0RQB-X3S11

Isolated DC-DC Converter

The 0RQB-X3S11 is an isolated DC/DC converter that operates from a nominal 50/54 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 1300 W of output power from a nominal 50/54 VDC input.

The output of the converter has the droop function which allow the modules operating in parallel with high output current sharing precision.

These converters are provided in a 1/4th brick package.

Key Features & Benefits

- 45 – 58.5 VDC Input
- 10.4 VDC @ 125 A Output
- 1/4th Brick Converter
- Isolated
- Fixed Frequency
- High Efficiency
- High Power Density
- Input Under-Voltage Lockout
- OCP/SCP
- Output Over-Voltage Protection
- Over Temperature Protection
- Remote On/Off
- Parallel Indication
- Approved to UL/CSA 60950-1
- Approved to IEC/EN 60950-1
- 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

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
0RQB-X3S11BG 0RQB-X3S11FG	10.4 VDC	45 – 58.5 VDC	125 A	1300 W	96.9%

PART NUMBER EXPLANATION

0	R	QB	-	X3	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		1300 W	45 – 58.5 V	10.4 V	B – Active Low, with Baseplate, Pin Length 0.18” F – Active Low, with Baseplate, Pin Length 0.125”	Tray Package

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.3	-	60	V
Remote On/Off		-0.3	-	16	V
Ambient Temperature	Long-Term Operating. All components on the Unit meet IPC-9592 (latest revision) derating guidelines.	-5	-	85	°C
	Short-Term Operating (96 hours/year). Unit’s component temperatures exceed IPC-9592 (latest revision) derating guidelines but not exceed component temperature ratings.	-20	-	90	°C
Altitude	Maximum operating temperature will be decreased 1°C per 1000 Feet of altitude above sea-level	-500	-	13120	feet
Storage Temperature		-40	-	100	°C

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	50/54	58.5	V
Input Current (full load)		-	-	31	A
Input Current (no load)		-	130	-	mA
Remote Off Input Current		-	10	-	mA
Input Reflected Ripple Current (rms)	10 uH source impedance, Vin = 45 - 58.5 V, Io = Io max. Refer to section 12 for detail input capacitance and waveforms.	-	5	10	mA
Input Reflected Ripple Current (pk-pk)		-	20	50	mA
Input Terminal Ripple Current (rms)		-	-	1300	mA
Input Turn on Voltage Threshold		42.5	44	45.0	V
Input Turn off Voltage Threshold		39	41	42.5	V
Over-voltage Shutdown Threshold		61	-	64	V
Over-voltage Recovery Threshold		57.3	-	59.7	V
Recommended input fast-acting fuse on system board		40	–	-	A

CAUTION: This converter is not internally fused. An input line fuse must be used in application.

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, Pout = 650 W	10.55	10.6	10.65	V
	Vin = 45 - 58.5 V	10.3	-	11	V
Load Regulation	Vin = 52 V, Io = 0 ~ 100% load	-	0.4	0.53	V
Line Regulation	Vin = 45 - 58.5 V, Io = 100% load	-	30	40	mV
Regulation Over Temperature	Vin = 50 V, Io = 100% load, Ta = -20 to 85°C	-	100	200	mV
Ripple and Noise (pk-pk)	Cout = 750 µF minimum, approximately 50% ceramic, 50% Oscon or POSCAP.	-	-	150	mV
Ripple and Noise (rms)		-	-	30	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	-	125	A
Output DC Current Limit	OCP: Hiccup mode	130	-	-	A
Rise Time	Defined as time between Vout at 10% of final value and Vout at 90% of final value.	-	-	15	ms
Turn on Time	Defined as time between Vin reaching Turn-On voltage and Vout reaching 10% of final value.	20	-	30	ms
	Defined as time between Enable and Vout reaching 10% of final value.	-	-	5	ms
Overshoot at Turn on		-	-	3	%
Output Capacitance	Typically 50% ceramic, 50% Oscon or POSCAP.	0	-	6250	µF
Transient Response					
△V 50%~75% of Max Load	di/dt = 1 A/µs, 4000 µF capacitors are near the brick output.	-	-	350	mV
Settling Time		-	-	-	µs
△V 75%~50% of Max Load		-	-	350	mV
Settling Time		-	-	-	µs

5. OUTPUT PLOT VS INPUT

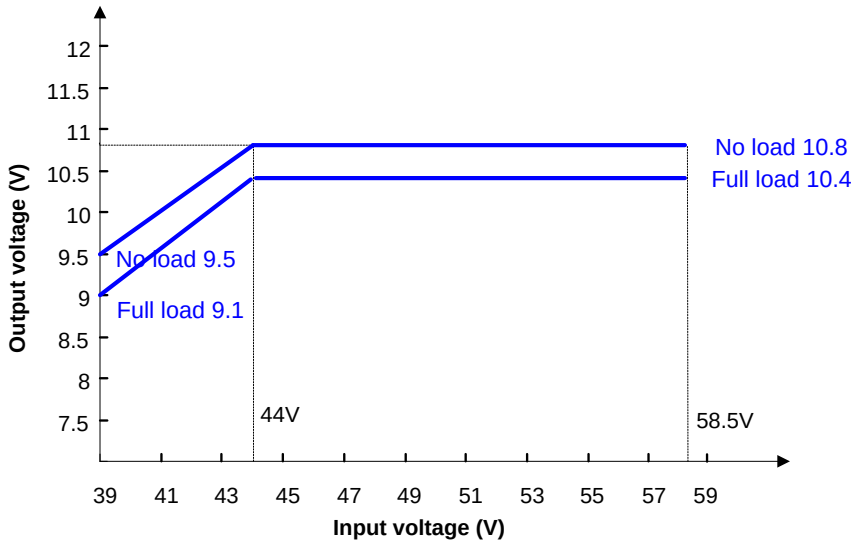

Figure 1. Output plot vs input

NOTE:

Parameter	Min	Typical	Max	Units
Turn on Voltage Threshold	42.5	44	45	V
Turn off Voltage Threshold	39	41	42.5	V

6. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin = 50 V, Io = 125 A, Ta = 25°C	96.2	96.9	-	%
Switching Frequency	Primary FETs	-	150	-	kHz
MTBF	Ta = 40°C	-	6.9	-	Mhrs
Over Temperature Protection	Auto-recovery.	-	130	-	°C
Output Over Voltage Protection		-	-	15	V
Weight		-	87.4	-	g
Dimensions (L × W × H)			2.30 x 1.45 x 0.57 58.42 x 36.83 x 14.50		inch mm
Isolation Characteristics					
Input to Output		-	-	500	V
Isolation Resistance		10M	-	-	Ohm
Isolation Capacitance		-	1000	-	pF

7. EFFICIENCY DATA

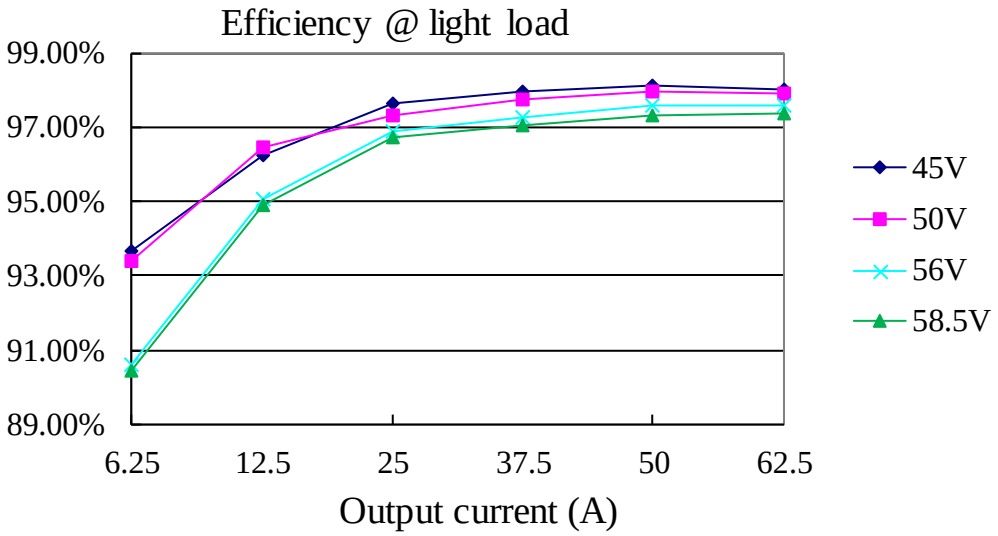

Figure 2. Efficiency data @light load

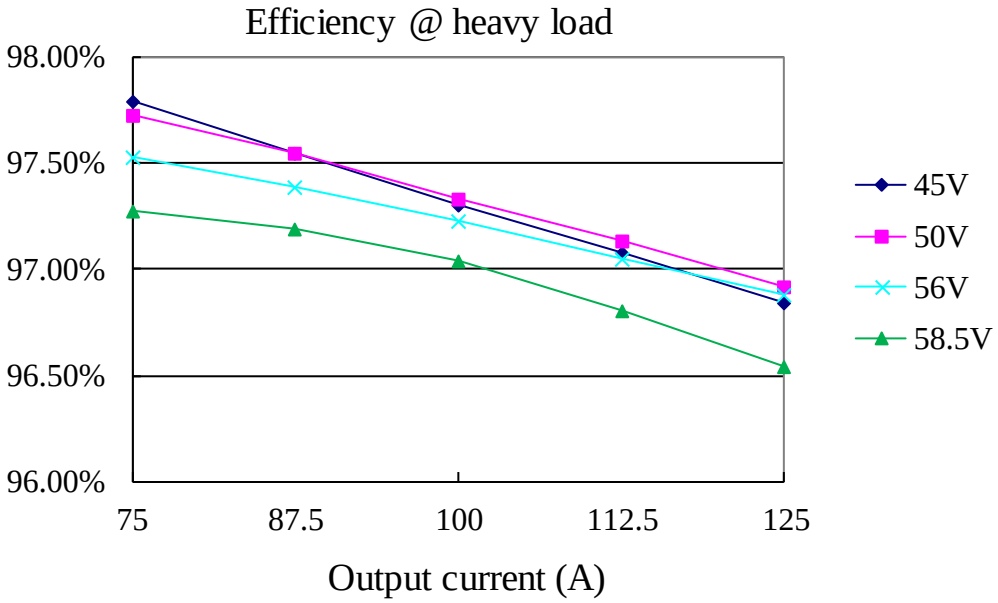

Figure 3. Efficiency data @ heavy load

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	-	16	V
Current (Out of pin)		Module is on, Venable = -0.3 to 0.8 V	-	-	200	µA
		Module is off, Venable = 2.4 V	10	-	-	µA
Current (into pin)		Remote on/off pin is pulled up to 10 V.	-	-	300	µA
		Remote on/off pin is pulled up to 15 V.	-	-	500	µA
Open Circuit Voltage			-	-	15	V

