

# 0RCY-D4T12H

## Isolated DC-DC Converter

The 0RCY-D4T12H is an isolated DC/DC converter that operate from a nominal 48 VDC source. This unit provides up to 240 W of output power from a nominal 48 VDC input. This unit is designed to be highly efficient and low cost.

Features include remote on/off, short circuit protection, over current protection, under voltage lockout and over-temperature protection.

The converter is provided in an industry standard eighth brick package.



### Key Features & Benefits

- 48 VDC Input
- 12 VDC @ 20 A Output
- 1/8th Brick Converter
- Fixed Frequency (350 kHz)
- High Efficiency
- High Power Density
- Input Under Voltage Lockout
- OCP/SCP
- Output Over-voltage Protection
- Over Temperature Protection
- Remote On/Off
- Low Cost
- Basic Isolation
- 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)

### Applications

- Networking
- Computers and Peripherals
- Telecommunications

## 1. MODEL SELECTION

| MODEL NUMBER | OUTPUT VOLTAGE | INPUT VOLTAGE | MAX. OUTPUT CURRENT | MAX. OUTPUT POWER | TYPICAL EFFICIENCY |
|--------------|----------------|---------------|---------------------|-------------------|--------------------|
| ORCY-D4T12HG | 12 VDC         | 48 VDC        | 20 A                | 240 W             | 95.5% (Half load)  |

### PART NUMBER EXPLANATION

| 0                  | R           | CY          | - | D4           | T           | 12             | H                      | G            |
|--------------------|-------------|-------------|---|--------------|-------------|----------------|------------------------|--------------|
| Mounting Type      | RoHS Status | Series Name |   | Output Power | Input Range | Output Voltage | Active Logic           | Package Type |
| Through hole mount | RoHS        | 1/8th Brick |   | 240 W        | 36 - 75 V   | 12 V           | Active Low, Open Frame | Tray package |

## 2. ABSOLUTE MAXIMUM RATINGS

| PARAMETER                              | DESCRIPTION    | MIN  | TYP | MAX  | UNITS |
|----------------------------------------|----------------|------|-----|------|-------|
| Continuous Non-operating Input Voltage |                | -0.3 | -   | 80   | V     |
| Input Transient Voltage                | 100 ms maximum | -    | -   | 100  | V     |
| Remote On/Off                          |                | -0.3 | -   | 18   | V     |
| I/O Isolation Voltage                  |                | -    | -   | 2250 | V     |
| Ambient Temperature                    |                | -40  | -   | 85   | °C    |
| Storage Temperature                    |                | -55  | -   | 125  | °C    |
| Altitude                               |                | -    | -   | 2000 | 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                                |                                                                                                                                                        | 36  | 48  | 75  | V                |
| Input Current (full load) <sup>1</sup>                 | Test at 40 V input voltage                                                                                                                             | -   | -   | 8   | A                |
|                                                        | Test at 36 V input voltage                                                                                                                             | -   | -   | 8.5 | A                |
| Start Up Current                                       | Test at 36 V input voltage, 100% load with 5000 $\mu$ F Co.                                                                                            | -   | 7   | 12  | A                |
| Input Current (no load)                                |                                                                                                                                                        | -   | 60  | 100 | mA               |
| Remote Off Input Current                               |                                                                                                                                                        | -   | 3   | 6   | mA               |
| Input Reflected Ripple Current (rms)                   | With simulated source impedance of 10 $\mu$ H, 5 Hz to 20 MHz. Use a 100 $\mu$ F/100 V electrolytic capacitor with ESR = 1 ohm max, at 200 kHz @ 25°C. | -   | 2   | -   | mA               |
| Input Reflected Ripple Current (pk-pk)                 |                                                                                                                                                        | -   | 10  | 20  | mA               |
| Input Voltage Ripple Rejection                         | 120 Hz                                                                                                                                                 | -   | 60  | -   | db               |
| Input Reflected Ripple Voltage (rms)                   | With simulated source impedance of 10 $\mu$ H, 5 Hz to 20 MHz. Use a 100 $\mu$ F/100 V electrolytic capacitor with ESR = 1 ohm max, at 200 kHz @ 25°C. | -   | 35  | -   | mV               |
| Input Reflected Ripple Voltage (pk-pk)                 |                                                                                                                                                        | -   | 130 | -   | mV               |
| I <sup>2</sup> t Inrush Current Transient <sup>2</sup> |                                                                                                                                                        | -   | -   | 2   | A <sup>2</sup> s |
| Turn-on Voltage Threshold                              |                                                                                                                                                        | -   | 34  | 35  | V                |
| Turn-off Voltage Threshold                             |                                                                                                                                                        | 32  | 33  | -   | V                |
| Vin Lockout Hysteresis Voltage                         |                                                                                                                                                        | 1   | 2   | 3   | V                |
| Inrush Current                                         |                                                                                                                                                        | -   | -   | 10  | A                |

