

0RQ1-Q0T12

Isolated DC-DC Converter

The 0RQ1-Q0T12 series are isolated DC/DC converters that operate from a nominal 48 Vdc source. These units provide up to 400 W of 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

- 36 - 75 VDC Input
- 12 VDC @ 33 A Output
- Basic Isolation
- Fixed Frequency (300 kHz)
- High Efficiency
- High Power Density
- Low Cost
- Input Under Voltage Lockout
- OCP / SCP
- Output Over-Voltage Protection
- Over Temperature Protection
- Remote On/Off
- Approved to IEC/EN 62368-1
- Approved to UL/CSA 62368-1
- Class II, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)



Applications

- Networking
- Computers and Peripherals
- Telecommunications

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
0RQ1-Q0T123G					
0RQ1-Q0T12HG	12 VDC	36 - 75 VDC	33 A	400 W	95.9%
0RQ1-Q0T12HAG					

PART NUMBER EXPLANATION

0	R	Q1	-	Q0	T	12	Options
Mounting Type	RoHS Status	Series Name		Output Power	Input Range	Output Voltage	xxx
Through Hole Mount	RoHS	1/4th Brick		400 W	36 - 75 V	12 V	3 G - Legacy model, active low, with baseplate & 0.180" pin H G - Active low, with baseplate & 0.145" pin HAG - Active low, with baseplate & 0.180" pin

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		-	-	1500	V
Ambient Temperature		-40	-	85	°C
Storage Temperature		-55	-	125	°C
Altitude		-	-	5000	m
Input Transient Voltage	100 ms maximum	-	-	100	V

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)		-	-	12.5	A
Input Current (no load)		-	140	200	mA
Remote Off Input Current		-	15	20	mA
Input Reflected Ripple Current (rms)	10 uH source impedance; Vin = 48 V, Io = Io max	-	50	-	mA
Input Reflected Ripple Current (pk-pk)		-	160	-	mA
I ² t Inrush Current Transient		-	-	1	A ² s
Turn-on Voltage Threshold		-	34.5	36	V
Turn-off Voltage Threshold		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 20 A on system board. Refer to the fuse manufacturer'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, load and ambient temperature condition.	11.30	-	12.30	V	
Load Regulation	Vin = 36~ 40 V, Io = 0 ~ 100% load	-	300	600	mV	
	Vin = 40 ~ 75 V, Io = 0 ~ 100% load	-	20	40	mV	
Line Regulation	Vin = 36 ~ 40 V, Io = 100% load	-	450	700	mV	
	Vin = 40 ~ 75 V, Io = 100% load	-	20	40	mV	
Regulation Over Temperature		-	50	100	mV	
Output Ripple and Noise(Pk-Pk)	Vin = 48 V, Io = 100% load at 25°C ambient, 0 – 20 MHz BW, with a 1 µF ceramic capacitor and a 270 uF AL. cap at output.	-	40	100	mV	
Output Ripple and Noise(RMS)		-	5	20	mV	
Ripple and Noise (pk-pk) under worst case	Over entire operating input voltage range, load and ambient temperature condition.	-	-	150	mV	
Output Current Range		0	-	33	A	
Output DC Current Limit		35	40	46	A	
Short Circuit Surge Transient		-	-	6	A ² s	
Rise Time		-	25	-	ms	
Turn on Time	Enable from Vin	-	40	45	ms	
	Enable from ON/OFF	-	40	45	ms	
Overshoot at Turn on		-	0	3	%	
Output Capacitance		270	-	10000	uF	
Transient Response						
ΔV 50%~75% of Max Load		-	300	-	mV	
Settling Time	Vo=12 V	di/dt = 0.1 A/µs, Vin = 48 Vdc, Ta = 25°C, with a 1 µF ceramic capacitor and a 270 µF AL. cap at output.	-	500	-	us
ΔV 75%~50% of Max Load			-	300	-	mV
Settling Time			-	500	-	us

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin = 48 V, full load,	-	95.9	-	%
Switching Frequency		-	300	-	kHz
Over Temperature Protection		-	125	-	°C
FIT	Calculated Per Bell Core SR-332 (Vin = 48 V, Vo = 12 V, Io = 26.4 A, Ta = 25°C, FIT = 10 ⁹ /MTBF)		161		-
Weight		-	68	-	g
Dimensions (L x W x H)			2.28 x 1.45 x 0.55		inch
			57.91 x 36.83 x 14.00		mm
<i>Isolation Characteristics</i>					
Input to Output		-	-	1500	V
Input to Case		-	-	1500	V
Output to Case		-	-	500	V
Isolation Resistance		10M	-	-	Ohm
Isolation Capacitance		-	2700	-	pF

