0RRQ-45M11R

Isolated DC-DC Converter

The 0RRQ-45M11R is an isolated DC/DC converter that operates from a nominal 54 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 480 W of output power from a nominal 54 VDC input. The output of the converter has the droop function which allows the modules operating in parallel with high output current sharing precision.

This converter is provided in an industry standard quarter brick package.

RoHS Compliant

Key Features & Benefits

- 51 - 57 VDC Input
- 9.7 VDC @ 51 A Output
- 1/4th Brick Converter
- Isolated
- Fixed Frequency (300 kHz)
- High Efficiency
- High Power Density
- Low Cost
- Parallel Operation with Droop
- Input Under-Voltage Protection
- Output Over-Voltage Protection
- OCP/SCP
- Over Temperature Protection
- Remote On/Off
- Approved to IEC/EN 62368-1
- Class II, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)

Applications

- Networking
- Computers and Peripherals
- Telecommunication

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
0RRQ-45M11R	9.7 VDC	51 - 57 VDC	51 A	480 W	96%

NOTE: 1. Add "G" suffix at the end of the model number to indicate a ROHS compliant module shipped in a standard tray packaging.

2. Add "P" suffix at the end of the model number to indicate a ROHS compliant module that is Paste in Hole compliant (see reflow temp specs in datasheet) shipped in a special Paste in Hole process compliant tray (see tray bake temp specs in datasheet).

PART NUMBER EXPLANATION

0	R	RQ	-	45	M	11	R	x
Mounting Type	RoHS Status	Series Name		Output Power	Input Range	Output Voltage	Active Logic	Package Type
Through hole mount	RoHS	1/4th Brick		480 W	51 – 57 V	9.7 V	Active Low, with Baseplate	G – Tray package P – Paste in Hole compliant

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.3	-	60	V
Remote On/Off		-0.3	-	10	V
Ambient Temperature		-20	-	70	°C
Storage Temperature		-40	-	100	°C
Altitude		-	-	2000	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		51	54	57	V
Input Current (full load)		-	-	11	A
Input Current (no load)		-	150	200	mA
Remote Off Input Current		-	4	8	mA
Input Reflected Ripple Current (rms)	With simulated source impedance of 12 µH, 5 Hz to 20 MHz. Use a 33 µF/100 V electrolytic capacitor with ESR < 0.5 Ω @ 100 kHz, 20°C	-	480	650	mA
Input Reflected Ripple Current (pk-pk)		-	1.8	2.6	A
I^2t Inrush Current Transient		-	-	1	A^2s
Turn-on Voltage Threshold		42	43.5	45	V
Turn-off Voltage Threshold		39	40.5	42	V
Over-Voltage Shutdown Threshold		58	62	66	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 16 A on system board. Refer to the fuse manufacture's datasheet for further information.

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 = 54 V, Io = 0 load	9.96	10.0	10.04	V
	Vin = 54 V, Io = 50% load	9.666	9.7	9.734	V
	Vin = 54 V, Io = 100% load	9.372	9.4	9.428	V
Load Regulation	Vin = 54 V, Io = 0~100% load (The output droop voltage from no load to full load is about 0.6 V)	-	0.6	0.668	V
Line Regulation	Vin = 51-57 V, Io = 100% load	-	25	40	mV
Ripple and Noise (pk-pk)	Vin = 54 V, Io = 100% load, 0-20 MHz BW, with a 1 μF ceramic capacitor and a 10 μF Tantalum cap at output	-	50	150	mV
Ripple and Noise (rms)		-	10	20	mV
Output 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	-	51	A
Output DC Current Limit		56	62	68	A
Short Circuit Surge Transient		-	-	2	A^2s
Current Share Accuracy	Vin = 54 V, Io = full load, two units parallel operation	-	-	±5	%
Rise Time		-	-	15	ms
Turn on Time	Enable from Vin	-	30	35	ms
	Enable from ON/OFF	-	30	35	ms
Overshoot at Turn on		-	0	3	%
Output Capacitance	Typically 50% ceramic + 50% electrolytic capacitors	0	-	5000	μF
Transient Response					
△V 50%~75% of Max Load	di/dt = 1 A/μs, Vin = 54 VDC, Ta=25°C, with a 1 μF ceramic capacitor and a 100 μF AL. cap at output	-	350	500	mV
Settling Time		-	100	200	μs
△V 75%~50% of Max Load		-	350	500	mV
Settling Time		-	100	200	μs

