

0RQB-50Y05L

Isolated DC-DC Converter

The 0RQB-50Y05L is an isolated DC/DC converter providing 50 W of output power from a wide input range (24 V, 48 V, 72 V, 96 V, 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 12 mS when the input supply is interrupted.

Conformal coated PCB is used for environmental ruggedness.

Key Features & Benefits

- 24/48/72/96/110 VDC Input / 5 VDC @ 10 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
- Approved to CSA/UL 62368-1
- Class II, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)



Applications

- Industrial
- Railways

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
ORQB-50Y05L	5 VDC	24/48/72/96/110VDC	10A	50 W	88% @110 V

NOTE: 1. Add "G" suffix at the end of the model number to indicate Packaging.

PART NUMBER EXPLANATION

0	R	QB	-	50	Y	05	L	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	24/48/72/96/110V	5 V	L- Active low, with baseplate	G - Tray package

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.5	-	160	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	137.5	V
			48		
			72		
			96		
			110		
Operating Input Voltage 2	Fully functioning for 0.1s operation. Full function is not guaranteed but Undamaged for 1s operation	12.9	-	14.4	V
			137.5	-	154
Input Voltage Rising Slope		-	-	2	V/ms
Input Current (full load)		-	-	5.0	A
Input Current (no load)		-	100	300	mA
Remote Off Input Current		-	-	40	mA
Input Reflected Ripple Current (rms)	With simulated source impedance of 1uH, 5Hz to 20MHz. Use a 100uF/250V electrolytic capacitor with ESR=1 ohm max, at 200KHz@25°C..	-	-	150	mA
Input Reflected Ripple Current (pk-pk)		-	-	500	mA
Turn-on Voltage Threshold		12.5	13.5	14	V
Turn-off Voltage Threshold		11	12	12.5	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 25 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	(Over all operating input voltage, resistive load, and temperature conditions until end of life)	4.9	5	5.1	V
Load Regulation		-	-	20	mV
Line Regulation		-	-	10	mV
Regulation Over Temperature		-	-	±100	mV
Output Ripple and Noise(PK-PK)	With 200uF electrolytic capacitors at output.	-	50	80	mV
Output Ripple and Noise(RMS)		-	10	15	mV
Output Current Range		0	-	10	A
Output DC Current Limit	Enter a hiccup mode, non-latching.	11	-	14	A
Rise time		-	-	70	ms
Output pre-bias Voltage		0	-	3	V
Start-up time	Start up from Vin	-	-	1500	ms
	Start up from remote on/off	-	-	150	ms
Overshoot at Turn on		-	0	3	%
Output Capacitance	Typically 50% ceramic and 50% electrolytic capacitors.	200	-	1000	uF
5V Auxiliary Supply Source Current		-	-	5	mA
Transient Response					
ΔV 50%~75% of Max Load		-	250	350	mV
Settling Time	di/dt=0.1A/us, with a 100uF ceramic and a 100uF electrolytic capacitors near the birck output.	-	0.5	1	ms
ΔV 75%~50% of Max Load		-	250	350	mV
Settling Time		-	0.5	1	ms

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin=24V, Iout=10A	78	-	-	%
	Vin=48V, Iout=10A	80	-	-	%
	Vin=72V, Iout=10A	84	-	-	%
	Vin=96V, Iout=10A	85	-	-	%
	Vin=110V, Iout=10A	87	-	-	%
Switching Frequency	1st stage	-	150	-	kHz
	2nd stage	-	250	-	kHz
Over Temperature Protection	Temperature measured at semiconductor component	-	125	135	°C
Over Voltage Protection(Static)	Enter a latching.non-hiccup mode	-	-	6	V
FIT2	Calculated Per Bell Core SR-332 (Vin=48 V, Vo=12 V, Io=28 A, FIT=10 ⁹ /MTBF)	-	93.7	-	-
MTBF		-	5.162	-	Mhrs
Isolation Voltage		-	-	3000	V
Weight		-	63	-	g
Dimensions					
Inches (L x W x H)			2.30 x 1.45x 0.59		Inches
Millimeters (L x W x H)			58.42 x 36.75 x 15		Millimeters
Isolation Characteristics					
Input to Output		-	-	3000	Vdc
Input to Heatsink		-	-	3000	Vdc
Output to Heatsink		-	-	3000	Vdc
Isolation Resistance	Test with 500VDC	100M	-	-	Ohm
Isolation Capacitance		-	-	2200	pF

6. EFFICIENCY DATA

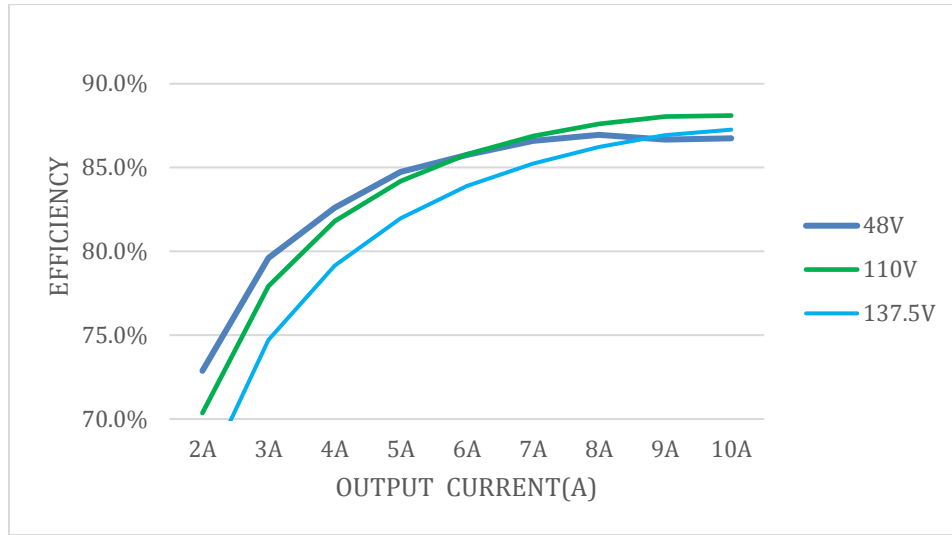


Figure 1. Efficiency data

7. REMOVE ON/OFF

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V
Signal High (Unit Off)		2.4	-	15	V
Current Sink		0	-	1	mA