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

6. EFFICIENCY DATA

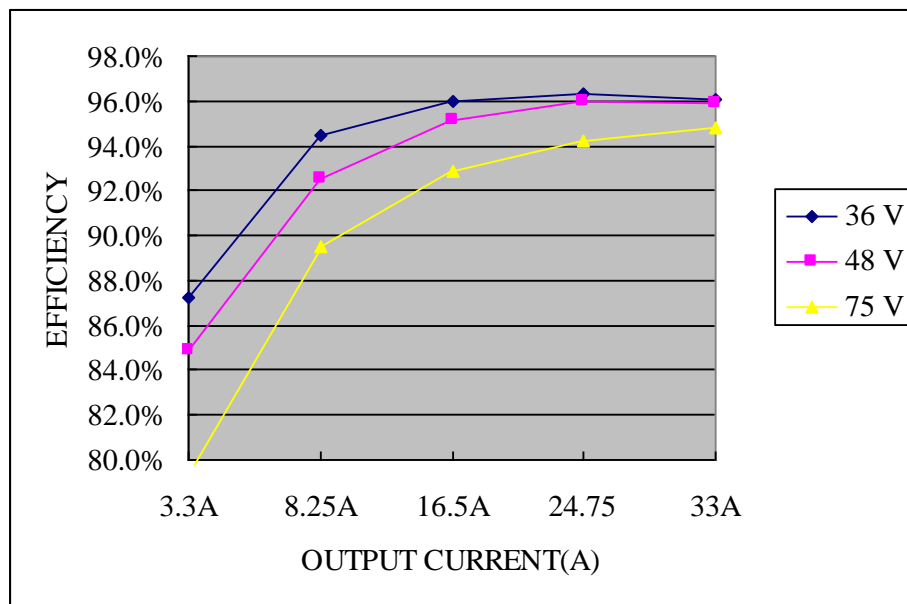


Figure 1. Efficiency data

7. REMOTE ON/OFF

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

Recommended remote on/off circuit for active low

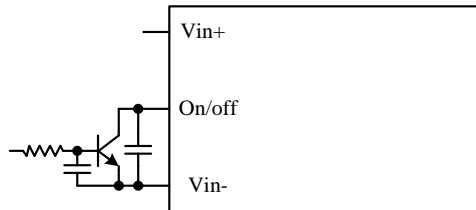


Figure 2. Control with open collector/drain circuit

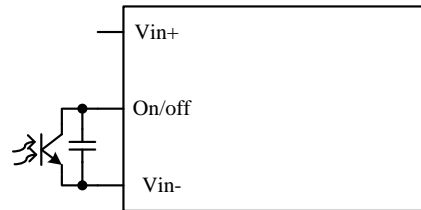


Figure 3. Control with photocoupler circuit

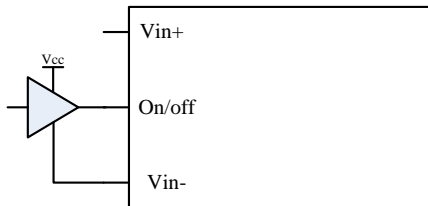


Figure 4. Control with logic circuit

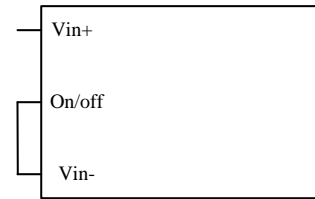


Figure 5. Permanently on

8. RIPPLE AND NOISE WAVEFORM

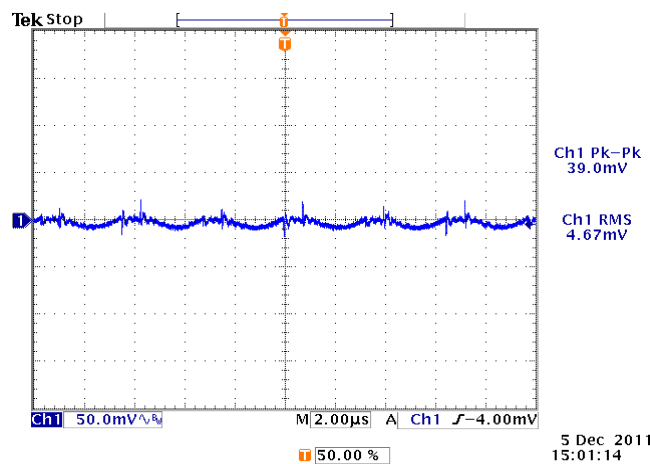


Figure 6. Ripple and noise waveform

Note: Ripple and noise at full load, 48 Vdc input, 12 Vdc/35 A output voltage and $T_a=25^\circ\text{C}$, and with a 1 μF ceramic cap and a 270 μF AL. cap at output.

