0RQB-X0S11
Isolated DC-DC Converter

0RQB-X0S11 series are isolated and regulated DC-DC converters that operate from a nominal 52 VDC source. These units provide up to 1000 W of output power from a nominal 52 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, power good indication and over temperature protection.

These converters are provided in an industry standard quarter brick package.

Key Features & Benefits

- 45 – 58 VDC Input
- 10.6 VDC @ 94.3 A Output
- Isolated 1/4th Brick Converter
- Fixed Frequency (300 kHz)
- High Efficiency
- High Power Density
- Input Under-Voltage Lockout
- OCP/SCP
- Output Over-Voltage Protection
- Over Temperature Protection
- Remote On/Off
- Power Good Indication
- Parallel Operation with Droop
- Approved to IEC/EN 62368-1 (TBC)
- Class II, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)

RoHS Compliant

Applications

- Networking
- Computers and Peripherals
- Telecommunications

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
0RQB-X0S11LG 0RQB-X0S110G 0RQB-X0S11BG	10.6 VDC	45 - 58 VDC	94.3 A	1000 W	97.3%

PART NUMBER EXPLANATION

0	R	QB	-	X0	S	11	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		1000 W	45 – 58 V	10.6 V	0 – Active High, Open frame L – Active Low, Open frame B – Active Low, with Baseplate	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		1500	-	-	V
Ambient Temperature		-40	-	85	°C
Storage Temperature		-40	-	125	°C
Altitude		-	-	4000	m
Relative Humidity	Operating, Non-Condensing	10	-	90	%

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		45	52	58	V
Input Current (full load)		-	-	28	A
Input Current (no load)		-	100	150	mA
Remote Off Input Current		-	10	20	mA
Input Reflected Ripple Current (rms)	Detail conditions please refer to input reflected ripple current section.	-	50	-	mA
Input Reflected Ripple Current (pk-pk)		-	200	-	mA
Input Terminal Ripple Current Ic (rms)		-	-	1000	mA
I^2t Inrush Current Transient		-	-	1	A^2s
UVLO Turn on Voltage Threshold	Input undervoltage lock-out (UVLO)	42.0	43.5	45.0	V
UVLO Turn off Voltage Threshold		39.0	40.5	42.0	V
OVLO Turn off Voltage Threshold	Input overvoltage lock-out (OVLO)	-	63	-	V
OVLO Turn on Voltage Threshold		-	60	-	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 30 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 = 52 V, Io = 0 load	11.045	11.1	11.155	V
	Vin = 52 V, Io = 100% load	10.52	10.6	10.68	V
Output Voltage Range	Over entire operating input voltage range, resistive load and temperature conditions until end of life	10.3	-	11.4	V
Load Regulation	Vin = 52 V, Io = 0~100% load	-	0.50	0.60	V
Line Regulation	Vin = 45 - 58 V, Io = 100% load	-	0.40	0.50	V
Regulation Over Temperature	Ambient temperature = -40°C to 85°C	-	50	100	mV
Ripple and Noise (pk-pk)	1000 uF, 50% ceramic, 50% Oscon or POSCAP. Measured at output pins, bandwidth = 20 MHz.	-	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	-	-	150	mV
Output Current Range	Vin = 45 V	0	-	96.2	A
	Vin = 52 V	0	-	94.3	A
	Vin = 58 V	0	-	92.9	A
Output DC Current Limit		100	108	116	A
Rise Time		-	6	15	ms
Turn on Time	Defined as time between Vin reaching Turn-On voltage and Vout reaching 90% of final value	-	23	30	ms
	Defined as time between Enable and Vout reaching 10% of final value	-	-	5	ms
Turn-On Overshoot	Overshoot at turn On	-	-	350	mV
Turn-Off Undershoot	Undershoot at turn Off	-	-	350	mV
Output Capacitance	Typically 50% ceramic, 50% Oscon or POSCAP.	0	-	6250	μF
Pre-Bias Voltage		0	-	Vout	V
Response to Vin Step	5 V step in 1 μs occurring within Vin Operating Range. Pout = 10%-100% Rated Power, Cout = Cout Max/2	-	-	1.25	V
Transient Response					
△V 50%~75% of Max Load	Load step = 25% of Rated Power at 1 A/μs, 4 μF/W of external capacitance, measured at output pins.	-	-	350	mV
Settling Time		-	200	-	μs
△V 75%~50% of Max Load		-	-	350	mV
Settling Time		-	200	-	μs

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin = 52 V, full load	-	97.3	-	%
Switching Frequency		-	300	-	kHz
Over Temperature Protection		-	130	-	°C
Output Over Voltage Protection		-	-	13.2	V
Weight	0RQB-X0S110/L	-	74.5	-	g
	0RQB-X0S11B	-	78.4	-	g
MTBF	Calculated Per Bell Core SR-332 (Vin = 52 V, Vo = 10.6 V, Io = 80% load, Ta = 40°C, 200 LFM, FIT = 10^9/MTBF)	2	-	-	Mhrs
Dimensions (L × W × H)	0RQB-X0S110/L	2.30 x 1.45 x 0.48 58.42 x 36.83 x 12.20			inch mm
	0RQB-X0S11B	2.30 x 1.45 x 0.57 58.42 x 36.83 x 14.48			inch mm
Isolation Characteristics					
Input to Output		1500	-	-	V
Input to Case		1500	-	-	V
Output to Case		500	-	-	V
Isolation Resistance		10M	-	-	Ohm
Isolation Capacitance		-	2700	-	pF

