0RQ1-H0T12

Isolated DC-DC Converter

0RQ1-H0T12 series are isolated DC/DC converters that operate from a nominal 48 VDC source. These units provide up to 600 W output power from a nominal 48 VDC input. These units are designed to be highly efficient and low cost.
Features include remote on/off, short circuit protection, over current protection, under voltage lockout and over temperature protection. These converters are provided in an industry standard quarter brick package.

Key Features & Benefits

- 48 VDC Input
- 12 VDC @ 50 A Output
- 1/4th Brick Converter
- Fixed Frequency (300 kHz)
- High Efficiency
- High Power Density
- Low Cost
- Input Under-Voltage Lockout
- Input Over-Voltage Lockout
- OCP/SCP
- Output Over-Voltage Protection
- Over Temperature Protection
- Remote On/Off
- Basic Isolation
- Approved to UL/CSA 62368-1
- Approved to IEC/EN 62368-1
- Class II, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)

RoHS Compliant

Applications

- Networking
- Computers and peripherals
- Telecommunications

bel POWER SOLUTIONS & PROTECTION
a bel group

belfuse.com/power-solutions

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
0RQ1-H0T12AG 0RQ1-H0T12BG 0RQ1-H0T12CG 0RQ1-H0T12DG	12 VDC	48 VDC	50 A	600 W	96%

PART NUMBER EXPLANATION

0	R	Q1	-	H0	T	12	x	G
Mounting Type	RoHS Status	Series Name		Output Power	Input Range	Output Voltage	Active Logic	Package Type
Through Hole Mount	RoHS	1/4th Brick		600 W	48 V	12 V	A – Active High, with Baseplate B – Active Low, with Baseplate C – Active High, with Baseplate and Fins D – Active Low, with Baseplate and Fins	Tray Package

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.3	-	80	V
Remote On/Off		-0.3	-	18	V
I/O Isolation Voltage	0RQ1-H0T12A/B	-	-	1500	V
	0RQ1-H0T12C/D	-	-	2250	V
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.

3. INPUT SPECIFICATIONS

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

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Operating Input Voltage		36	48	75	V
Input Current (full load)	Test at 36 V input voltage	-	-	17	A
Input Current (no load)		-	110	150	mA
Remote Off Input Current		-	15	20	mA
Input Reflected Ripple Current (rms)	10 µH source impedance; Vin = 48 V, Io = Io max	-	50	-	mA
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.

4. OUTPUT SPECIFICATIONS

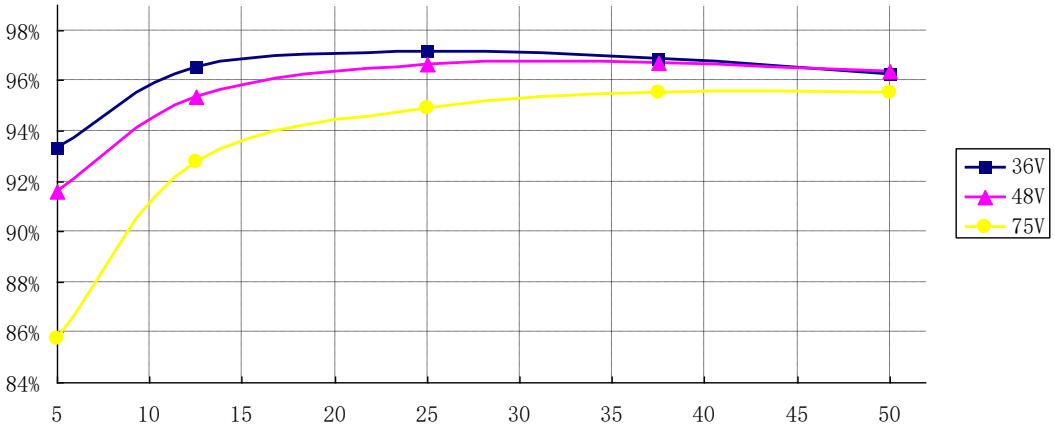
All specifications are typical at nominal input, full load at 25°C unless otherwise stated.

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Output Voltage Set Point	Vin = 48 V, Io = 50% load	11.76	12.00	12.24	V
Output Voltage	Over entire operating input voltage range, resistive load and temperature conditions until end of life	10.80	-	12.24	V
Load Regulation	Vin = 36~40 V, Io = 0~100% load	-	200	350	mV
	Vin = 40~75 V, Io = 0~100% load		20	70	mV
Line Regulation	Vin = 36~40 V, Io = 100% load	-	1000	1440	mV
	Vin = 40~75 V, Io = 100% load	-	20	80	mV
Regulation Over Temperature	Vin = 40~75 V, Io = 100% load over all ambient temperature condition	-	100	200	mV
Output Ripple and Noise(pk-pk)	Vin = 48 V, Io = 100% load, 0 - 20 MHz BW, with a 1 µF ceramic capacitor and a 270 µF AL. cap at output.	-	50	150	mV
Output Ripple and Noise(rms)		-	10	20	mV
Ripple and Noise (pk-pk) under worst case	Over entire operating input voltage range, load and ambient temperature condition.	-	-	200	mV
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	Enable from Vin	-	28	50	ms
	Enable from ON/OFF	-	28	50	ms
Overshoot at Turn on		0	-	3	%
Output Capacitance		0	-	10000	µF
Transient Response (single module)					
△V 50%~75% of Max Load	di/dt = 0.1 A/µs, Vin = 48 VDC, with a 1 µF ceramic capacitor and a 270 µF AL. cap at output.	-	200	-	mV
Settling Time		-	200	-	us
△V 75%~50% of Max Load		-	200	-	mV
Settling Time		-	200	-	us

