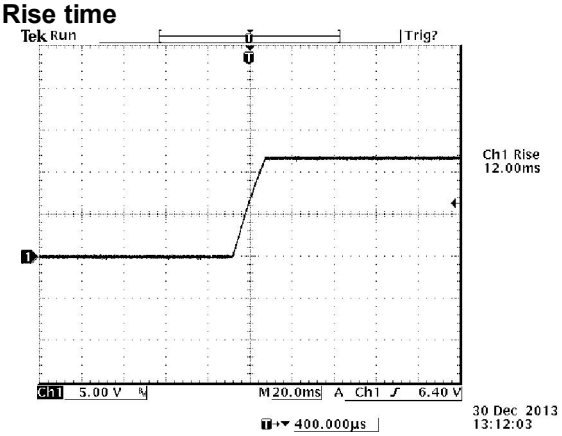
Input Under-voltage Lockout



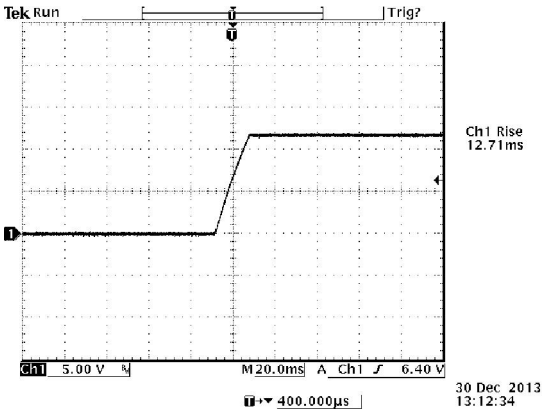
V1=33.5V
V2=34.5V

Startup & Shutdown

Rise time

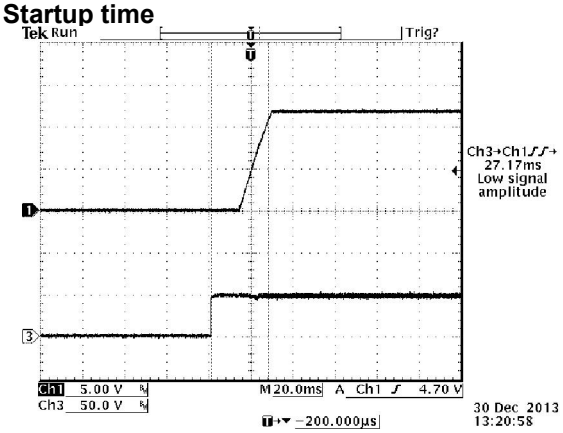


Vout= 12V/50A @Vin=48V,Ta=25℃

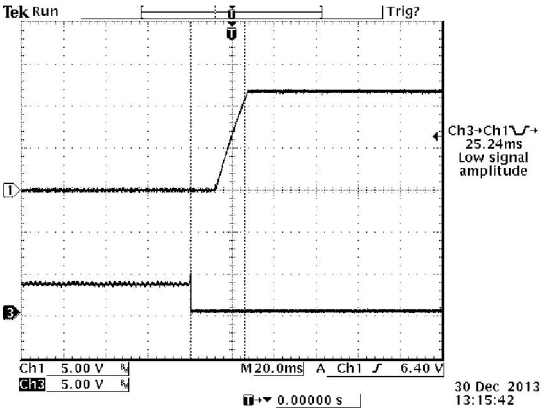


Vout= 12V/50A @Vin=48V,Ta=25℃ , Cext =10000uF

Startup time

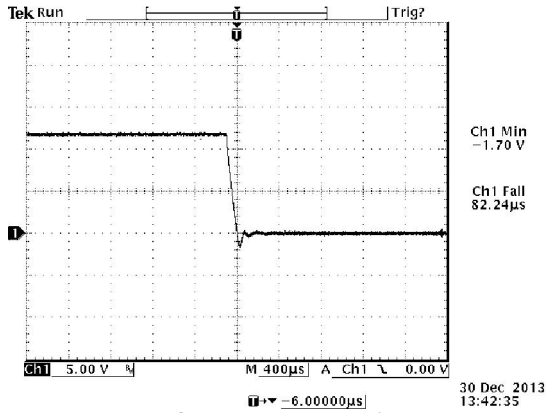


Startup from Vin
Ch1: Vo
Ch2: Vin
Vout= 12V/50A @Vin=48V,Ta=25℃

