0RQB-S0S10

Isolated DC-DC Converter

0RQB-S0S10 is an isolated and regulated DC/DC converter that operates from a nominal 51 VDC source. This unit provides up to 600 W output power from a nominal 51 VDC input.

This unit is designed to be highly efficiency and low cost. Features include remote on/off, short circuit protection, over current protection, under voltage lockout, over temperature protection and parallel operation.

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

Key Features & Benefits

- 40 - 56 VDC Input
- 9.7 VDC / 62 A Output
- Isolated
- High Efficiency
- Fixed Frequency (300 kHz)
- High Power Density
- Low Cost
- Parallel operation
- Input Under / Over-Voltage Protection
- Output Over-Voltage Protection
- OCP/SCP
- 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)

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-S0S10LG 0RQB-S0S10BG	9.7 VDC	40 - 56 VDC	62 A	600 W	97.2% @51 Vdc

PART NUMBER EXPLANATION

0	R	QB	-	S0	S	10	x	G
Mounting Type	RoHS Status	Series Name		Output Power	Input Range	Output Voltage	Active Logic & HSK Feature	Package Type
Through Hole Mount	RoHS	DOSA Quarter Brick		600 W	40 – 56 V	9.7 V	L – Active Low, Open Frame B – Active Low, with Baseplate	Tray Package

2. ABSOLUTE MAXIMUM RATINGSS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous Input Voltage	Non-operating	-0.5	-	60	V
Remote On/Off		-0.3	-	18	V
I/O Isolation Voltage		-	-	1500	V
Relative Humidity	Operating, Non-Condensing	10	-	90	%
Ambient Temperature		-20	-	85	°C
Storage Temperature		-40	-	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

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Operating Input Voltage			40	51	56	V
Input Current			-	-	17	A
Input Current (no load)			-	100	150	mA
Remote Off Input Current			-	4	8	mA
Input Reflected Ripple Current (pk-pk)		For detail conditions please refer to input reflected ripple current section	-	50	-	mA
Input Reflected Ripple Current (rms)			-	10	-	mA
Input Terminal Ripple Current Ic (rms)			-	-	600	mA
I^2t Inrush Current Transient			-	-	1	A^2s
OVLO Threshold	Turn-off	Input over voltage lock-out (OVLO)	-	61	-	V
	Turn-on		-	58	-	
UVLO Threshold	Turn-on	Input under voltage lock-out (UVLO)	33.5	35.5	37.5	V
	Turn-off		31.5	33.5	35.5	

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 manufacture's datasheet for further information.

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

4. OUTPUT SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Output Voltage Set Point	Vin = 51 V, Io = 0 load	10.250	10.300	10.350	V
	Vin = 51 V, Io = 100% load	9.650	9.700	9.750	
Line Regulation	Vin = 40 ~ 56 V, Io = 100% load	-	25	50	mV
Load Regulation	Vin = 51 V, Io = 0 ~ 100% load (The output droop voltage from no load to full load is about 0.6 V)	-	0.6	0.7	mV
Output Voltage Range	Vin = 40 ~ 56 V, Io = 0 ~ 100% load	9.5	-	10.4	V
Regulation Over Temperature		-	80	150	mV
Output Ripple and Noise (pk-pk)	Vin = 51 V, Io = 100% load, Cout = 600 µF minimum, approximately 50% ceramic, 50% Oscon or POSCAP. Measured at output pins, bandwidth = 20 MHz	-	50	120	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	-	62	A
Output DC Current Limit		70	75	80	A
Current Share accuracy	Vin = 51 V, Io = full load, two units parallel operation	-	-	±10	%
Short Circuit Surge Transient		-	-	2	A^2s
Turn on Time	Ton (Enable form Vin)	-	15	30	ms
	Ton (Enable form ON/OFF)	-	15	30	
Rise Time		-	-	15	ms
Overshoot at Turn on		-	0	3	%
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
Pre-Bias Voltage		0	-	Vout	V
Output Capacitance	Typically 50% ceramic and 50% electrolytic capacitors	0	-	4500	µF
Transient Response					
△V 50% ~ 75% of Max Load	di/dt = 1 A/µs, Vin = 51 VDC, Ta = 25°C, with a 1 µF ceramic capacitor and a 2200 µF AL. cap at output	-	-	350	mV
Settling Time		-	100	200	µs
△V 75% ~ 50% of Max Load		-	-	350	mV
Settling Time		-	100	200	µs

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

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	The efficiency is measured at Vin = 51 V, Po = 600 W and Ta = 25°C	96.2	97.2	-	%
Switching Frequency		280	300	320	kHz
Over Temperature Protection		-	125	-	°C
Over Voltage Protection		12	-	13.5	V
Dimensions (L × W ×H)	0RQB-S0S10L		2.30 × 1.45 × 0.48		inch
			58.42 × 36.83 × 12.20		mm
	0RQB-S0S10B		2.30 × 1.45 × 0.57		inch
			58.42 × 36.83 × 14.48		mm
FIT*	Calculated Per Bell Core SR-332 (Vin = 51 V, Vo = 9.7 V, Io = 50 A Ta = 40°C, 200 LFM, FIT = 10^9/MTBF)	-	102	-	-
MTBF*		-	9.81	-	Mhrs
Weight	0RQB-S0S10L	-	65	-	g
	0RQB-S0S10B	-	75	-	g
Isolation Characteristics					
Isolation Capacitance		-	2700	-	pF
Isolation Resistance		10M	-	-	ohm
Input to Output		-	-	1500	VDC
Input to Case		-	-	1500	VDC
Output to Case		-	-	500	VDC