9. TRANSIENT RESPONSE WAVEFORMS

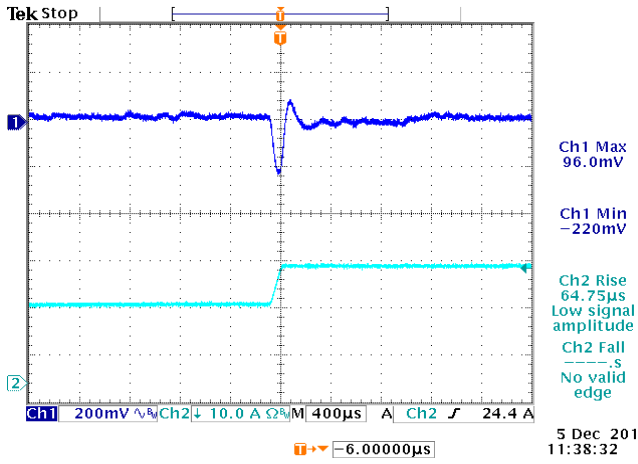


Figure 7. $V_{out} = 12V$, 50%-75% Load Transients

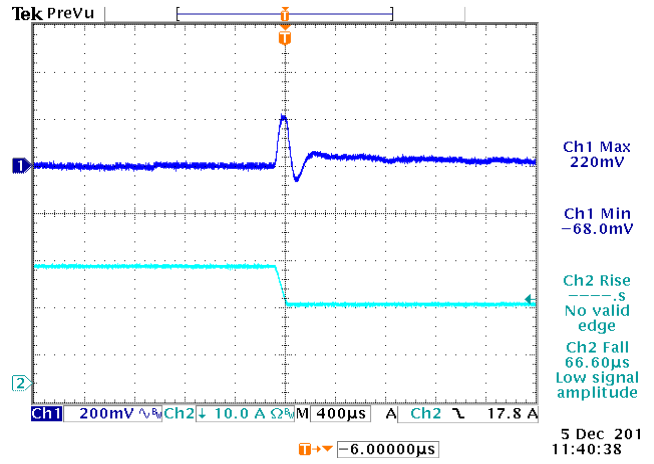


Figure 8. $V_{out} = 12V$, 75%-50% Load Transients

Note: Transient Response at $V_{in}=48V$ $di/dt=0.1A/\mu s$, 1 μF ceramic cap and 270 μF AL. cap at output, $T_a=25^\circ C$.

10. STARTUP & SHUTDOWN

Turn on rise time

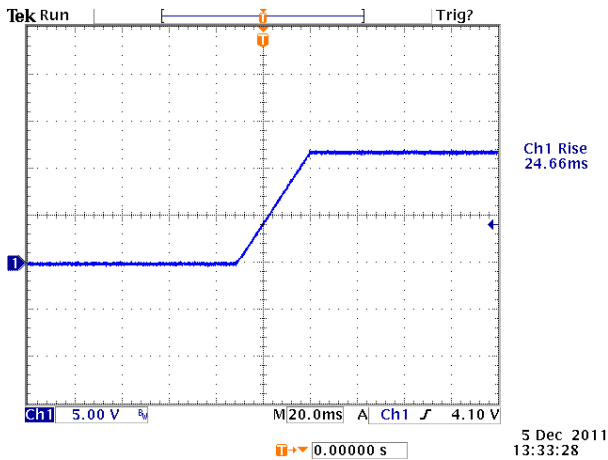


Figure 9. $V_{in} = 48V @ T_a=25^\circ C$, $V_o = 12V$, $I_o = 33A$, $C_{ext} = 270\mu F$

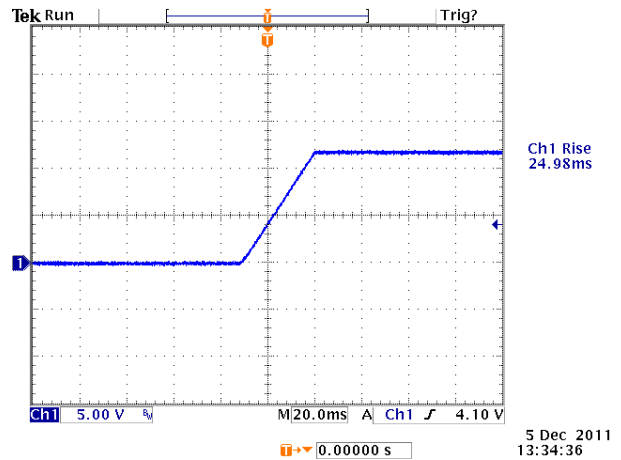


Figure 10. $V_{in} = 48V @ T_a=25^\circ C$, $V_o = 12V$, $I_o = 33A$, $C_{ext} = 270\mu F$

Turn on startup time

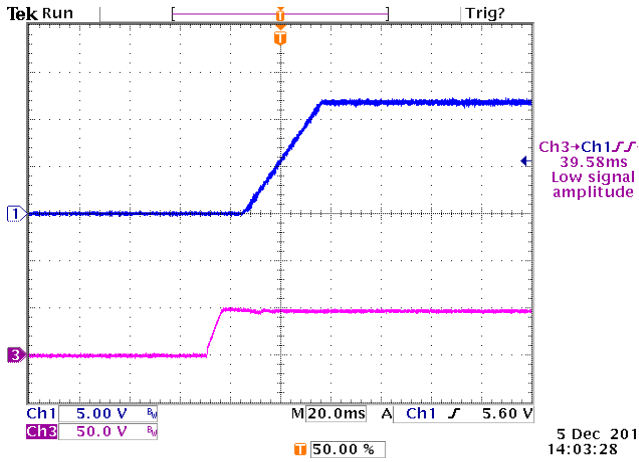


Figure 11. Startup from Vin
 Ch1: Vo
 Ch2: Vin
 Vin = 48 V@Ta=25°C, Vo = 12 V, Io = 33 A
 Cext = 10000 µF