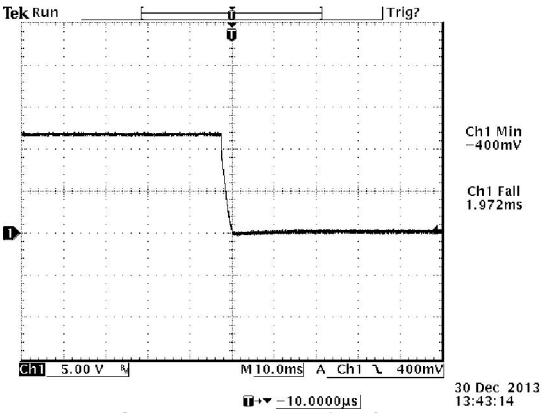


Startup from ON/OFF
Ch1: Vo
Ch2: ON/OFF
Vout= 12V/50A @Vin=48V,Ta=25℃

Shutdown



Vout= 12V/50A @Vin=48V,Ta=25℃



Vout= 12V/50A @ Vin=48V,Ta=25℃, Cext = 10000uF

Safety & EMC

Safety

1. Material flammability UL94V-0
2. 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:

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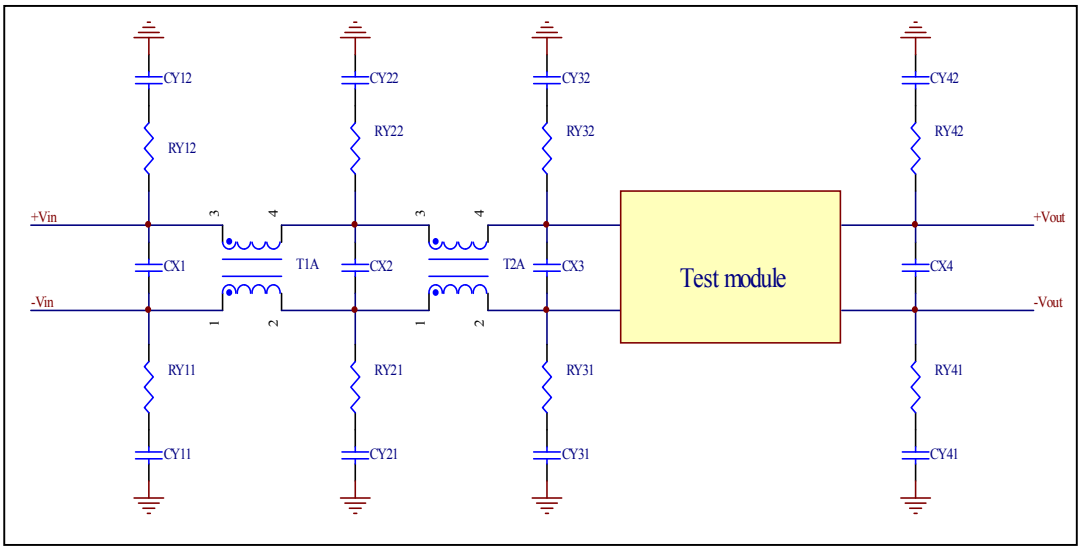
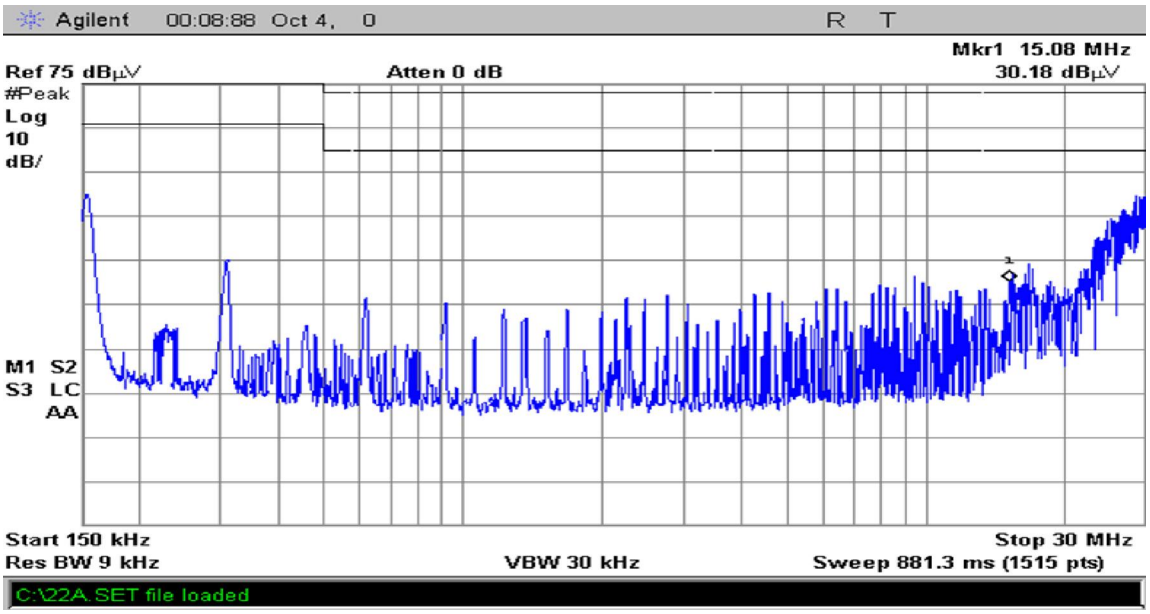