5. OUTPUT PLOT VS INPUT

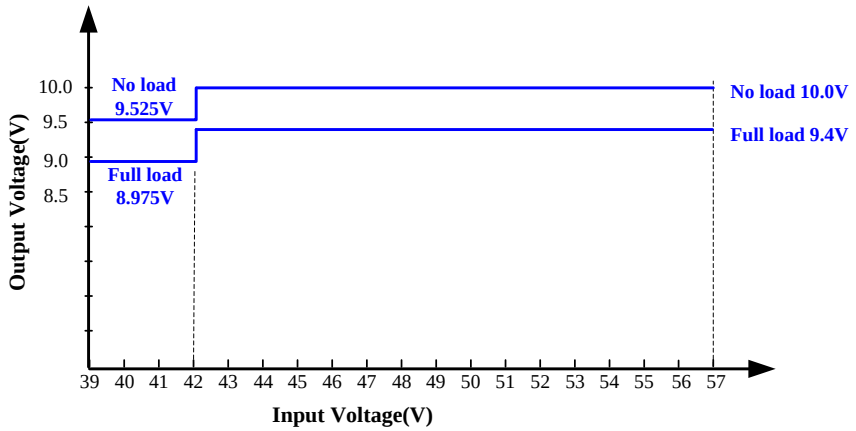

Figure 1. Output plot vs input

PARAMETER	MIN	TYP	MAX	UNITS
Turn-on Voltage Threshold	42	43.5	45	V
Turn-off Voltage Threshold	39	40.5	42	V

6. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin = 54 V, full load	94	96	-	%
Switching Frequency		280	300	320	kHz
FIT	Calculated Per Bell Core SR-332 (Vin = 54 V, Vo = 9.5 V, Io = 41 A, Ta = 25°C, FIT = 10^9/MTBF)	-	161	-	-
Over Temperature Protection		-	125	-	°C
Over Voltage Protection	-	-	-	15	V
Weight		-	65	-	g
Dimensions (L × W × H)			2.28 x 1.45 x 0.48 57.91 x 36.83 x 12.20		inch mm
Isolation Characteristics					
Input to Output		-	-	500	V
Isolation Resistance		10M	-	-	Ohm
Isolation Capacitance		-	2700	-	pF

7. EFFICIENCY DATA

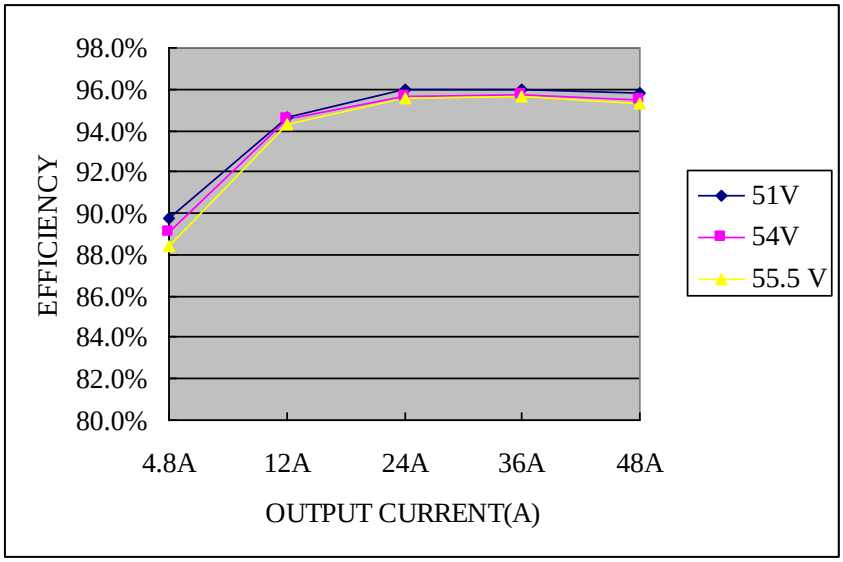

Figure 2. Efficiency data

8. REMOTE ON/OFF

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit On)	Active Low	0RRQ-45M11R	-0.3	-	0.8	V
Signal High (Unit Off)		The remote on/off pin open, Unit off	2.4	-	10	
Current Sink			0	-	0.5	mA