Recommended Remote On/Off Circuit for Active Low

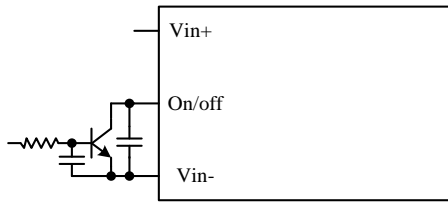


Figure 2. Control with open collector/drain circuit

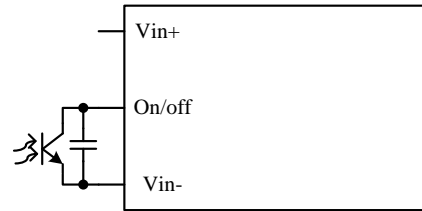


Figure 3. Control with photocoupler circuit

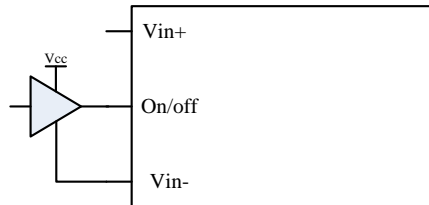


Figure 4. Control with logic circuit

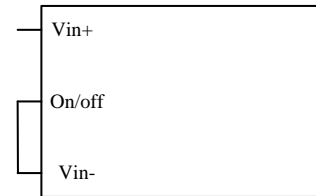


Figure 5. Permanently on

8. INPUT NOISE

Input reflected ripple current

Testing set up

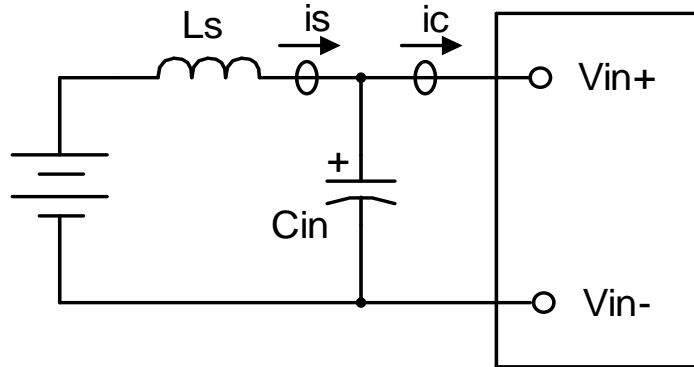


Figure 6.

Notes and values in testing.

is: Input Reflected Ripple Current

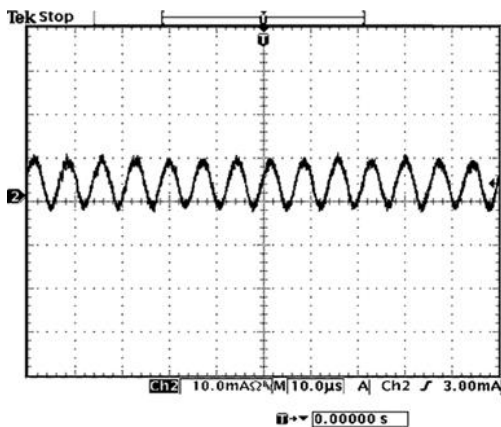
ic: Input Terminal Ripple Current

Ls: Simulated Source Impedance (1μH)

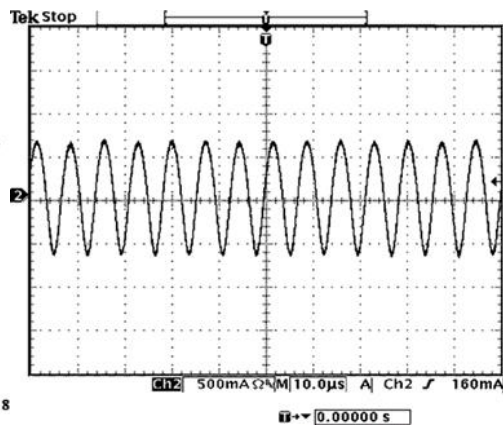
Cin: Electrolytic capacitor, should be as closed as possible to the power module to swallow ic ripple current and help with stability.

Recommendation: 2* 100μF, ESR<0.5R @ 100 kHz, 20C

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



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11:11:11



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11:09:51

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

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

Test condition: 48Vdc input, 5Vdc/10A output and Ta=25 deg C, with 200μF AL capacitor at output

9. RIPPLE AND NOISE WAVEFORM

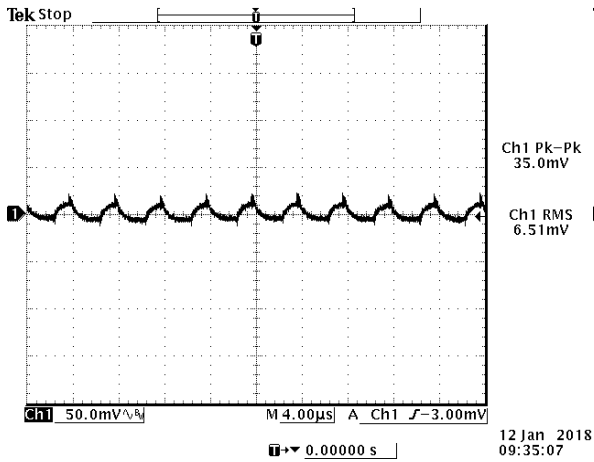


Figure 9. Ripple and noise, 48Vdc input
5Vdc/10A output and $T_a=25$ deg C
With 200µF AL capacitor at output.

