0RQB-50Y48x

Isolated DC-DC Converter

The 0RQB-50Y48x is an isolated DC/DC converter providing 50 W of output power from a wide input range (24 / 48 / 72 / 96 / 110 V typical). Standard features include remote on/off, input under-voltage protection, output over-voltage protection, over current and short circuit protection.

This converter can also provide a 5 V / 5 mA auxiliary supply. When a large hold-up capacitor is added, the converter can still work up to 10 ms when the input supply is interrupted.

Conformal coated PCB is used for environmental ruggedness.

RoHS Compliant

Key Features & Benefits

- 24/48/72/96/110 VDC Input
- 48 VDC @ 1.04 A Output
- Reinforced Isolation
- High Efficiency
- Hold-Up Function
- Remote ON/OFF
- Conformal Coated
- Input Under-Voltage Lockout
- Input Under-Voltage Protection
- Output Over-Voltage Protection
- Over Current and Short Circuit Protection
- 5V Auxiliary Supply at Primary Side
- Wide Input Range (24 V,48 V,72 V,96 V,110 V typical)
- Approved to IEC/EN 62368-1 (TBC)
- Approved to CSA/UL 62368-1 (TBC)
- Class II, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)

Applications

- Industrial
- Railway

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
0RQB-50Y48x	48 VDC	24/48/72/96/110 VDC	1.04 A	50 W	88%@110 V

NOTE: Add "G" suffix at the end of the model number to indicate packaging.

PART NUMBER EXPLANATION

0	R	QB	-	50	Y	48	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		50 W	14.4-154 V	48 V	L– Active low, with baseplate 0– Active high, with baseplate F- Active low, with flange E- Active high, with flange	G – Tray package

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.5	-	200	V
Remote On/Off		-0.3	-	15	V
Operating Temperature	Hot spot temperature, see Thermal Derating Curves section	-40	-	105	°C
Storage Temperature		-55	-	125	°C
Altitude		-	-	5000	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 1	Fully functioning for long term operation.	14.4	24 48 72 96 110	154	V
Operating Input Voltage 2	Fully functioning for 0.1 s operation.	12.9	-	14.4	V
	Full function is not guaranteed but undamaged for 1 s operation.	154	-	200	V
Input Voltage Rising Slope		-	-	2	V/ms
Input Current (full load)		-	-	4.5	A
Input Current (no load)	Vin = 48 V	-	130	170	mA
	Vin = 110 V	-	25	40	mA
Remote Off Input Current		-	-	40	mA
Input Reflected Ripple Current (rms)	With simulated source impedance of 1µH, 5 Hz to 20 MHz. Use a 100 µF / 250 V electrolytic capacitor with ESR = 1 ohm max, at 200 kHz @ 25°C.	-	-	150	mA
Input Reflected Ripple Current (pk-pk)		-	-	500	mA
Turn-on Voltage Threshold		12.5	13.5	14.4	V
Turn-off Voltage Threshold		11	12	12.9	V
Over-voltage Recovery Threshold		156	160	164	V
Over-voltage Shutdown Threshold		162	165	168	V
Input L/C	Inner inductance	-	3.3	-	µH
	Inner capacitance, Ctotal	-	2.7	-	µF
Input Capacitance	Outside capacitance, typically electrolytic capacitors.	100	-	-	µF
Recommended input fast-acting fuse on system board	**CAUTION:** This converter is not internally fused. An input line fuse must be used in application.	-	15	-	A

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		47.52	48	48.48	V
Load Regulation		-	-	100	mV
Line Regulation		-	-	100	mV
Regulation Over Temperature		-	-	±480	mV
Output Ripple and Noise (Pk-Pk)	With a 100 µF ceramic and a 100 µF electrolytic capacitors at output.	-	100	200	mV
Output Ripple and Noise (RMS)		-	15	30	mV
Output Current Range		0	-	1.04	A
Output DC Current Limit	Enter a hiccup mode, non-latching.	1.1	1.5	2	A
Rise Time		-	-	150	ms
Start-up Time	Start up from Vin	-	-	1500	ms
	Start up from remote on/off	-	-	300	ms
Overshoot at Turn on		-	0	3	%
Output Capacitance	Typically, 50% ceramic and 50% electrolytic capacitors.	200	-	1000	µF
5V Auxiliary Supply Source Current		-	-	5	mA
Transient Response					
△V 50%~75% of Max Load	di/dt = 0.1 A/µs, with a 100 µF ceramic and a 100 µF electrolytic capacitors near the brick output.	-	200	480	mV
Settling Time		-	0.5	1	ms
△V 75%~50% of Max Load		-	200	480	mV
Settling Time		-	0.5	1	ms

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin = 24 V, Iout = 1.04 A at 25°C	-	84	-	%
	Vin = 48 V, Iout = 1.04 A at 25°C	-	86	-	%
	Vin = 110 V, Iout = 1.04 A at 25°C	-	88	-	%
Switching Frequency	1st stage	-	150	-	kHz
	2nd stage	-	250	-	kHz
Over Temperature Protection		-	125	-	°C
Over Voltage Protection (Static)	Enter a latching. non-hiccup mode	-	52	-	V
FIT	Calculated Per Bell Core SR-332 (Vin = 48 V, Vo = 48 V, Io=1.04A, Ta = 40°C, FIT=10^9/MTBF)	-	173	-	-
MTBF		-	4.5	-	Mhrs
Weight	Baseplate version	-	62	-	g
	Flange version	-	71	-	g
Dimensions (L × W × H)	Baseplate version		2.30 x 1.45 x 0.59 58.42 x 36.83 x 15.00		inch mm
	Flange version		2.386 x 2.20 x 0.59 60.60 x 55.88 x 15.00		inch mm
Isolation Characteristics					
Input to Output		-	-	3000	Vdc
Input to Heatsink		-	-	3000	Vdc
Output to Heatsink		-	-	3000	Vdc
Isolation Resistance	Test with 500 VDC	100M	-	-	Ohm
Isolation Capacitance		-	-	2200	pF

6. EFFICIENCY DATA

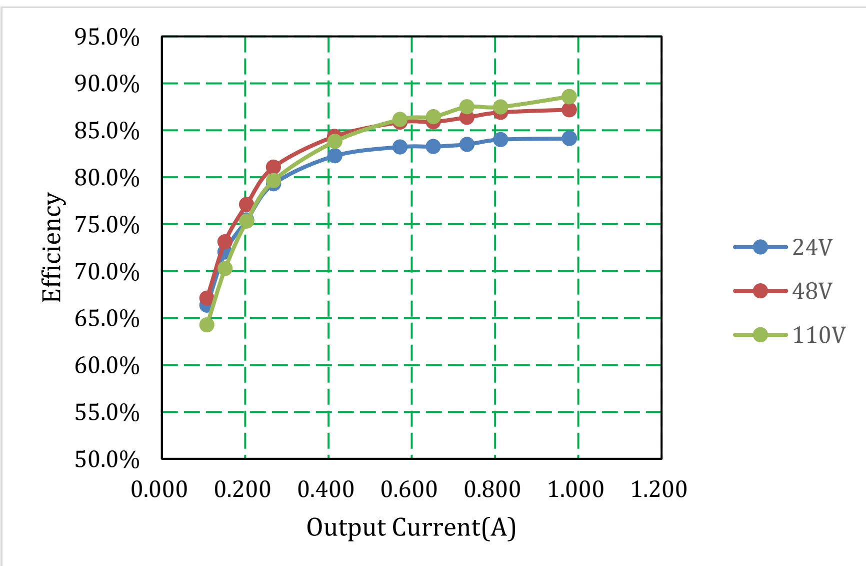


Figure 1. Efficiency data

7. 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	-	15	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	-	15	V
Current Sink			0	-	1	mA