**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 15 A on system board. Refer to the fuse manufacture's datasheet for further information.

**Note:** <sup>1</sup> When Vin = 36V~40 V, the output voltage will decrease to 10 V, refer to the "5. OUTPUT SETPOINT VS. INPUT PLOT".

<sup>2</sup> Test condition please refer to the "10. Test condition and Parameter".

## 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 = 48 V, Io = 50% load at 25°C ambient.                                                                                  | 11.76 | 12.00 | 12.24 | V                |
| Load Regulation                                 | Vin = 40 – 75 V, Io = 0~100% load at 25°C ambient.                                                                          | -     | 20    | 100   | mV               |
| Line Regulation                                 | Vin = 36 – 75 V, Io = 100% load                                                                                             | 1.8   | 2.0   | 2.2   | V                |
|                                                 | Vin = 40 – 75 V, Io = 100% load                                                                                             | -     | 20    | 100   | mV               |
| Regulation Over Temperature (-40°C to 85°C)     | Vin = 40- 75 V                                                                                                              | -     | 20    | 100   | mV               |
| Total Output Voltage Range                      | Over sample load and temperature                                                                                            | 10.2  | -     | 12.2  | V                |
| Output Ripple and Noise(Pk-Pk)                  | Vin = 48 V, Io=100% load, 0 – 20 MHz BW, with a 1 µF ceramic capacitor, a 10 µF Tantalum cap and a 270 µF AL cap at output. | -     | 50    | 100   | mV               |
| Output Ripple and Noise(RMS)                    |                                                                                                                             | -     | 10    | 20    | mV               |
| Output Ripple and Noise(Pk-Pk) under worst case | Over entire operating input voltage range, load and ambient temperature condition.                                          | -     | -     | 150   | mV               |
| Output Current Range                            |                                                                                                                             | 0     | -     | 20    | A                |
| Output DC Current Limit <sup>①</sup>            |                                                                                                                             | 23    | 28    | 33    | A                |
| Short Circuit Surge Transient                   | Iout surge                                                                                                                  | -     | -     | 1     | A <sup>2</sup> s |
| Rise Time                                       |                                                                                                                             | -     | 10    | 15    | ms               |
| Turn on Time                                    | Ton (Enable form Vin)                                                                                                       | -     | 25    | 30    | ms               |
|                                                 | Ton (Enable form ON/OFF)                                                                                                    | -     | 25    | 30    | ms               |
| Overshoot at Turn on                            |                                                                                                                             | -     | 0     | 3     | %                |
| Output Capacitance                              |                                                                                                                             | 270   | -     | 6800  | µF               |
| <b>Transient Response</b>                       |                                                                                                                             |       |       |       |                  |
| ΔV 50%~75% of Max Load                          |                                                                                                                             | -     | 300   | 400   | mV               |
| Settling Time                                   | di/dt = 0.1 A/µs, Vin = 48 VDC, with a 1 µF ceramic capacitor, a 10 µ Tantalum cap and a 270 µF AL cap at output.           | -     | 500   | -     | µs               |
| ΔV 75%~50% of Max Load                          |                                                                                                                             | -     | 300   | 400   | mV               |
| Settling Time                                   |                                                                                                                             | -     | 500   | -     | µs               |

**Note<sup>①</sup>:** Hiccup mode.

Before the over current protection, the output voltage won't decrease even the load increase.