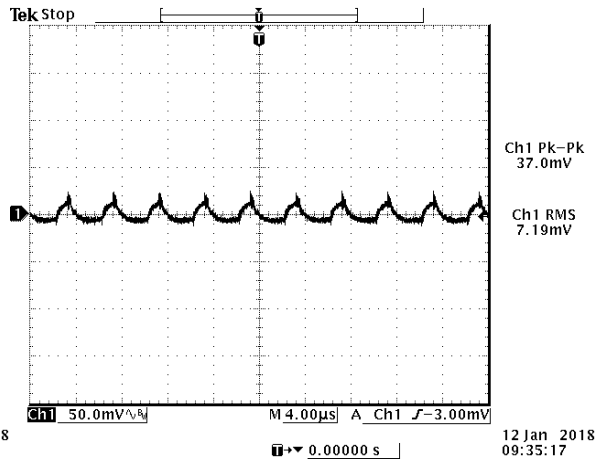


Figure 10. Ripple and noise, 110Vdc input
5Vdc/10A output and $T_a=25$ deg C
With 200µF AL capacitor at output.

10. THERMAL DERATING CURVES

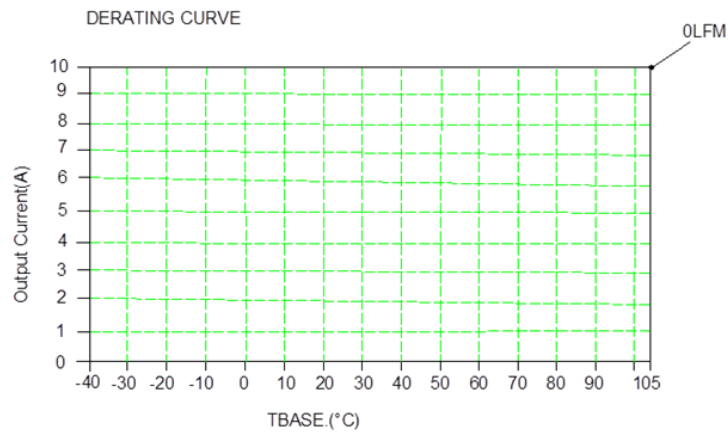


Figure 11. Derating curve

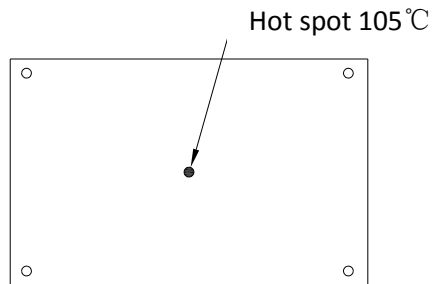


Figure 12. Module top view

11. TRANSIENT RESPONSE WAVEFORMS

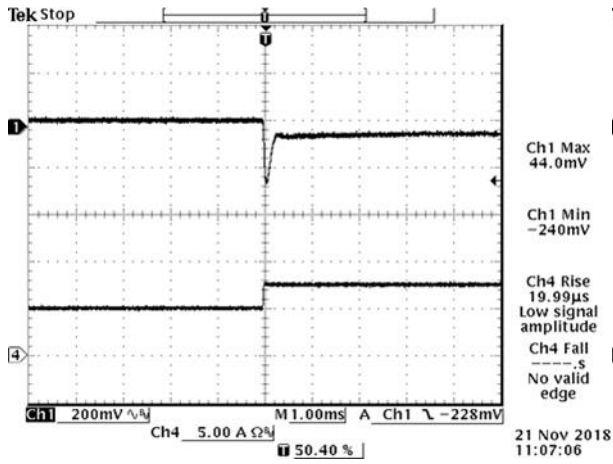


Figure 13. 50%-75% Load Transients at $V_{in}=48V@T_a=25^\circ C$

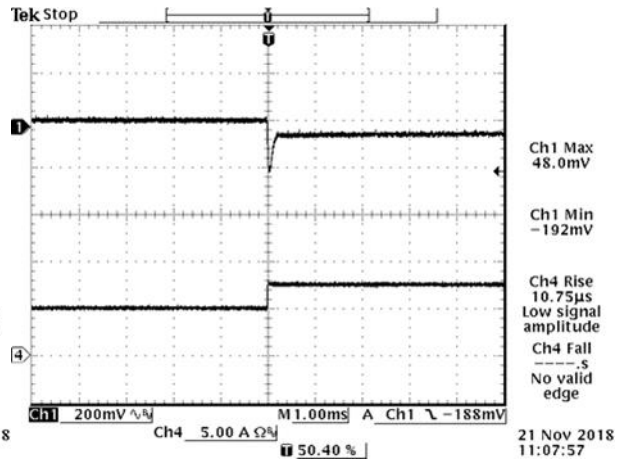


Figure 14. 50%-75% Load Transients at $V_{in}=110V@T_a=25^\circ C$

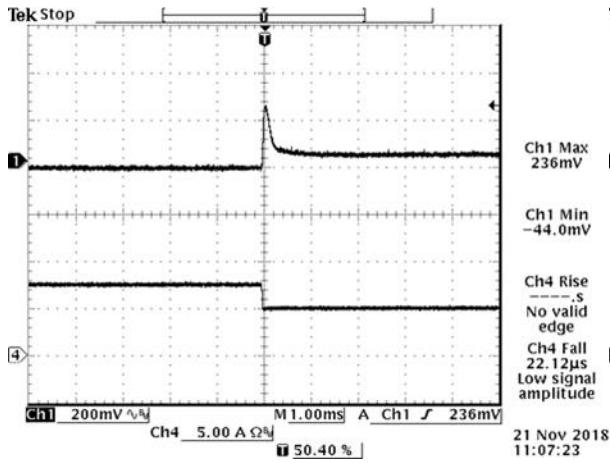


Figure 15. 75%-50% Load Transients at $V_{in}=48V@T_a=25^\circ C$

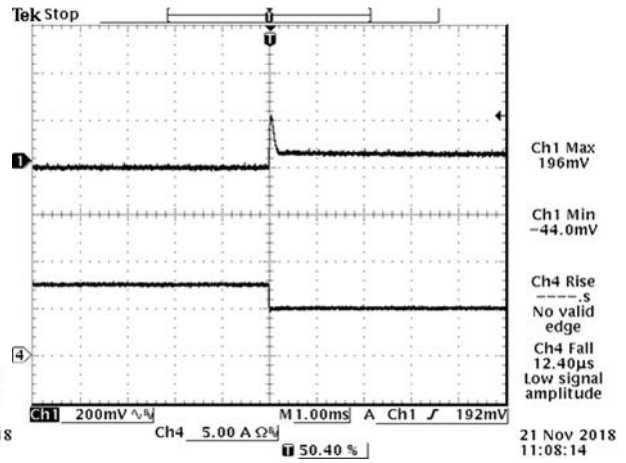
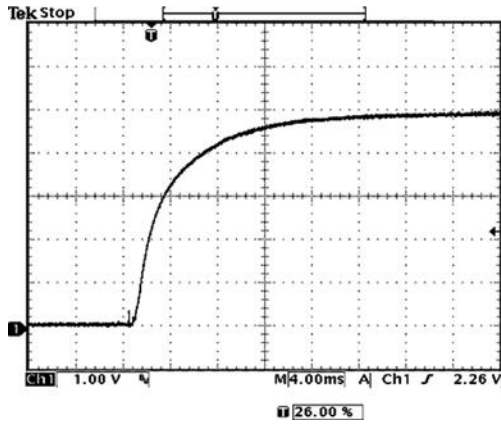


Figure 16. 75%-50% Load Transients at $V_{in}=110V@T_a=25^\circ C$