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin = 48 V, full load,	-	96	-	%
Switching Frequency		-	300	-	kHz
Over Temperature Protection		-	130	-	°C
Over Voltage Protection (Static)		-	-	14	V
FIT[2]	Calculated Per Bell Core SR-332 (Vin = 48 V, Vo = 12 V, Io = 40 A, FIT = 10^9/MTBF)	-	277	-	-
Weight	0RQ1-H0T12A/B	-	85	-	g
	0RQ1-H0T12C/D	-	96	-	g
Dimensions (L × W × H)	0RQ1-H0T12A/B		2.30 x 1.45 x 0.57		inch
			58.42 x 36.83 x 14.48		mm
	0RQ1-H0T12C/D		2.30 x 1.45 x 1.10		inch
			58.42 x 36.83 x 28.0		mm
Isolation Characteristics					
Input to Output	0RQ1-H0T12A/B	-	-	1500	V
	0RQ1-H0T12C/D	-	-	2250	V
Input to Case	0RQ1-H0T12A/B	-	-	1500	V
	0RQ1-H0T12C/D	-	-	2250	V
Output to Case		-	-	500	V
Isolation Resistance		10M	-	-	Ohm
Isolation Capacitance		-	2700	-	pF

6. EFFICIENCY DATA



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

Figure 1. Efficiency data

7. OUTPUT PLOT VS INPUT

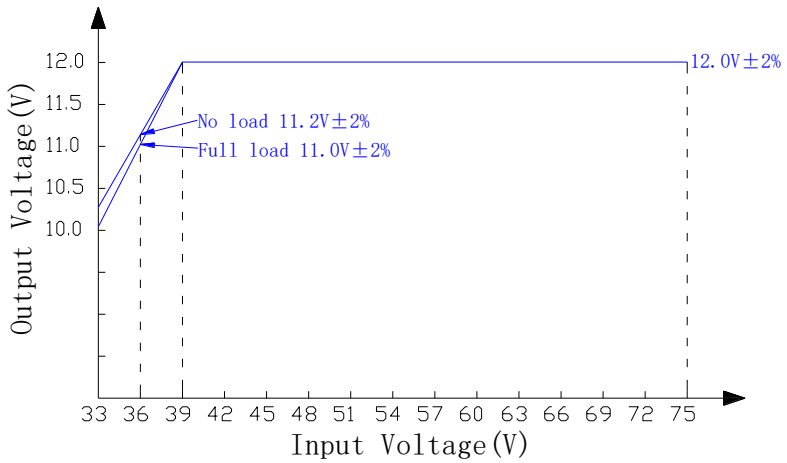


Figure 2. Output plot vs input

PARAMETER	MIN	TYP	MAX	UNIT
Turn-on Voltage Threshold	-	34.5	35.5	V
Turn-off Voltage Threshold	32.5	33.5	-	V

8. REMOTE ON/OFF

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit On)	Active Low	Remote On/Off pin is open, the module is off.	-0.3	-	0.8	V
Signal High (Unit Off)			2.4	-	18	V
Signal Low (Unit Off)	Active High	Remote On/Off pin is open, the module is on.	-0.3	-	0.8	V
Signal High (Unit On)			2.4	-	18	V
Current Sink			0	-	1	mA