6. EFFICIENCY DATA

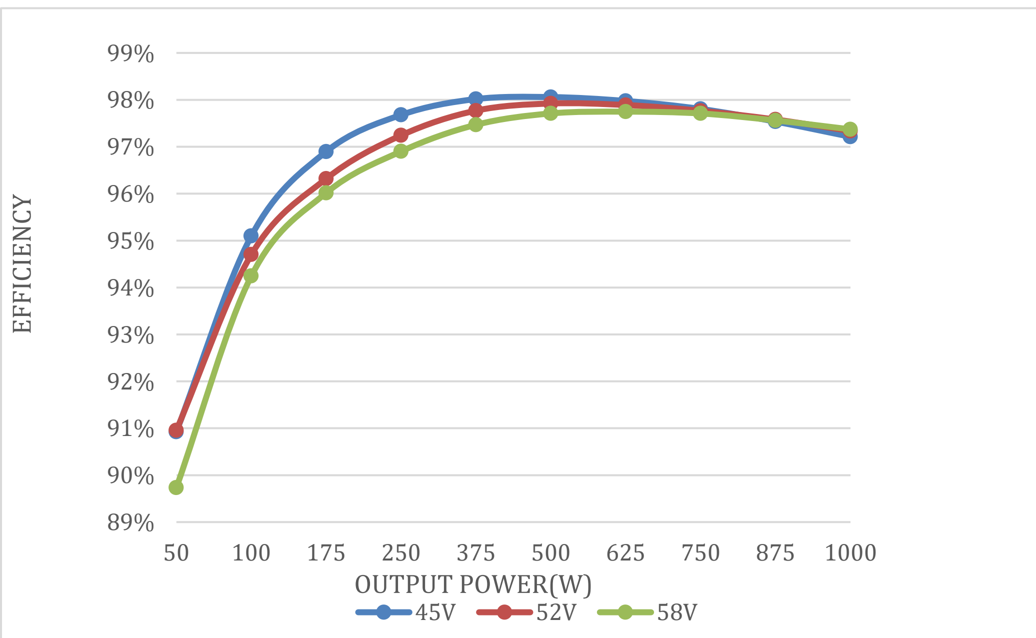


Figure 1. Efficiency data

7. OUTPUT PLOT VS INPUT

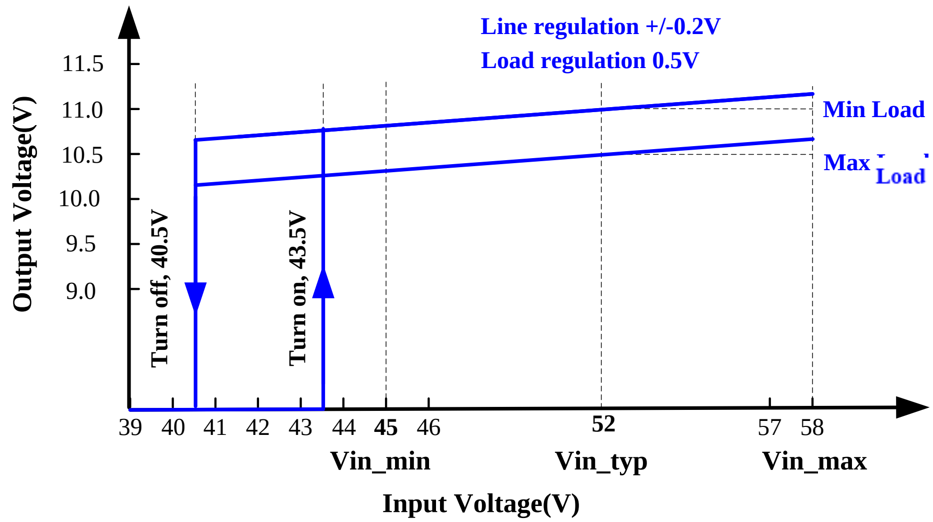


Figure 2. Output plot vs input

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
Enable Pin Open-Circuit Voltage			-	-	18	V
Enable Pin Current (into pin, ext. pull-up to 15 V)			-	-	0.5	mA
Enable Pin Current (into pin, ext. pull-up to 10 V)			-	-	0.3	mA
Enable Pin Current (out of pin, Unit On)			-	-	200	μA
Enable Pin Current (out of pin, Unit Off)			10	-	-	μA

Recommended remote on/off circuit for active low

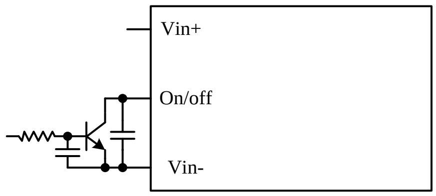


Figure 3. Control with open collector/drain circuit

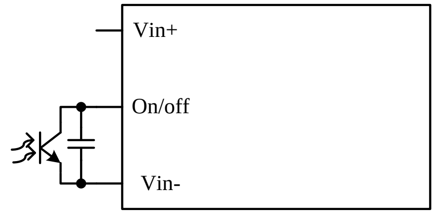


Figure 4. Control with photocoupler circuit

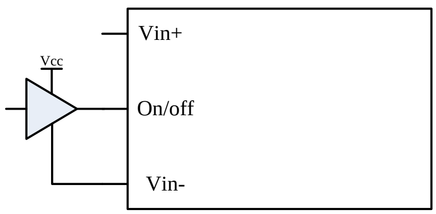


Figure 5. Control with logic circuit

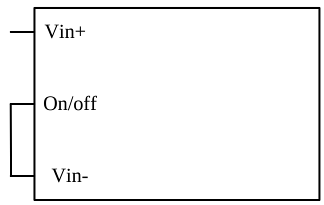


Figure 6. Permanently on

Recommended remote on/off circuit for active high

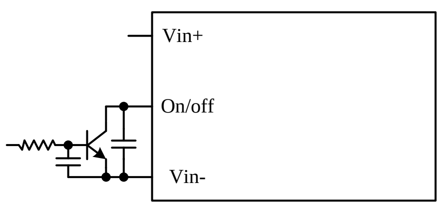


Figure 7. Control with open collector/drain circuit

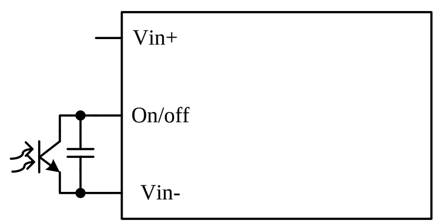


Figure 8. Control with photocoupler circuit

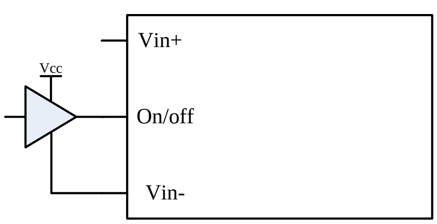


Figure 9. Control with logic circuit

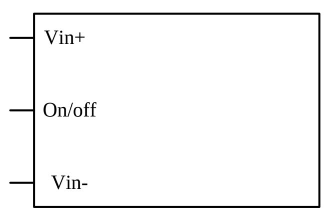


Figure 10. Permanently on

9. INPUT REFLECTED RIPPLE CURRENT

Testing setup:

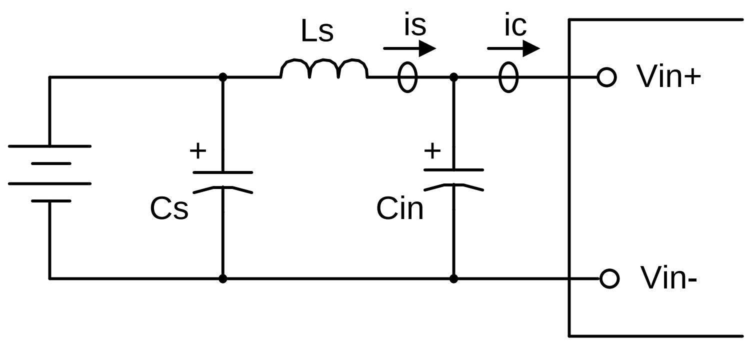


Figure 11. Test setup

Notes and values in testing:

Ls: Simulated Source Impedance (10 uH).

Cs: Offset possible source Impedance (100 µF, ESR < 0.2 Ω @ 100 kHz, 20 °C).

Cin: Electrolytic capacitor, should be as close as possible to the power module to damp ic ripple current and enhance stability. Recommendation: 100 µF, ESR < 0.2 Ω @ 100 kHz, 20 °C.

Below measured waveforms are based on above simulated and recommended inductance and capacitance.

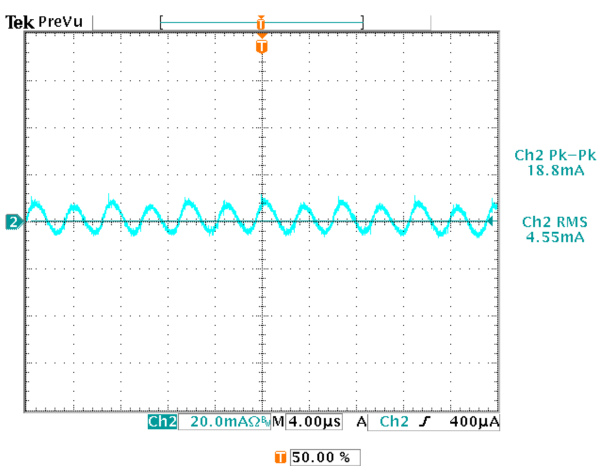


Figure 12. is (input reflected ripple current), AC component

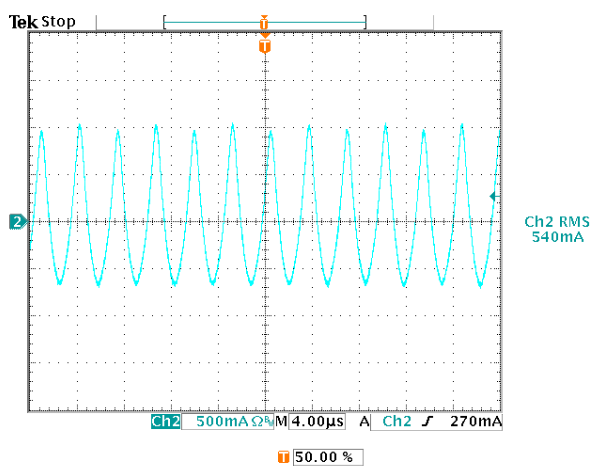


Figure 13. ic (input terminal ripple current), AC component

Test condition: 52 VDC input, 10.6 VDC / 94.3 A output and Ta = 25 °C, with a 1 µF ceramic capacitor and a 270 µF AL. cap at output.

10. RIPPLE AND NOISE WAVEFORM

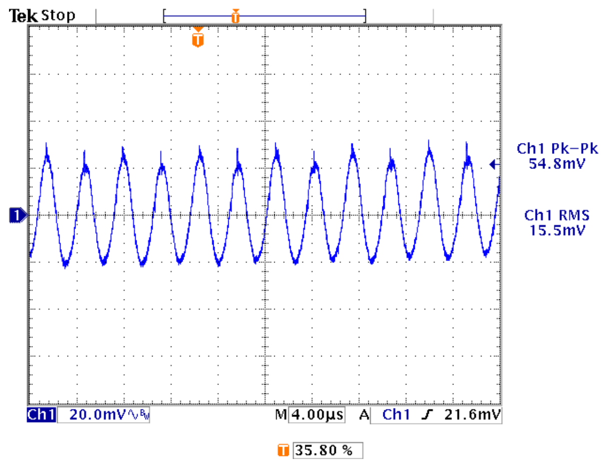


Figure 14. Ripple and noise waveform

Note: Ripple and noise at full load, 52 VDC input, 10.6 VDC/94.3 A output and Ta = 25°C, and with a 1 µF ceramic cap & a 1000 µF cap (50% ceramic, 50% Oscon or POSCAP) at output.

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 250 ms. The module operates normally when the output current goes into specified range. The typical average output current is 1.6 A during hiccup.