Safety & EMC (continued)

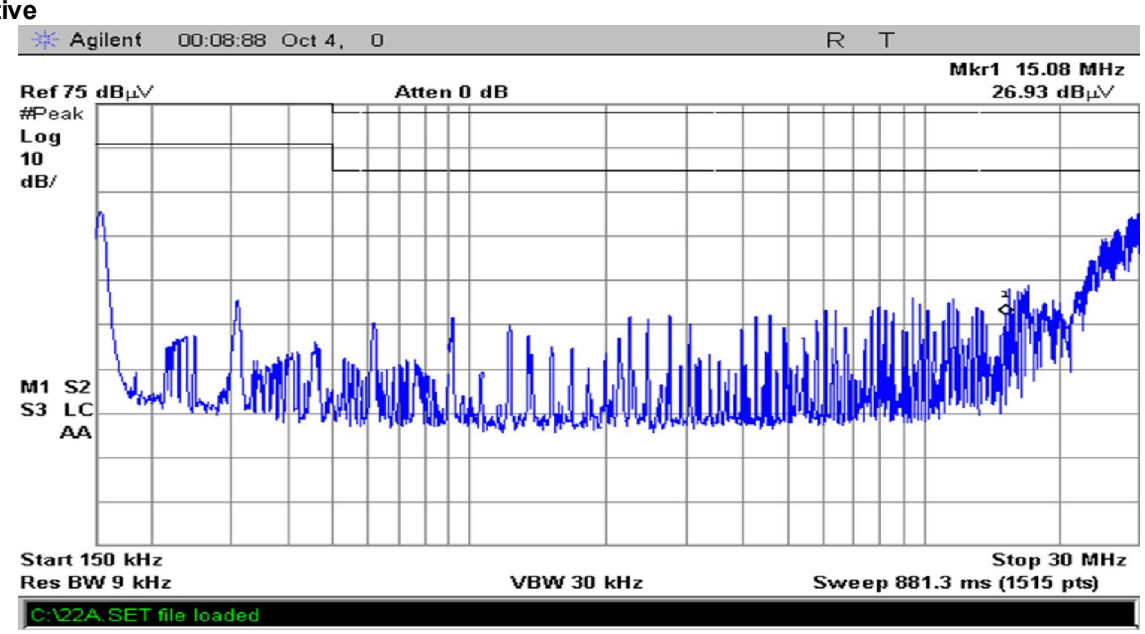
Item	Designator	Parameter	Vendor	Vendor P/N
1	CX2	AL-EL CAP 220UF 20% 100V UHE2A221MHD6 Lead Type	Nichicon	UHE2A221MHD6
2	CX3	AL-EL CAP 330UF 20% 100V UPW2A331MHD Lead Type	Nichicon	UPW2A331MHD
3	CX4	SMD TAN 10uF +/-20% 35V CASE D	KEMET	T491D106M035AS
4	CY32	CHIP CAP X7R 6800PF +/-10% 2KV 1808	Johanson	202R29W682KV4E-****-RC
5	CY31	CHIP CAP X7R 6800PF +/-10% 2KV 1808	Johanson	202R29W682KV4E-****-RC
6	CY41	CHIP CAP X7R 6800PF +/-10% 2KV 1808	Johanson	202R29W682KV4E-****-RC
7	CY42	CHIP CAP X7R 6800PF +/-10% 2KV 1808	Johanson	202R29W682KV4E-****-RC
8	RY31	CHIP RES TKF 0R +/-5% 0.25W 1206	SEI	RMCF1206ZT0R00
9	RY32	CHIP RES TKF 0R +/-5% 0.25W 1206	SEI	RMCF1206ZT0R00
10	RY41	CHIP RES TKF 0R +/-5% 0.25W 1206	SEI	RMCF1206ZT0R00
11	RY42	CHIP RES TKF 0R +/-5% 0.25W 1206	SEI	RMCF1206ZT0R00
12	T2A	1mH CM inductor		
13	T1A,CX1,RY11,RY12, CY11,CY12,RY21, RY22,CY22,CY21,	NIL		