Recommended remote on/off circuit for active low

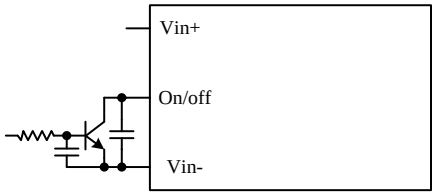


Figure 3. Control with open collector/drain circuit

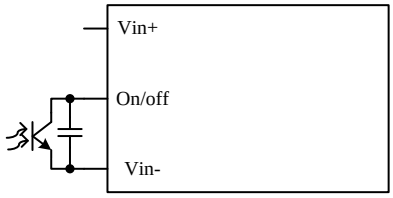


Figure 4. Control with photocoupler circuit

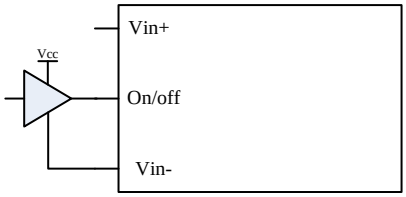


Figure 5. Control with logic circuit

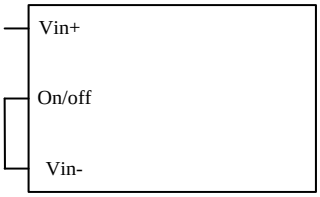


Figure 6. Permanently on

Recommended remote on/off circuit for active high

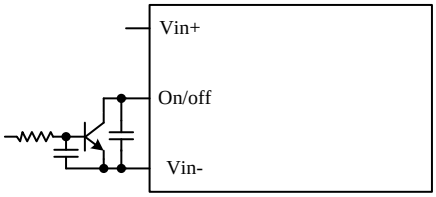


Figure 7. Control with open collector/drain circuit

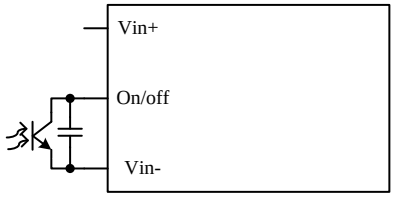


Figure 8. Control with photocoupler circuit

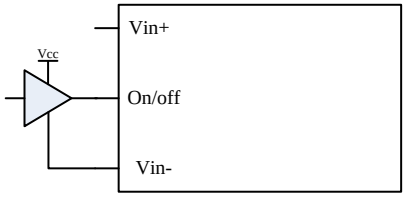


Figure 9. Control with logic circuit

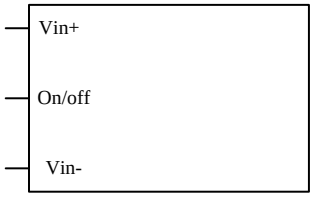


Figure 10. Permanently on

9. RIPPLE AND NOISE WAVEFORM

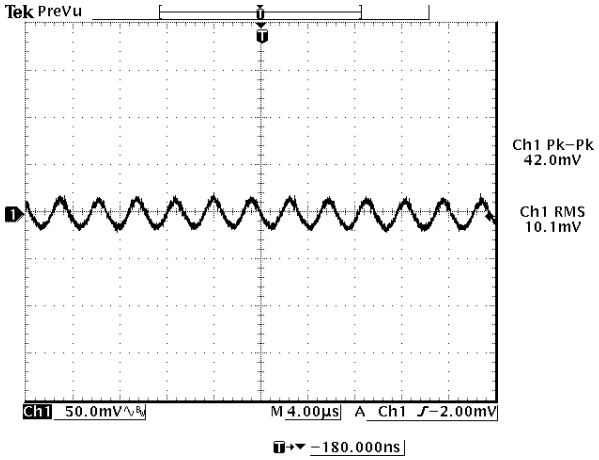


Figure 11. Ripple and noise waveform

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

10. TRANSIENT RESPONSE WAVEFORMS

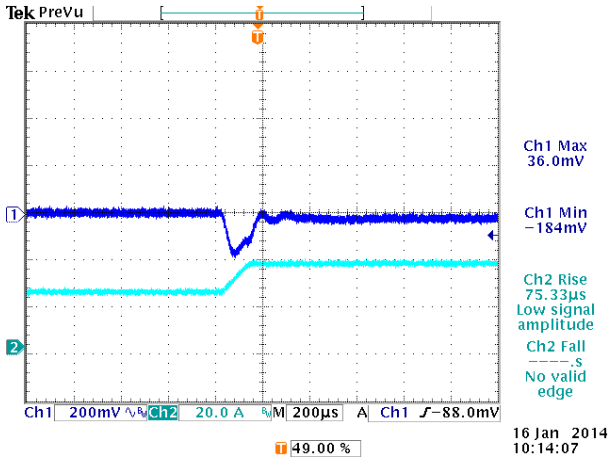


Figure 12. 50%-75% Load Transients at Vin = 48 V @ Ta = 25°C

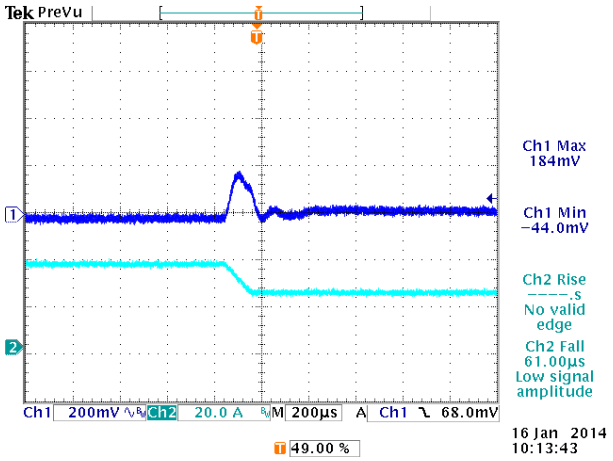


Figure 13. 75%-50% Load Transients at Vin = 48 V @ Ta = 25°C

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