## 5. OUTPUT SETPOINT VS. INPUT PLOT

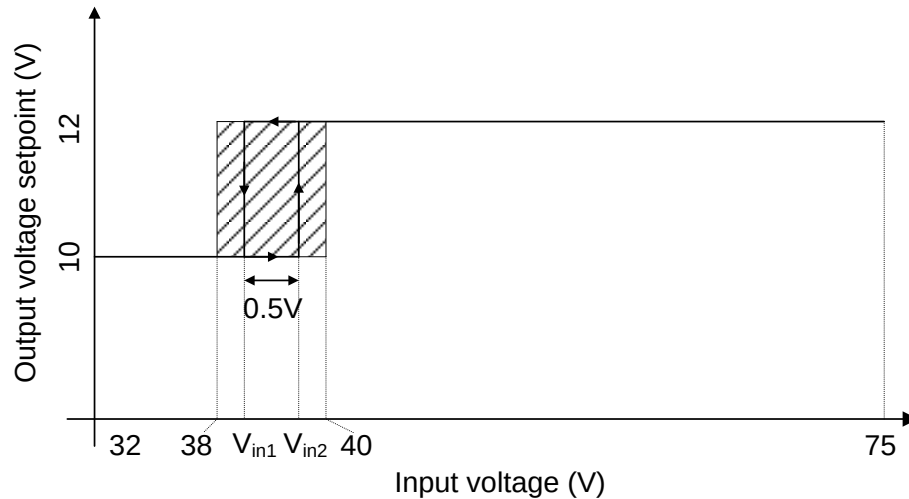


Figure 1. Output setpoint vs. input plot

- Notes:** 1. Output voltage set point is set to 2 different values according to the input voltage range, and the boundary of the input voltage range is within 38 – 40 V.  
2. There is a ~0.5 V hysteresis between  $V_o$  setpoint-changing thresholds (shown as  $V_{in1}$  and  $V_{in2}$  above).

## 6. GENERAL SPECIFICATIONS

| PARAMETER                                             | DESCRIPTION                                                                                                              | MIN | TYP                   | MAX  | UNIT  |
|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----|-----------------------|------|-------|
| Efficiency ( $V_{in} = 48V$ ; $I_o = 0.5I_{o(max)}$ ) | The efficiency is measured at $V_{in} = 48V$ , full load                                                                 | -   | 95.5                  | -    | %     |
| Switching Frequency                                   |                                                                                                                          | -   | 350                   | -    | kHz   |
| Over Temperature Protection                           |                                                                                                                          | -   | 125                   | -    | °C    |
| Output Over Voltage Protection                        |                                                                                                                          | -   | 13.6                  | -    | V     |
| FIT                                                   | Calculated Per Bell Core SR-332 ( $V_{in} = 48V$ , $V_o = 12V$ , $I_o = 16A$ , $T_a = 25^{\circ}C$ , $FIT = 10^9/MTBF$ ) | -   | 142                   | -    | -     |
| MTBF                                                  |                                                                                                                          |     | 7000000               |      | hours |
| Weight                                                |                                                                                                                          | -   | 33.7                  | -    | g     |
| Dimensions (L x W x H)                                |                                                                                                                          |     | 2.30 x 0.90 x 0.45    |      | inch  |
|                                                       |                                                                                                                          |     | 58.42 x 22.86 x 11.50 |      | mm    |
| <b>Isolation Characteristics</b>                      |                                                                                                                          |     |                       |      |       |
| Input to Output                                       |                                                                                                                          | -   | -                     | 2250 | V     |
| Isolation Resistance                                  |                                                                                                                          | 10M | -                     | -    | Ohm   |
| Leakage Current                                       |                                                                                                                          | -   | -                     | 1    | mA    |
| Isolation Capacitance                                 |                                                                                                                          | -   | 1000                  | -    | pF    |