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

6. EFFICIENCY DATA

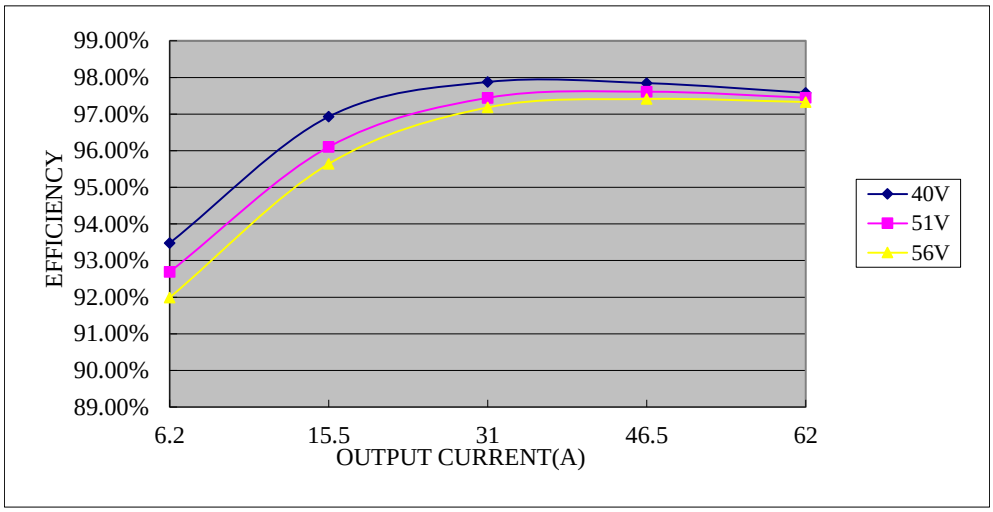

Figure 1. Efficiency data

7. REMOTE ON/OFF

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit On) Signal High (Unit Off)	Active Low	0RQB-S0S10L/B The remote on/off pin open, Unit off	-0.3 2.4	- -	0.8 18	V
Enable Pin Open-Circuit Voltage		-	-	-	18	V
Enable Pin Current (into pin, ext. pull-up to 10V)		-	-	-	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

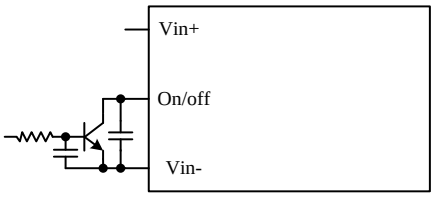

Figure 2. Control with open collector/drain circuit

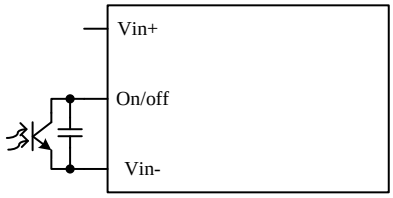

Figure 3. Control with photocoupler circuit

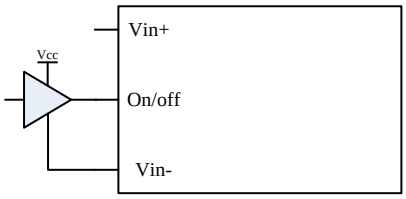

Figure 4. Control with logic circuit

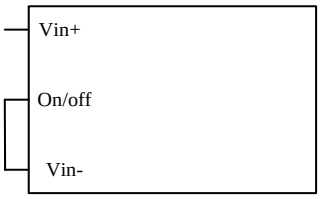

Figure 5. Permanently on

8. INPUT REFLECTED RIPPLE CURRENT

Testing set up

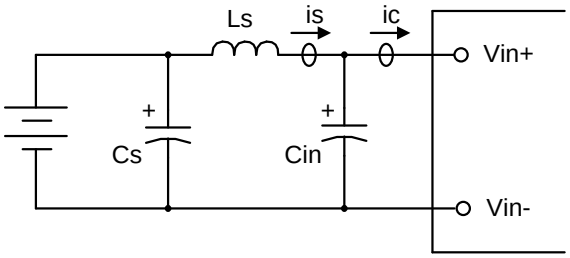

Figure 6.

Notes and values in testing:

Ls: Simulated Source Impedance (10 µH).

Cs: Offset possible source Impedance (10 0µF, ESR < 0.2 Ω @ 100 kHz, 20 ˚C).

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

is: Input Reflected Ripple Current.

ic: Input Terminal Ripple Current.

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

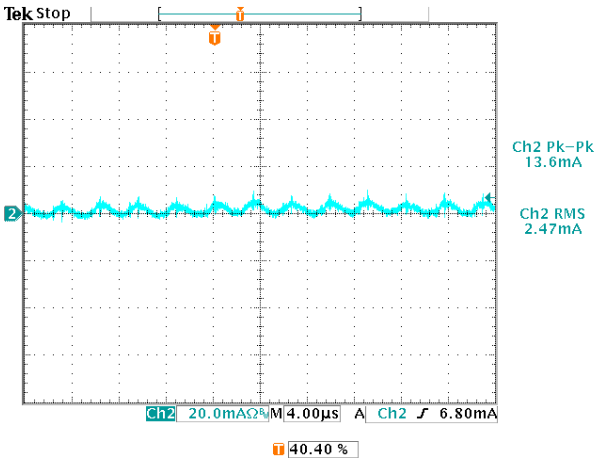

Figure 7. is (input reflected ripple current), AC component

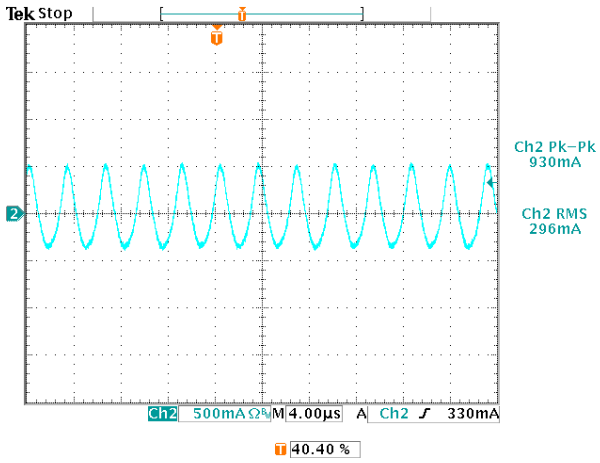

Figure 8. ic (input terminal ripple current), AC component

NOTE: 51 VDC input, 9.7 VDC / 62 A output and Ta = 25 ˚C, with a 1 µF ceramic capacitor and a 270 µF AL. cap at output.