Recommended remote on/off circuit for active low

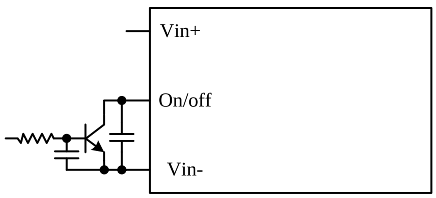


Figure 2. Control with open collector/drain circuit

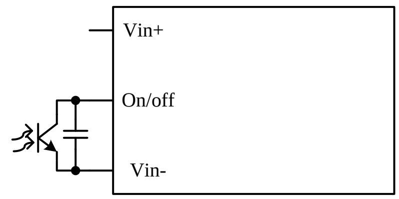


Figure 3. Control with photocoupler circuit

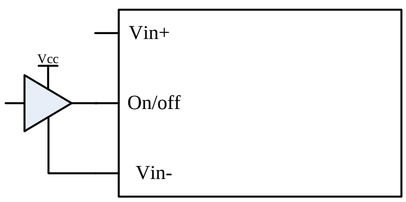


Figure 4. Control with logic circuit

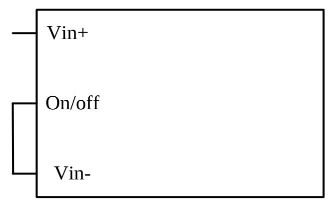


Figure 5. Permanently on

Recommended remote on/off circuit for active high

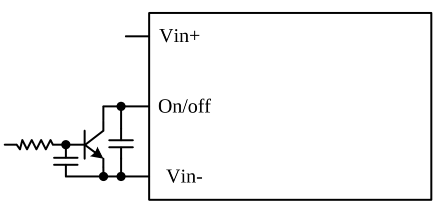


Figure 6. Control with open collector/drain circuit

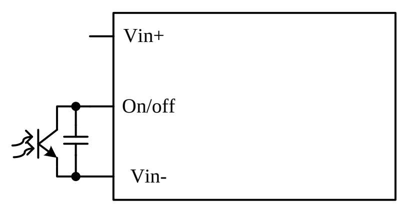


Figure 7. Control with photocoupler circuit

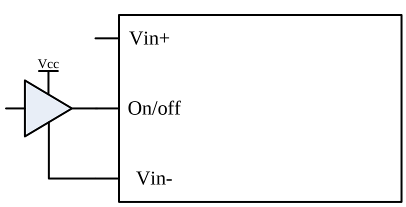


Figure 8. Control with logic circuit

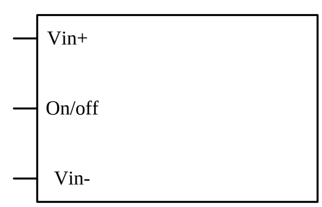
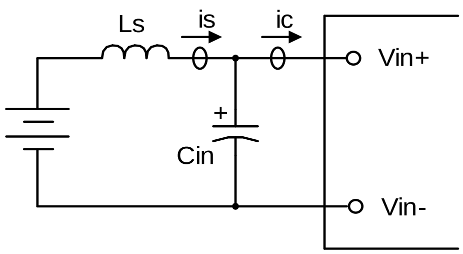


Figure 9. Permanently on

8. INPUT NOISE

Input reflected ripple current

Testing setup



Notes and values in testing:

is: Input Reflected Ripple Current
ic: Input Terminal Ripple Current
Ls: Simulated Source Impedance (1µH)
Cin: Electrolytic capacitor, should be as closed as possible to the power module to damped ic ripple current and enhance stability.
Recommendation: 2* 100µF, ESR<0.5R @ 100 kHz, 20°C

Figure 10.

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

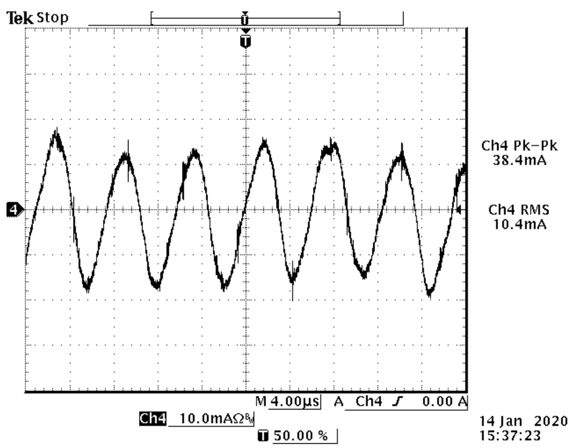


Figure 11. is (input reflected ripple current), AC component

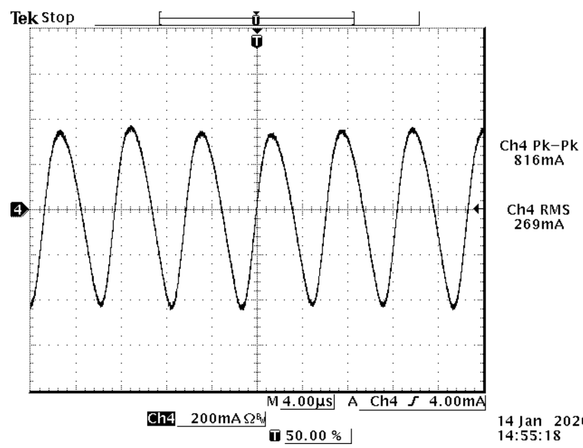


Figure 12. ic (input terminal ripple current), AC component

Test condition: 48Vdc input, 48Vdc/1.04A output and Ta=25 deg C, with 200µF capacitor at output

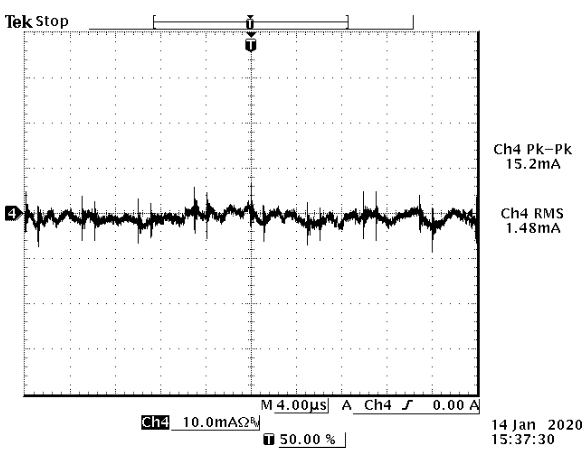


Figure 13. is (input reflected ripple current), AC component

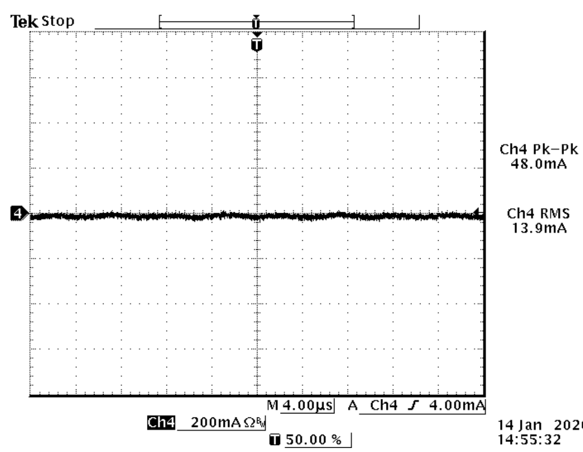


Figure 14. ic (input terminal ripple current), AC component

Test condition: 110Vdc input, 48Vdc/1.04A output and Ta=25 deg C, with 200µF capacitor at output.

9. RIPPLE AND NOISE WAVEFORMS

Testing setup

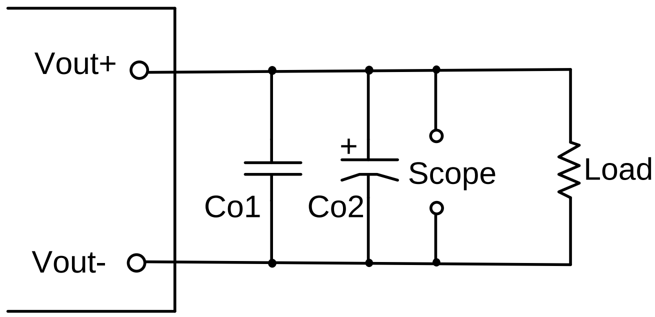


Figure 15.

Notes and values in testing.
Co1: 100uF ceramic capacitor
Co2: 100uF POSCAP capacitor
The capacitor should be as closed as possible to the power module to swallow ripple current and help with stability.

Below measured waveforms are based on above capacitance.

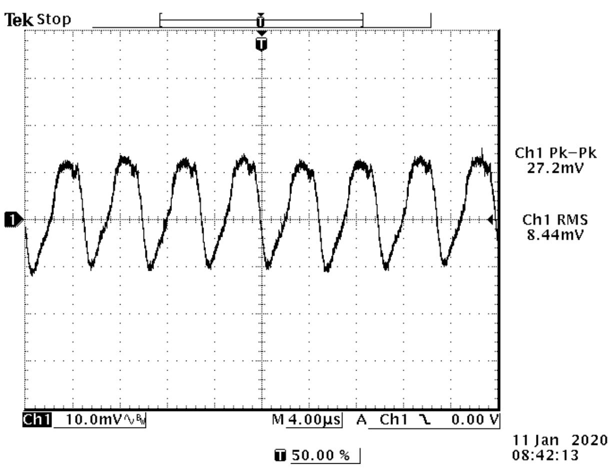


Figure 16. Ripple and noise,
Vin=48Vdc, 48Vdc/1.04A output @Ta=25℃ with Cext=200uF

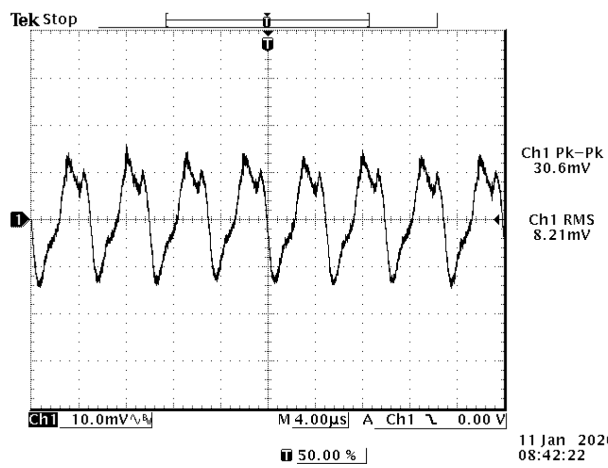


Figure 17. Ripple and noise,
Vin=110Vdc, 48Vdc/10.4A output @Ta=25℃ with Cext=200uF