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

## 7. EFFICIENCY DATA

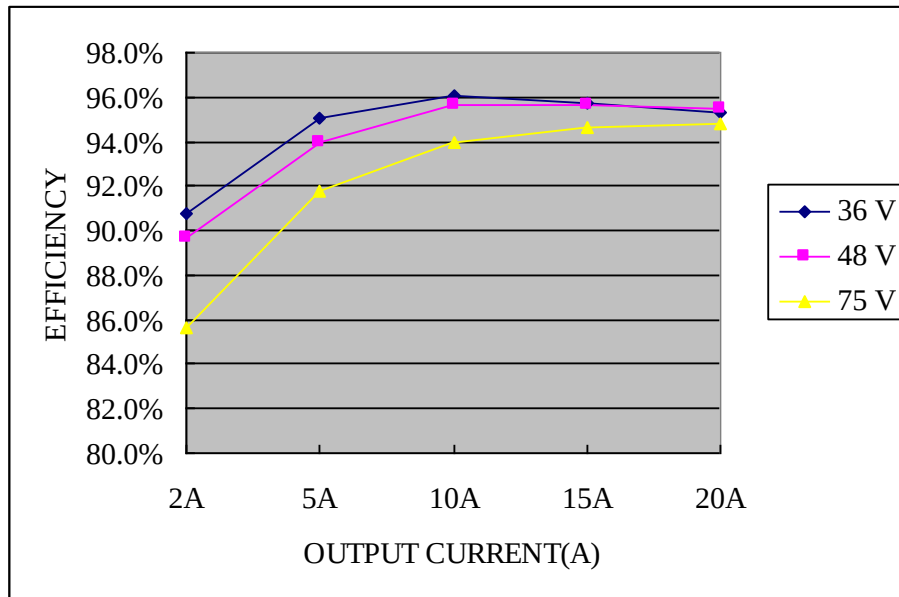


Figure 2. Efficiency data

## 8. REMOTE ON/OFF

| PARAMETER              | DESCRIPTION                                              | MIN  | TYP | MAX | UNIT          |
|------------------------|----------------------------------------------------------|------|-----|-----|---------------|
| Signal Low (Unit On)   | Active Low Remote On/Off pin is open, the module is off. | -0.3 | -   | 0.8 | V             |
| Signal High (Unit Off) |                                                          | 2.4  | -   | 18  | V             |
| ON/OFF Current 1       | $V_{on/off} = 0.0\text{ V}$                              | -    | 13  | -   | $\mu\text{A}$ |
| ON/OFF Current 2       | $V_{on/off} = 2.4\text{ V}$                              | -    | 10  | -   | $\mu\text{A}$ |
| Current Sink           |                                                          | 0    | -   | 1   | mA            |