Recommended remote on/off circuit for active low

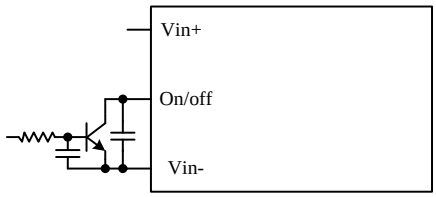

Figure 4. Control with open collector/drain circuit

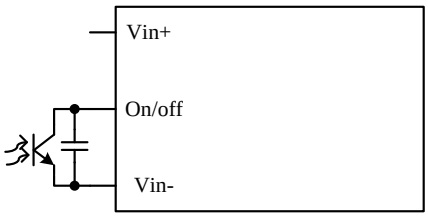

Figure 5. Control with photocoupler circuit

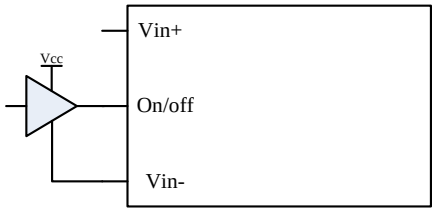

Figure 6. Control with logic circuit

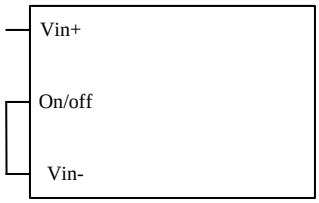

Figure 7. Permanently on

9. RIPPLE AND NOISE

Testing setup

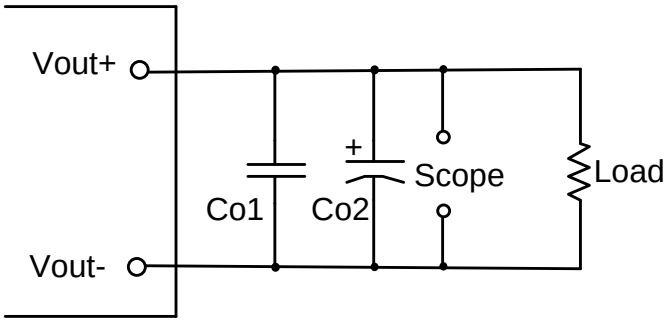

Figure 8. Test setup

Notes and values in testing.
Co1: 3100 µF ceramic capacitor
Co2: NIL
The capacitor should be as close as possible to the power module to damp ripple current and enhance stability.

Below measured waveforms are based on above capacitance.

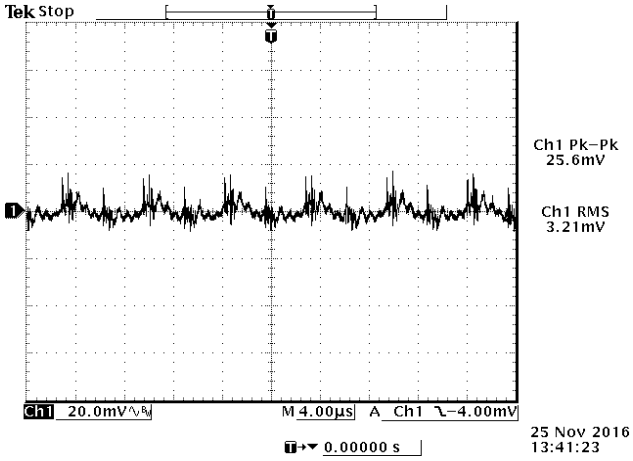

Figure 9. Ripple and noise waveform

Note: Ripple and noise, 50 VDC input, 1300 W output, Ta = 25 °C, with Cout = 3100 µF.

10. INPUT NOISE

Input reflected ripple current

Testing setup

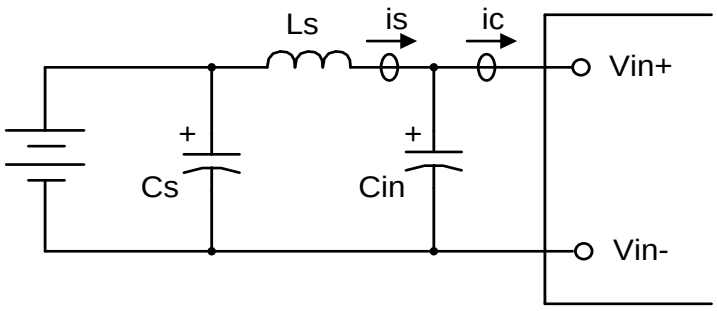

Figure 10. Test setup

Notes and values in testing.
is: Input Reflected Ripple Current
ic: Input Terminal Ripple Current
Ls: Simulated Source Impedance (12 µH)
Cs: Offset possible source Impendence (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.