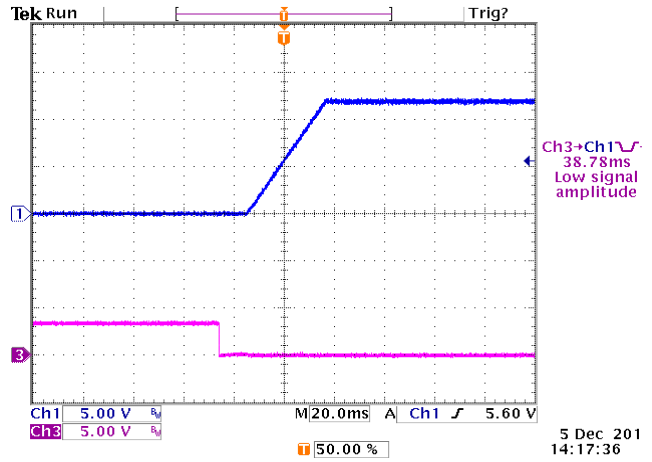


Figure 12. Startup from on/off
 Ch1: Vo
 Ch2: On/off
 Vin = 48 V@Ta=25°C, Vo = 12 V, Io = 33 A
 Cext = 10000 µF

Shutdown

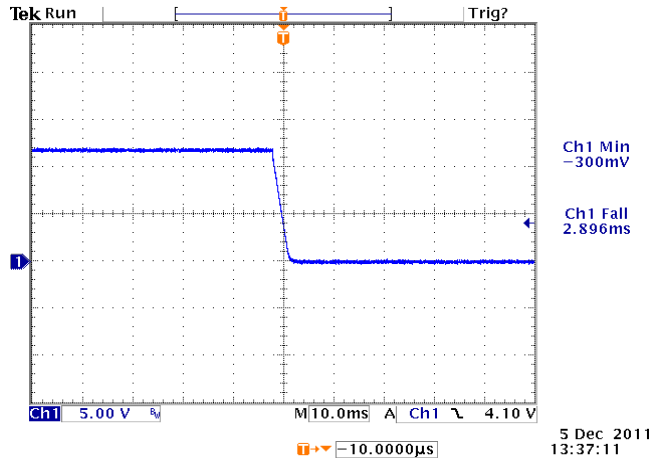


Figure 13. Vin = 48 V@Ta=25°C, Vo = 12 V, Io = 33 A, Cext = 10000 µF

11. 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 9.06 A during hiccup.

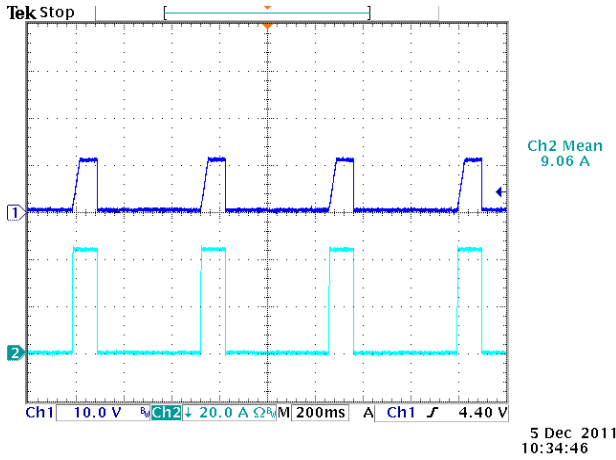


Figure 14. OCP-1
 CH1: Output Voltage
 CH2: Output Current Waveform
 Test condition: $V_{in} = 48 V @ T_a = 25^{\circ}C$

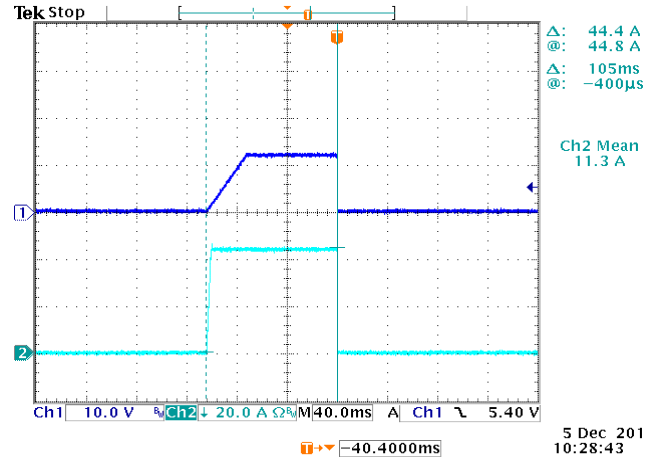


Figure 15. OCP-2
 CH1: Output Voltage
 CH2: Output Current Waveform
 Expansion of on time portion of above figure