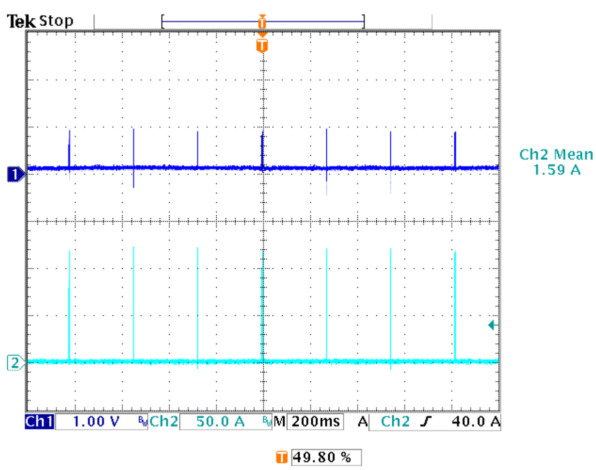


Figure 15.
CH1: Output Voltage
CH2: Output current waveform
Test condition: Vin = 52 V @ Ta = 25°C

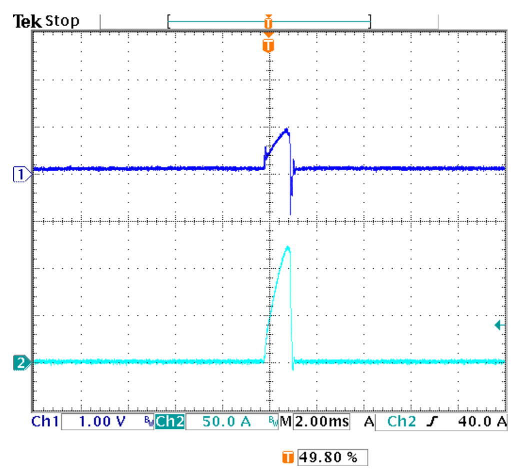


Figure 16.
CH1: Output Voltage
CH2: Output current waveform
Expansion of on time portion of above figure

12. STARTUP & SHUTDOWN

Rise time

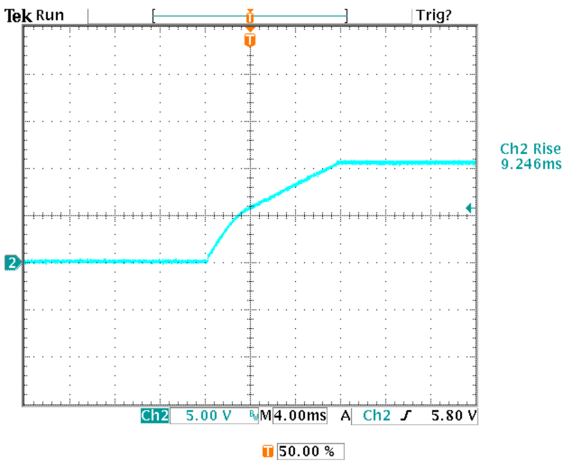


Figure 17. Vout = 10.6 V / 94.3 A @ Vin = 52 V,
Ta = 25°C, Cext = 0 μF

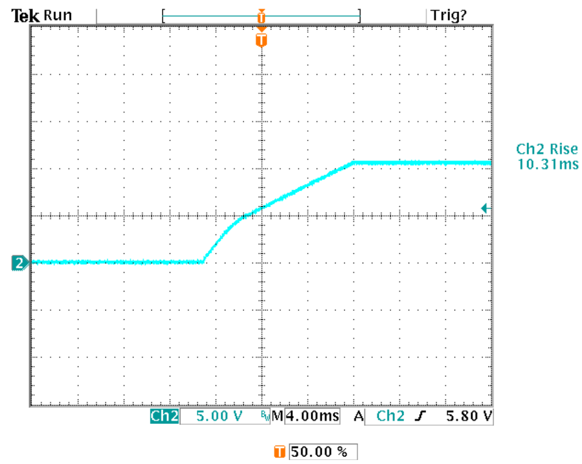


Figure 18. Vout = 10.6 V / 94.3 A @ Vin = 52 V,
Ta = 25°C, Cext = 6250 μF

Startup time

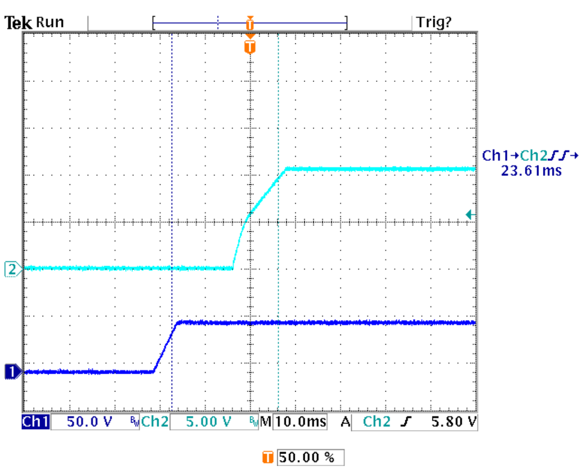


Figure 19. Startup from Vin;
Ch1: Vo;
Ch3: Vin
Vout = 10.6 V / 94.3 A @ Vin = 52 V, Ta = 25°C, Cext = 0 μF

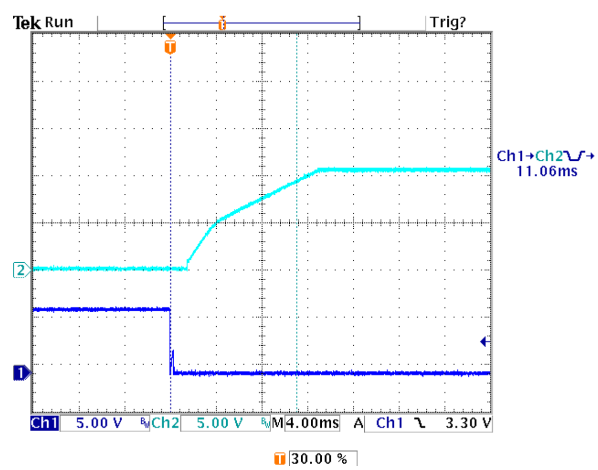


Figure 20. Startup from on/off;
Ch1: Vo;
Ch3: on/off
Vout = 10.6 V / 94.3 A @ Vin = 52 V, Ta = 25°C, Cext = 0 μF