10. TRANSIENT RESPONSE WAVEFORMS

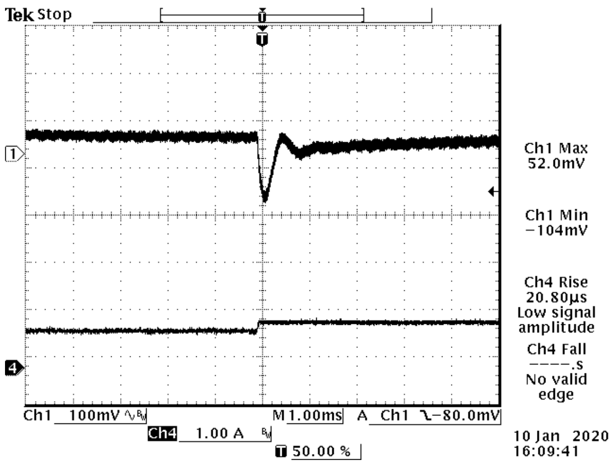


Figure 18. 50%-75% Load Transients
at Vin=48V@Ta=25℃ with Cext=200uF

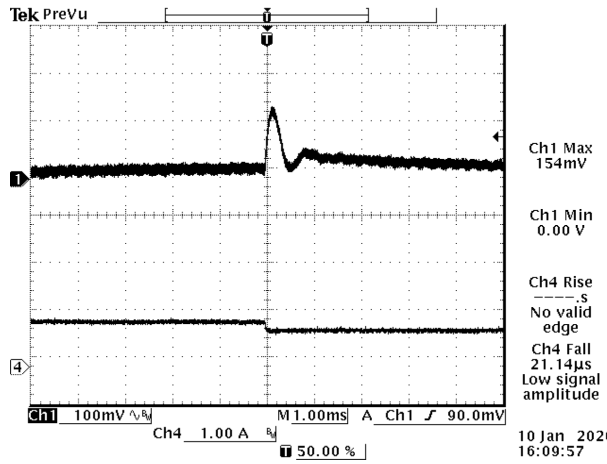


Figure 19. 50%-75% Load Transients
at Vin=110V@Ta=25℃ with Cext=200uF

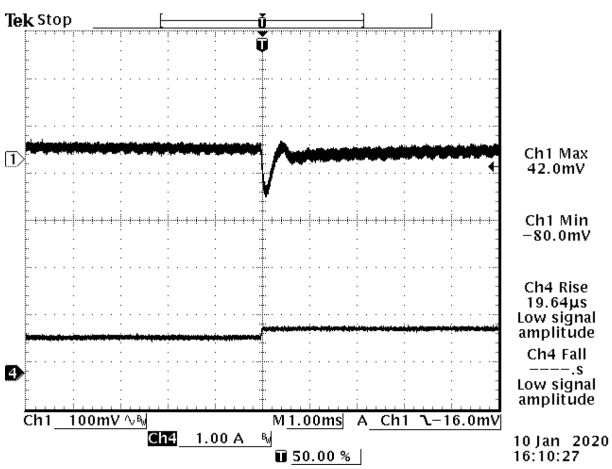


Figure 20. 75%-50% Load Transients
at Vin=48V@Ta=25℃ with Cext=200uF

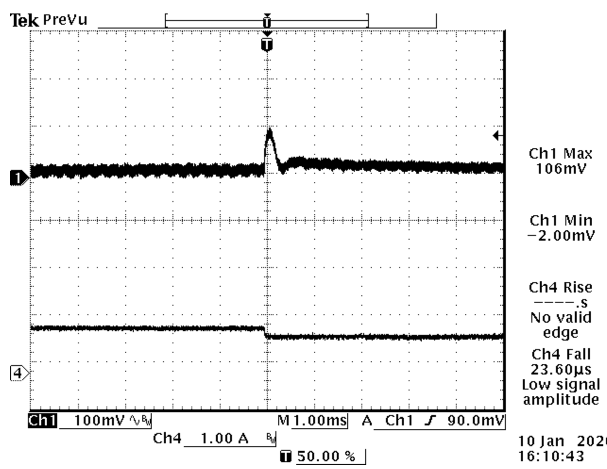


Figure 21. 75%-50% Load Transients
at Vin=110V@Ta=25℃ with Cext=200uF

11. STARTUP & SHUTDOWN

Turn on rise time

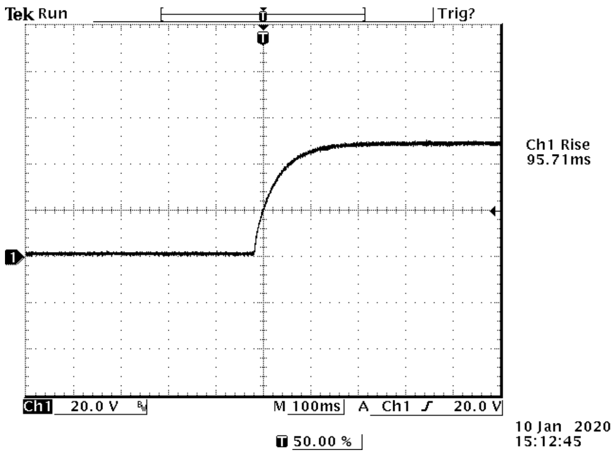


Figure 22. Vin=48V, Io=1.04A, Vo=48V with Cext=200uF

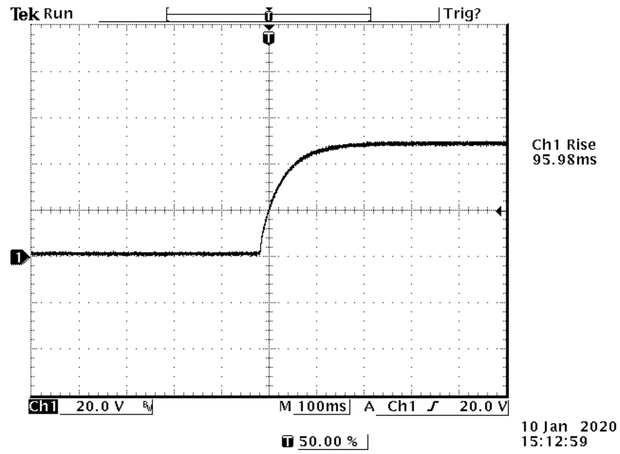


Figure 23. Vin=110V, Io=1.04A, Vo=48V with Cext=200uF

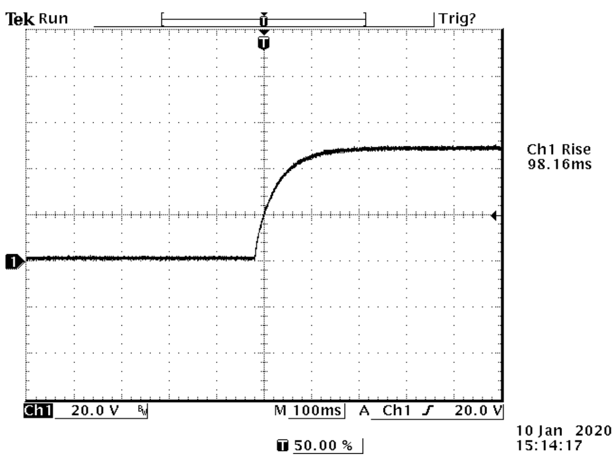


Figure 24. Vin=48V, Io=1.04A, Vo=48V with Cext=1200uF

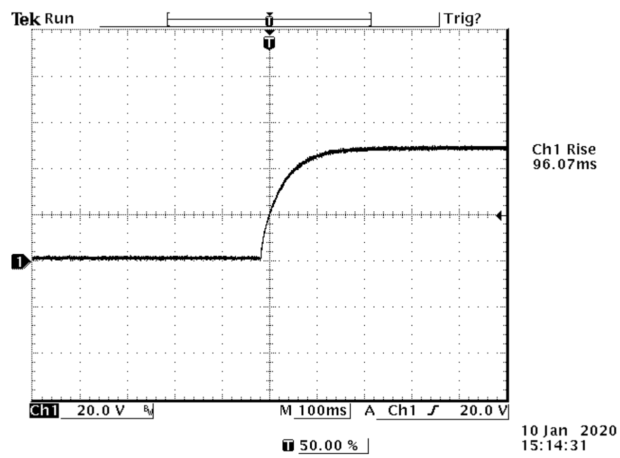


Figure 25. Vin=110V, Io=1.04A, Vo=48V with Cext=1200uF

Turn on delay time

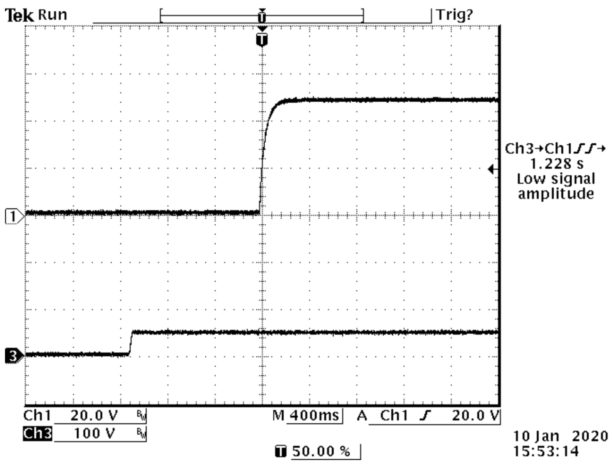


Figure 26. Startup from Vin
Ch1: Vo
Ch3: Vin
***Test Condition:** Vin=48V, Io=1.04A, Vo=48V with Cext=200uF*