11. STARTUP & SHUTDOWN

Rise time

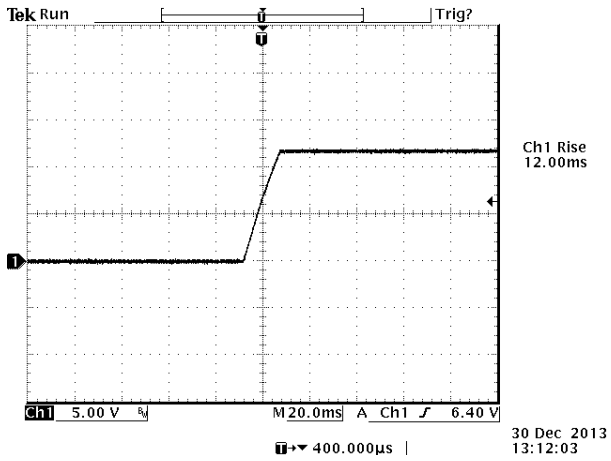


Figure 14. Vout = 12 V / 50 A @ Vin = 48 V, Ta = 25°C

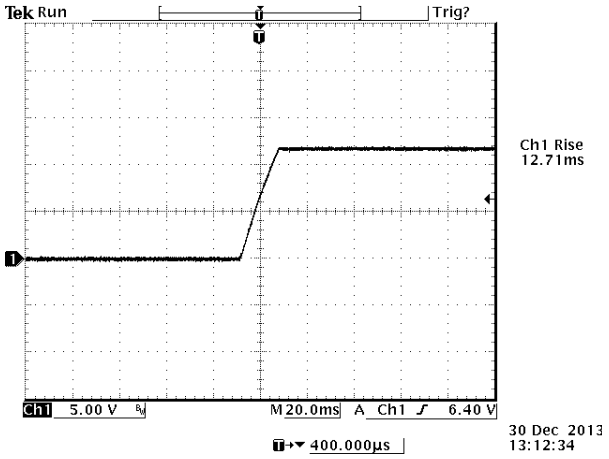


Figure 15. Vout = 12 V / 50 A @ Vin = 48 V, Ta = 25°C, Cext =10000 µF

Startup time

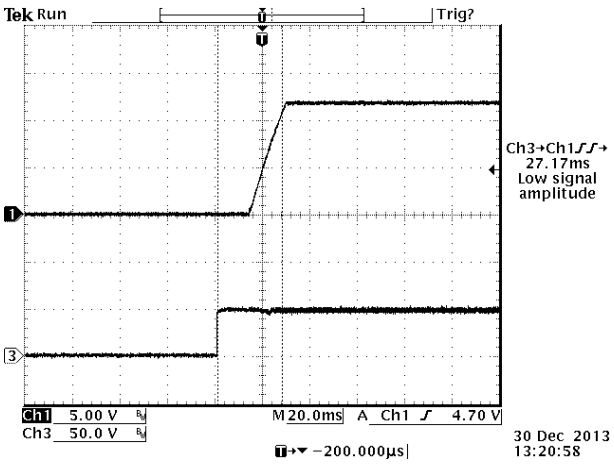


Figure 16. Startup from Vin
Ch1: Vo
Ch2: Vin
Vout = 12 V / 50 A @ Vin = 48 V, Ta = 25°C

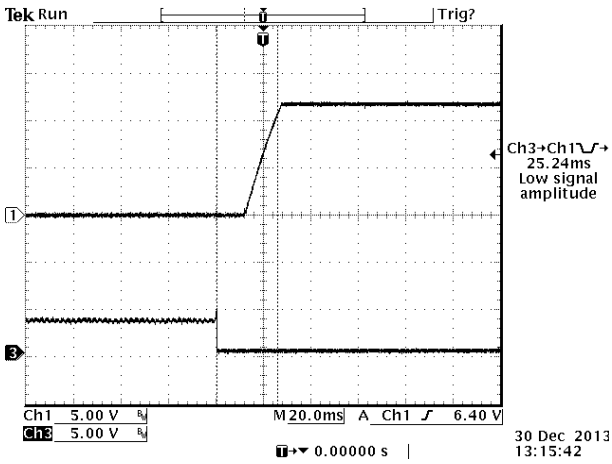


Figure 17. Startup from ON/OFF
Ch1: Vo
Ch2: ON/OFF
Vout = 12V / 50 A @ Vin = 48 V, Ta = 25°C

Shutdown

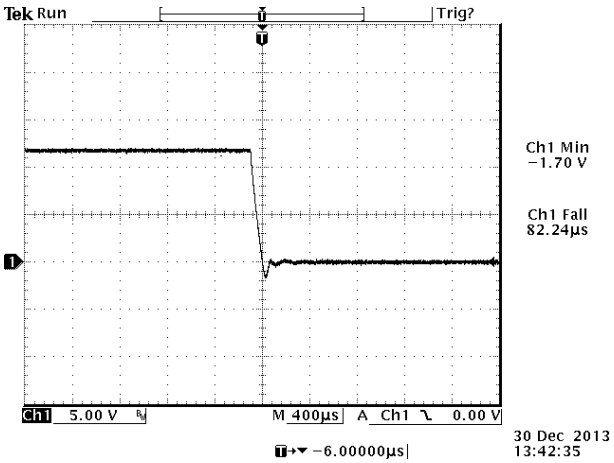


Figure 18. Vout = 12 V / 50 A @ Vin = 48 V, Ta = 25°C

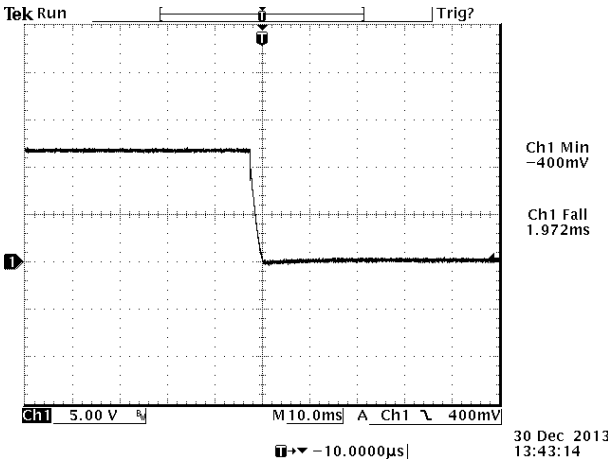


Figure 19. Vout = 12 V / 50 A @ Vin = 48 V, Ta = 25°C, Cext = 10000 µF

12. OVER CURRENT PROTECTION

To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry which 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 400 ms. The module operates normally when the output current goes into specified range. The typical average output current is 5.06 A during hiccup.

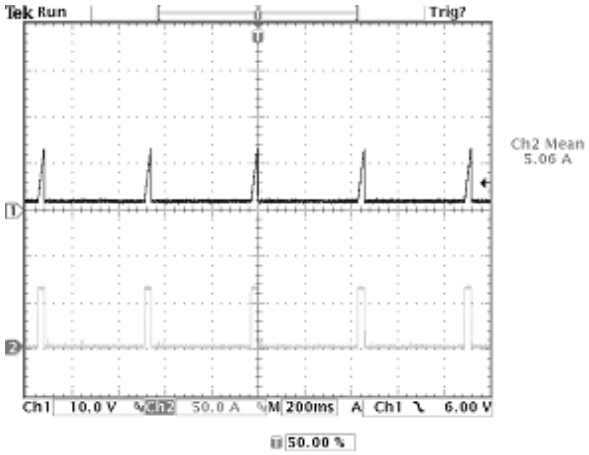


Figure 20.
CH1: Output Voltage
CH2: Output Current Waveform
Test condition: Vin = 48 V @ Ta = 25°C