Recommended remote on/off circuit for active low

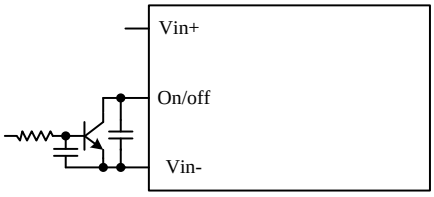

Figure 3. Control with open collector/drain circuit

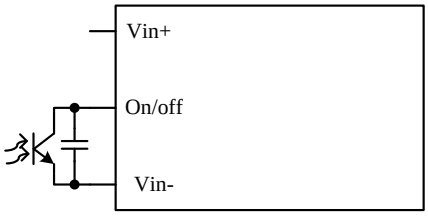

Figure 4. Control with photocoupler circuit

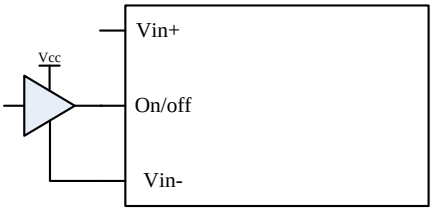

Figure 5. Control with logic circuit

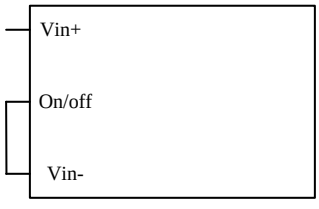

Figure 6. Permanently on

9. RIPPLE AND NOISE WAVEFORM

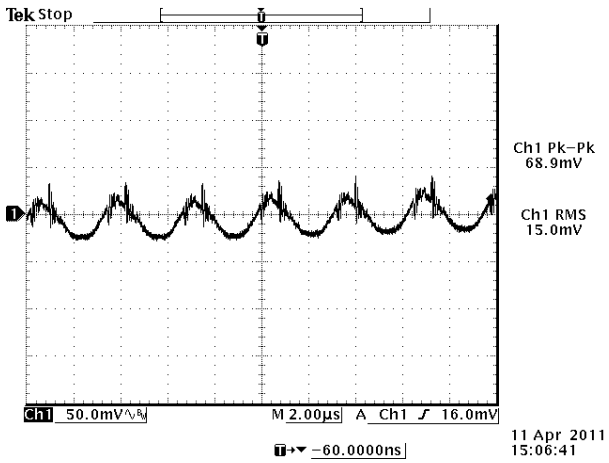

Figure 7. 54 VDC input, 9.4 VDC / 51 A output

Note: Ripple and noise at full load, with a 1 µF ceramic cap and a 270 µF Tantalum cap at output, Ta = 25 ˚C.

10. TRANSIENT RESPONSE

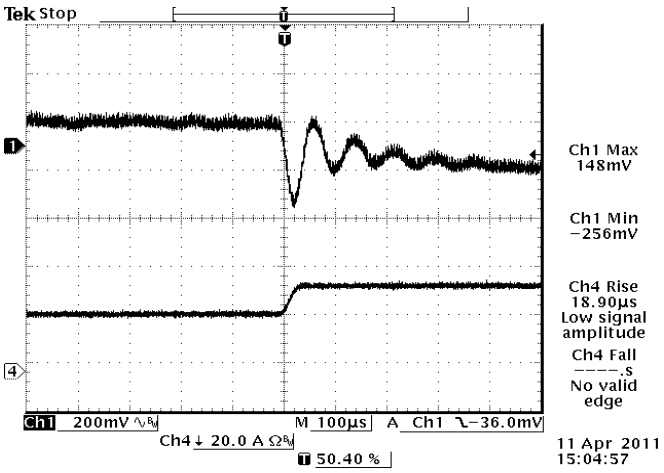

Figure 8. Vin = 54 V, 50%-75% Load Transients

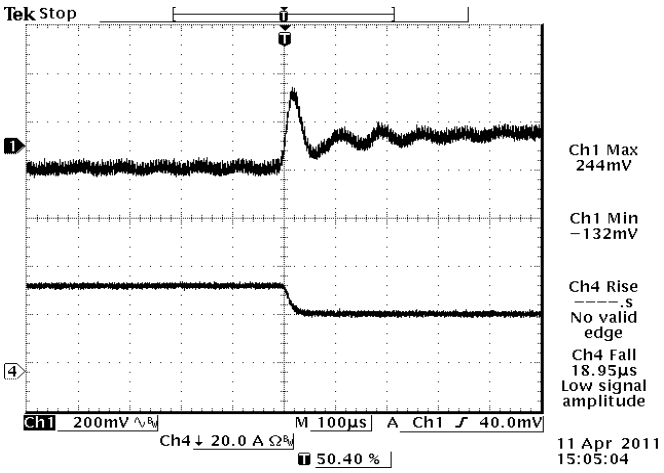

Figure 9. Vin = 54 V, 75%-50% Load Transients

Note: Transient Response at di/dt = 1 A/µs, with a 1µF ceramic cap and a 270 µF aluminum cap at the output, Ta = 25 ˚C.