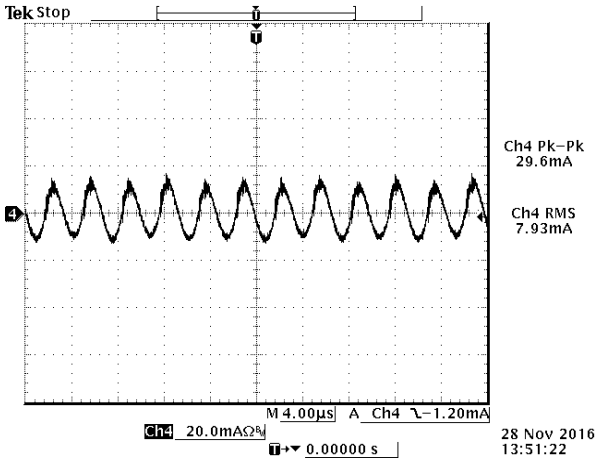

Figure 11. is (input reflected ripple current), AC component

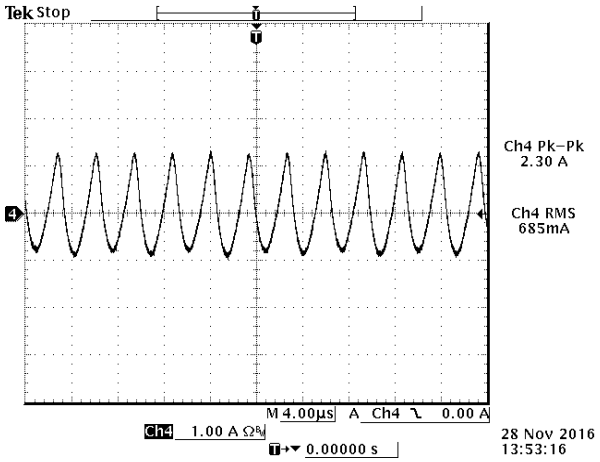

Figure 12. ic (input terminal ripple current), AC component

Test condition: 50 VDC input, 1300 W output and Ta = 25 °C, with 31 * 100 µF ceramic capacitor at output.

11. STARTUP & SHUTDOWN

Rise time

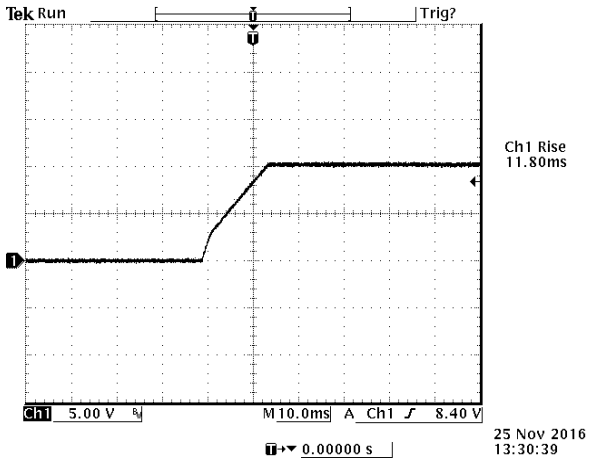

Figure 13. Rise time

Test Condition: Vin = 50 V, Po = 1300 W, with 31 * 100 µF ceramic capacitor and 3200 µF AL. cap at output.

Startup time

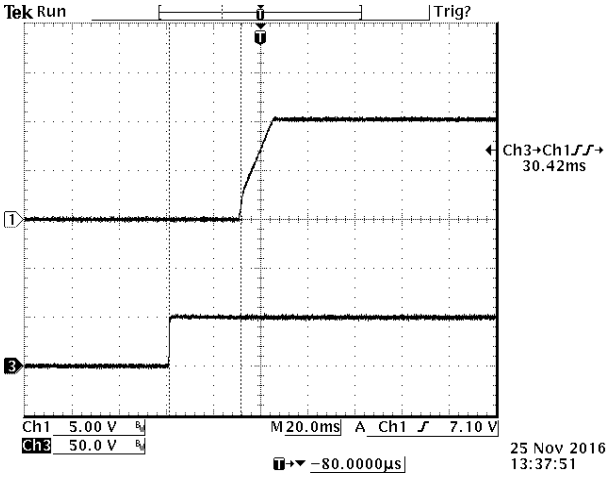

Figure 14. Startup from Vin
Ch1: Vo
Ch3: Vin

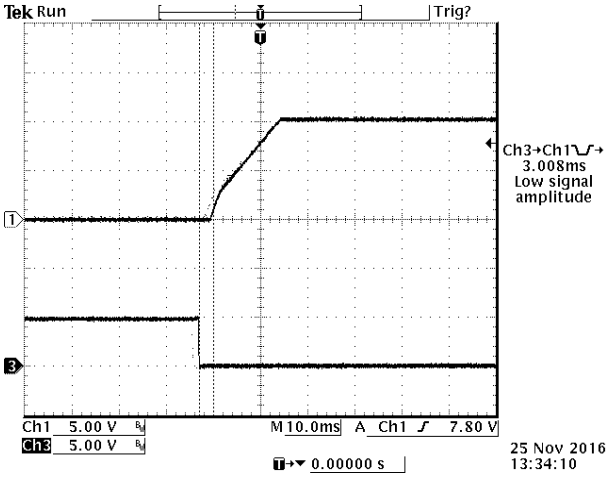

Figure 15. Startup from on/off
Ch1: Vo
Ch3: on/off

Test Condition: Vin = 50 V, Po = 1300 W, with 31 * 100 µF ceramic capacitor and 3200 µF AL. cap at output