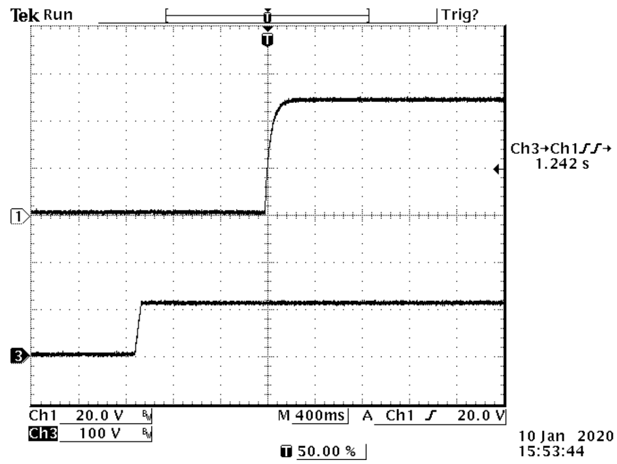


Figure 27. Startup from Vin
Ch1: Vo
Ch3: Vin
***Test Condition:** Vin=110V, Io=1.04A, Vo=48V with Cext=200uF*

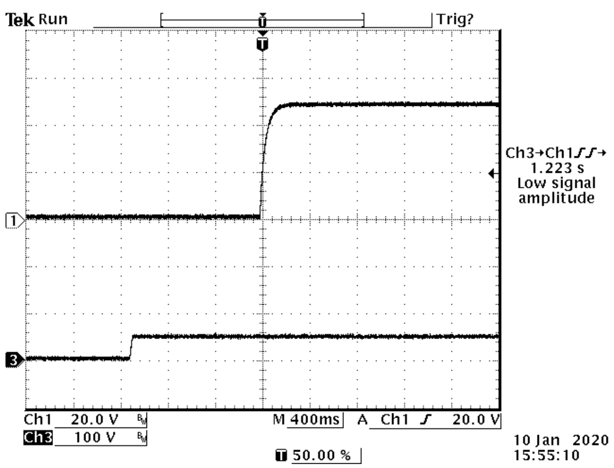


Figure 28. Startup from Vin
Ch1: Vo
Ch3: Vin
***Test Condition:** Vin=48V, Io=1.04A, Vo=48V with Cext=1200uF*

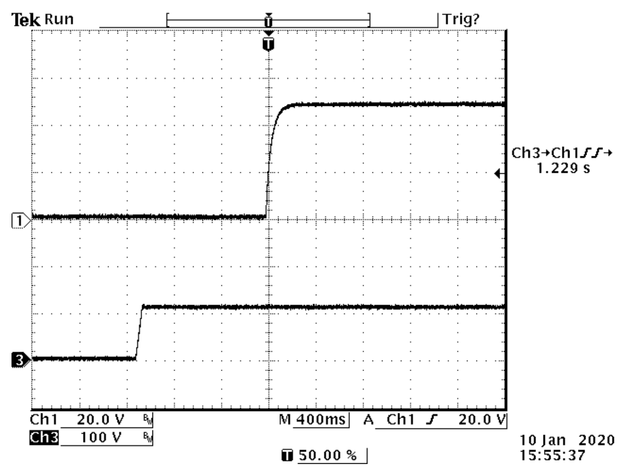


Figure 29. Startup from Vin
Ch1: Vo
Ch3: Vin
***Test Condition:** Vin=110V, Io=1.04A, Vo=48V with Cext=1200uF*

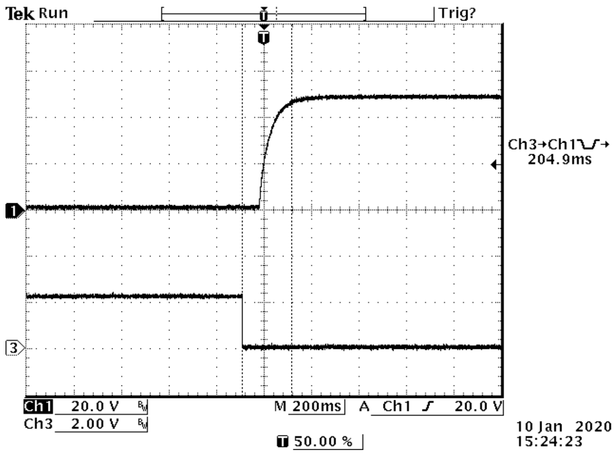


Figure 30. Startup from on/off
Ch1: Vo
Ch3: Vin
***Test Condition:** Vin=48V, Io=1.04A, Vo=48V with Cext=200uF*

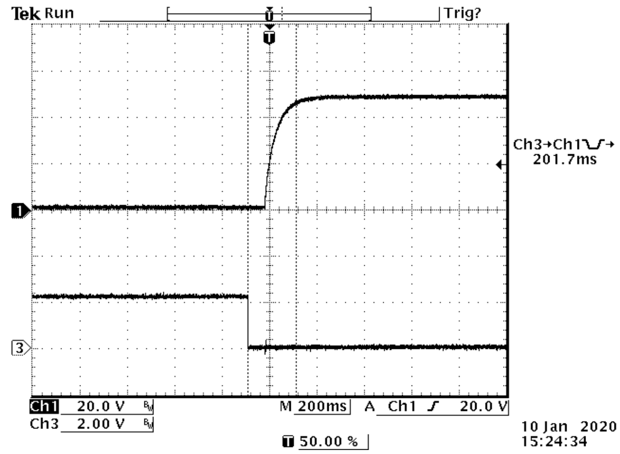


Figure 31. Startup from on/off
Ch1: Vo
Ch3: Vin
***Test Condition:** Vin=110V, Io=1.04A, Vo=48V with Cext=200uF*

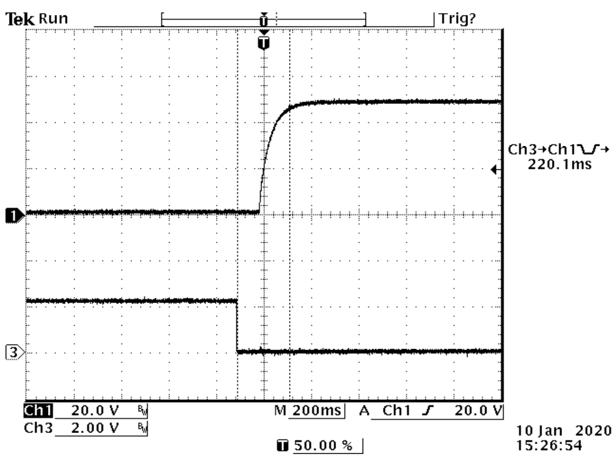


Figure 32. Startup from on/off
Ch1: Vo
Ch3: Vin
***Test Condition:** Vin=48V, Io=1.04A, Vo=48V with Cext=1200uF*

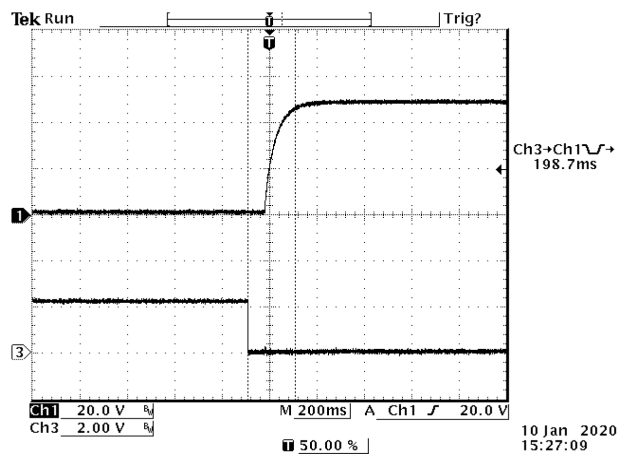


Figure 33. Startup from on/off
Ch1: Vo
Ch3: Vin
***Test Condition**: Vin=110V, Io=1.04A, Vo=48V with Cext=1200uF*