12. INPUT UNDER-VOLTAGE LOCKOUT

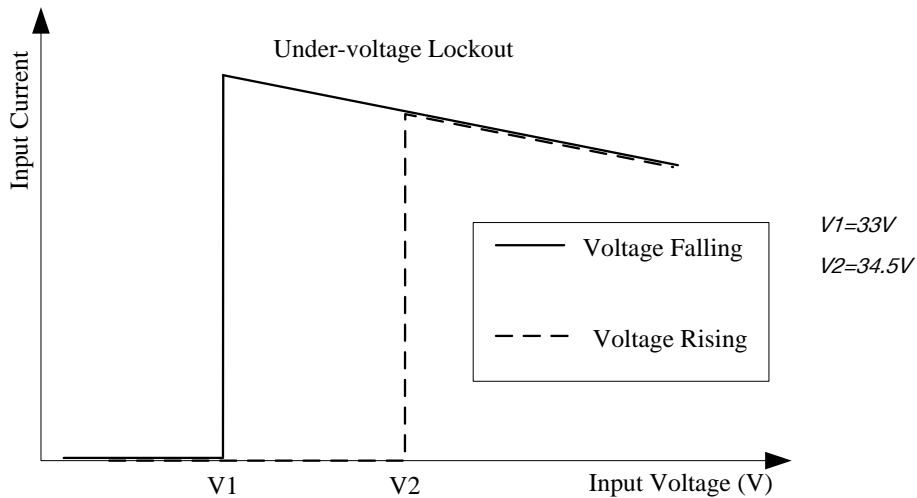


Figure 16. Input under-voltage lockout

13. THERMAL DERATING CURVE

The OTP is achieved by temperature sensor U10 and it's in non-latch mode when the hottest component U7 reaches 115°C with 200 LFM 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...).

Maximum junction temperature of semiconductors derated to 120 °C.

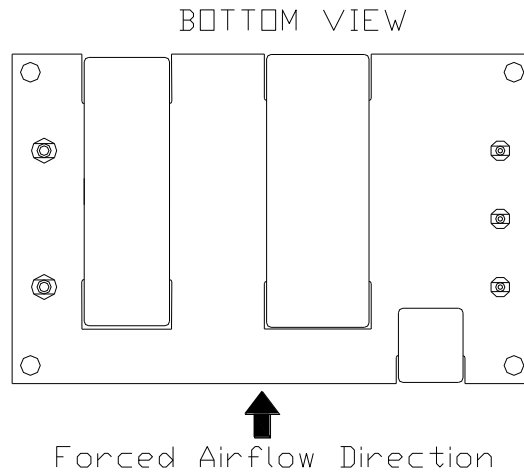


Figure 17. Airflow direction

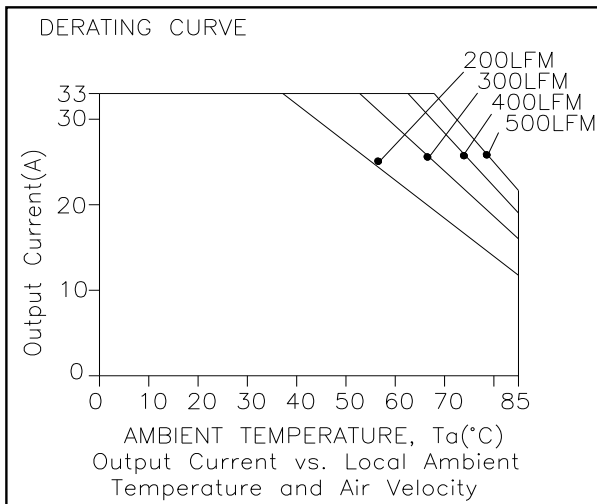


Figure 18. Vin = 48 V
Derating curve for the base plate

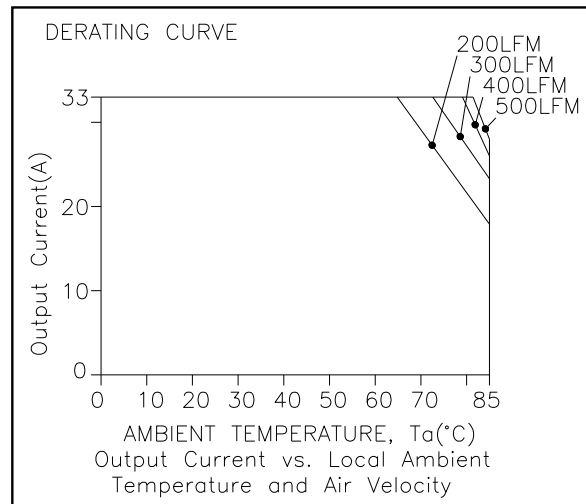
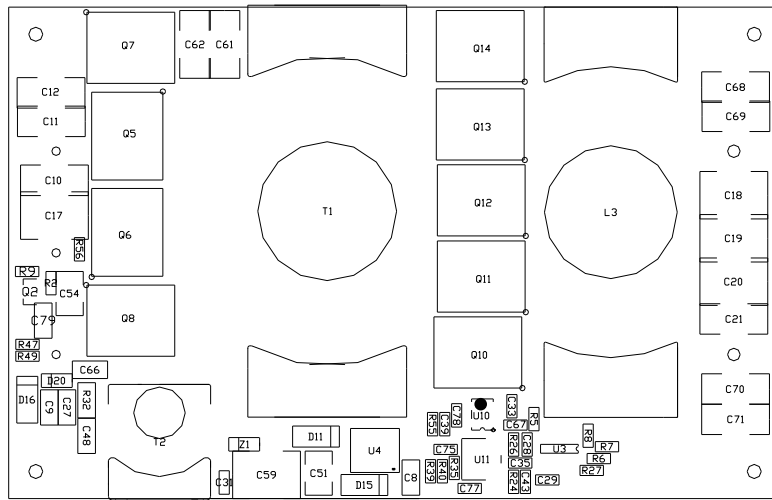
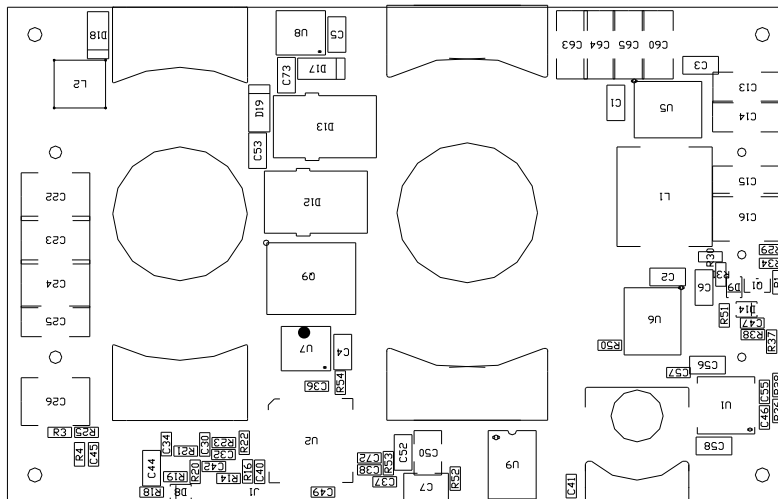