9. RIPPLE AND NOISE WAVEFORM

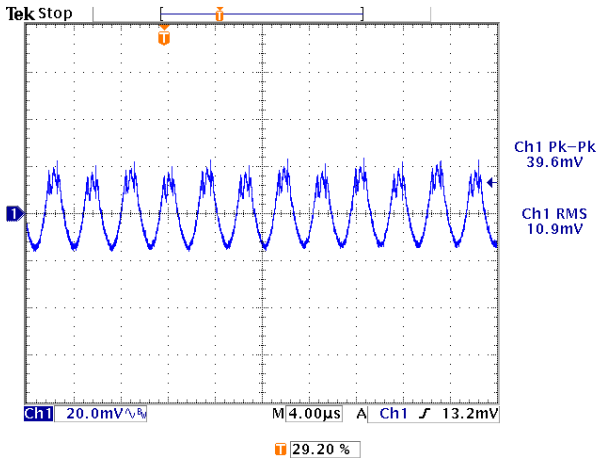

Figure 9.

NOTE: Ripple and noise at full load, 51 VDC input, 9.7 VDC / 62 A output and Ta = 25°C, and with a 1 µF ceramic cap and a 270 µF OSCON cap at output.

10. OUTPUT 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 2.25 A during hiccup.

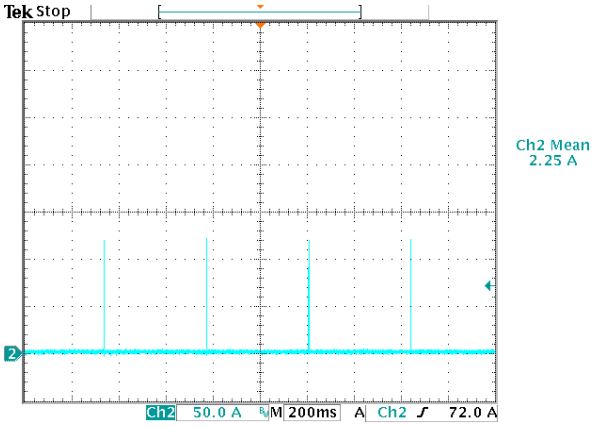

Figure 10. CH2: Output current waveform
Vin = 51 V @ 25°C

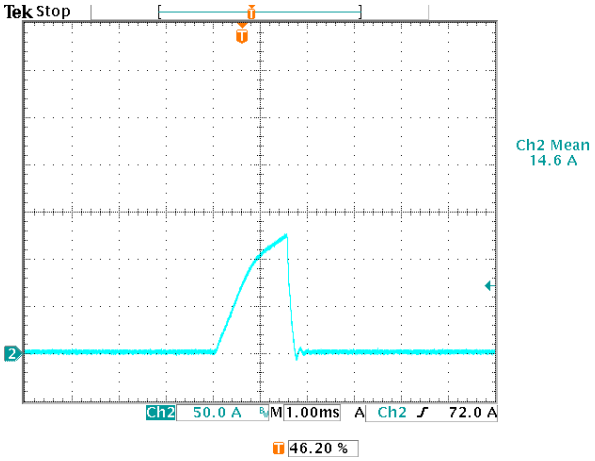

Figure 11. CH2: Output current waveform
Expansion of on time portion of above figure