Shut down time

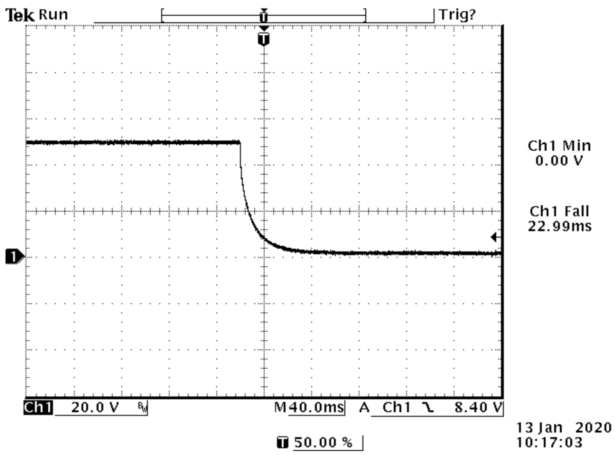


Figure 34. Typical Shut down From Vin

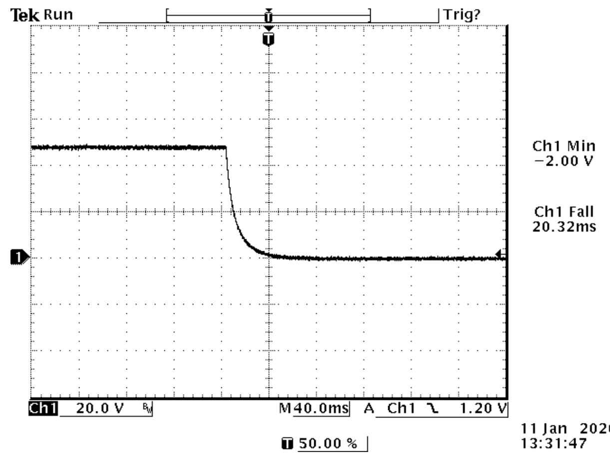


Figure 35. Typical Shut down From Venable

Test Condition: 48Vdc input, 48Vdc/1.04A output and Ta=25 deg C, with 200μF capacitor at output

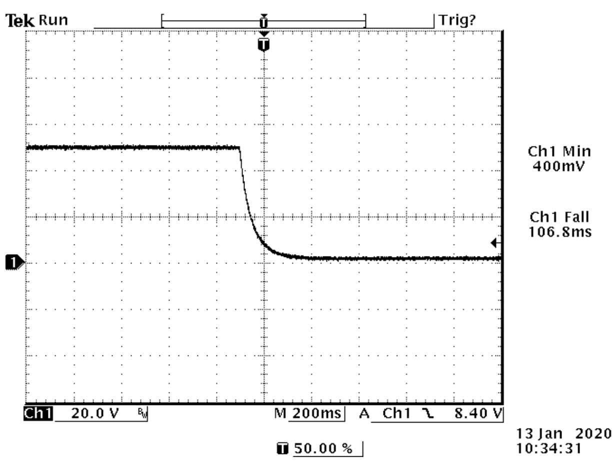


Figure 36. Typical Shut down From Vin

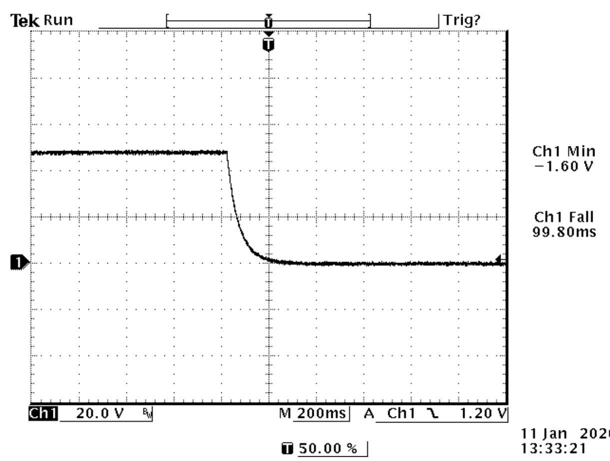


Figure 37. Typical Shut down From Venable

Test Condition: 48Vdc input, 48Vdc/1.04A output and Ta=25 deg C, with 1200μF capacitor at output

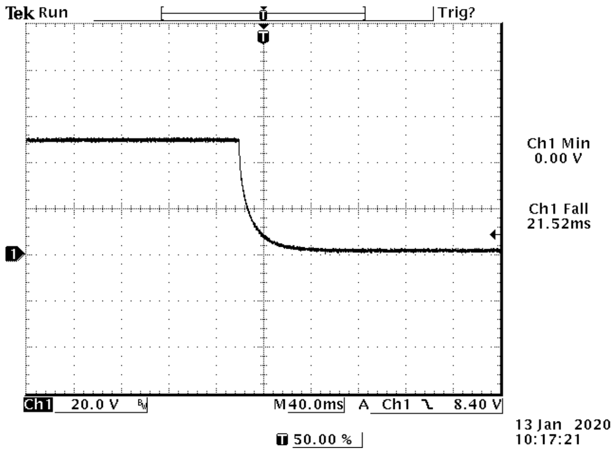


Figure 38. Typical Shut down From Vin

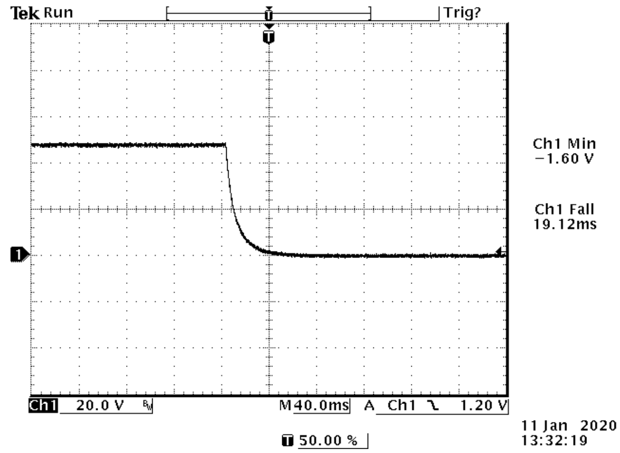


Figure 39. Typical Shut down From Venable

Test Condition: 110Vdc input, 48Vdc/1.04A output and Ta=25 deg C, with 200µF capacitor at output

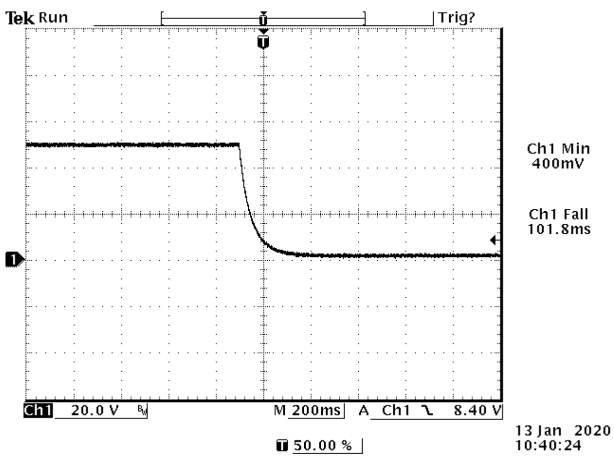


Figure 40. Typical Shut down From Vin

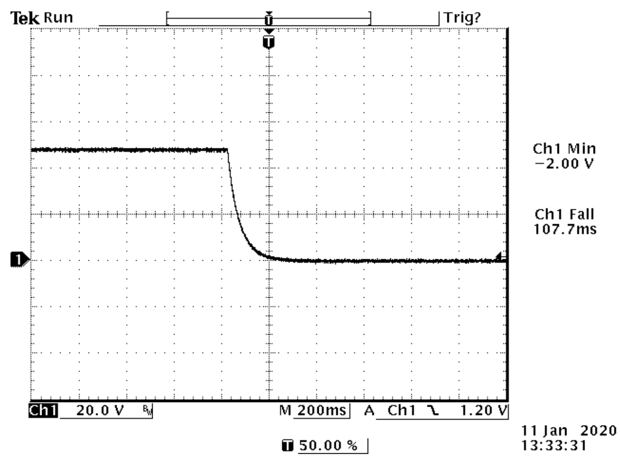


Figure 41. Typical Shut down From Venable

Test Condition: 110Vdc input, 48Vdc/1.04A output and Ta=25 deg C, with 1200µF capacitor at output

12. OVER CURRENT PROTECTION

Hiccup: 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 1600ms. The module operates normally when the output current goes into specified range.