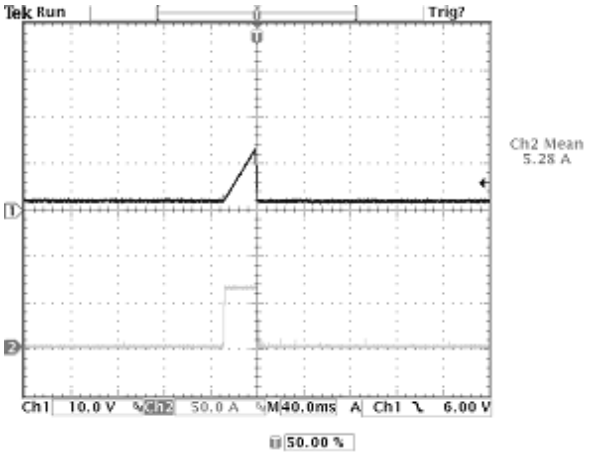


Figure 21.
CH1: Output Voltage
CH2: Output Current Waveform
Expansion of on time portion of above figure

13. INPUT UNDER-VOLTAGE LOCKOUT

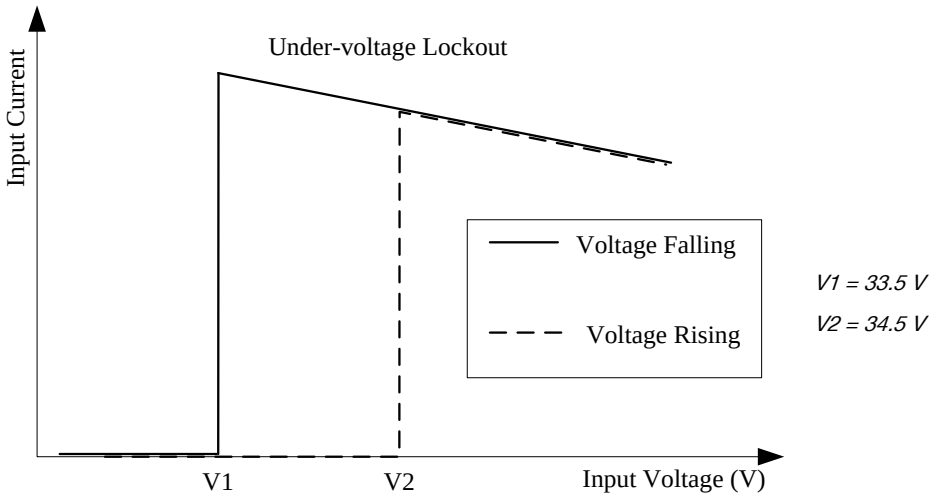


Figure 22. Input under-voltage lockout

14. THERMAL DERATING CURVES

The OTP is achieved by temperature sensor U10 and it's in non-latch mode when the hottest component U6 reaches 115°C with 200LFM air flow correspondingly. It will restart automatically when the temperature falls to 105°C. The protecting point will be varied a little under different conditions (air flow, ambient temperature, input voltage, load...).