11. STARTUP & SHUTDOWN

RISE TIME

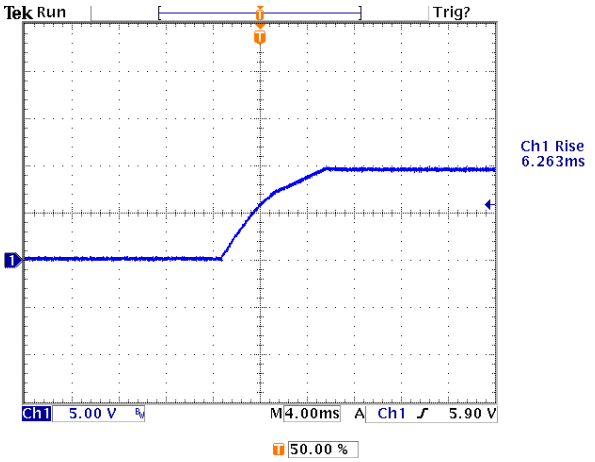

Figure 12. Vout = 9.7 V / 62 A @ Vin = 51 V,
Ta = 25°C, Cext = 0 µF

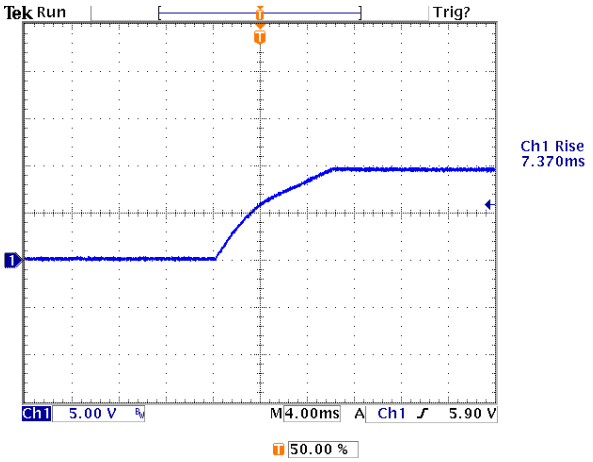

Figure 13. Vout = 9.7 V / 62 A @ Vin = 51 V,
Ta = 25°C, Cext = 4500 µF

STARTUP TIME

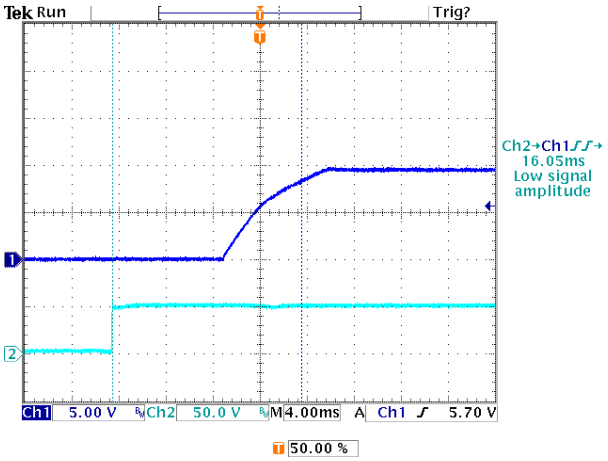

Figure 14. Startup from Vin
Ch1: Vo
Ch2: Vin
Vout = 9.7 V / 62 A @ Vin = 51 V,
Ta = 25°C, Cext = 0 µF

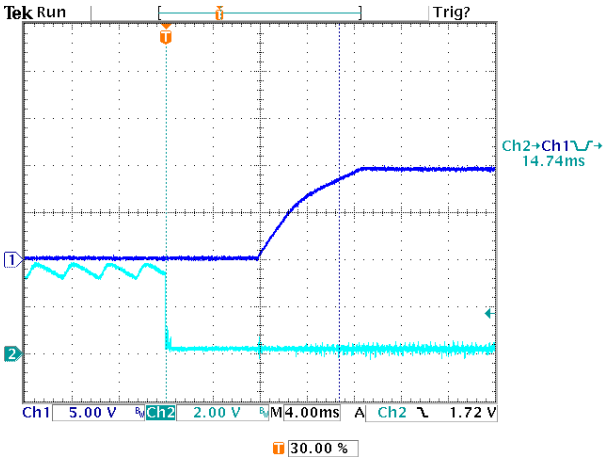

Figure 15. Startup from onn/off
Ch1: Vo
Ch3: on/off
Vout = 9.7 V / 62 A @ Vin = 51 V,
Ta = 25°C, Cext = 0 µF