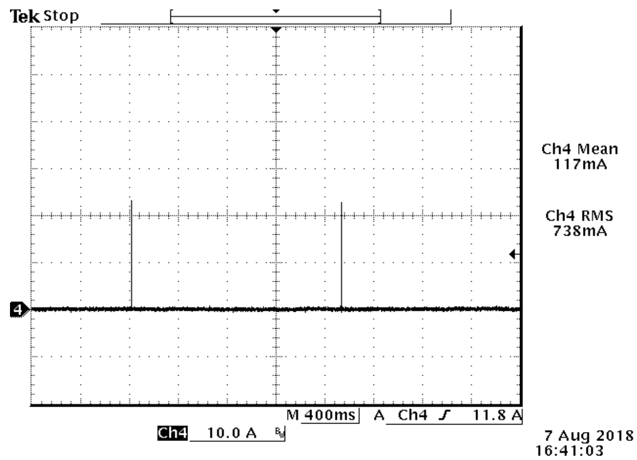


Figure 42. Over current protection

13. INPUT UNDER-VOLTAGE LOCKOUT

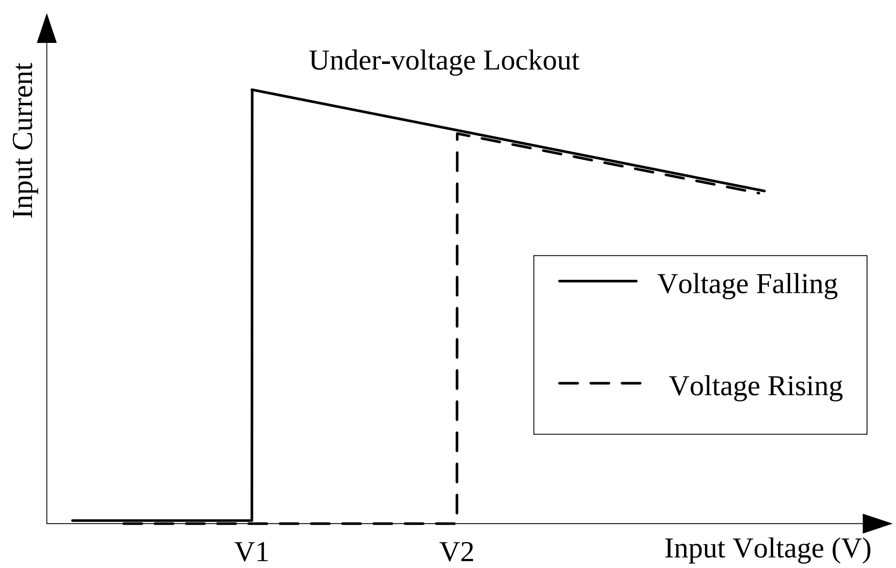


Figure 43. Input under-voltage lockout
V1=12V
V2=13.5V

14. THERMAL DERATING CURVE

Test setup

Vin=24V,48V,110V, 0LFM, external HSK Dimension: 142 x 110 x 16 mm

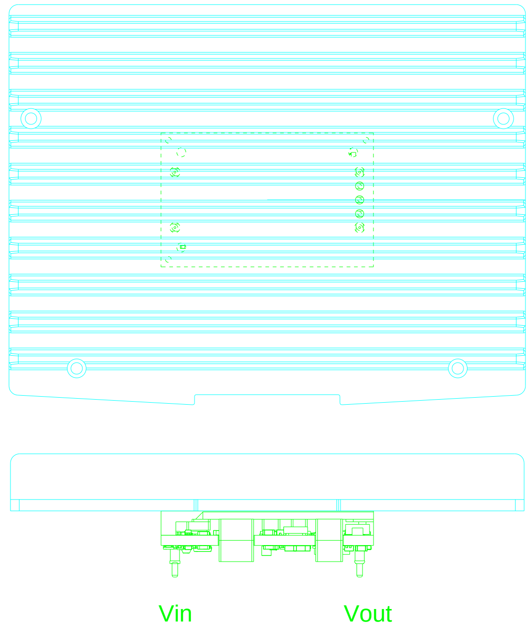


Figure 44. Thermal test setup

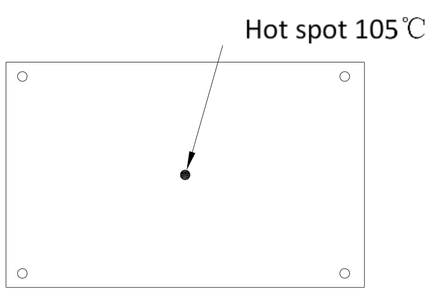


Figure 45. Module top view hot spot

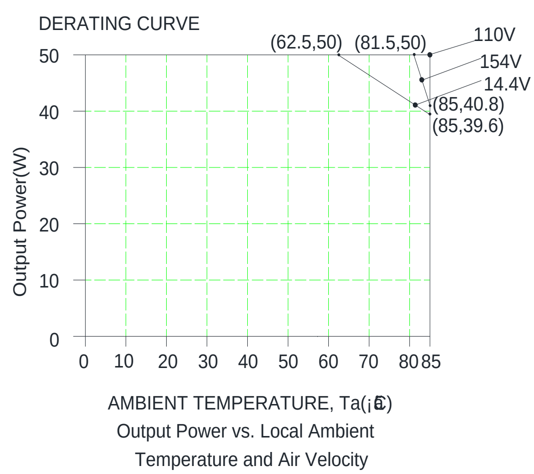


Figure 46. Thermal derating curve

15. HOLD UP CAPACITOR

Recommended external hold up circuit (Option 1)

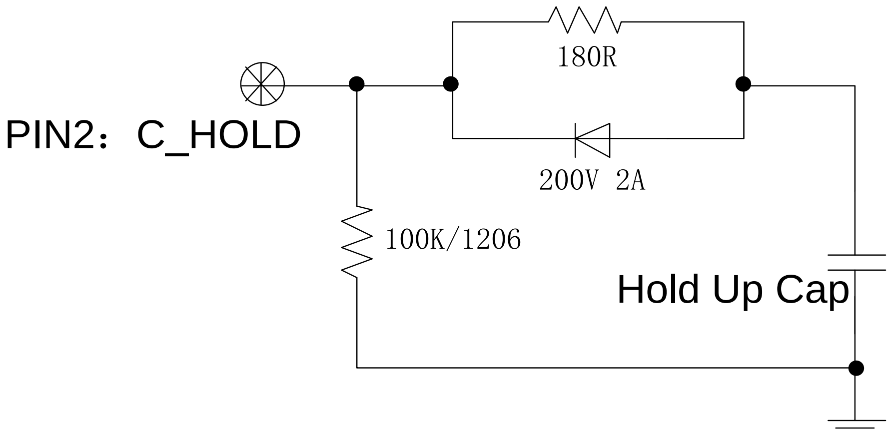


Figure 47. Recommended external hold up circuit-1

NOTE: The rated power of the current-limiting resistor 180R is determined by the rise slope of the input voltage.

PARAMETER	NOTES	SYMBOL	MIN	TYP	MAX	UNITS
Hold up capacitor	Working voltage rating should be 200V. **Caution:** This capacitor is necessary for both normal and hold up operation.	C_HOLD	100	470	-	uF
Hold up voltage	Normal operation	V_HOLD	40	80	154	V
Hold up time	14.4-154 V input and all output range.	T_HOLD	-	12	-	ms

Recommended external hold up circuit (Option 2)

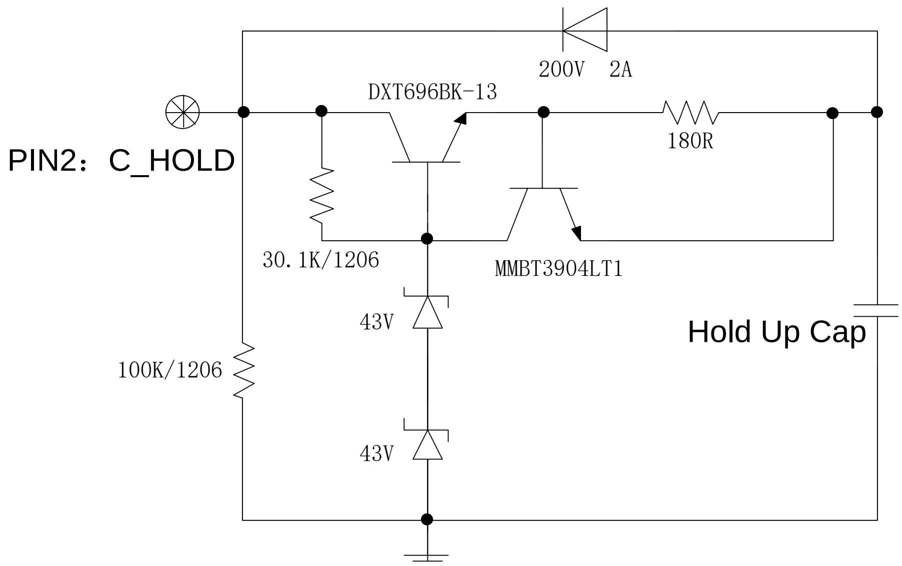


Figure 48. Recommended external hold up circuit-2

NOTE: The rated power of the current-limiting resistor 180R is determined by the rise slope of the input voltage.

PARAMETER	NOTES	SYMBOL	MIN	TYP	MAX	UNITS
Hold up capacitor	Working voltage rating should be 100V. **Caution:** This capacitor is necessary for both normal and hold up operation.	C_HOLD	100	470	-	uF
Hold up voltage	Normal operation	V_HOLD	40	80	86	V
Hold up time	14.4-154 V input and all output range.	T_HOLD	-	12	-	ms

16. SAFETY & EMC

Safety

1. Material flammability UL94V-0
2. Nemko certification EN 62368-1 (TBC)
3. CSA certification CSA/UL 62368-1 (TBC)
4. CB certification IEC/EN 62368-1 (TBC)

EMC

1. Conductive EMI: EN55032 class A

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

Test Setup:

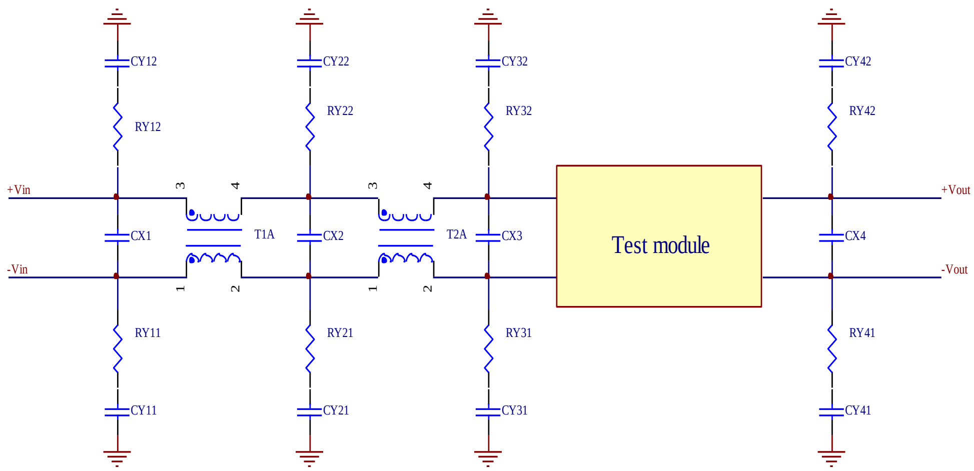


Figure 49.