12. TRANSIENT RESPONSE

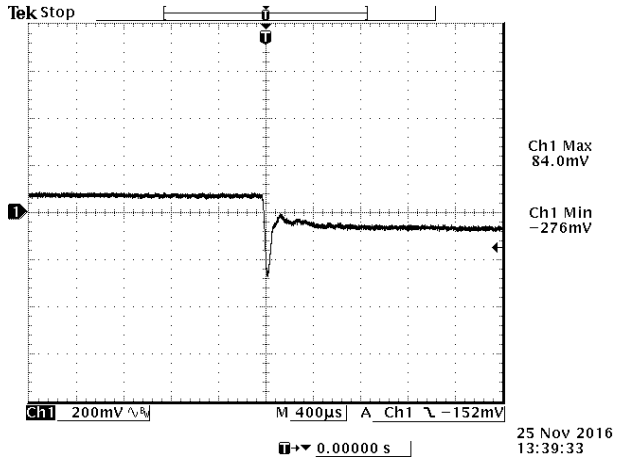

Figure 16. 50%-75% Load Transients at Vin = 50 V @ Ta = 25°C

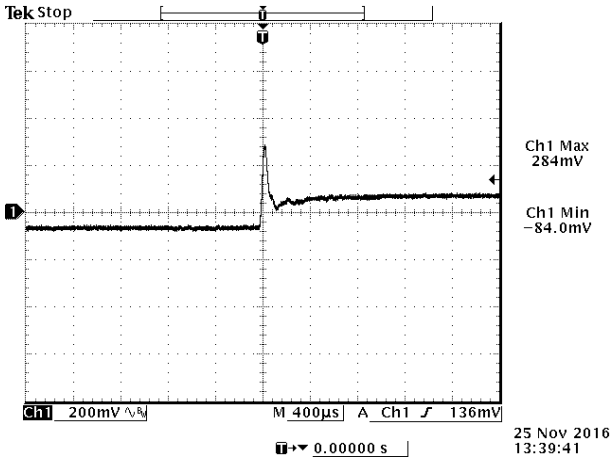

Figure 17. 75%-50% Load Transients at Vin = 50 V @ Ta = 25°C

13. INPUT UNDER-VOLTAGE LOCKOUT

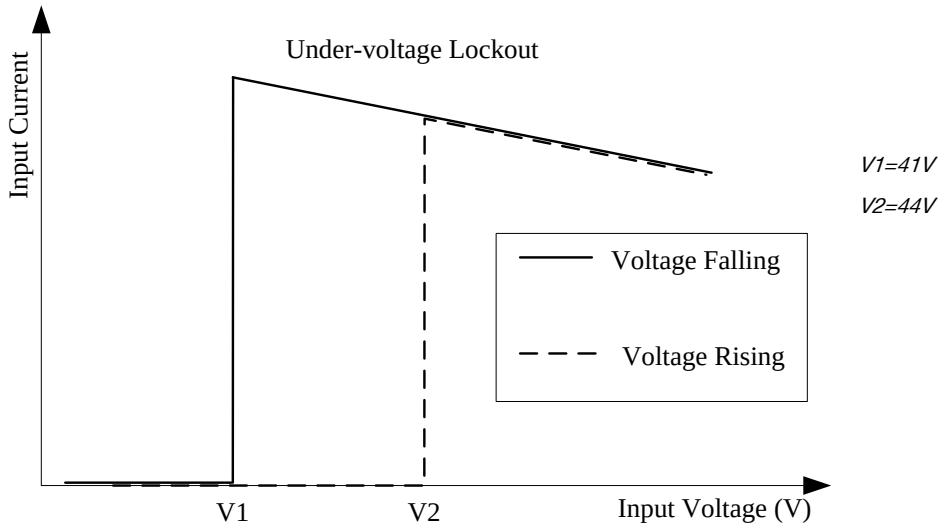

Figure 18. Input under-voltage lockout

14. 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).