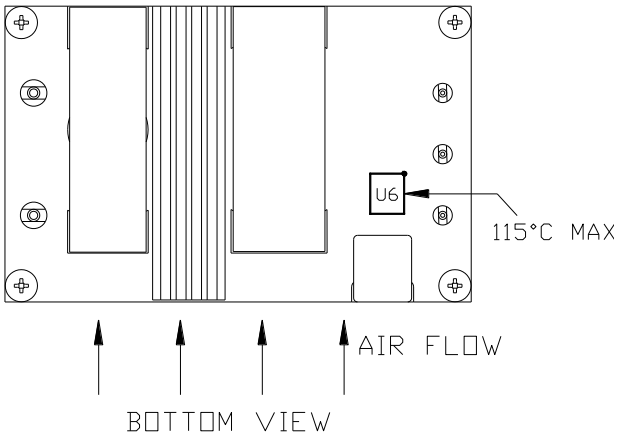


Figure 23. Temperature reference points on bottom side

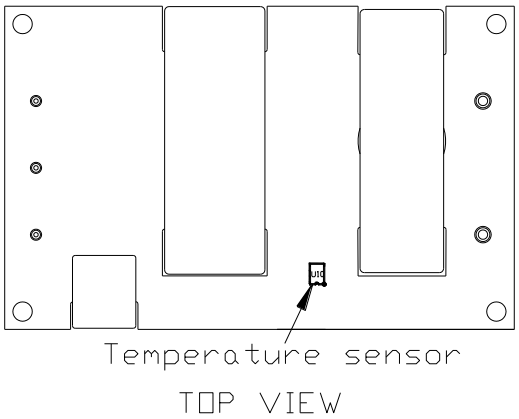


Figure 24. Temperature reference points on top side

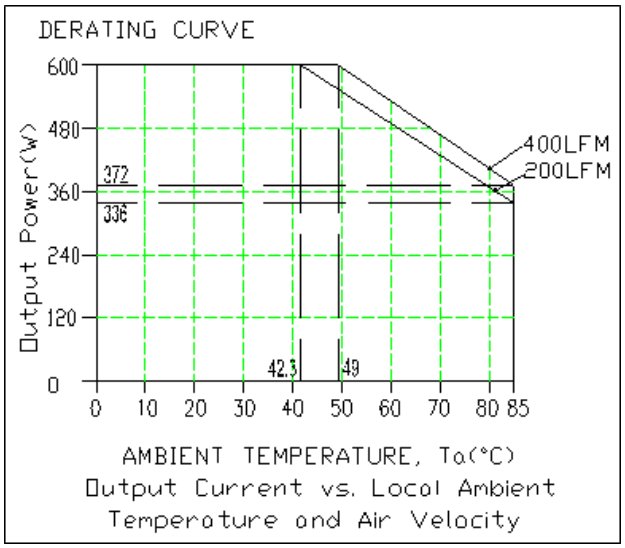


Figure 25. Thermal derating curve for 0RQ1-H0T12A/B

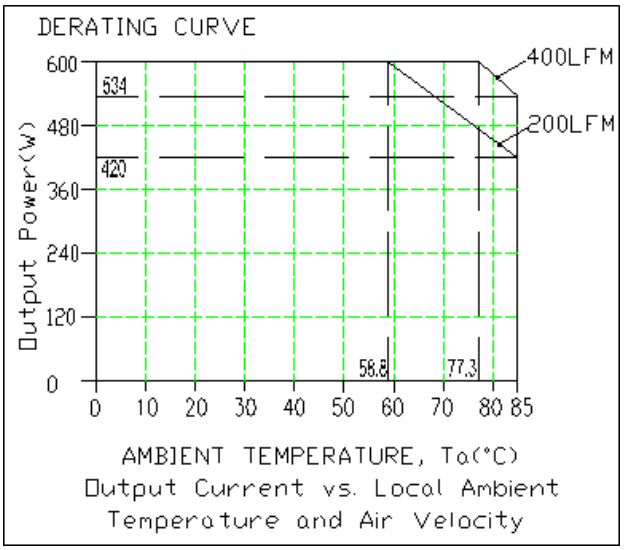


Figure 26. Thermal derating curve for 0RQ1-H0T12C/D

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

15. SAFETY & EMC

Safety:

1. Material flammability: UL94V-0
2. Approved to UL/CSA 62368-1
2. Approved to IEC/EN 62368-1

EMC:

1. Surge: IEC61000-4-5
2. DC-DIP: IEC61000-4-29
3. Conductive EMI: EN 55032 class A

Compliance to EN 55032 class A (both peak and average) with the following inductive and capacitive filter

Test Setup:

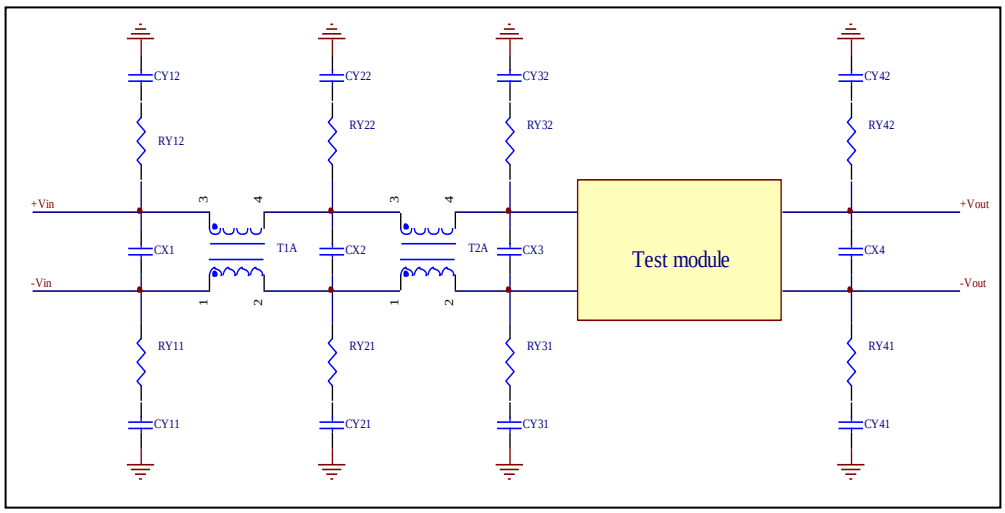


Figure 27.

Item	Designator	Parameter	Vendor	Vendor P/N
1	CX2	AL-EL CAP 220µF 20% 100V UHE2A221MHD6 Lead Type	Nichicon	UHE2A221MHD6
2	CX3	AL-EL CAP 330µF 20% 100V UPW2A331MHD Lead Type	Nichicon	UPW2A331MHD
3	CX4	SMD TAN 10µF +/-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		

Positive

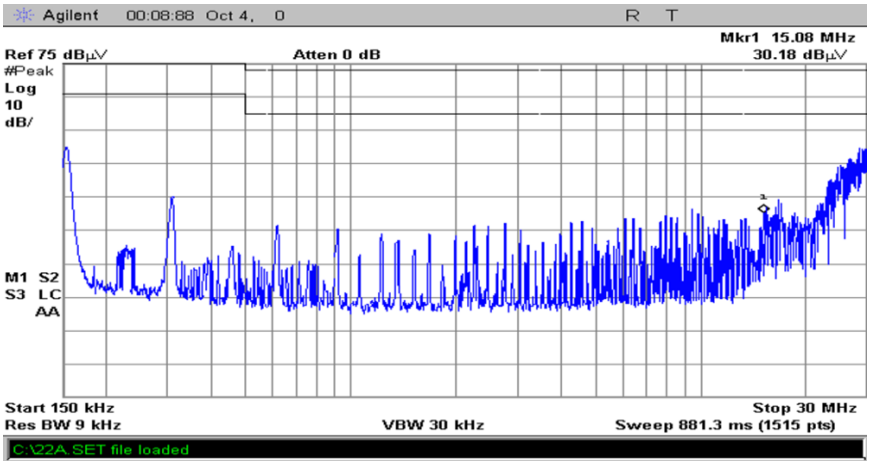


Figure 28.