ITEM	DESIGNATOR	PARAMETER	VENDOR	VENDOR P/N
1	T1A	1.85mH Common mode Choke		
2	CX1	CAP X2 1.377uF+/-20% 310VAC		
3	CY11	CAP Y2 4700PF+/-20% 250VAC		
4	CY12	CAP Y2 4700PF+/-20% 250VAC		
5	T2A	12uH Differential Mode Choke		
6	CX3	CAP X2 1uF +/-20% 310VAC		

Positive:

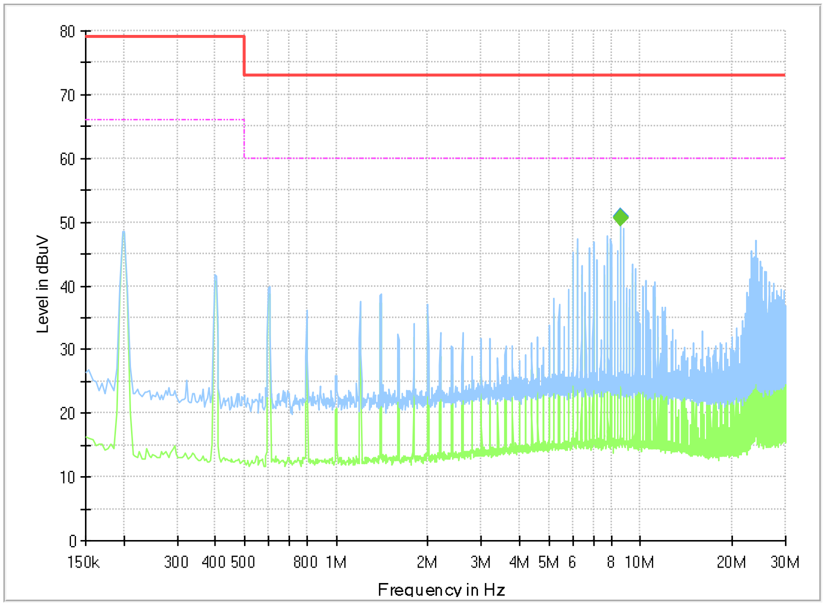


Figure 50.

Negative:

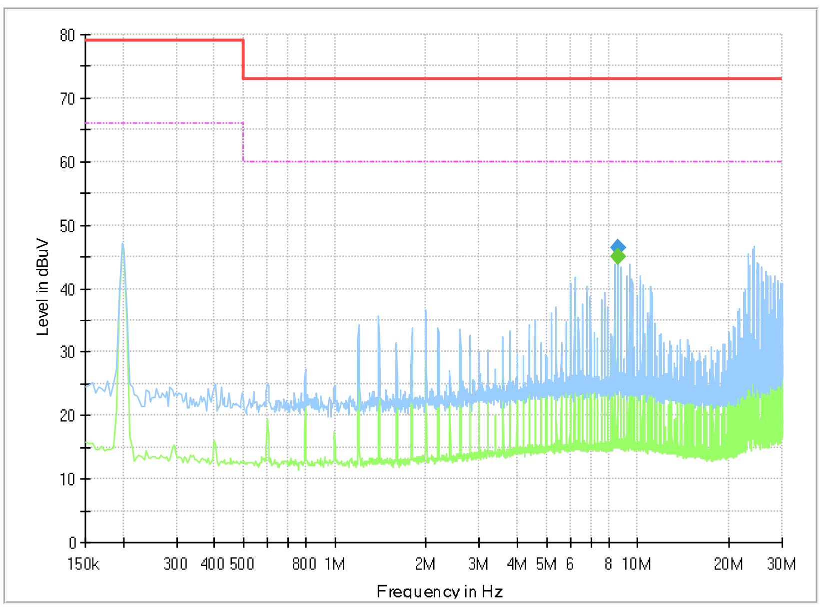


Figure 51.

17. MECHANICAL DIMENSIONS

0RQB-50Y48L/0 OUTLINE

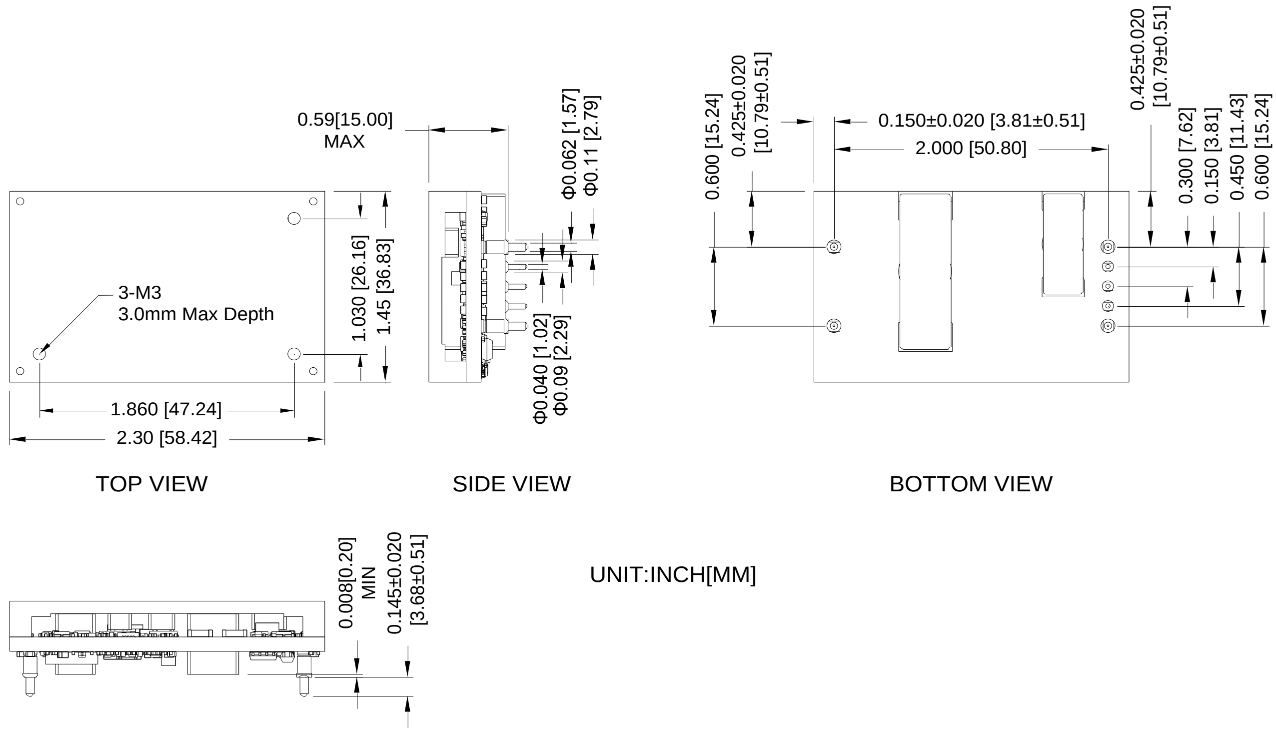


Figure 52. 0RQB-50Y48L/0 Outline

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 inches; Tolerances: x.xx +/-0.02 in [0.51 mm]. x.xxx +/-0.010 in [0.25 mm]. Unless otherwise stated.