12. STARTUP & SHUTDOWN

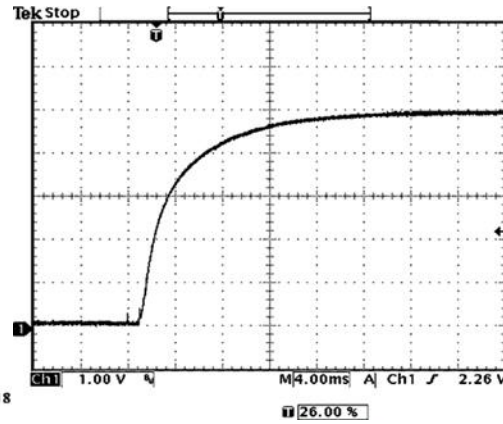
Turn on rise time



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Figure 17.

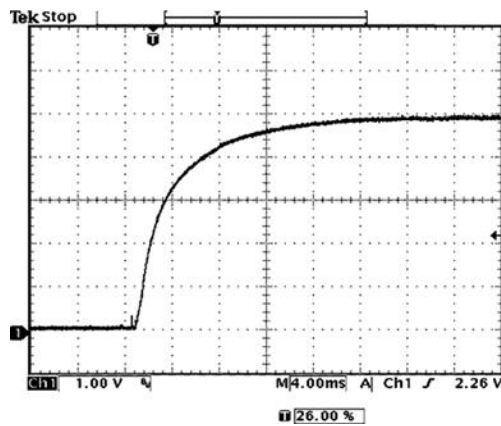
Test Condition: $V_{in}=48V$, $I_o=10A$, $V_o=5V$:



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13:10:48

Figure 18.

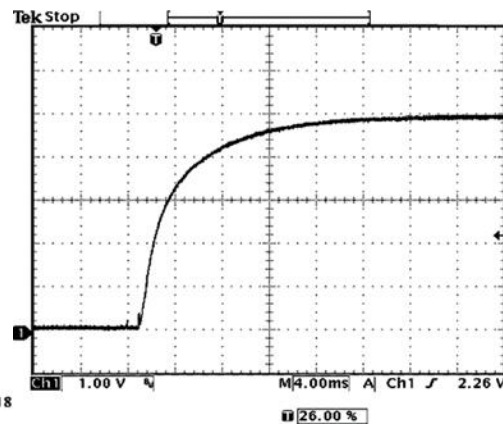
Test Condition: $V_{in}=110V$, $I_o=10A$, $V_o=5V$



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13:09:54

Figure 19.

Test Condition: $V_{in}=48V$, $I_o=10A$,
 $V_o=5V$, with $C_{ext}=1000\mu F$



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13:10:21

Figure 20.

Test Condition: $V_{in}=110V$, $I_o=10A$,
 $V_o=5V$, with $C_{ext}=1000\mu F$

STARTUP & SHUTDOWN (CONTINUED)

Turn on delay time

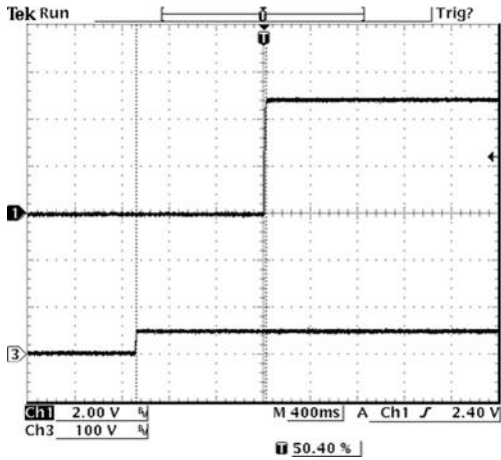


Figure 21.