### Recommended remote on/off circuit for active low

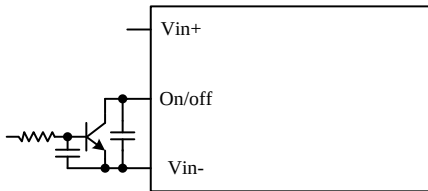


Figure 3. Control with open collector/drain circuit

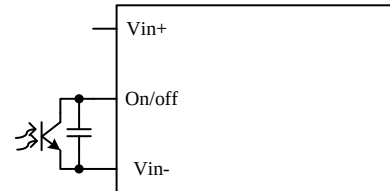


Figure 4. Control with photocoupler circuit

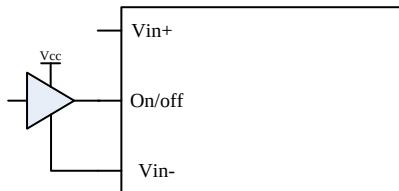


Figure 5. Control with logic circuit

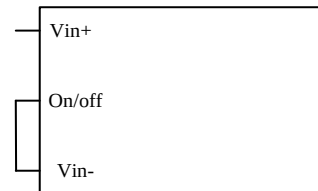


Figure 6. Permanently on

## 9. TEST CONDITION AND PARAMETER

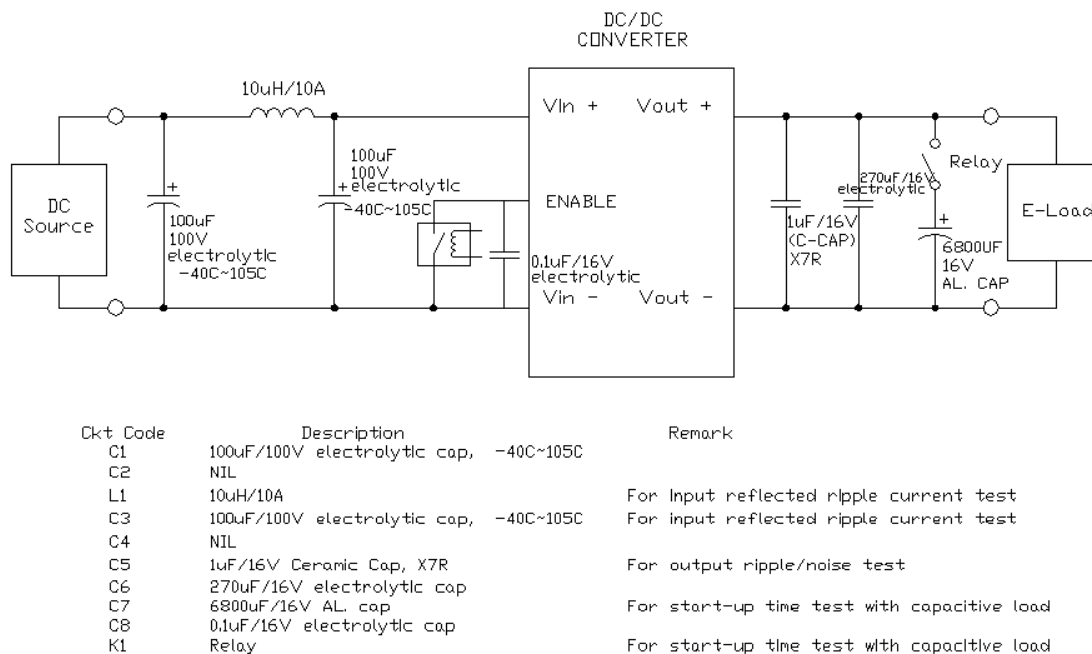


Figure 7. Test condition and parameter

## 10. RIPPLE AND NOISE WAVEFORM

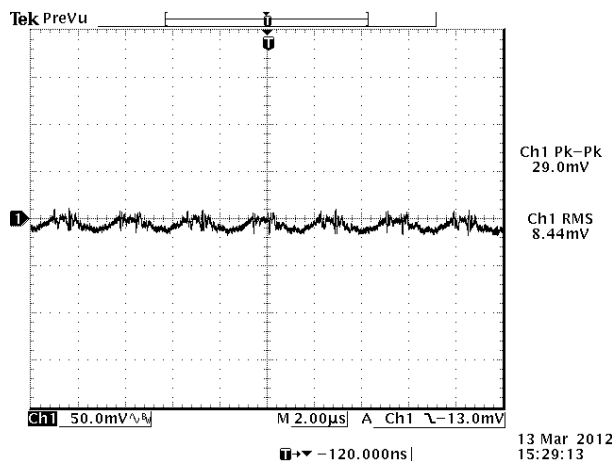


Figure 8. Ripple and noise waveform

**Note:** Ripple and noise at full load, 48 VDC input, 12 VDC / 20 A output and  $T_a = 25^\circ\text{C}$ , and with a 1  $\mu\text{F}$  ceramic capacitor, a 10  $\mu\text{F}$  Tantalum cap and a 270  $\mu\text{F}$  AL.cap at output.