Negative

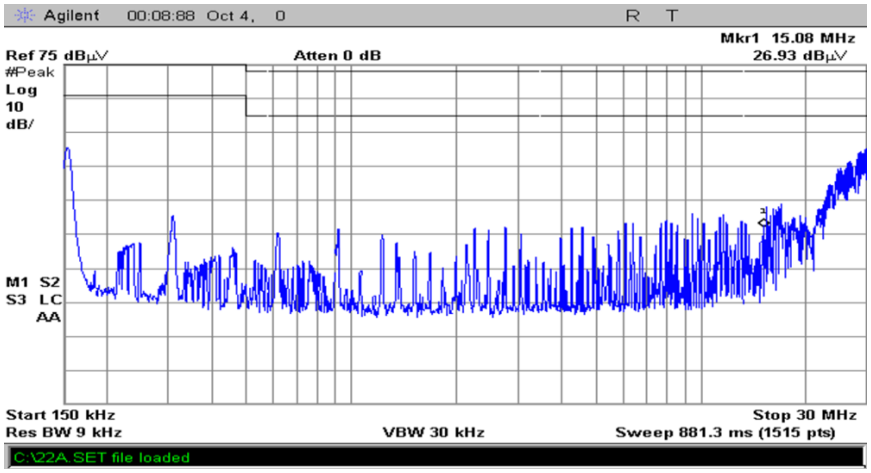


Figure 29.

16. MECHANICAL DIMENSIONS

0RQ1-H0T12A/B OUTLINE

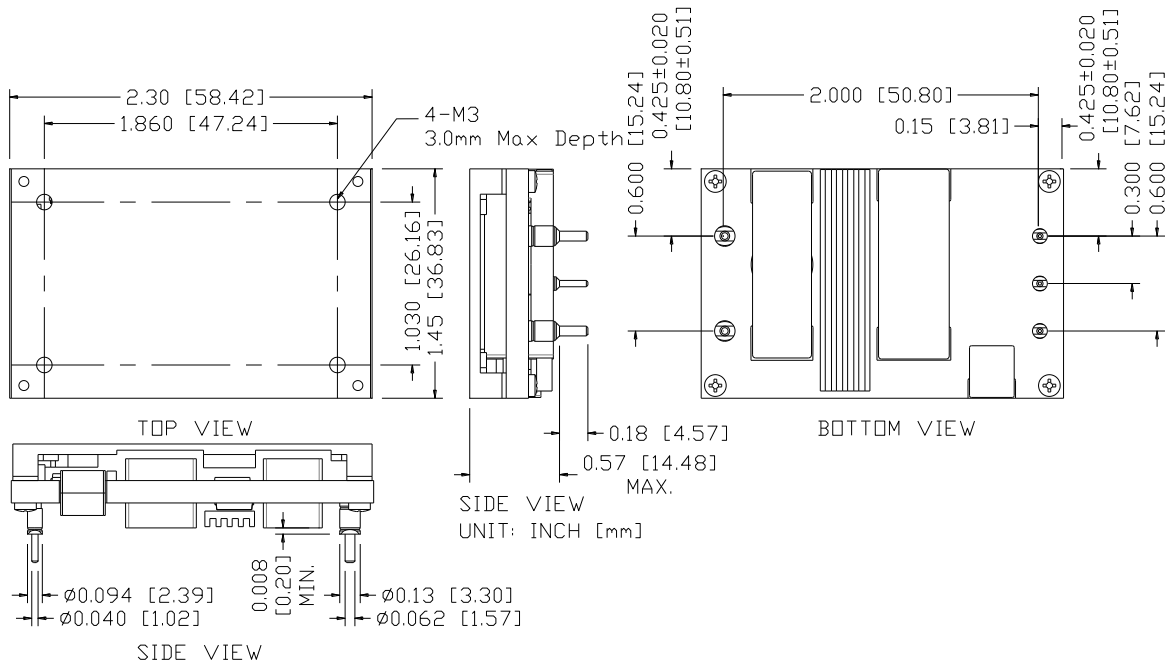


Figure 30. 0RQ1-H0T12A/B Outline

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.

NOTES:

1) All Pins: Material - Copper Alloy;
   Finish – 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
2) Un-dimensioned components are shown for visual reference only.
3) All dimensions in inch [mm]; Tolerances: x.xx +/-0.020 inch [0.51 mm]. x.xxx +/-0.010 inch [0.25 mm].