Startup from Vin

Ch1: Vo
Ch2: Vin

Test Condition: Vin=48V, Io=10A, Vo=5V

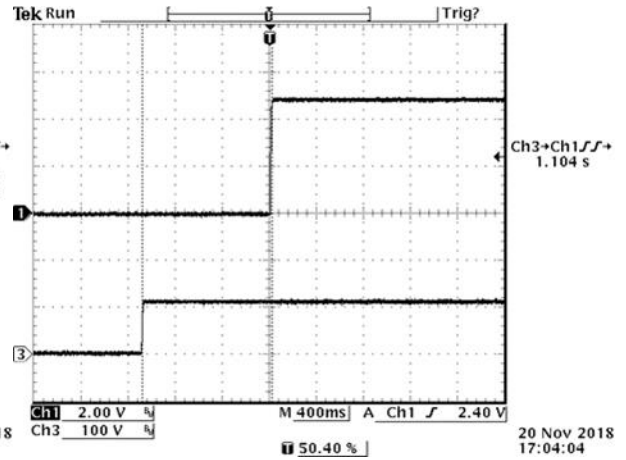


Figure 22.

Startup from Vin

Ch1: Vo
Ch2: Vin

Test Condition: Vin=110V, Io=10A, Vo=5V

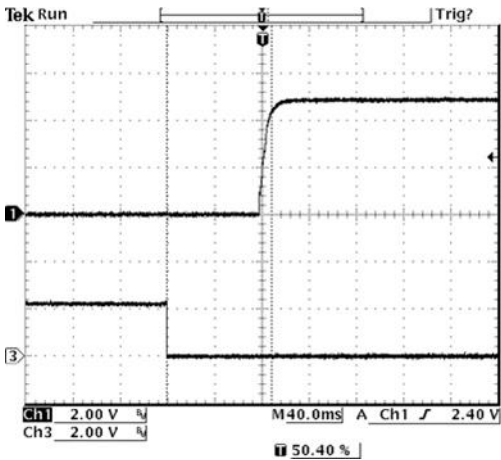


Figure 23.

Startup from on/off

Ch1: Vo
Ch2: on/off

Test Condition: Vin=48V, Io=10A, Vo=5V

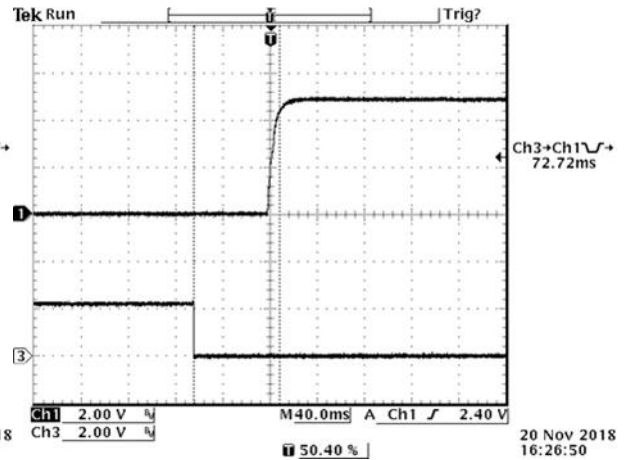


Figure 24.

Startup from on/off

Ch1: Vo
Ch2: on/off

Test Condition: Vin=110V, Io=10A, Vo=V

STARTUP & SHUTDOWN (CONTINUED)

Shut down time

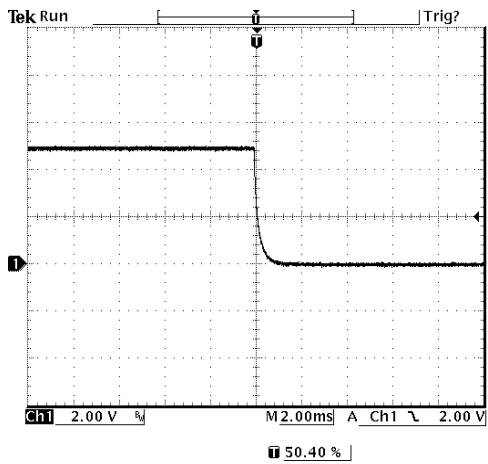


Figure 25.

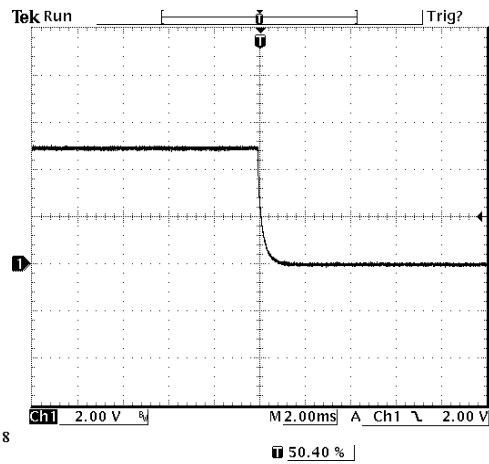


Figure 26.

Test Condition: 48VDC Vin, 5V, 10A output, Cout 1000uF

Notes: Typical Shut down From Vin.

Notes: Typical Shut down From Venable.