Safety & EMC (continued)

Positive

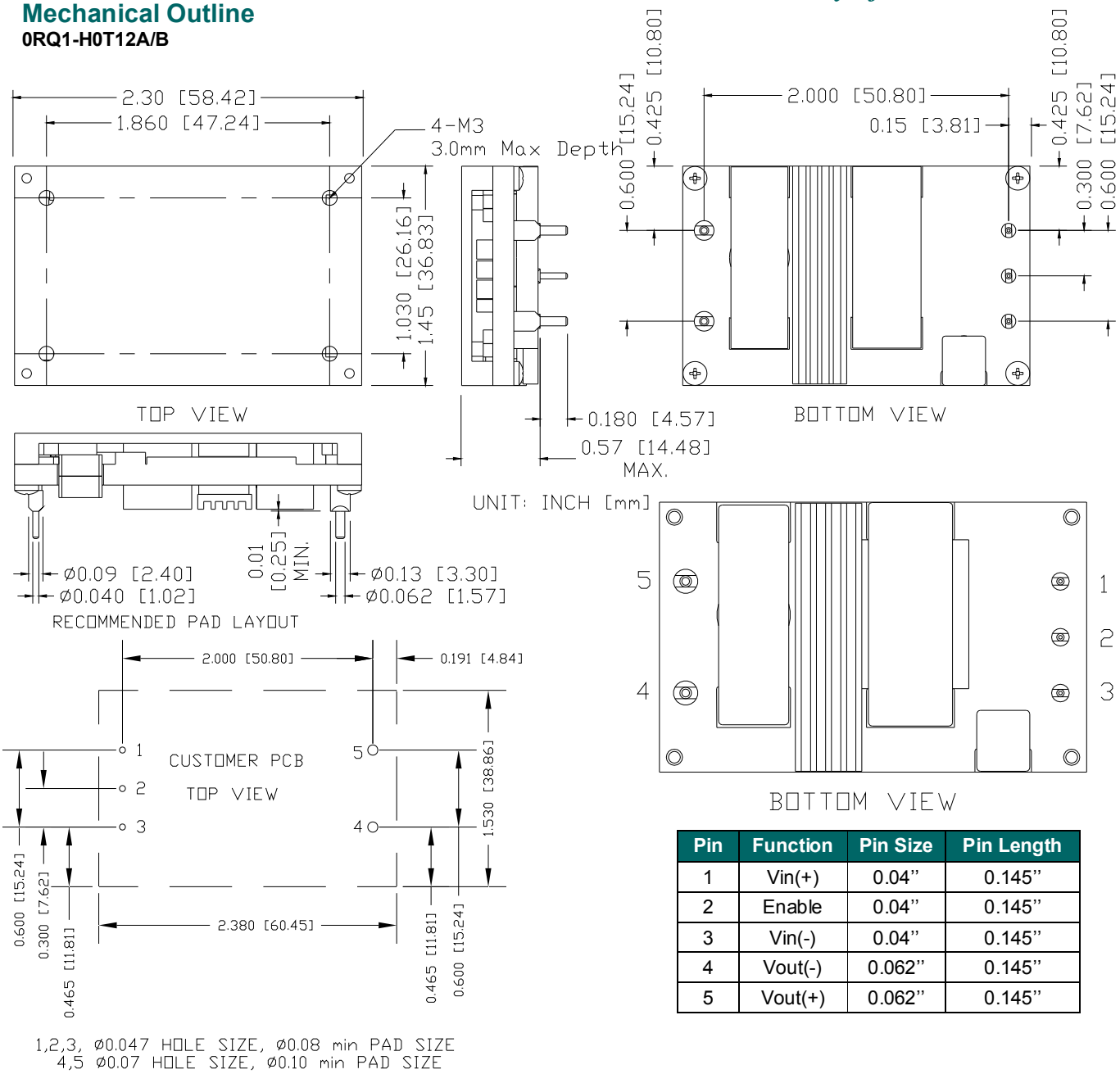


Negative



Mechanical Outline

0RQ1-H0T12A/B



Pin	Function	Pin Size	Pin Length
1	Vin(+)	0.04”	0.145”
2	Enable	0.04”	0.145”
3	Vin(-)	0.04”	0.145”
4	Vout(-)	0.062”	0.145”
5	Vout(+)	0.062”	0.145”