Figure 19. Vin = 48 V
Derating curve for the base plate with 0.5 inch heatsink



TOP VIEW

Figure 20. Temperature reference points on top side



BOTTOM VIEW

Figure 21. Temperature reference points on bottom side

14. SAFETY & EMC

Safety

1. Material flammability UL94V-0
2. Safety approved by IEC/EN 62368-1, UL/CSA 62368-1
3. Safety approved by IEC/EN 60950-1, UL/CSA 60950-1

EMC

1. Surge: IEC61000-4-5
2. DC-DIP: IEC61000-4-29
3. Conductive EMI: EN55032 class A

Compliance to EN55032 class A (both peak and average) with the following inductive and capacitive filter

Test Setup:

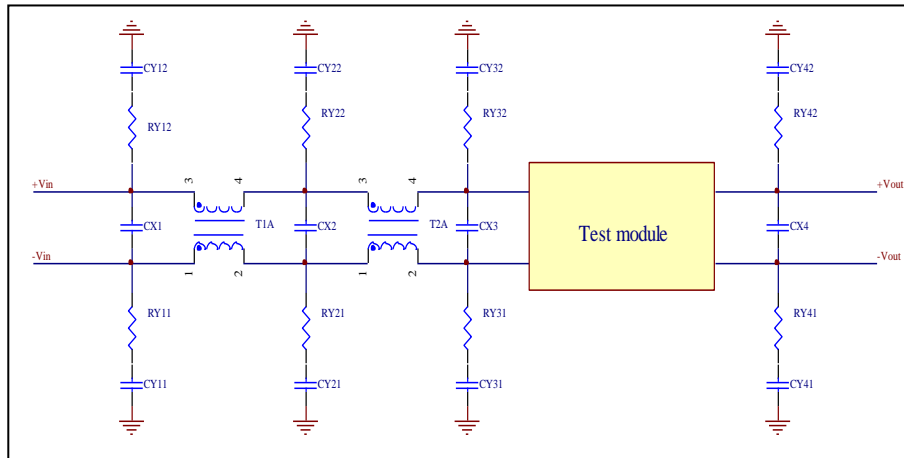


Figure 22. Test setup

Item	Designator	Parameter	Vendor	Vendor P/N
1	CX2	100µF/100V, AL cap		
2	CX3	100µF/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/1000 V,ceramic		
7	RY31	1206,0R,Resistor		
8	RY32	1206,0R,Resistor		
9	RY41	1206, 0R,Resistor		
10	RY42	1206, 0R,Resistor		
11	T2A	1mH, common mode		
12	T1A, CX1, CX2, RY11, RY21, RY12, RY22, CY11, CY21,	NIL		