13. INPUT UNDER VOLTAGE LOCKOUT

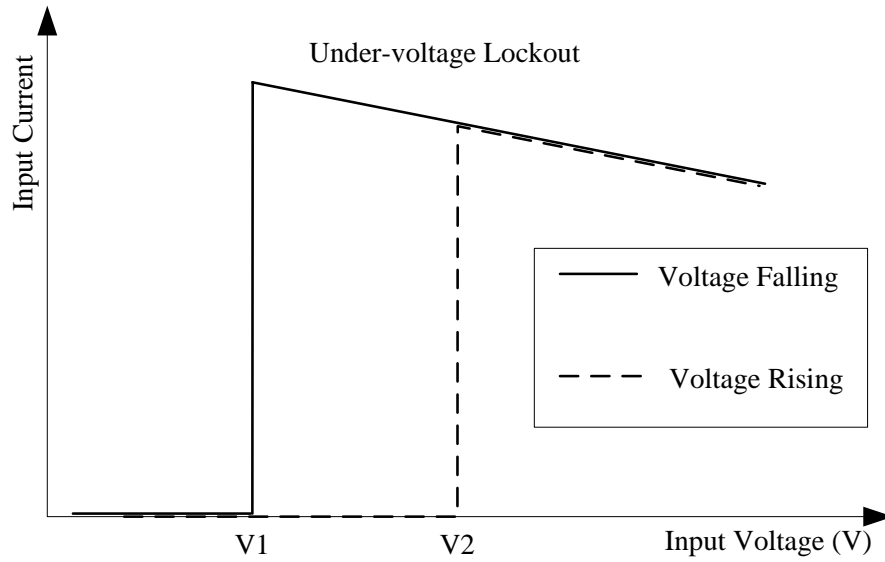


Figure 27. Input under voltage lockout

$V_1 = 12V$

$V_2 = 13.5V$

14. HOLD UP CAPACITOR

Recommended external hold up circuit (Option 1)

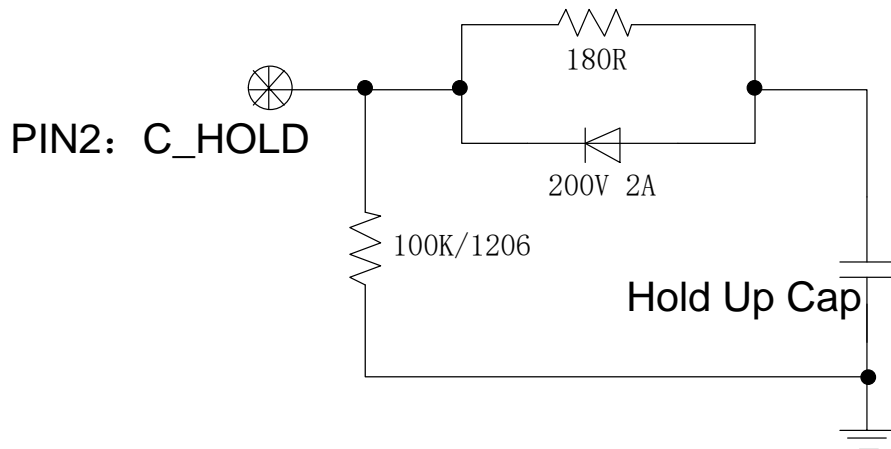


Figure 28. Recommended external hold up circuit-1

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	-	470	-	uF
Hold up voltage	Normal operation	V_HOLD	40	80	154	V
Hold up time	14.4-154V input and all output range.	T_HOLD	12	-	-	ms

HOLD UP CAPACITOR (CONTINUED)

Recommended external hold up circuit (Option 2)

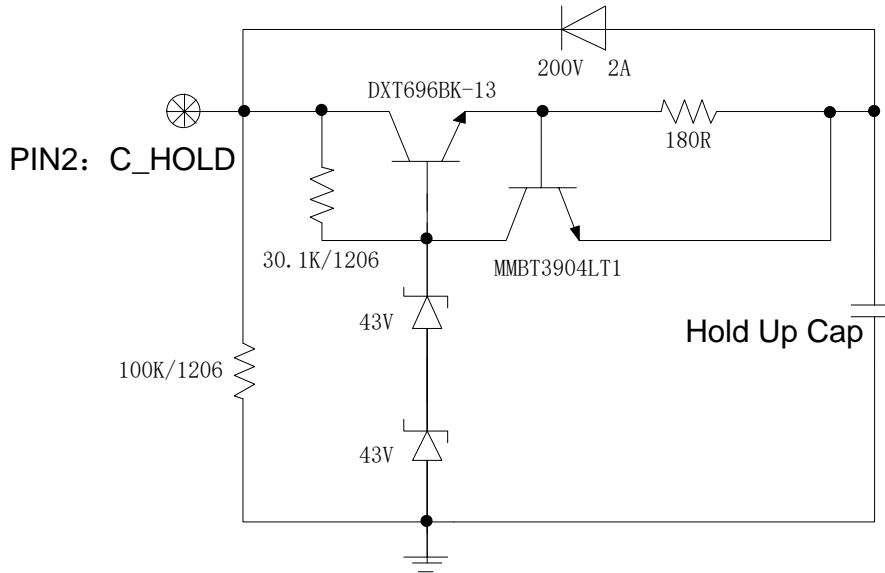


Figure 29. Recommended external hold up circuit-2

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	-	470	-	uF
Hold up voltage	Normal operation	V_HOLD	40	80	86	V
Hold up time	14.4-154V input and all output range	T_HOLD	12	-	-	ms

15. OVER CURRENT PROTECTION

Requirement: Describe OCP is in hiccup mode or latch off mode. If in hiccup mode, please provide the waveform of OCP which should include 2-3 restart cycles, and mark the time of restart period. It is better to provide the waveform of zooming in to show the time of working.

Hiccup: To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry and can endure current limiting for a few mili-seconds. If the overcurrent 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. The typical average output current is 0.1A during hiccup.