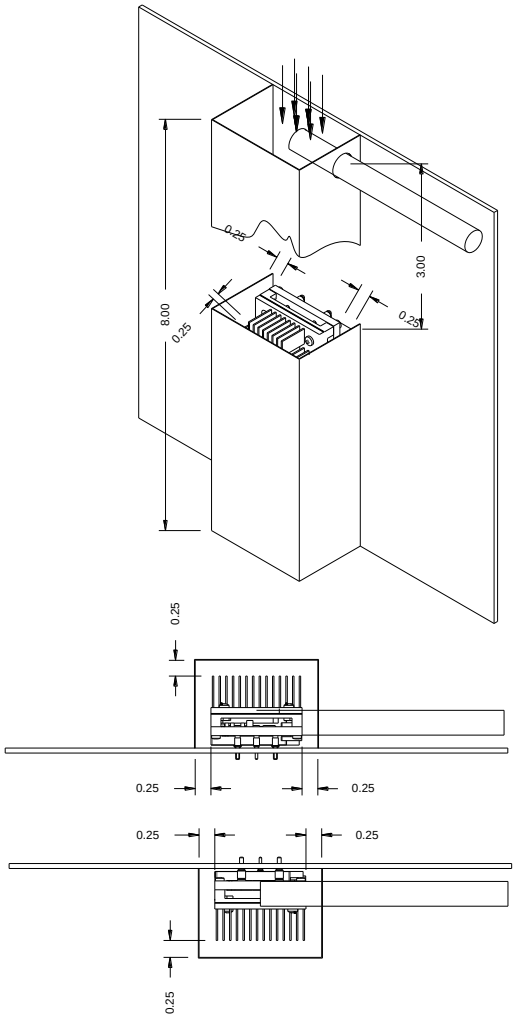

Figure 19. 0RQB-X3S11(B, F) + External heatsink

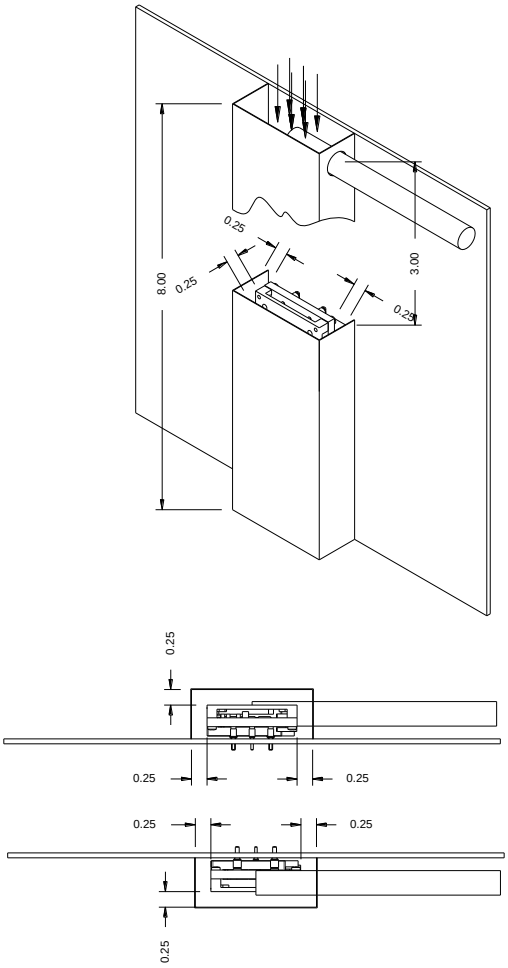

Figure 20. 0RQB-X3S11(B, F)

Test setup drawings all measured in inch.

*The size of external heatsink is 2.30” x 1.45” x 0.61”, recommended model number: S08CAA02 from ALPHA.

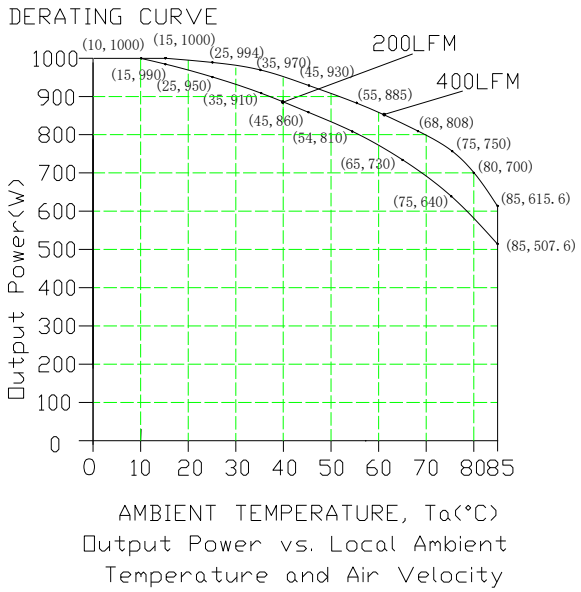

Figure 21. For 0RQB-X3S11(B, F)

Note: Output power vs. ambient temperature and air velocity @ Vin = 56 V (Longitudinal Orientation, airflow from Vout to Vin).

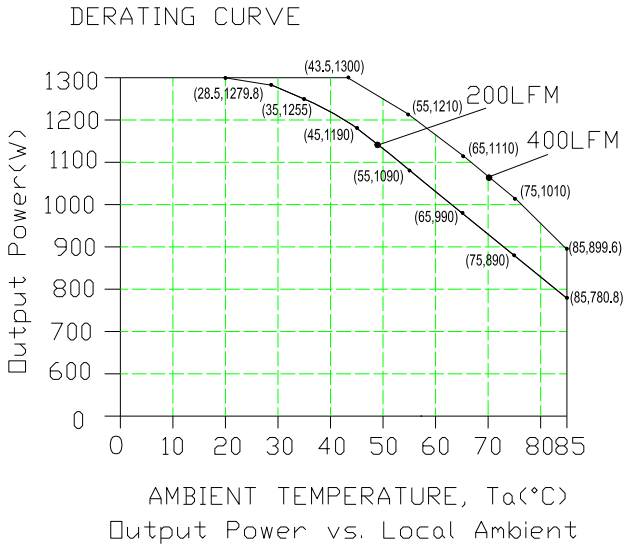

Figure 22. For 0RQB-X3S11(B, F) + External heatsink

Note: Output power vs. ambient temperature and air velocity @Vin = 56 V (Longitudinal Orientation, airflow from Vout to Vin)
Heatsink information: S08CAA02 from ALPHA.