11. STARTUP & SHUTDOWN

Turn on Rise Time

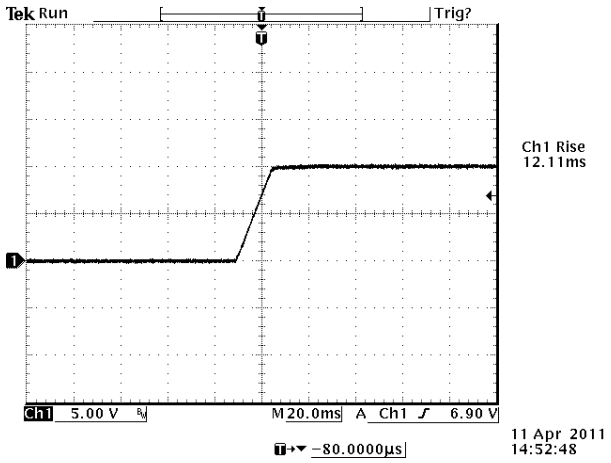

Figure 10.
Vin = 54 V, Vo = 9.4 V, Io = 51 A

Turn on Delay Time

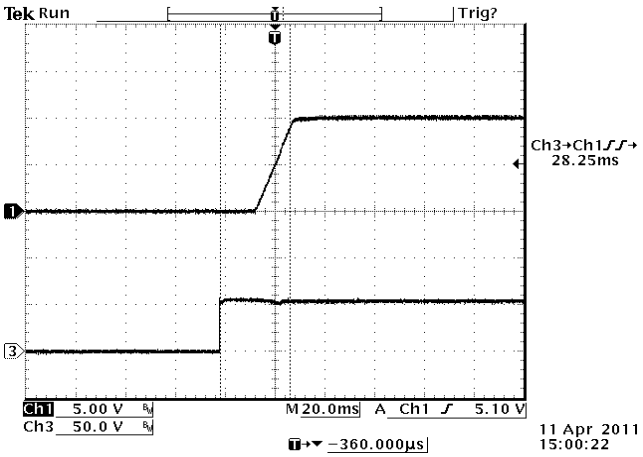

Figure 11.
Startup from Vin
Ch1: Vo
Ch2: Vin
Test Condition: *Vin = 54 V, Vo = 9.4 V, Io = 51 A*

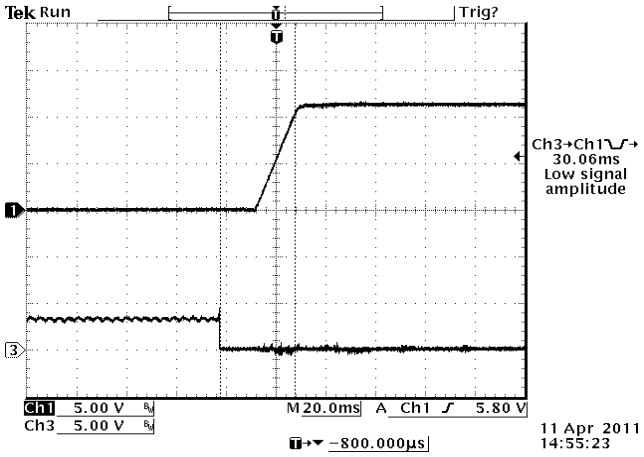

Figure 12.
Startup from on/off
Ch1: Vo
Ch2: on/off
Test Condition: *Vin = 54 V, Vo = 9.4 V, Io = 51 A*

Shutdown

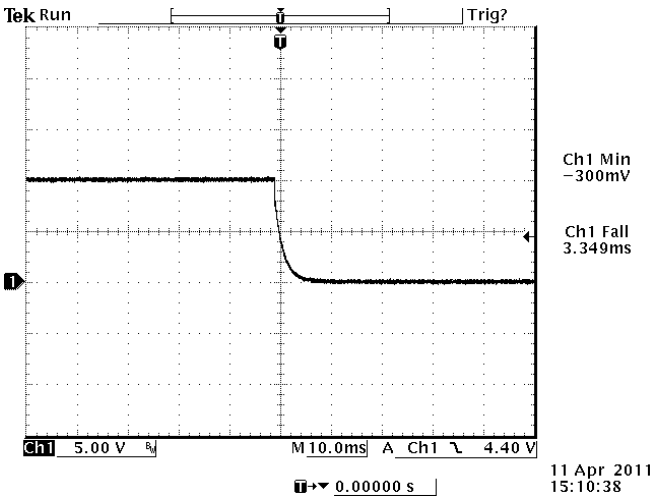

Figure 13. Vin = 54 V, Vo = 9.4 V, Io = 51 A

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 2.8 A during hiccup.

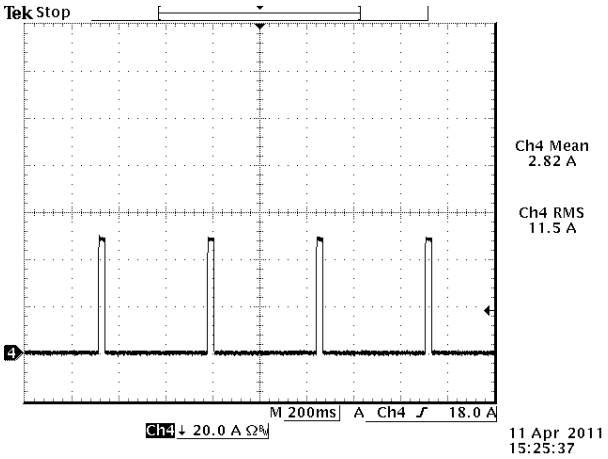

Figure 14. CH4: Output Current Waveform

Test condition: *Vin = 54 V*

13. OVER VOLTAGE PROTECTION

The output over-voltage protection consists of circuitry that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over voltage protection threshold, the module will shut down into hiccup mode and restart once every 400 ms. The module operates normally when the fault is cleared.