SHUTDOWN

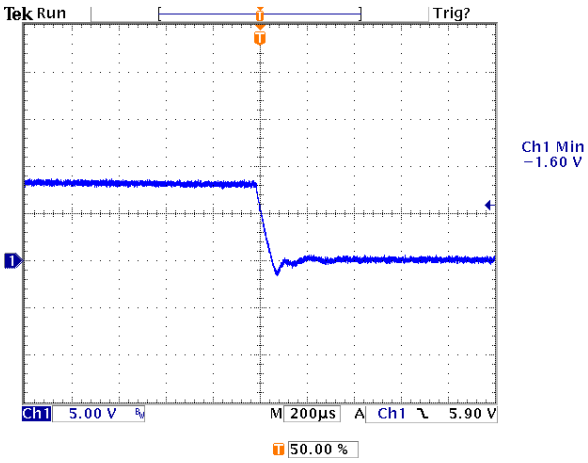

Figure 16. Vout = 9.7 V / 62 A @ Vin = 51 V, Ta = 25°C, Cext = 0 µF

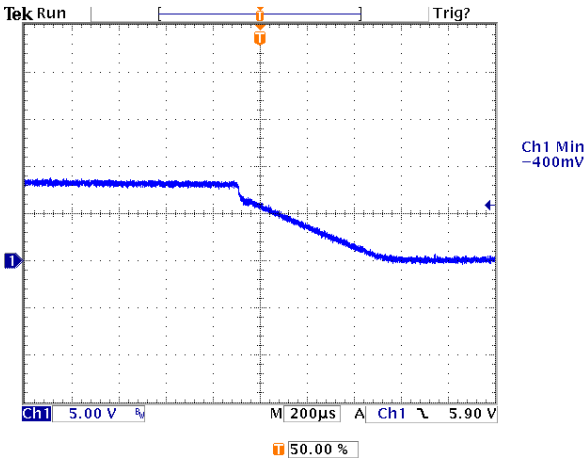

Figure 17. Vout = 9.7 V / 62 A @ Vin = 51 V, Ta = 25°C, Cext = 4500 µF

12. TRANSIENT RESPONSE WAVEFORMS

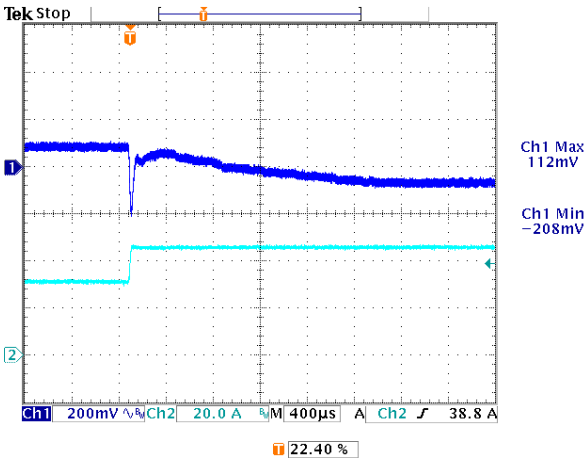

Figure 18. 50%-75% Load Transients @ Vin = 51 V, Ta = 25°C

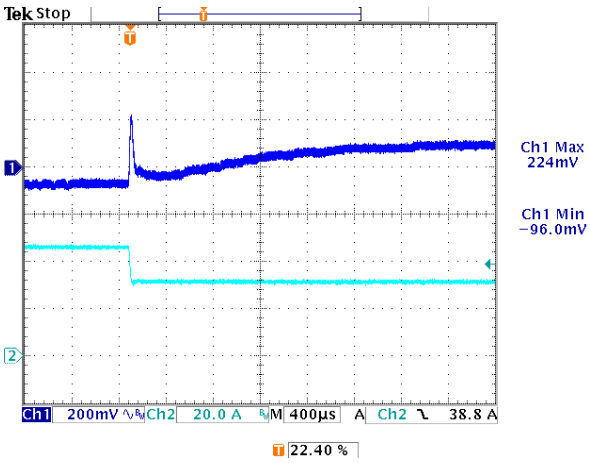

Figure 19. 75%-50% Load Transients @ Vin = 51 V, Ta = 25°C

13. THERMAL DERATING CURVES

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).

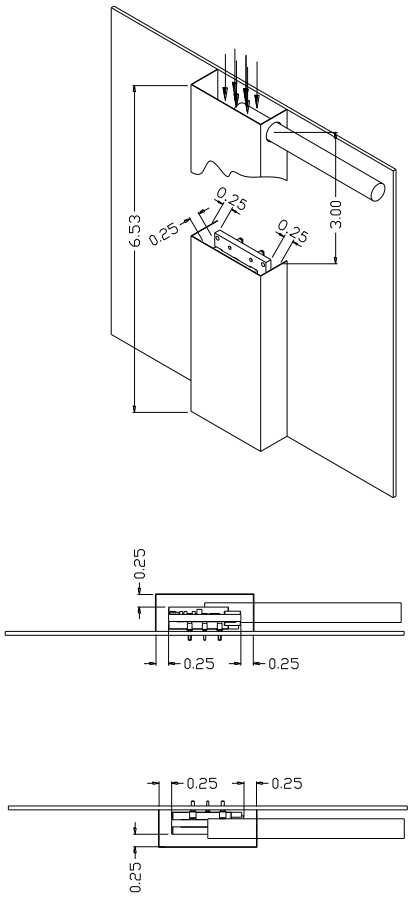

Figure 20. For Open frame 0RQB-S0S10L

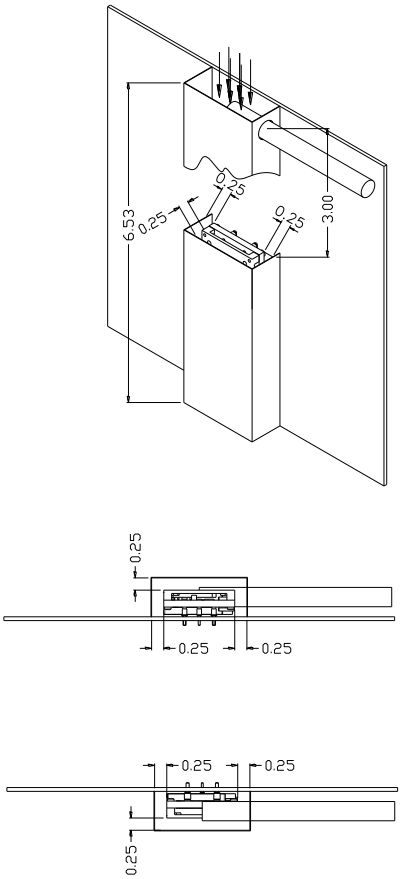

Figure 21. For Baseplate 0RQB-S0S10B

NOTE: Test setup drawing all measures are in inch.

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.