15. 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 Low (trigger limits)		8.2	-	8.6	V
Output Voltage High (trigger limits)		12.6	-	13.1	V
Input Voltage Low (trigger limits) Rising	PG signal indicates good when Vin is within operating range and indicates bad ~20 ms before unit is shut-down due to UV.	42.5	-	45	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.	-	10°C below OTP threshold	-	-
OT Warning PG signal frequency		90	100	110	kHz
OT Warning PG signal duty cycle		47.5	50	52.5	%

16. MECHANICAL DIMENSIONS

0RQB-X3S11B OUTLINE

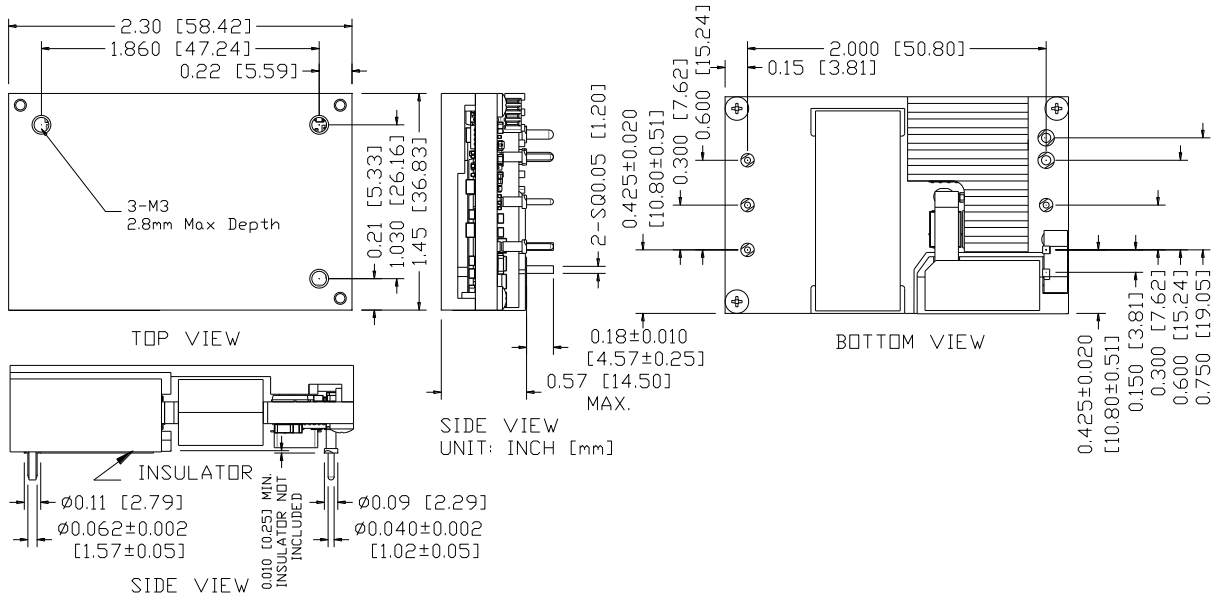

Figure 23. 0RQB-X3S11B Outline

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 – 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-X3S11F OUTLINE