Shutdown

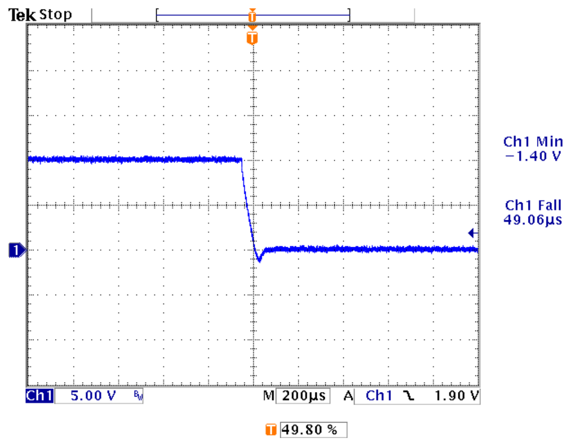


Figure 21. Vout = 10.6 V / 94.3 A @ Vin = 52 V, Ta = 25°C, Cext = 0 µF

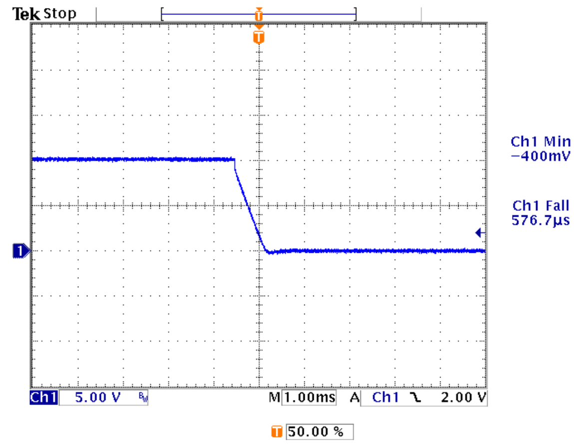


Figure 22. Vout = 10.6 V / 94.3 A @ Vin = 52 V, Ta = 25°C, Cext = 6250 µF

13. TRANSIENT RESPONSE

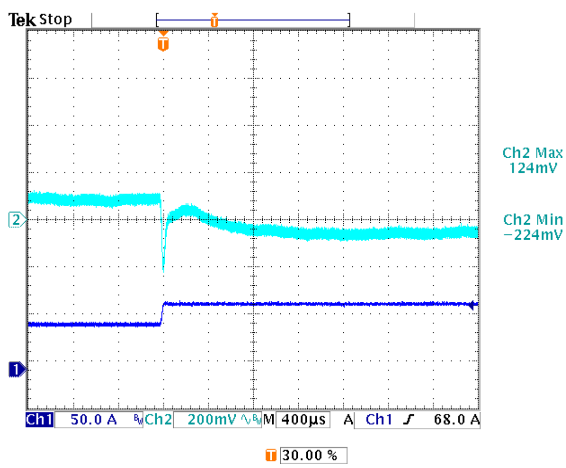


Figure 23. 50%-75% Load Transients at Vin = 52 V @ Ta = 25°C

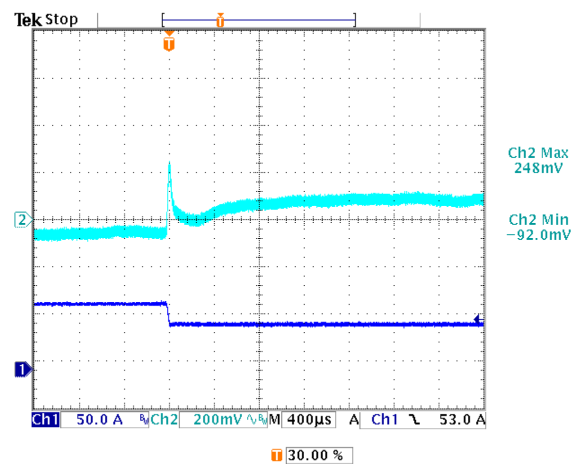
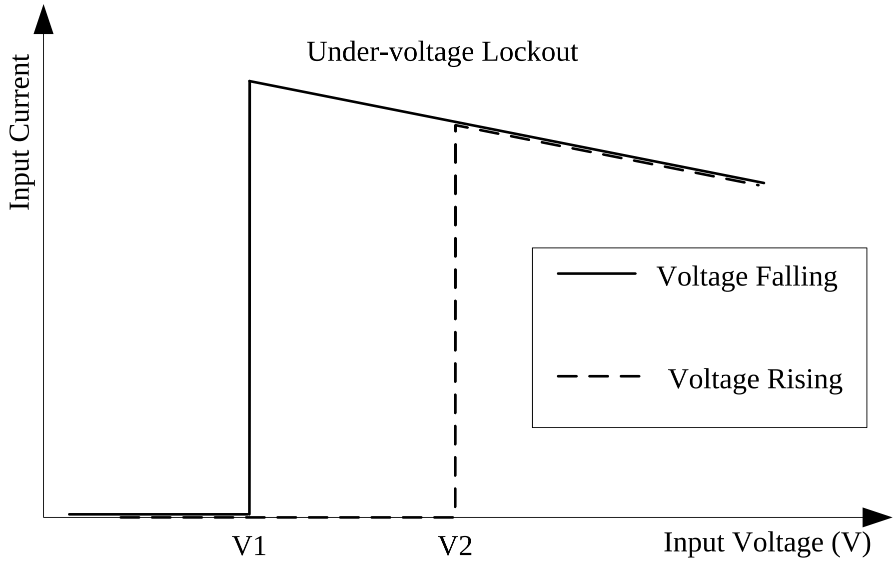


Figure 24. 75%-50% Load Transients at Vin = 52 V @ Ta = 25°C

Note: Transient Response at Vin = 52 V, di/dt = 1 A/µs, 1 µF ceramic cap and 3300 µF AL. cap at output, Ta = 25°C.

14. INPUT UNDER-VOLTAGE LOCKOUT



V1 = 40.5 V

V2 = 43.5 V

Figure 25. Input under-voltage lockout

15. THERMAL DERATING CURVE

Thermal Considerations:

New high power architectures require an accurate thermal design. Design engineers have to optimize the module working conditions and ensure reliable operation. Convection cooling is the common mode to cool down the module.
Heat transfer is dependent on a test setup and it is important to characterize the module in an environment similar to existent electronic applications.
Reported thermal data reflects real operating conditions because the values are physically measured in a wind tunnel.

Thermal Test Setup:

A module in electronic cards is typically located in a busy area without relevant space around it. To simulate a real condition and avoid turbulence we add a cover with defined dimensions.
The distance has to be 6.35 mm (0.25 inch) from the top of the module and 6.35 mm (0.25 inch) on the left and right side of the module. The values reflect most of the real applications and it is a common procedure in the power module market.
Ambient temperature and airflow are measured in front of the module at the distance of 76.2 mm (3 inch).