0RQ1-H0T12C/D OUTLINE

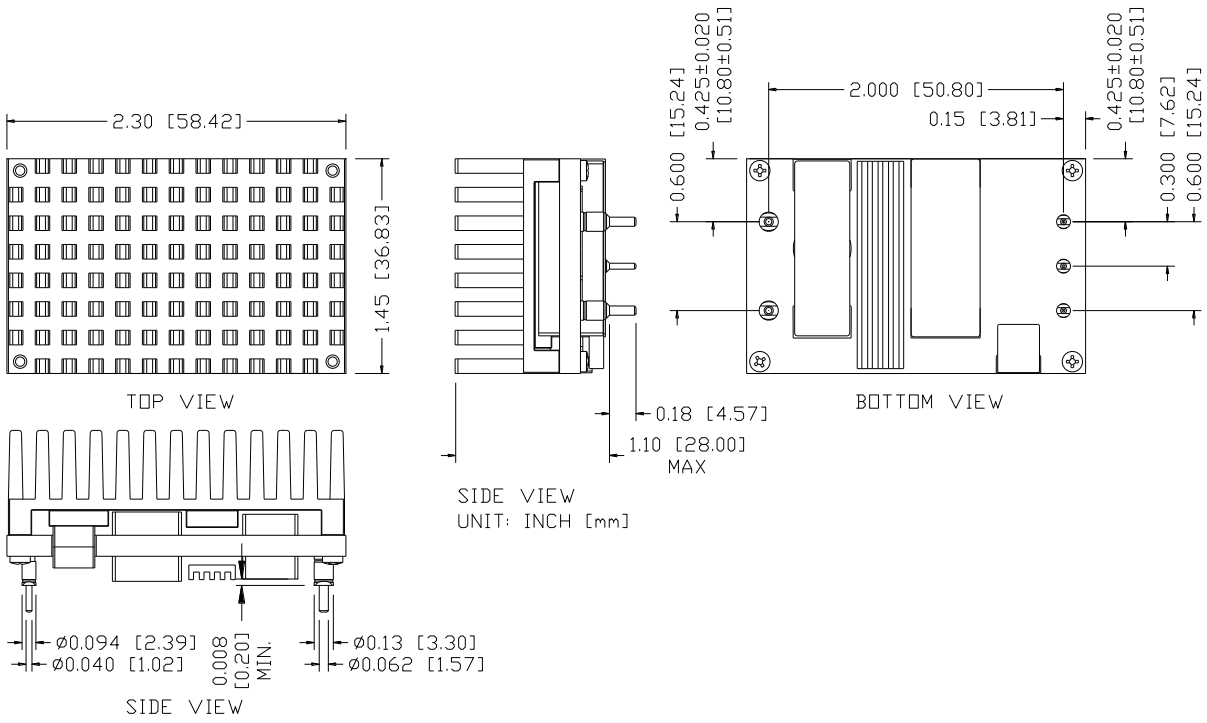


Figure 31. 0RQ1-H0T12C/D Outline

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 ºC for less than 5 seconds.

NOTES:

1) All Pins: Material - Copper Alloy;
   Finish – 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
2) Un-dimensioned components are shown for visual reference only.
3) All dimensions in inch [mm]; Tolerances: x.xx +/-0.020 inch [0.51 mm]. x.xxx +/-0.010 inch [0.25 mm].

PIN DEFINITIONS

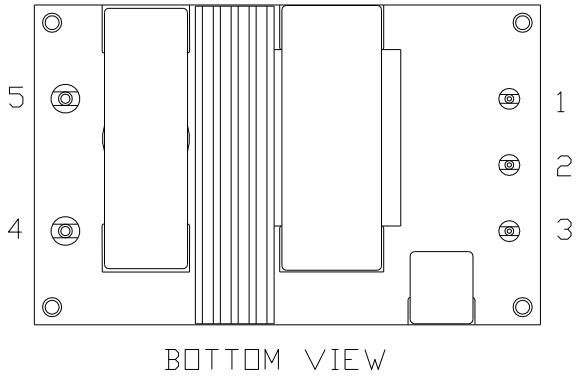


Figure 32. Pins

PIN	FUNCTION	PIN SIZE	PIN LENGTH
1	Vin (+)	0.040''	0.145''
2	Enable	0.040''	0.145''
3	Vin (-)	0.040''	0.145''
4	Vout (-)	0.062''	0.145''
5	Vout (+)	0.062''	0.145''

RECOMMENDED PAD LAYOUT

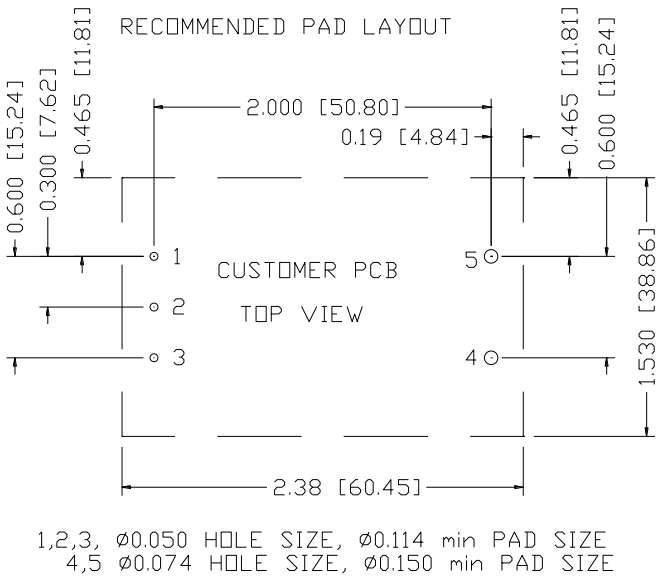


Figure 33. Recommended pad layout

17. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2013-05-07	A	First release	S.Wang
2013-07-11	B	Update the derating curve	S.Wang
2014-01-16	C	Added baseplate version of 0RQ1-H0T12A/B, Update the derating curve, efficiency curve and other specifications	Z.Tang
2014-12-31	D	Added Over Voltage Protection, Add Output Plot VS Input curve	S.Wang
2015-07-02	E	Update I/O Isolation Voltage to 2250V max	S.Wang
2015-09-25	F	Update the derating curve, Safety & EMC	S.Wang
2016-07-12	G	Update I/O isolation voltage, Input to Output, Input to Case	S.Wang
2021-05-25	AH	Add object ID. Update to new form. Update mechanical outline and recommended pad layout.	XF.Jiang
2021-09-06	AJ	Modified thermal derating curve description to change the hottest component from U5 to U6.	DW.Ren

For more information on these products consult: tech.support@psbel.com

NUCLEAR AND MEDICAL APPLICATIONS - Products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.
TECHNICAL REVISIONS - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.