## 11. TRANSIENT RESPONSE WAVEFORMS

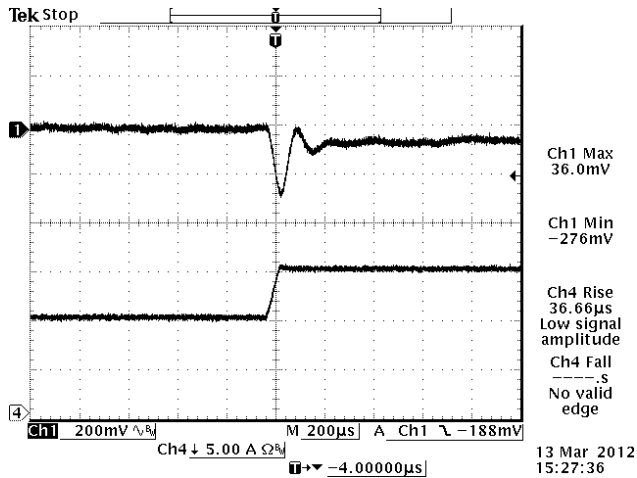


Figure 9.  $V_{out} = 12\text{ V}$ , 50% - 75% Load Transients at  $V_{in} = 48\text{ V}$  @  $T_a = 25^\circ\text{C}$

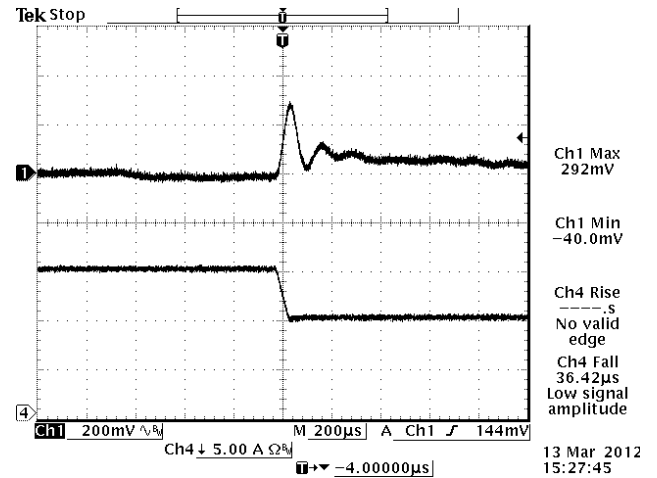


Figure 10.  $V_{out} = 12\text{ V}$ , 75% - 50% Load Transients at  $V_{in} = 48\text{ V}$  @  $T_a = 25^\circ\text{C}$

**Note:** Transient Response:  $di/dt = 0.1\text{ A}/\mu\text{s}$ , with a  $1\text{ }\mu\text{F}$  ceramic capacitor, a  $10\text{ }\mu\text{F}$  Tantalum cap and a  $270\text{ }\mu\text{F}$  AL cap at output.