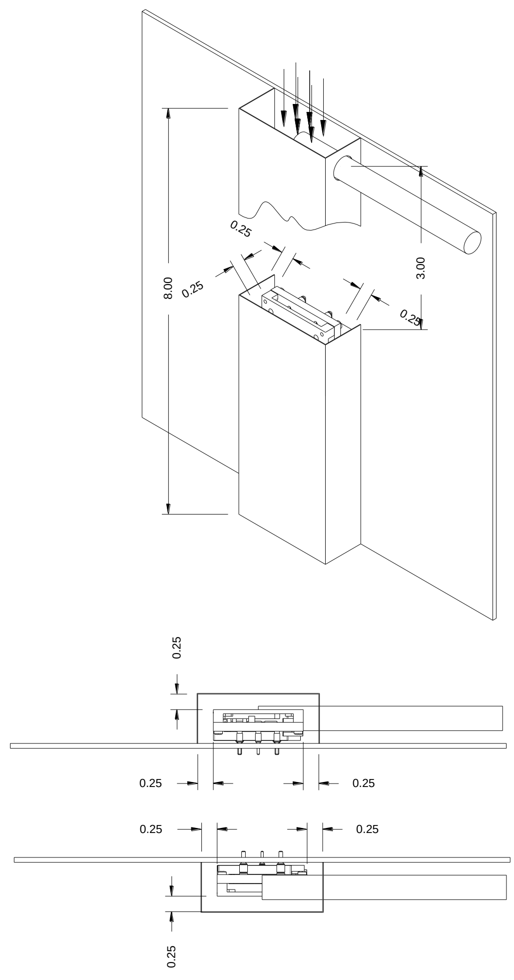


Figure 26. Test setup for 0RQB-X0S11B

The OTP is achieved by temperature sensor U10 and it's in non-latch mode when OTP occurs. The protecting point will be varied a little under different conditions (air flow, ambient temperature, input voltage, load...). To enhance system reliability, the power module should always be operated below the maximum operating temperature shown as blow figures.

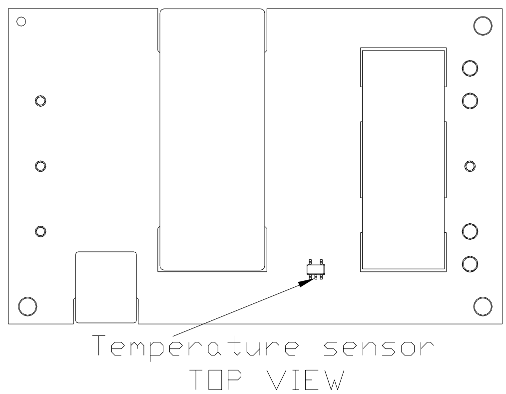


Figure 27. Temperature reference points on top side

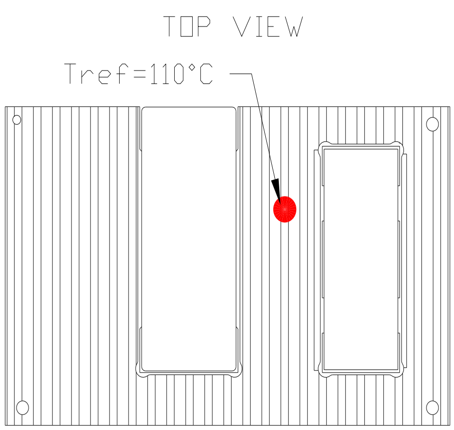


Figure 28. Temperature reference point for 0RQB-X0S110/L

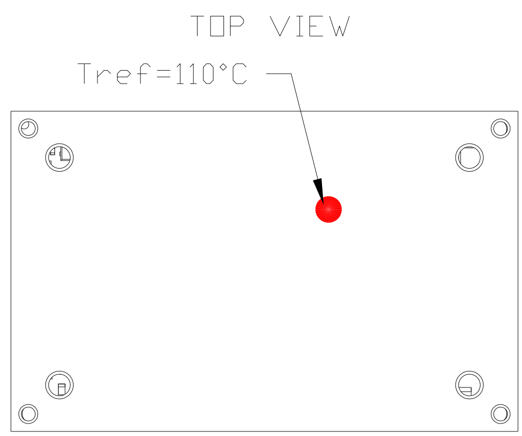


Figure 29. Temperature reference point for 0RQB-X0S11B

Derating Curves for 0RQB-X0S110/L

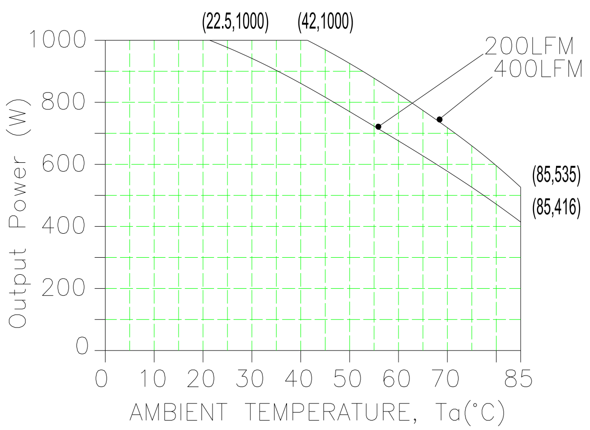


Figure 30. Vin = 52 V, Longitudinal Orientation, airflow from Vout to Vin.

Derating Curves for 0RQB-X0S110/L

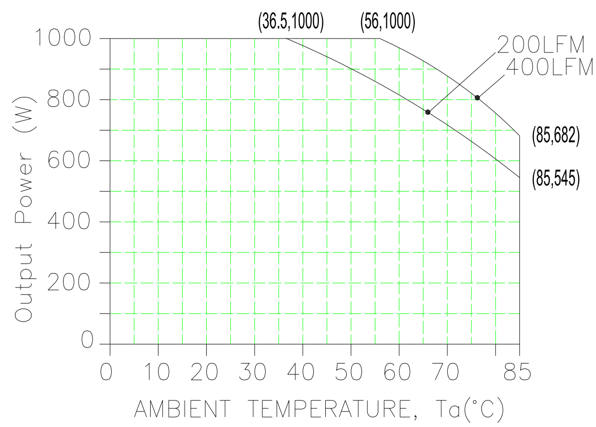


Figure 31. Vin = 52 V, Transverse Orientation, airflow from Vout+ to Vout-.