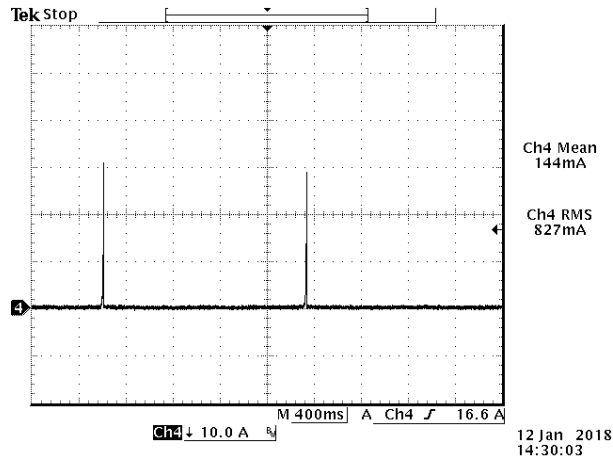


Figure 30. Over current protection

16. SAFETY & EMC

Safety:

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

EMC

- 1. Conductive EMI: EN55022 class A Compliance to EN55022 class A (both peak and average) with the following inductive and capacitive filter

Setup:

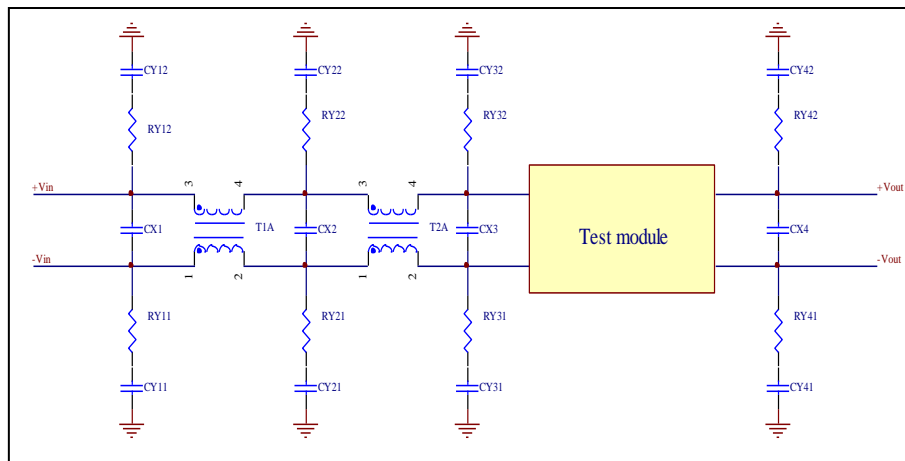


Figure 31.

Item	Designator	Parameter	Vendor	Vendor P/N
1	CX2	1µF/305V,X2		
2	CX3	100µF/200V, AL cap		
3	CX4	2*100µF/16V, tantalum capacitor		
4	CY31	4700PF, Y2		
5	CY32	4700PF, Y2		
6	RY31	1206,0R,Resistor		
7	RY32	1206,0R,Resistor		
8	T2A	2.4mH, common mode inductance		
9	RY11, RY12, CY11, CY12, CX1, T1A, RY21, RY22, CY21, CY22, RY41, RY42, CY41, CY42	NIL		

SAFETY & EMC(CONTINUED)

Positive

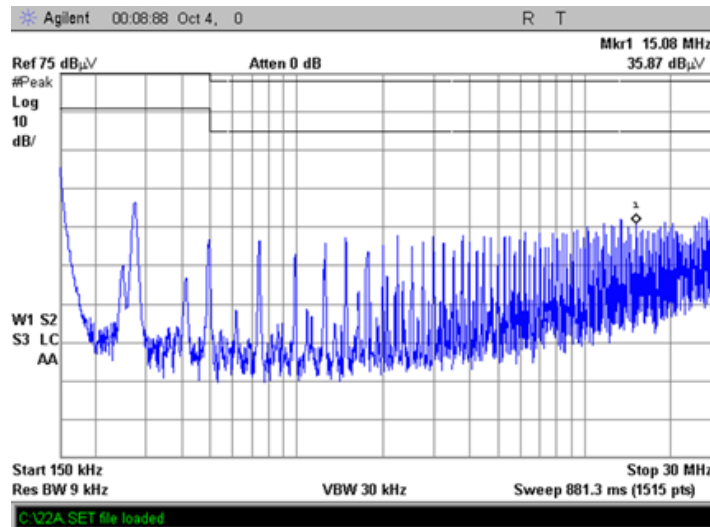


Figure 32.

Negative

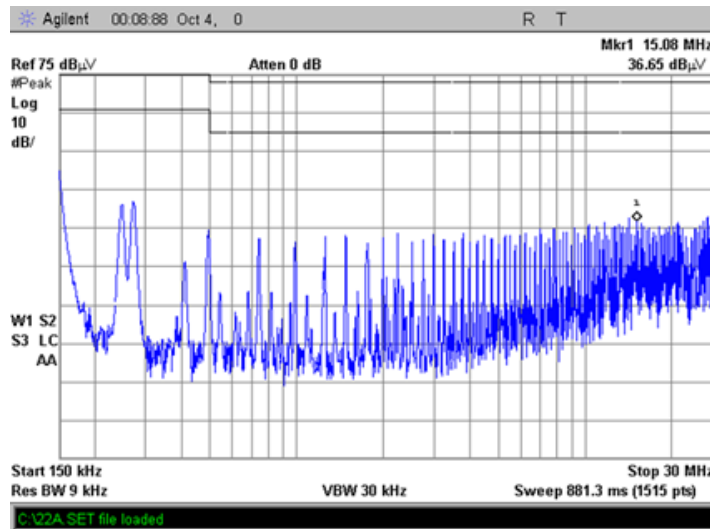


Figure 33.