14. INPUT UNDER-VOLTAGE LOCKOUT

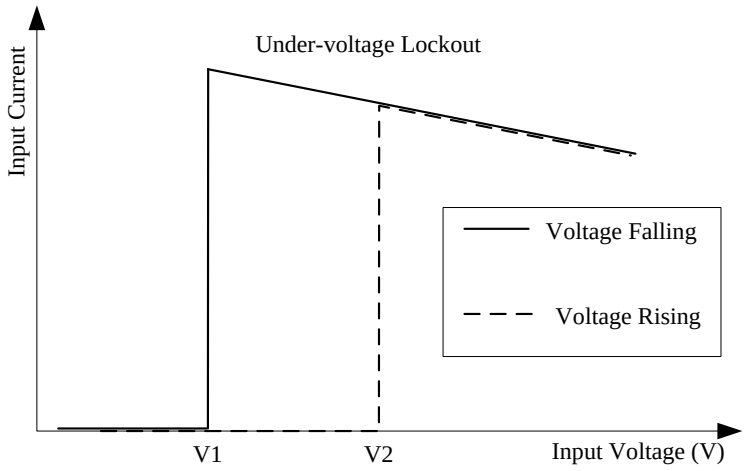

Figure 15. Input under-voltage lockout

V1 = 40.5 V

V2 = 43.5 V

15. THERMAL DERATING CURVES

Maximum junction temperature of semiconductors derated to 120 ˚C.

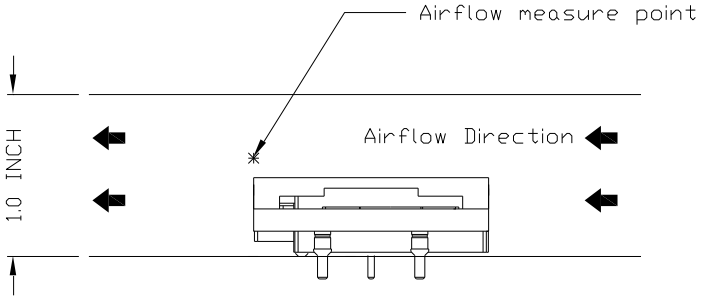

Figure 16. Airflow direction-1

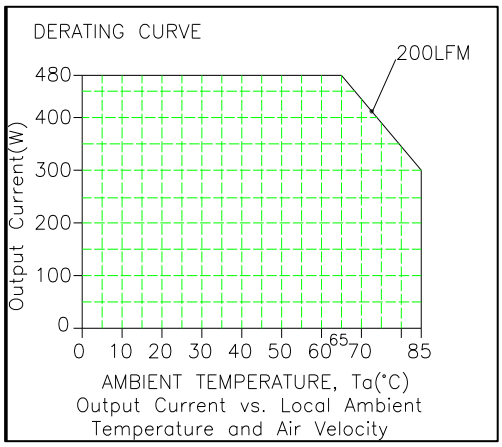

Figure 17. Thermal derating curve-1

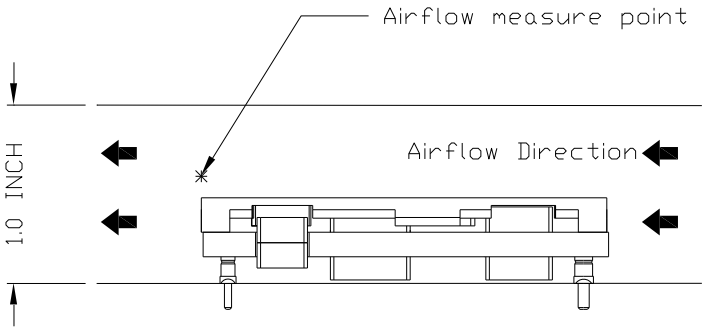

Figure 18. Airflow direction-2

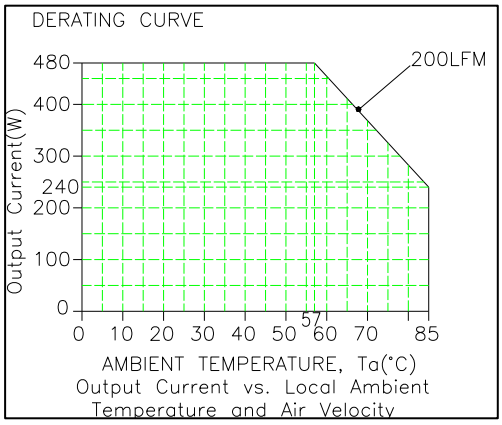

Figure 19. Thermal derating curve-2

NOTE: Airflow is measured by HHF-SD1 from OMEGA.