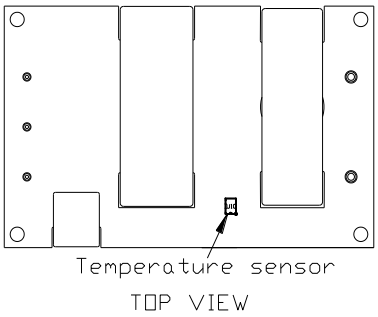

Figure 22. Temperature reference point on top side

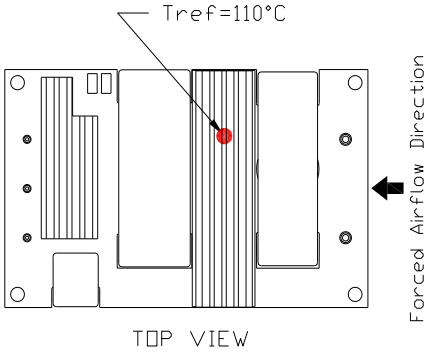

Figure 23. Temperature reference point for 0RQB-S0S10L

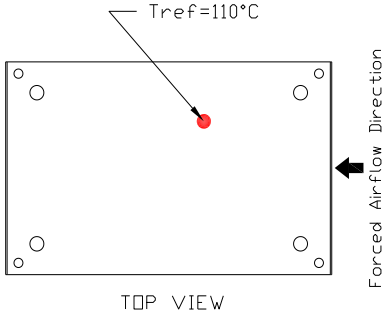

Figure 24. Temperature reference point for 0RQB-S0S10B

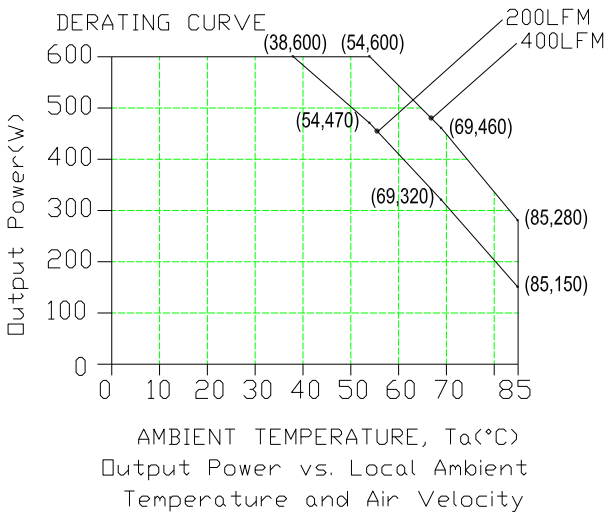

Figure 25. Derating Curve for Open Frame 0RQB-S0S10L, Longitudinal Airflow

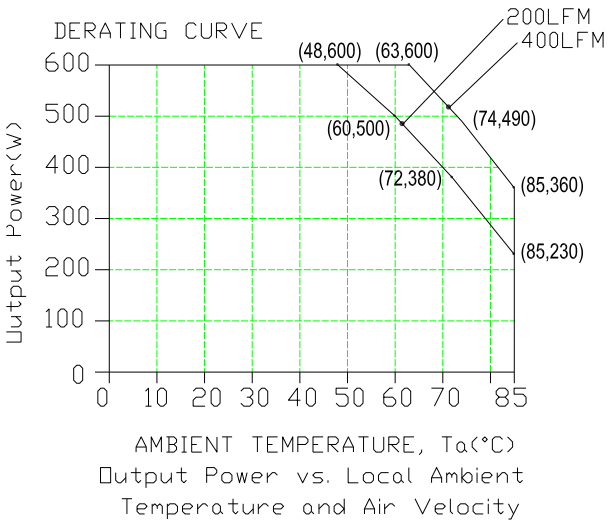

Figure 26. Derating Curve for Baseplate 0RQB-S0S10B, Longitudinal Airflow

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

14. INPUT UNDER-VOLTAGE LOCKOUT

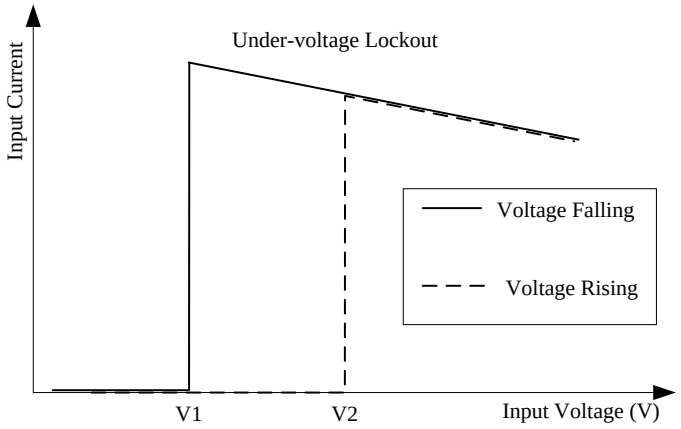

Figure 27. Input under-voltage lockout
V1 = 33.5 V
V2 = 35.5 V

15. SAFETY & EMC

SAFETY:

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

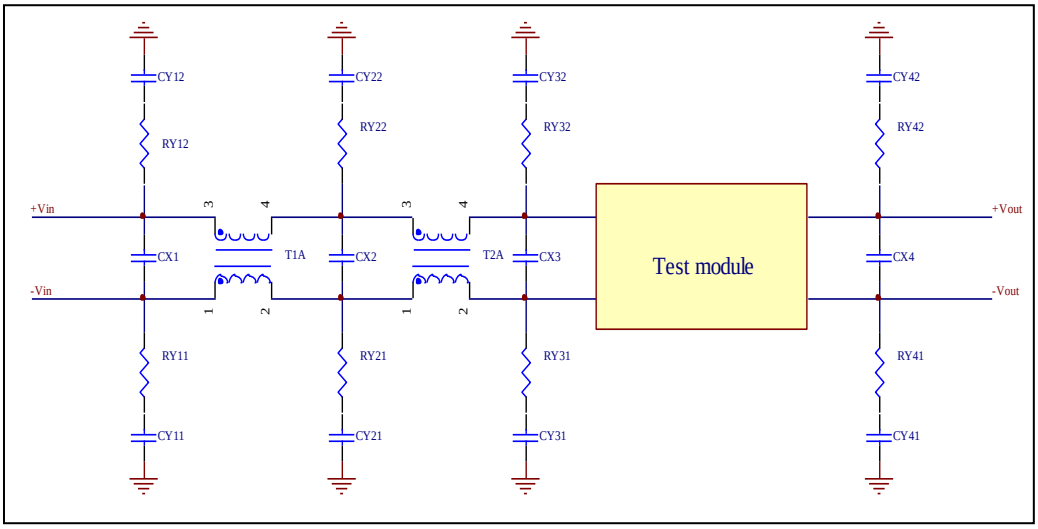

Figure 28.