CY12, CY22

Positive

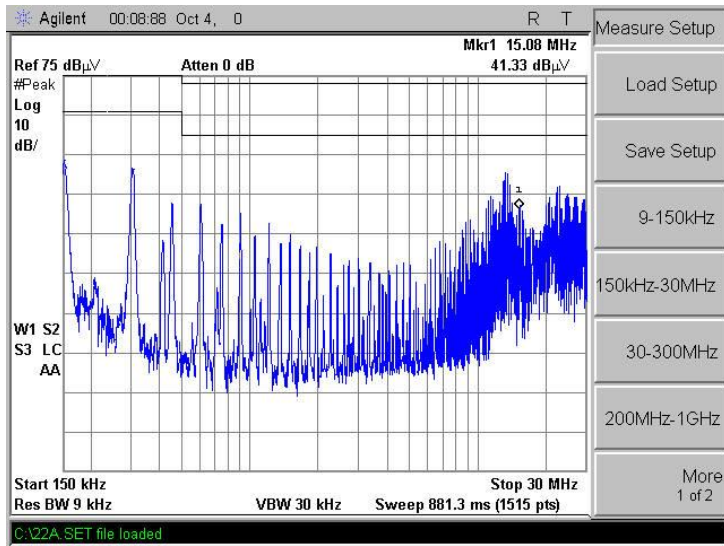


Figure 23. Positive

Negative

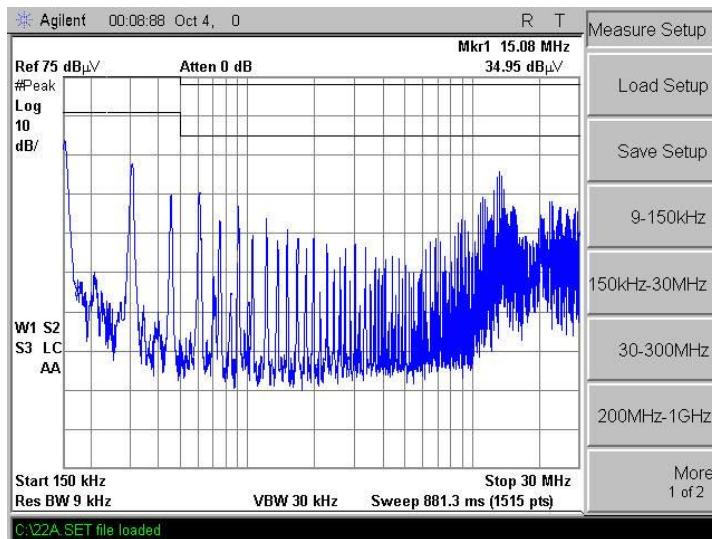


Figure 24. Negative

15. MECHANICAL DIMENSIONS

0RQ1-Q0T123G/0RQ1-Q0T12HAG OUTLINE



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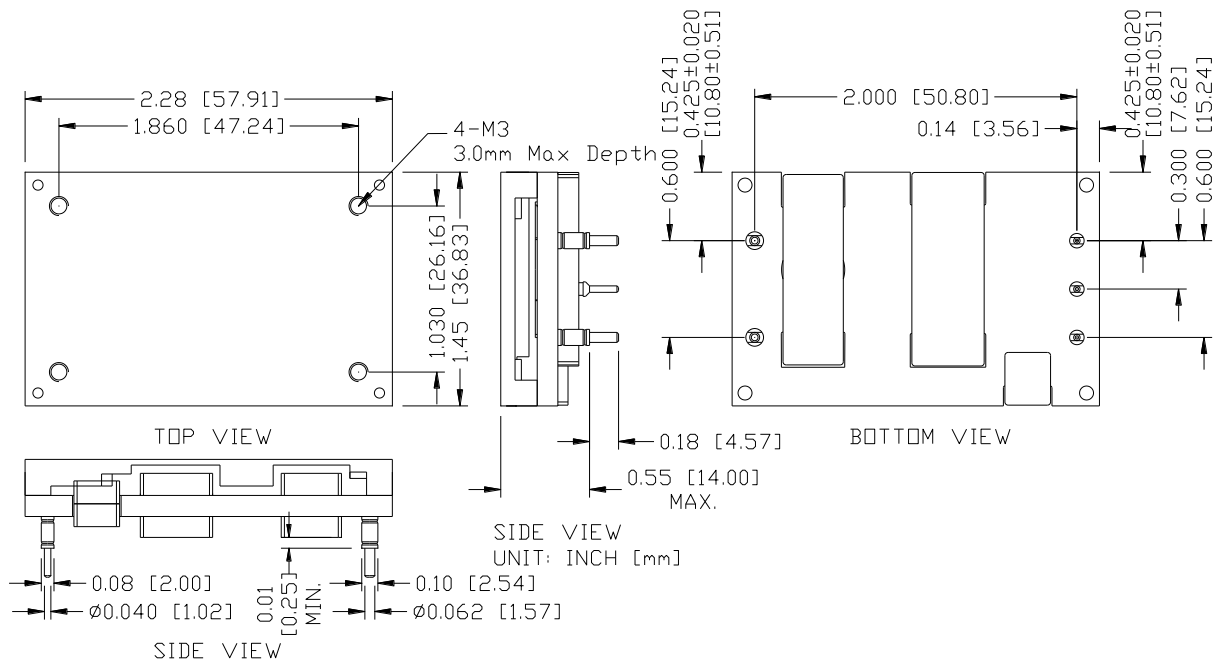


Figure 25. 0RQ1-Q0T123G/0RQ1-Q0T12HAG Outline

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 +/-0.02 inch [0.51 mm]. x.xxx +/-0.010 inch [0.25 mm].