The OTP is achieved by temperature sensor U10 and it is in non-latch mode when the hottest component Q9 reaches 125°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…).

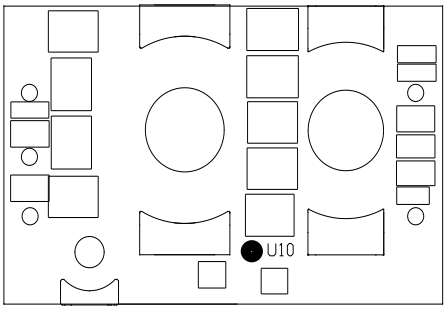

Figure 20. Temperature reference points on top side

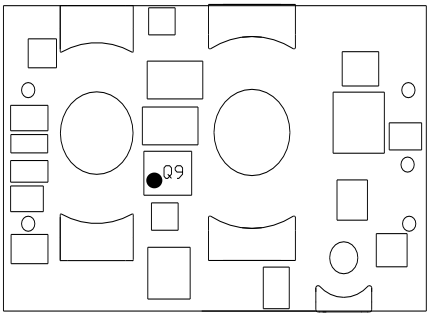

Figure 21. Temperature reference points on bottom side

16. SAFETY & EMC

SAFETY:

1. Material flammability UL94V-0
2. Compliance to IEC/EN 62368-1

EMC:

1. Surge IEC 61000-4-5
2. DC-DIP IEC 61000-4-29
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:

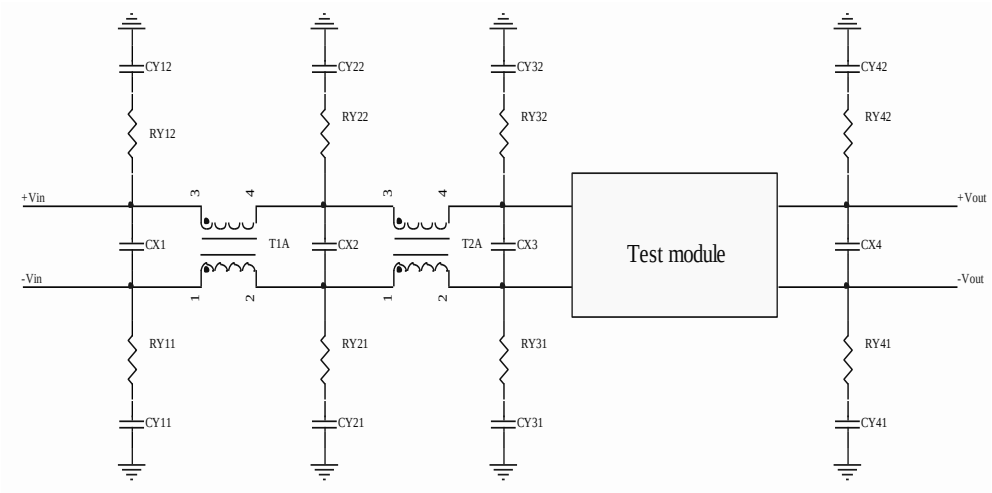

Figure 22.

ITEM	DESIGNATOR	PARAMETER	VENDOR	VENDOR P/N
1	CX2	220μF/100V, AL cap		
2	CX3	330μF/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		

Positive:

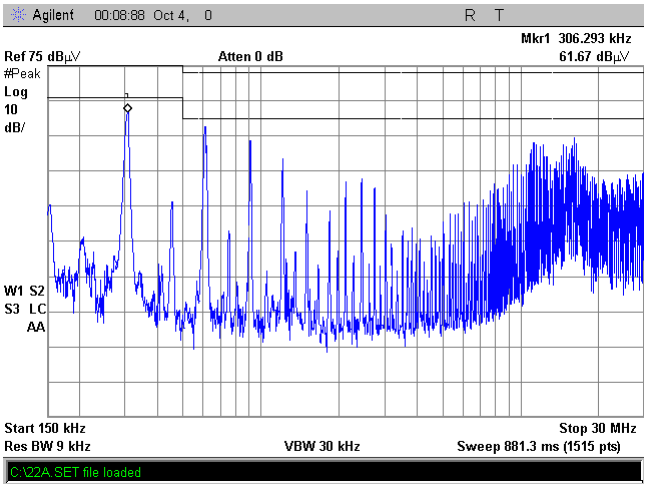

Figure 23.