T1A	CX1	RY11	RY12	CY11	CY12
-	-	-	-	-	-
T2A	CX2	RY21	RY21	CY21	CY22
1 mH	1uF	-	-	-	-
	CX3	RY31	RY32	CY31	CY32
	220uF	4.7nf	4.7nf	-	-
	CX4	RY41	RY42	CY41	CY42
	270uf	-	-	-	-

Positive

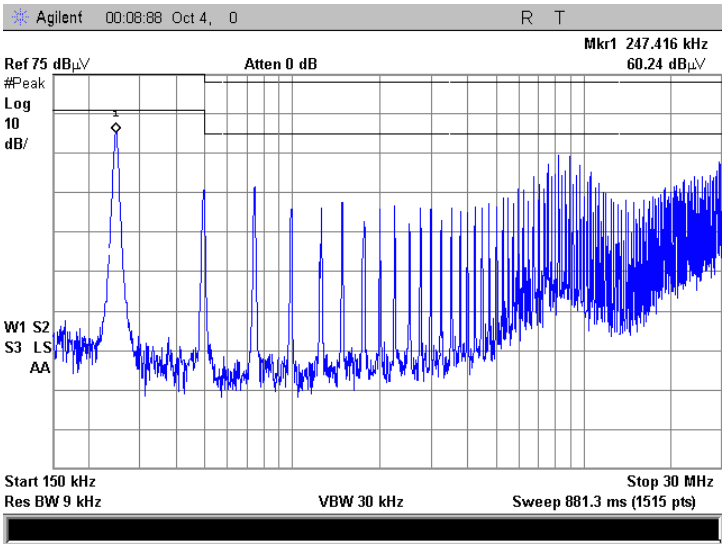

Figure 29.

Negative

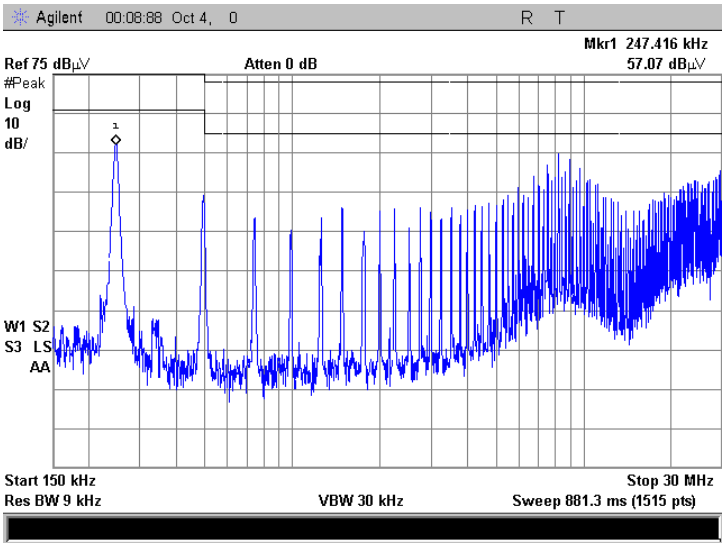

Figure 30.

16. MECHANICAL DIMENSIONS

0RQB-S0S10L OUTLINE

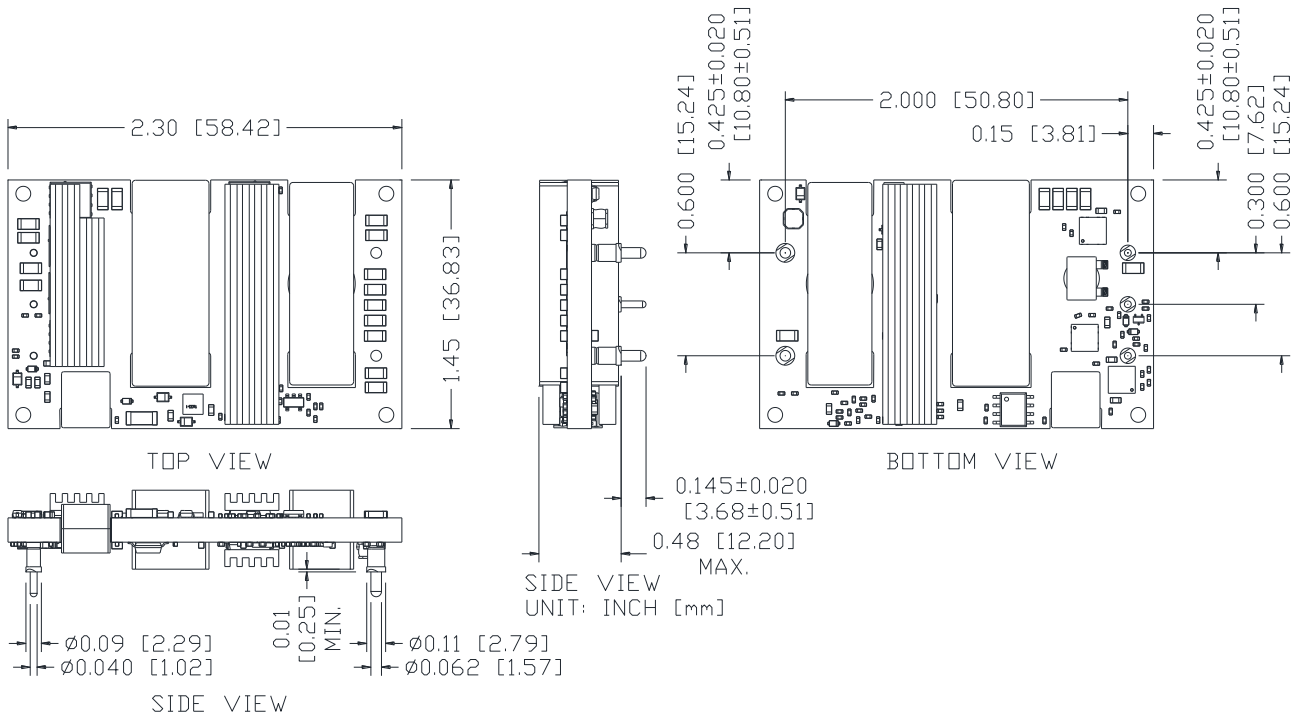

Figure 31. 0RQB-S0S10L outline

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 +/-0.02 inch [0.5 mm]. x.xxx +/-0.010 inch [0.25 mm].