Derating Curves for 0RQB-X0S11B

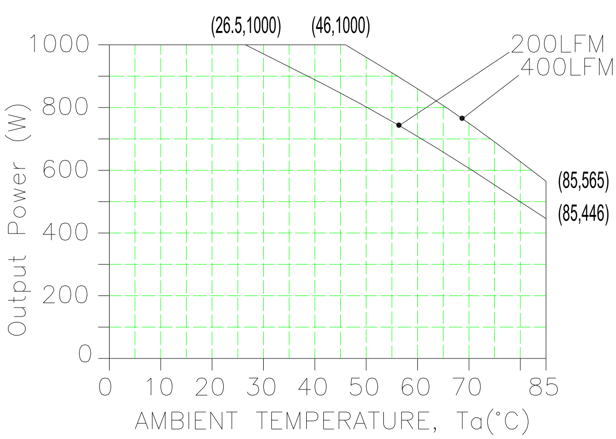


Figure 32. Vin = 52 V, Longitudinal Orientation, airflow from Vout to Vin.

Derating Curves for 0RQB-X0S11B

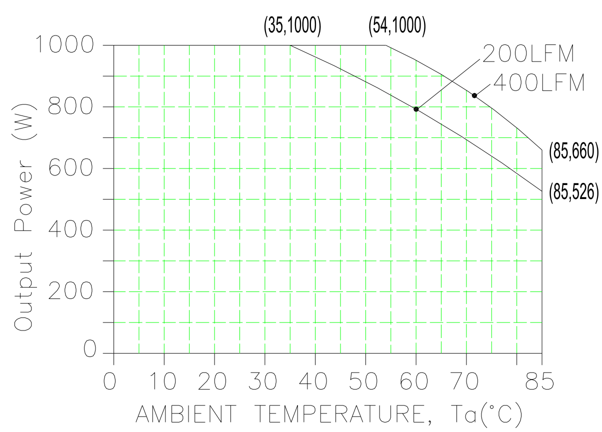


Figure 33. Vin = 52 V, Transverse Orientation, airflow from Vout+ to Vout-.

16. POWER GOOD

1. The Power Good signal is a non-latching open-collector output that is Low during normal operation and is pulled High when any of the following conditions occur:
   - Over-Temperature
   - Over-Current
   - Vout is outside of the DC Output Band while Vin is within the Vin Operating Range
   - In Parallel configuration, Vin is within operating range, no Vout due to one of the units not operational.
   - Vin is outside of the Vin Operating Range

2. The Power Good signal is referenced to Vout(-).

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Output Voltage High (trigger limits)		8.6	-	9.0	V
Output Voltage High (trigger limits)		12.8	-	13.2	V
Input Voltage Low (trigger limits) Rising	PG signal indicates good when Vin is within operating range and indicates bad ~20ms before unit is shut-down due to OV	42.5	-	45	V
Input Voltage High (trigger limits) Rising		59	-	62	V
Hysteresis		-	1	-	V
High State Voltage		0	-	5.5	V
High State Leakage Current (into Pin)		0	-	10	μA
Low State Voltage		0	-	0.8	V
Low State Current (into Pin)		0	-	5	mA
Power Good Signal De-assert Response Time	Duration between the fault occurring and the Power-Good Signal de-asserting	0	-	3	ms
Power Good Signal Assert Response Time	Duration between unit powering up with no faults and the Power Good Signal asserting	0	-	3	ms
Power Good Signal Duration	Duration the Power-Good signal stays de-asserted if a transient fault occurs	200		600	ms
Over Temperature Warning	For OT Warning, the PG signal will toggle as an impulse wave.		120		ºC
OT Warning PG signal frequency		70	-	110	kHz
OT Warning PG signal duty cycle		47.5	50	52.5	%

17. MECHANICAL DIMENSIONS

0RQB-X0S110/L OUTLINE

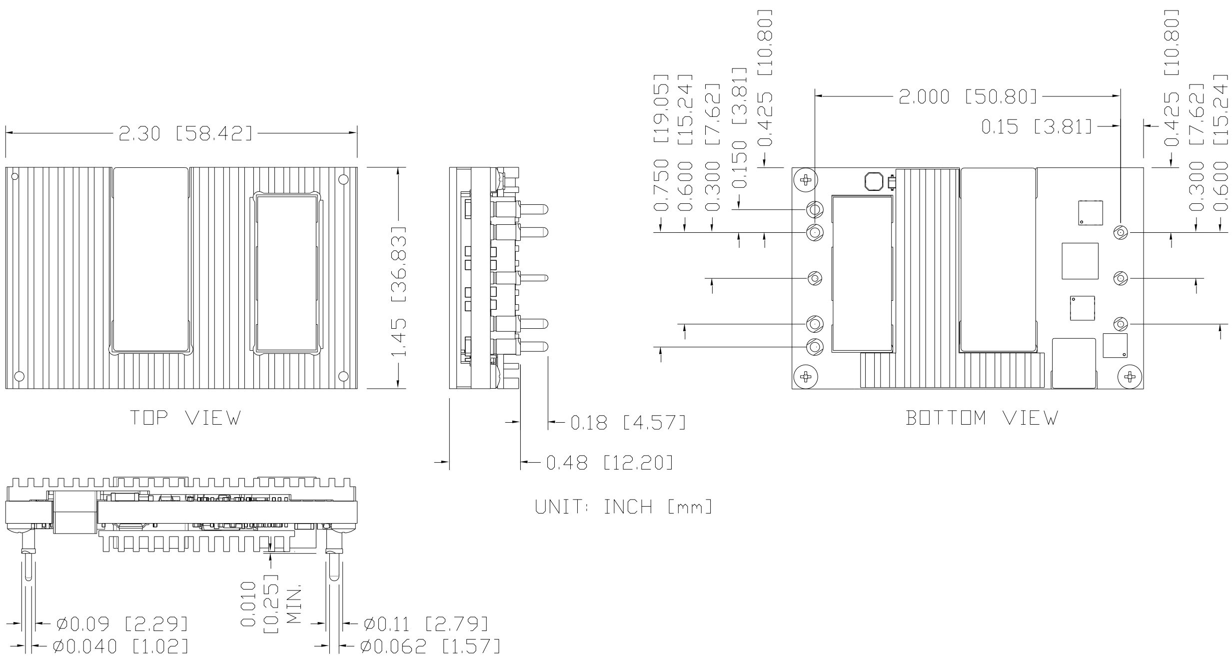


Figure 34. 0RQB-X0S110/L Outline

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 – Tin plated
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].