Negative:

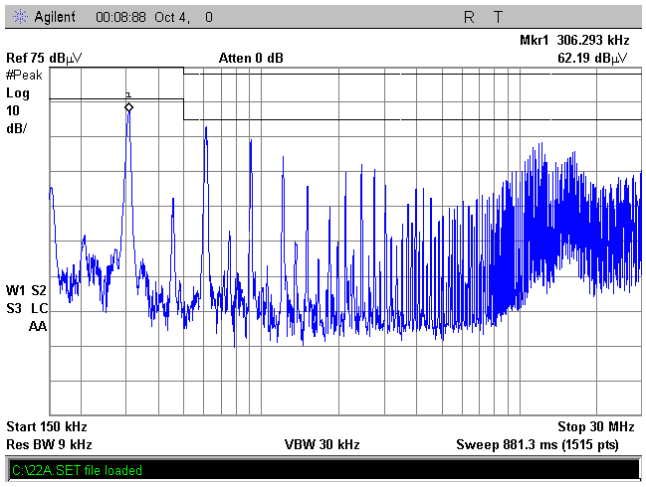

Figure 24.

17. SOLDERING INFORMATION

The 0RRQ-45M11R modules are designed to be compatible with reflow soldering process. The suggested Pb-free solder paste is Sn/Ag/Cu(SAC). The recommended reflow profile using Sn/Ag/Cu solder is shown in the following. Recommended reflow peak temperature is 245°C while the part can withstand peak temperature of 260°C maximum for 10seconds. This profile should be used only as a guideline. Many other factors influence the success of SMT reflow soldering. Since your production environment may differ, please thoroughly review these guidelines with your process engineers.

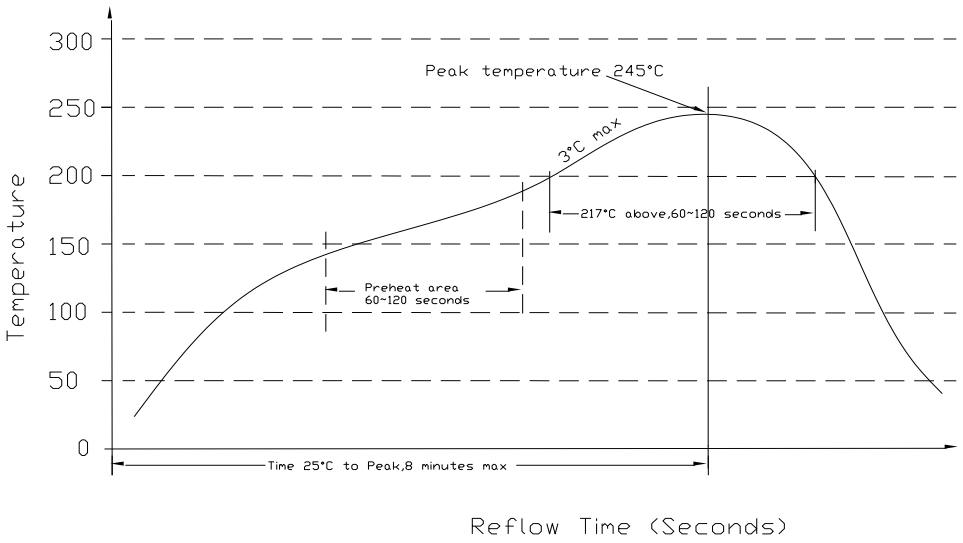

Figure 25. Soldering temperature

18. MSL RATING

The 0RRQ-45M11R modules have a MSL rating of 3.

19. STORAGE AND HANDING

The 0RRQ-45M11R modules are designed to be compatible with J-STD-033 Rev:A (Handling, Packing, Shipping and Use of Moisture /Reflow Sensitive surface Mount devices). Moisture barrier bags (MBB) with desiccant are applied. The recommended storage environment and handling procedure is detailed in J-STD-033.

20. PRE-BAKING

This component has been designed, handled, and packaged ready for Pb-free reflow soldering. If the assembly shop follows J-STD-033 guidelines, no pre-bake of this component is required before being reflowed to a PCB. Our packaging tray can only withstand temperature of 70°C max.