ORQ1-Q0T12HG OUTLINE

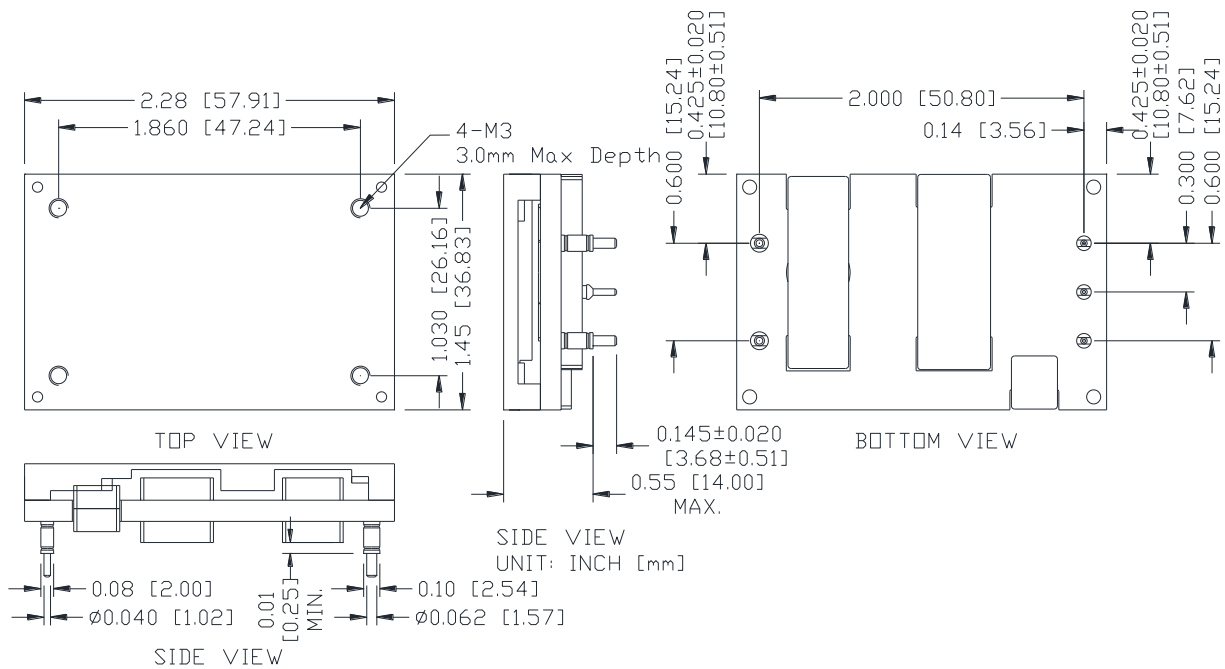


Figure 26. ORQ1-Q0T12HG Outline

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 +/-0.02 inch [0.51 mm]. x.xxx +/-0.010 inch [0.25 mm].

PIN DEFINITIONS

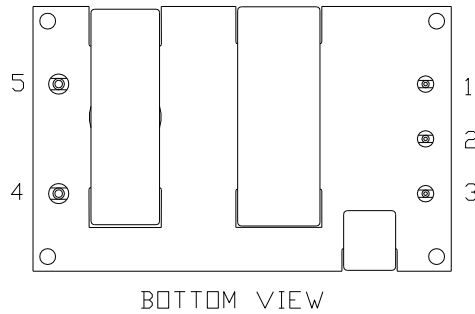


Figure 27. Pins

PIN	FUNCTION	PIN SIZE
1	Vin(+)	0.04"
2	Enable	0.04"
3	Vin(-)	0.04"
4	Vout(-)	0.06"
5	Vout(+)	0.06"

RECOMMENDED PAD LAYOUT

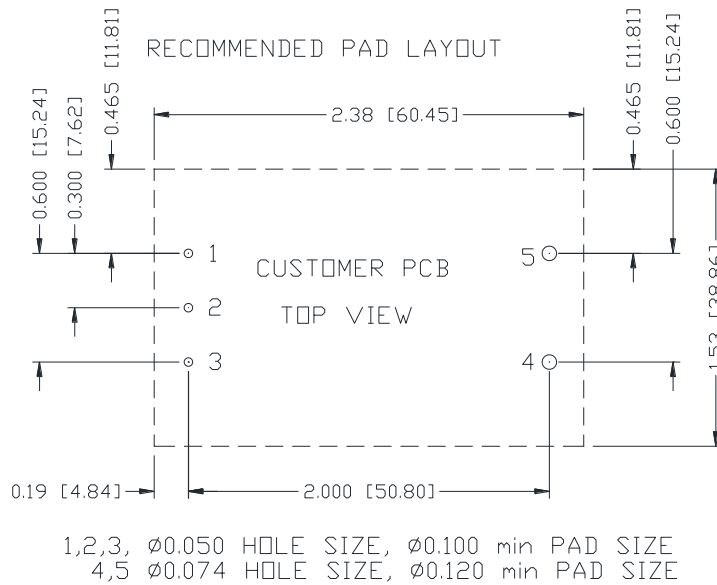


Figure 28. Recommended pad layout

16. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2016-12-05	AA	First release	S.Wang
2018-04-16	AB	Add 0RQ1-Q0T12H	S.Wang
2020-11-10	AC	Update safety certificate, 0RQ1-Q0T12H outline and recommended pad layout. Add module photo and altitude.	H.Yu
2021-06-17	AD	Add object ID. Adding PN of 0RQ1-Q0T12HAG, updating description of outline.	DW.Ren
2021-07-09	AE	Correct typo on page 13.	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.



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