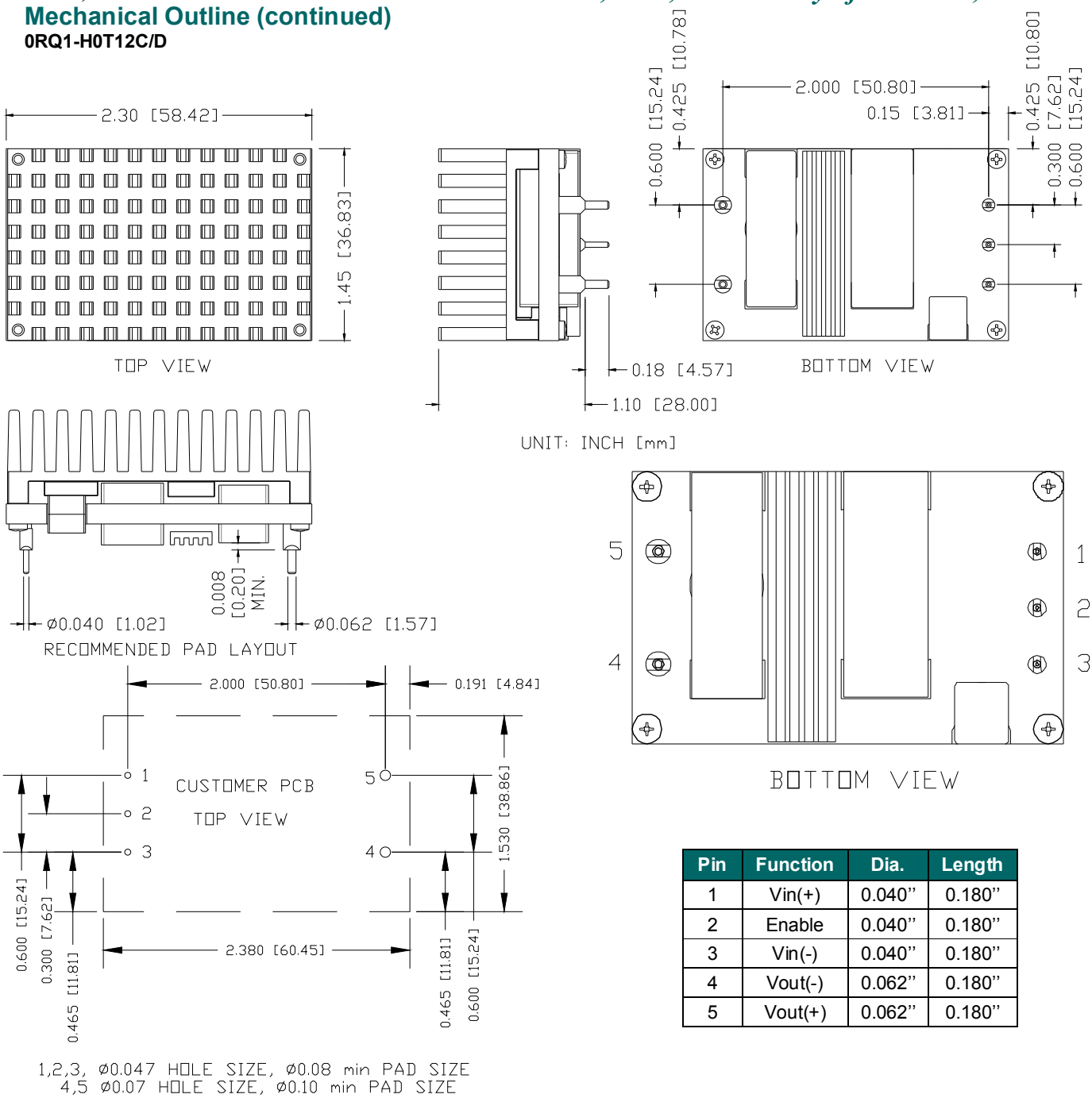
Note: This module is recommended and compatible with Pb-Free Wave Soldering and must be soldered using a peak solder temperature of no more than 260 ºC for less than 5 seconds.

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[0.5mm]. x.xxx +/-0.010 in[0.25mm].

Mechanical Outline (continued)

0RQ1-H0T12C/D



Pin	Function	Dia.	Length
1	Vin(+)	0.040”	0.180”
2	Enable	0.040”	0.180”
3	Vin(-)	0.040”	0.180”
4	Vout(-)	0.062”	0.180”
5	Vout(+)	0.062”	0.180”

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[0.5mm]. x.xxx +/-0.010 in[0.25mm].

Datasheet Revision History

Date	Revision	Changes Detail	Approval
2013-05-07	A	First release	Summer
2013-07-11	B	Update the derating curve	Summer
2014-01-16	C	Added baseplate version of 0RQ1-H0T12A/B, Update the derating curve , efficiency curve and other specifications	Zhao Tang
2014-12-31	D	Added Over Voltage Protection,Added Output Plot VS Input curve	Summer
2015-07-02	E	Update I/O Isolation Voltage to 2250V max	Summer
2015-09-25	F	Update the derating curve, Safety & EMC	Summer
2016-07-12	G	Update I/O isolation voltage , Input to Output, Input to Case	Summer

RoHS Compliance

Complies with the European Directive 2011/65/EU, calling for the elimination of lead and other hazardous substances from electronic products.

CORPORATE

Bel Fuse Inc.
206 Van Vorst Street
Jersey City, NJ 07302
Tel 201-432-0463
Fax 201-432-9542
www.belfuse.com

FAR EAST

Bel Fuse Ltd.
8F/ 8 Luk Hop Street
San Po Kong
Kowloon, Hong Kong
Tel 852-2328-5515
Fax 852-2352-3706
www.belfuse.com

EUROPE

Bel Fuse Europe Ltd.
Preston Technology Management Centre
Marsh Lane, Suite G7, Preston
Lancashire, PR1 8UD, U.K.
Tel 44-1772-556601
Fax 44-1772-888366
www.belfuse.com