0RQB-50Y48L/0 PIN DEFINITIONS

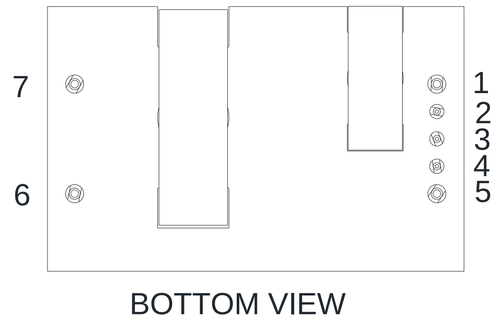


Figure 53. 0RQB-50Y48L/0 Pins

PIN	FUNCTION	PIN	FUNCTION
1	Vin (+)	5	Vin (-)
2	C_HOLD	6	Vout (-)
3	ON/OFF	7	Vout (+)
4	V_AUX(5V)		

0RQB-50Y48L/0 RECOMMENDED PAD LAYOUT

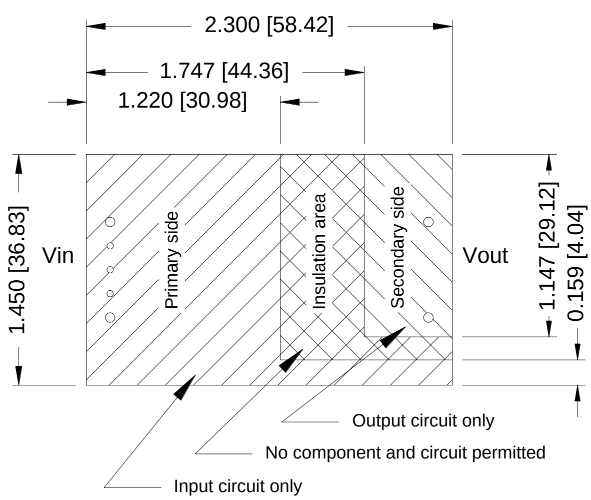


Figure 54. 0RQB-50Y48L/0 Recommended pad layout-1

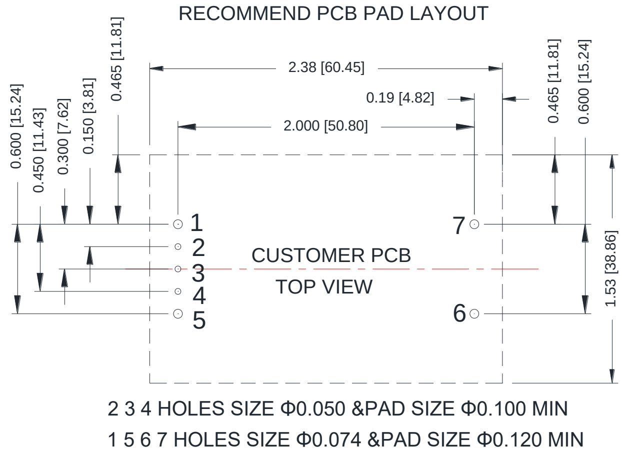


Figure 55. 0RQB-50Y48L/0 Recommended pad layout-2

0RQB-50Y48E/F OUTLINE

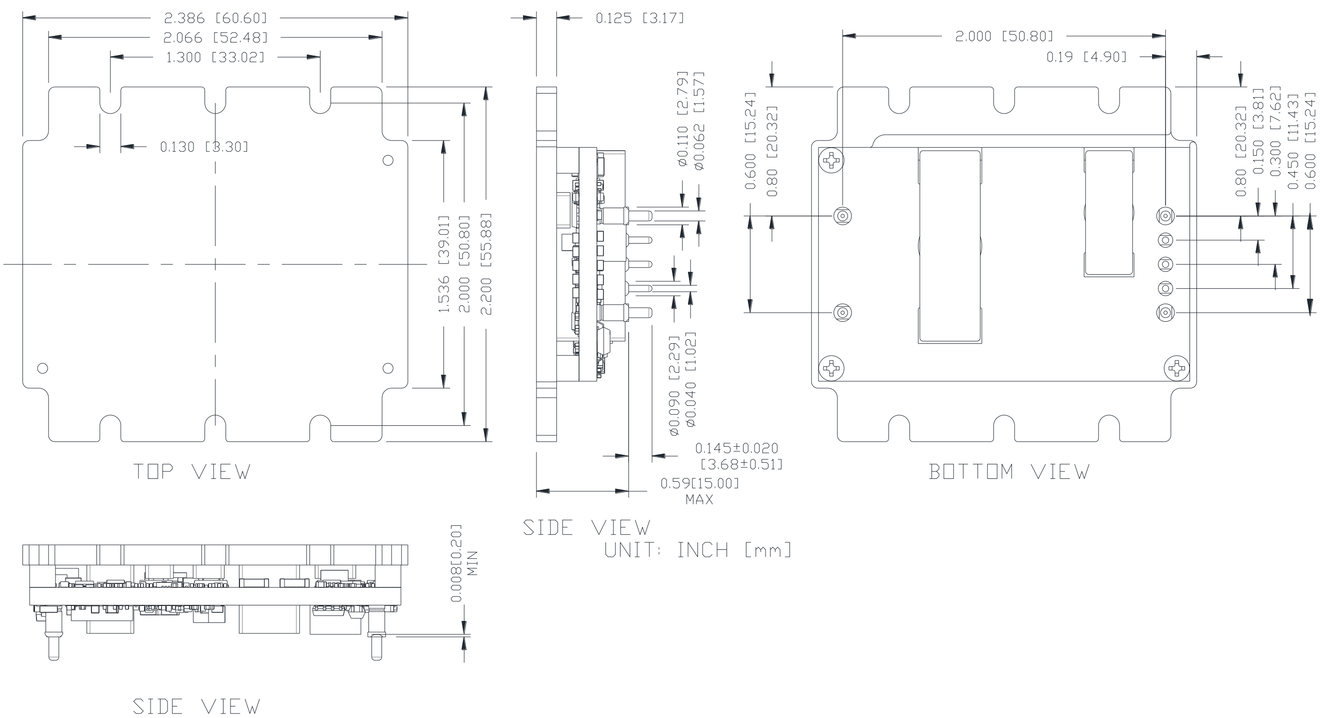


Figure 56. 0RQB-50Y48E/F Outline

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 inches; Tolerances: x.xx +/-0.02 in [0.51 mm]. x.xxx +/-0.010 in [0.25 mm]. Unless otherwise stated.

0RQB-50Y48E/F PIN DEFINITIONS

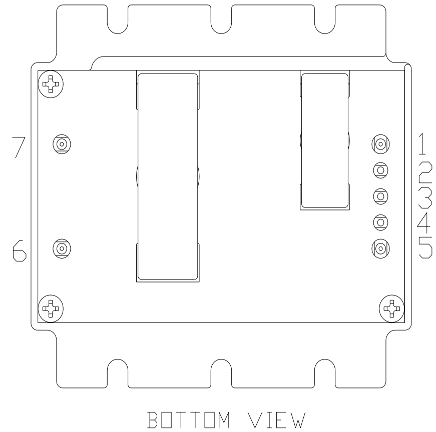


Figure 57. 0RQB-50Y48E/F Pins

PIN	FUNCTION	PIN	FUNCTION
1	Vin (+)	5	Vin (-)
2	C_HOLD	6	Vout (-)
3	ON/OFF	7	Vout (+)
4	V_AUX(5V)		

0RQB-50Y48E/F RECOMMENDED PAD LAYOUT

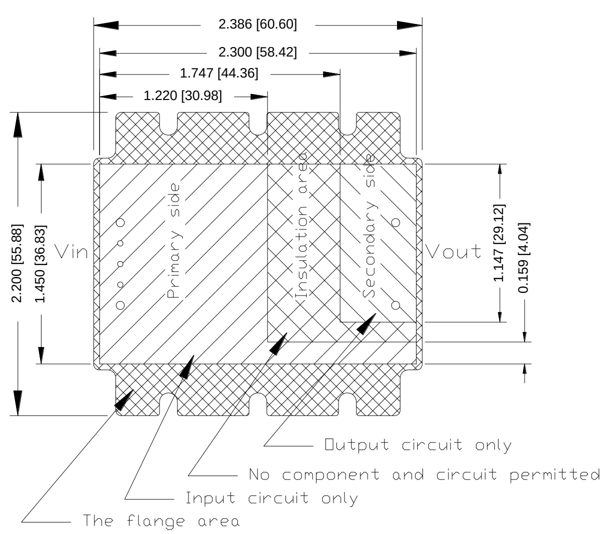


Figure 58. 0RQB-50Y48E/F Recommended pad layout-1

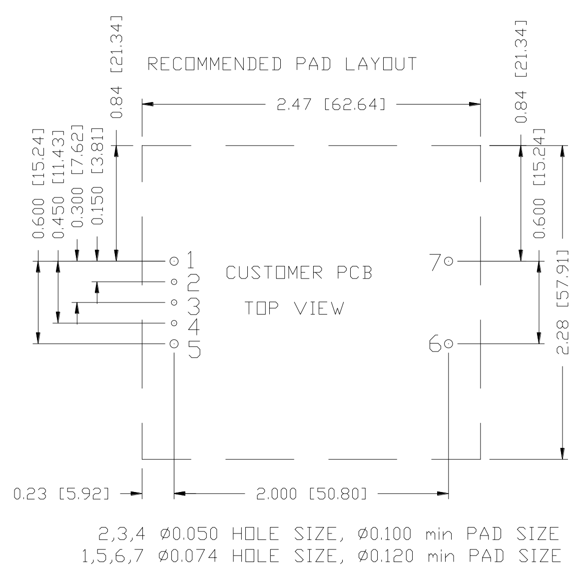


Figure 59. 0RQB-50Y48E/F Recommended pad layout-2

18. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2018-01-10	AA	First release	J Yao
2018-04-26	AB	Update MD	J Yao
2019-10-24	AC	Add feature reinforced isolation	J.Yao
2020-10-08	AD	Update electrical feature	J.Yao
2020-10-13	AE	Change TBD to TBC	F.Tao
2020-11-04	AF	Delete watermark	J.Yao
2020-11-25	AG	Update hold up capacitor.	J.Yao
2021-04-01	AH	Add object ID. Add FIT, MTBF, weight and dimensions for flange version.	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.