0RQB-S0S10B OUTLINE

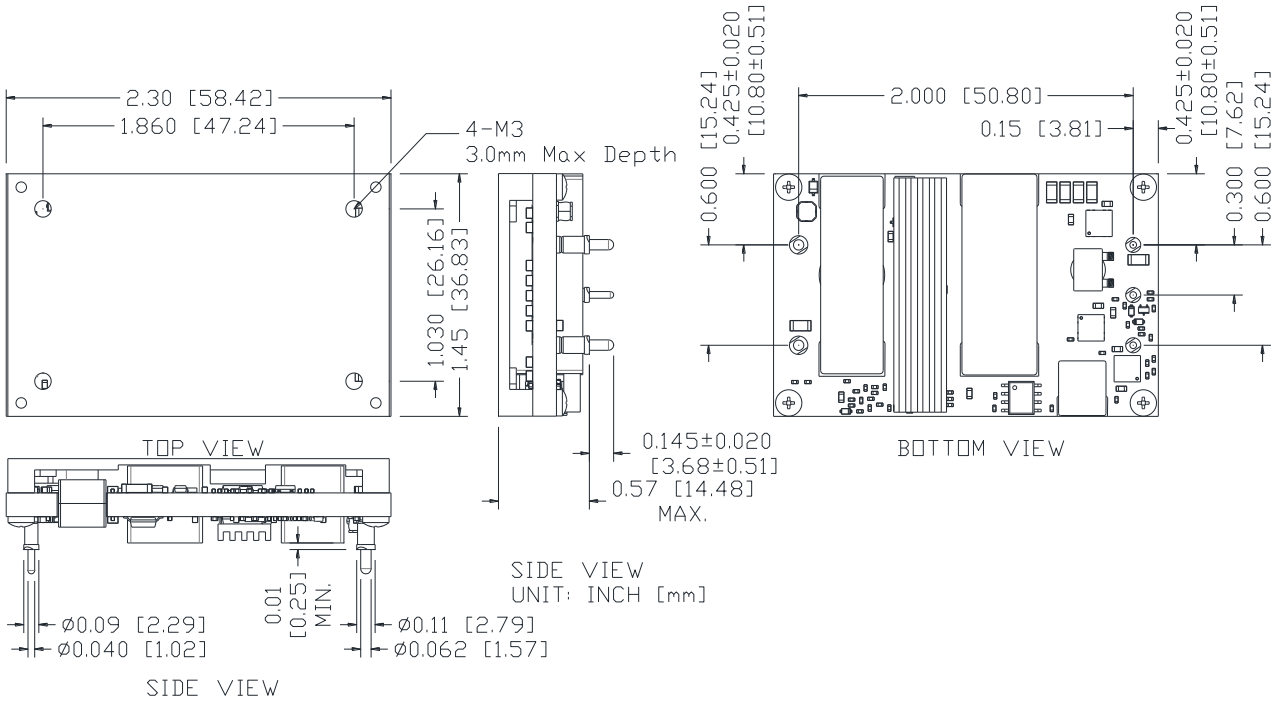

Figure 32. 0RQB-S0S10B outline

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.

NOTE:

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 +/-0.02 inch [0.5 mm]. x.xxx +/-0.010 inch [0.25 mm].

PIN DEFINITIONS

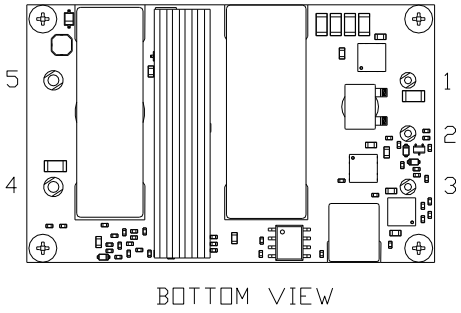

Figure 33. Pins

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

RECOMMENDED PAD LAYOUT

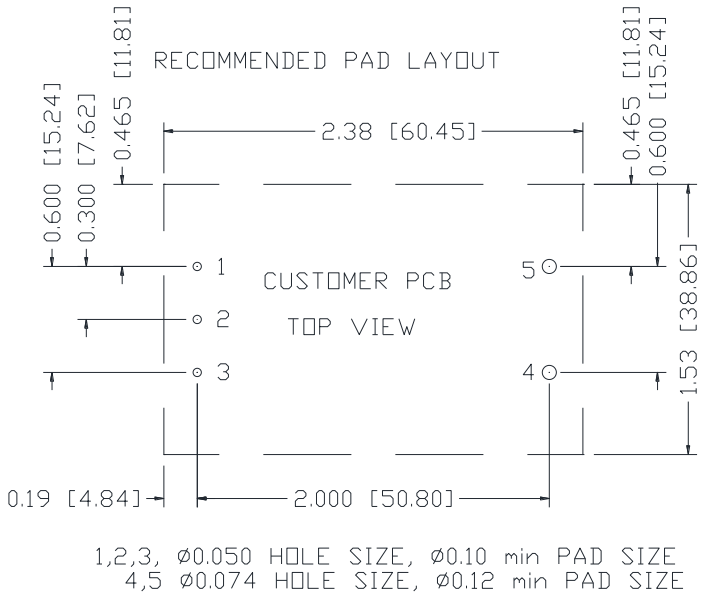

Figure 34. Recommended pad layout

17. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2015-05-12	A	First release.	Z.Tang
2015-05-20	B	Add Thermal Test Setup, Thermal Derating & MTBF Item.	Z.Tang
2016-04-26	C	Update Electrical Parameters and Mechanical Outline.	Z.Tang
2018-07-03	AD	Add Part Number 0RQB-S0S10C/D	Z.Tang
2019-06-18	AE	Update safety certification	F.Tao
2020-10-10	AF	Delete preliminary watermark. Delete 0RQB-S0S100/A/C/D.	XF.Jiang
2021-05-19	AG	Add object ID and EMC curve.	XF.Jiang