0RQB-X0S11B OUTLINE

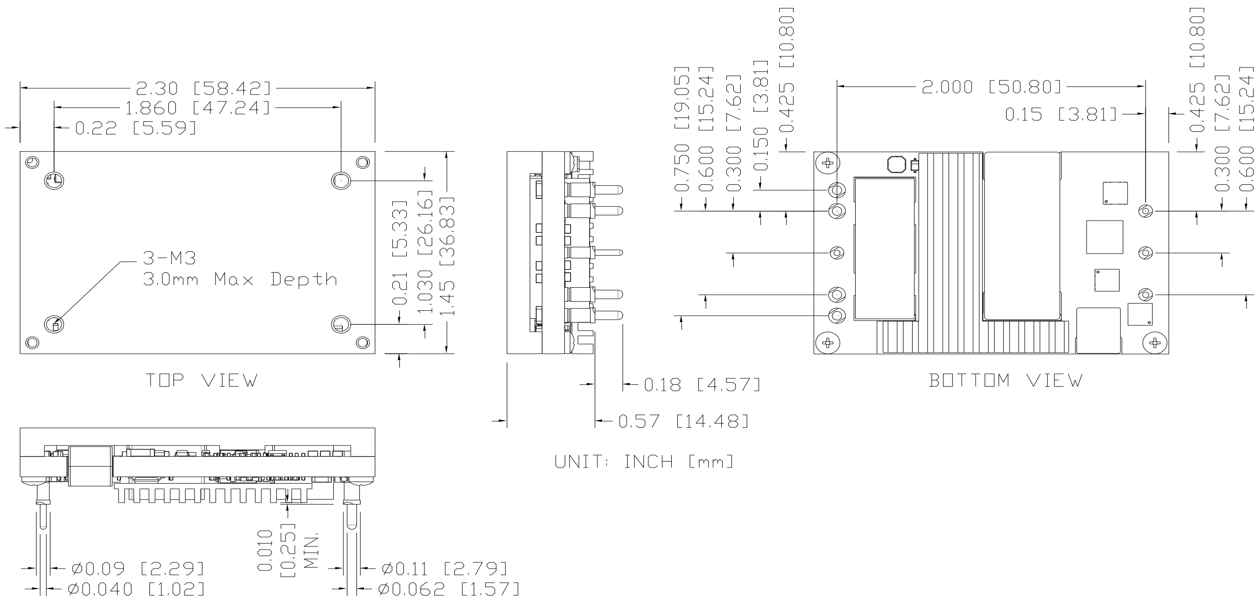


Figure 35. 0RQB-X0S11B Outline

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 – Tin plated
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

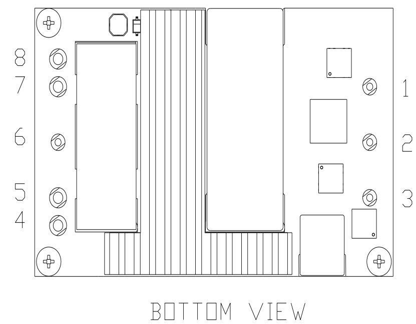


Figure 36. Pins

PIN	FUNCTION	PIN SIZE	LENGTH
1	Vin (+)	0.04”	0.180”
2	Enable	0.04”	0.180”
3	Vin (-)	0.04”	0.180”
4	Vout(-)	0.062”	0.180”
5	Vout(-)	0.062”	0.180”
6	PGOOD	0.04”	0.180”
7	Vout(+)	0.062”	0.180”
8	Vout(+)	0.062”	0.180”

RECOMMENDED PAD LAYOUT

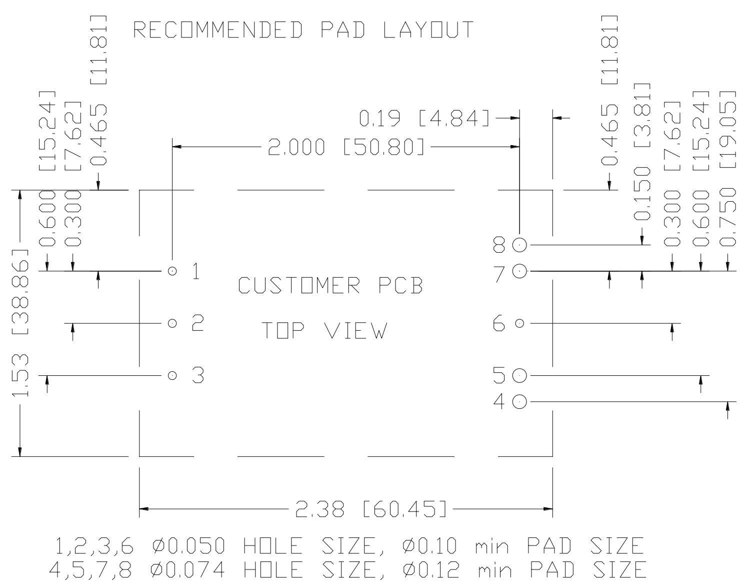


Figure 37. Recommended pad layout

18. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2016-2-19	A	First release	Z.Tang
2016-05-17	B	Add PGOOD Item; Change Remote turn-on time and Mechanical Outline.	Z.Tang
2016-06-20	C	Update Start up Figures	Z.Tang
2016-08-10	D	Update UVLO, TD Curve and Mechanical Outline	Z.Tang
2020-10-15	AE	Delete 0RQB-X0S11A, 0RQB-X0S11C, 0RQB-X0S11D	XF.Jiang
2021-05-24	AF	Add object ID. Update recommended pad layout. Update thermal test setup drawing for correcting the height.	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.