21. MECHANICAL DIMENSIONS

OUTLINE

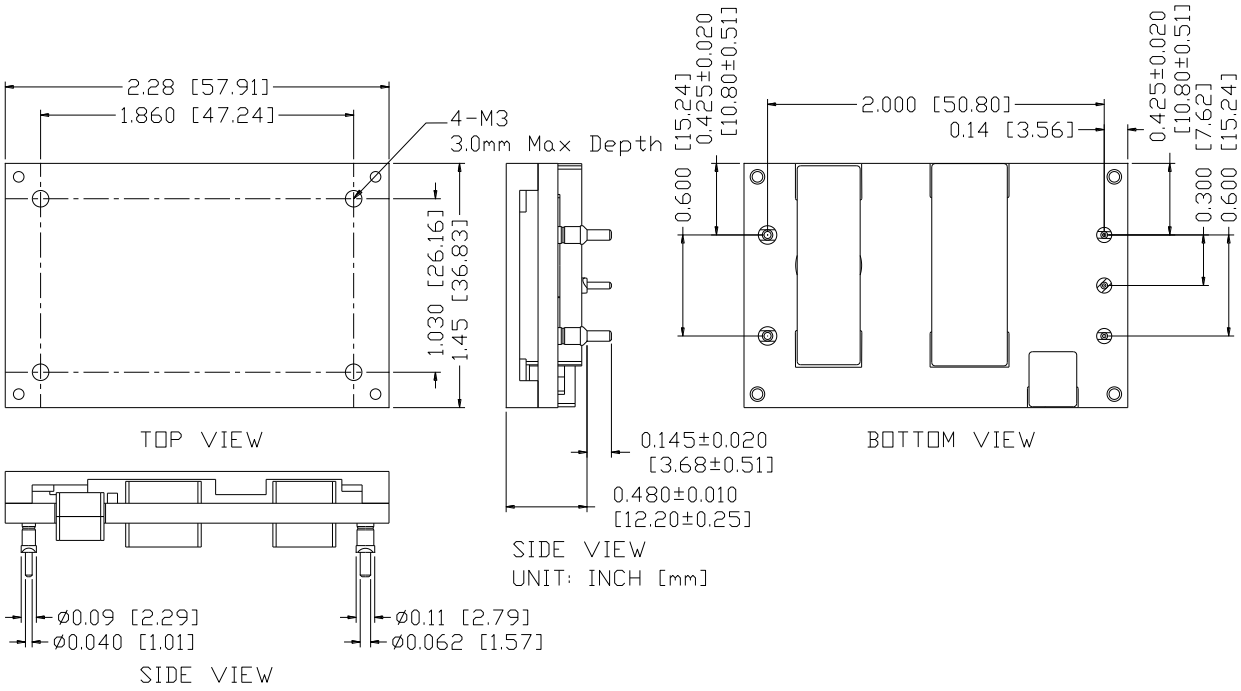

Figure 26. Outline

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

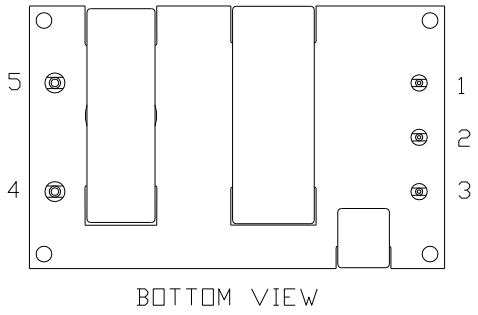

Figure 27. Pins

PIN	FUNCTION	DIA	LENGTH
1	Vin (+)	0.040''	0.145''
2	Remote	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

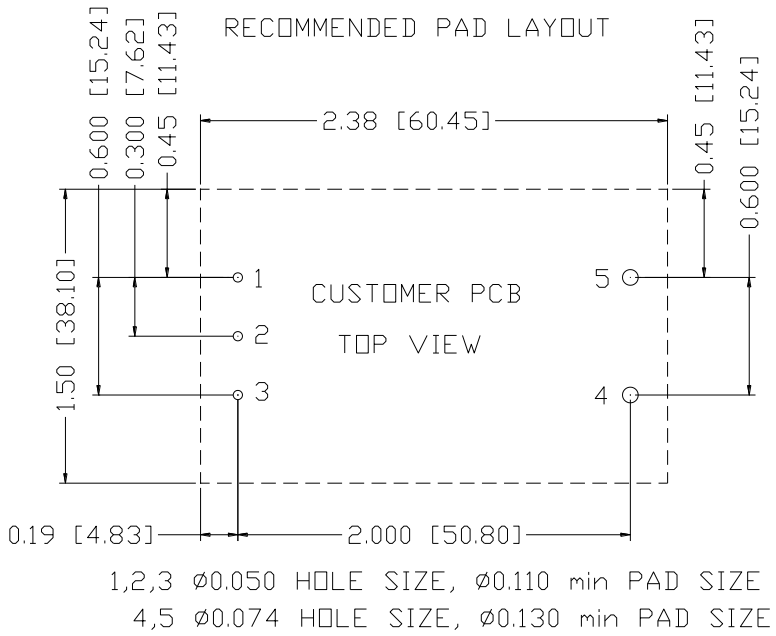

Figure 28. Recommended pad layout

22. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2013-05-21	PA	First release	XF.Jiang
2013-08-20	PB	Updated Output Voltage, Turn on Turn off, Thermal Derating. Added Output Plot	XF.Jiang
2016-03-29	PC	Updated Input Voltage range.	XF.Jiang
2016-08-24	AD	Add Over-voltage shutdown threshold	J.Yan
2018-06-26	AE	Update Remote on/off	XF.Jiang
2019-06-18	AF	Update to new form	F.Tao
2021-05-25	AG	Add object ID. Update mechanical drawing.	XF.Jiang

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.