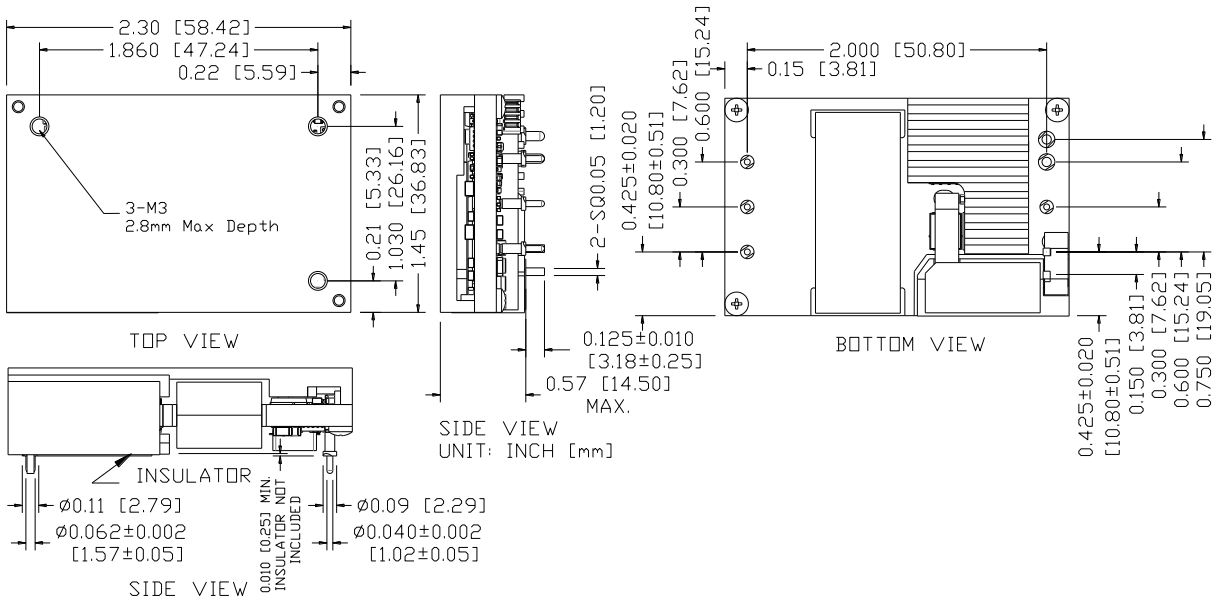

Figure 24. 0RQB-X3S11F Outline

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

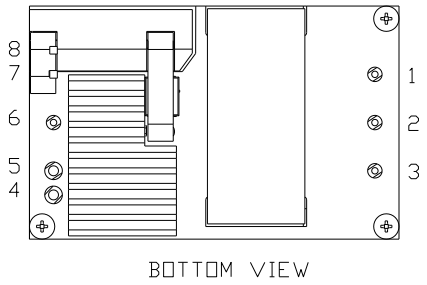

Figure 25. Pins

PIN	FUNCTION	FUNCTION	PIN SIZE
1	Vin (+)	Positive input voltage	0.04"
2	ON/OFF	Input to turn converter on and off, referenced to Vin(-)	0.04"
3	Vin (-)	Negative input voltage	0.04"
4	Vout(-)	Negative output voltage	0.062"
5	Vout(-)	Negative output voltage	0.062"
6	PGOOD	Power-Good	0.04"
7	Vout(+)	Positive output voltage	SQ0.05"
8	Vout(+)	Positive output voltage	SQ0.05"

RECOMMENDED PAD LAYOUT

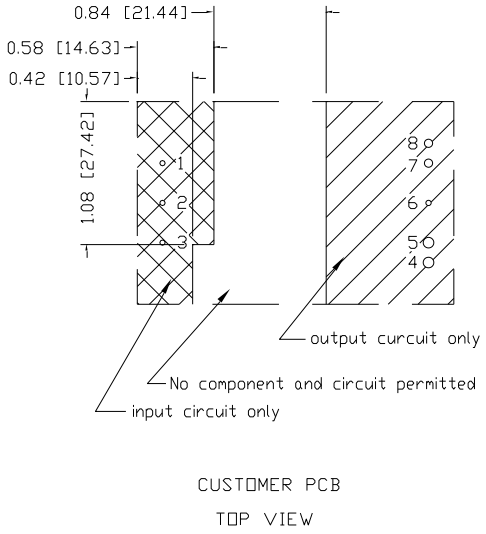

Figure 26. Recommended pad layout-1

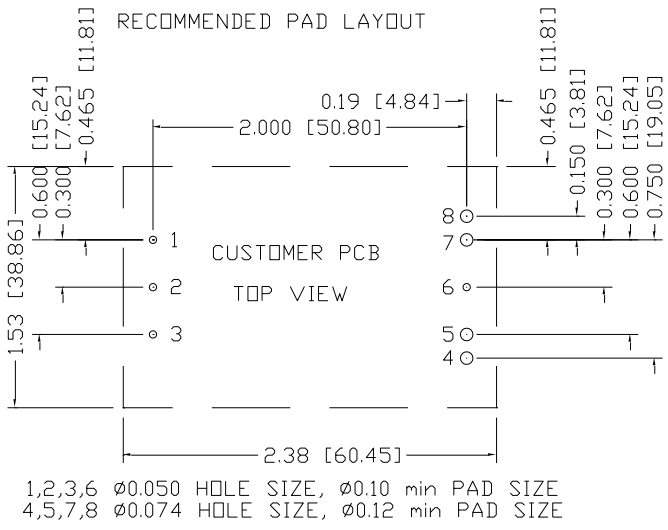

Figure 27. Recommended pad layout-2

17. FEATURE DISCRIPTIONS

Output over current protection

The module is equipped with internal output current limiting circuitry which can endure limiting current continuously. If the output current exceeds the limited value, the module will shut down and enter either hiccup mode or latch mode, which is stated in the output spec table previously.

For hiccup mode, the module will try to restart after shutdown. If the over current situation still exists, the module will shut down continuously until this fault condition is cleared. The hiccup interval time is 250ms.

For latch mode, the module will latch off once shutdown. The latch mode can be reset by cycling the input power or resetting the remote on/off pin.

Over temperature protection

The module is equipped with internal over temperature protection circuitry to safeguard against thermal damage. If the maximum device reference temperature exceeds the limited value, the module will shut down and enter either auto-recovery mode or latch mode, which is stated in the general spec table previously.

For auto-recovery mode, the module will keep monitoring the reference temperature after shutdown and auto restart once the temperature is lower than the protection threshold by ~20C hysteresis.

For latch mode, the module will latch off once shutdown. The latch mode can be reset by cycling the input power or resetting the remote on/off pin.

Under/Over input voltage protection

The module is equipped with internal input UVLO and OVLO protection. If the input voltage is below the UV threshold or above the OV threshold, the module will shut down and auto-restart once the input voltage is within the limited range which is stated in the input spec table previously.

18. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2016-04-14	AA	First release	J.Yan
2016-12-05	AB	Update Cover, input specs, output specs, general, Efficiency data, TD, NR, TR.	J.Yan
2017-04-07	AC	Add PN and Mechanical drawing of 0RQB-X3S11F.	J.Yan
2017-08-04	AD	Add Output Plot VS Input.	J.Yan
2017-09-27	AE	Update General Specifications, Efficiency data, Input voltage max and Power good.	J.Yan
2017-11-09	AF	Add performance data at 58.5Vin and protection feature description.	J.Yan
2018-04-10	AG	Update the MD	F.Tao
2021-02-09	AH	Update safety certificate.	XF.Jiang
2021-05-20	AI	Add object ID and MTBF value. Update thermal test setup drawings by correcting the height.	J.Yao

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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