## 12. STARTUP & SHUTDOWN

### Rise time

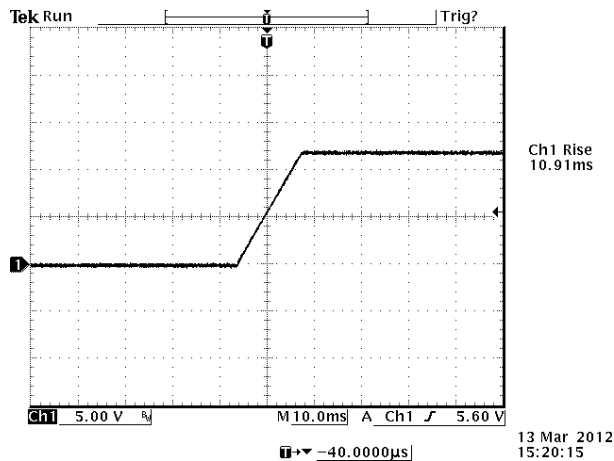


Figure 11.  $V_{out} = 12\text{ V} / 20\text{ A}$  at  $V_{in} = 48\text{ V}$  @  $T_a = 25^\circ\text{C}$   $C_{ext} = 270\text{ }\mu\text{F}$

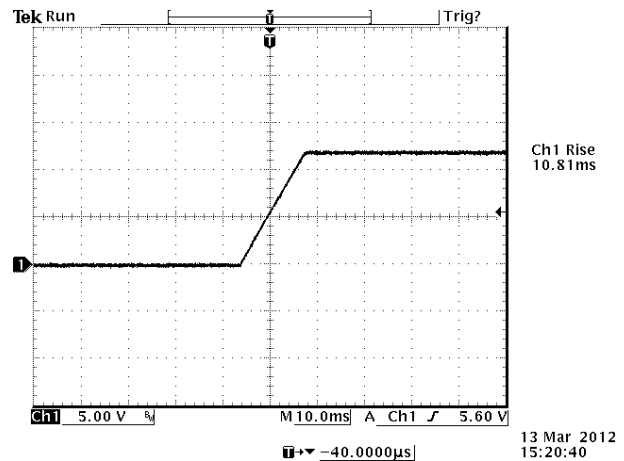


Figure 12.  $V_{out} = 12\text{ V} / 20\text{ A}$  at  $V_{in} = 48\text{ V}$  @  $T_a = 25^\circ\text{C}$   $C_{ext} = 6800\text{ }\mu\text{F}$