17. MECHANICAL DIMENSIONS

OUTLINE

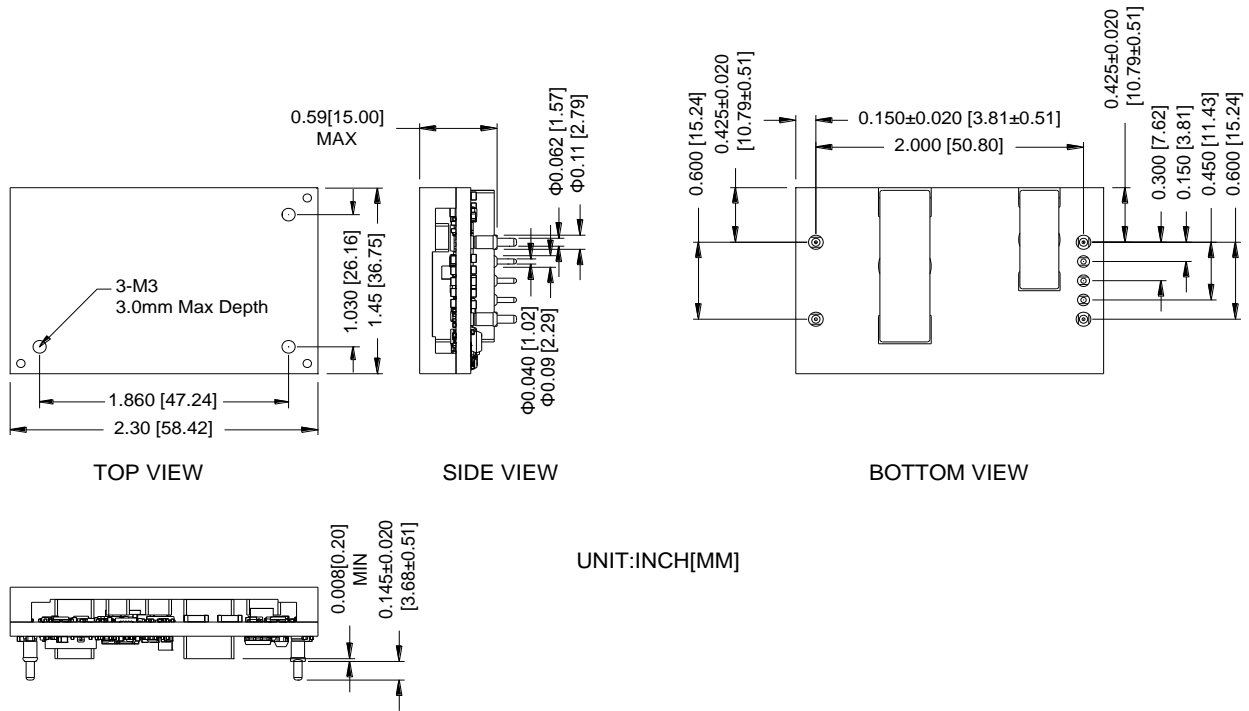


Figure 34. Outline

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.

All Pins: Material - Copper Alloy;
Finish - Tin plated.

Note:

- 1) Undimensioned components are shown for visual reference only.
- 2) All dimensions in inches; Tolerances: x.xx +/-0.02 in [0.5 mm]. x.xxx +/-0.010 in [0.25 mm]. Unless otherwise stated.
- 3) In pin definition, "NA" means no pin is assembled, the corresponding function is not available.

MECHANICAL DIMENSIONS(CONTINUED)

PIN DEFINITIONS

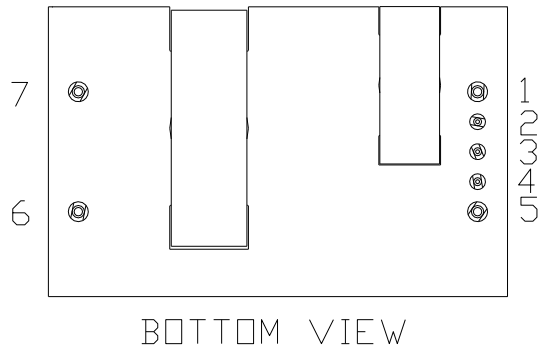


Figure 35. Pins

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

RECOMMENDED PAD LAYOUT

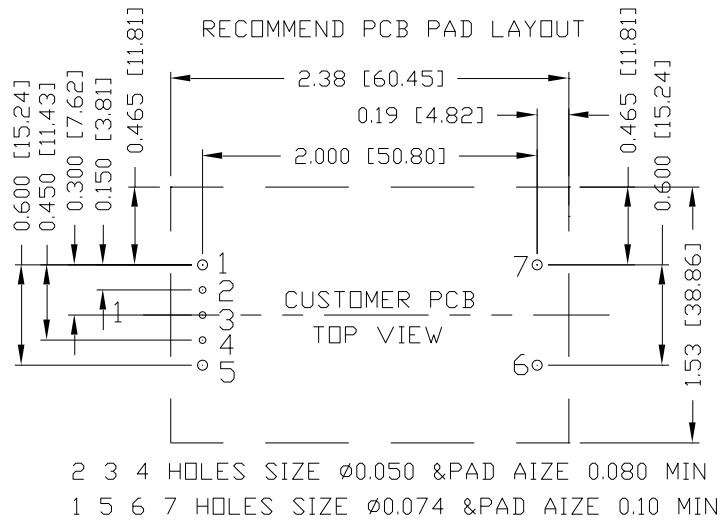


Figure 36. Recommended pad layout

18. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2017-09-18	AA	First release	S. Wang
2018-05-07	AB	Update Efficiency, TD, Specifications, Mechanical Dimensions and Key Features & Benefits Add Waveforms and Safety &EMC	S.Wang
2018-12-14	AC	Update input specifications, Transient Response, efficiency, TD, Mechanical dimensions, OCP and Safety &EMC	S.Wang
2019-03-13	AD	Update input specifications	S.Wang
2019-04-10	AE	Update general specifications	S.Wang
2019-05-14	AF	Update Transient Response and general specifications	S.Wang
2019-09-06	AG	Update output pre-bias ,star up time Turn-on Voltage Threshold and Turn-off Voltage Threshold	S.Wang
2019-10-24	AH	Add feature reinforced isolation	S.Wang
2020-01-15	AI	Add safety approved to IEC/EN 62368-1 and CSA/UL 62368-1. Update altitude to 5000m	F.Tao

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.