## Startup time

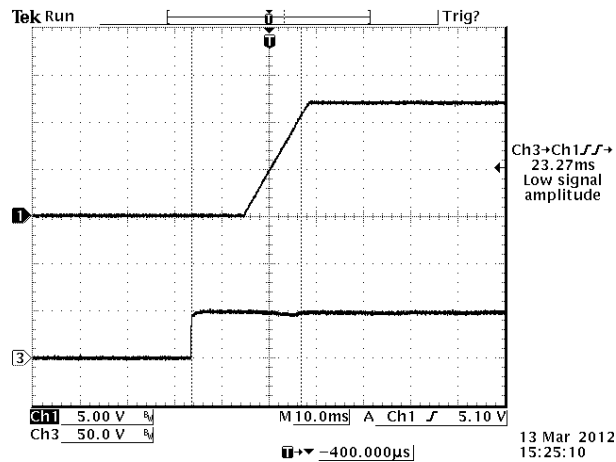


Figure 13. Startup from Vin

Ch1: Vo

Ch3: Vin

Vout = 12 V / 20 A at Vin = 48 V @Ta = 25°C Cext = 6800 μF

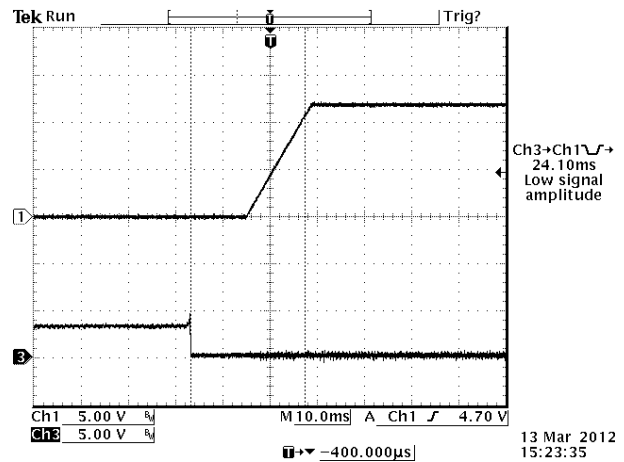


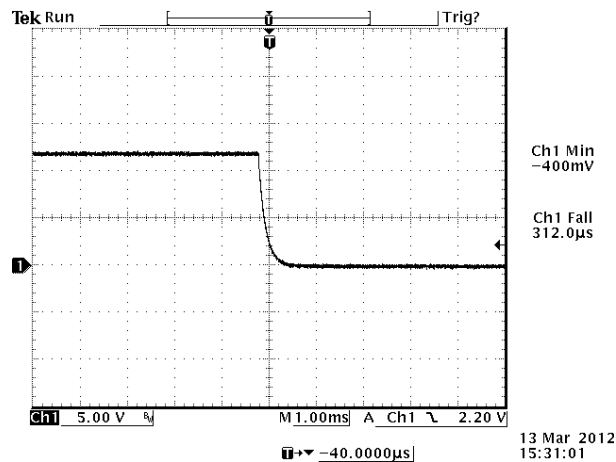
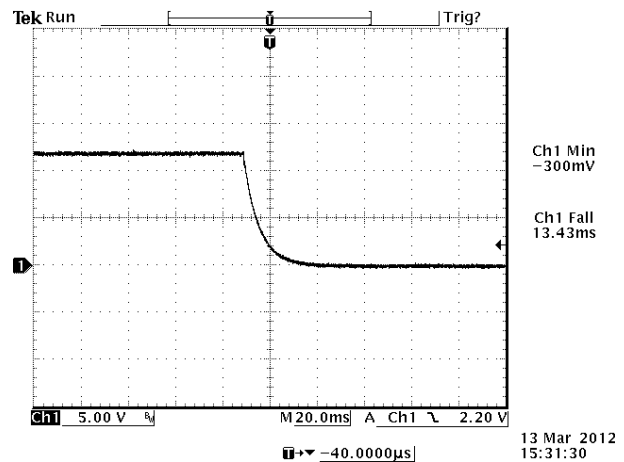
Figure 14. Startup from on/off

Ch1: Vo

Ch3: on/off

Vout = 12 V / 20 A at Vin = 48 V @Ta = 25°C Cext = 6800 μF

## Shutdown

Figure 15. Vout = 12 V / 20 A at Vin = 48 V  
@Ta = 25°C Cext = 270 μFFigure 16. Vout = 12 V / 20 A at Vin = 48 V  
@Ta = 25°C Cext = 6800 μF

### 13. OVER CURRENT PROTECTION

To provide protection in a fault output overload condition, the module is equipped with internal over current protection circuitry. If the over current condition occurs, 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.

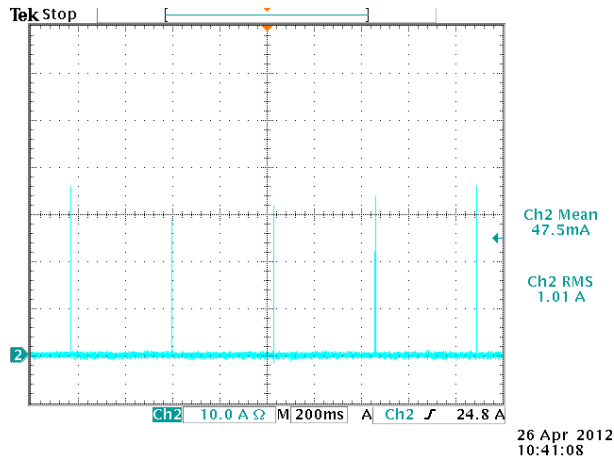


Figure 17.  $V_{in} = 48\text{ V}$  @  $T_a = 25^\circ\text{C}$

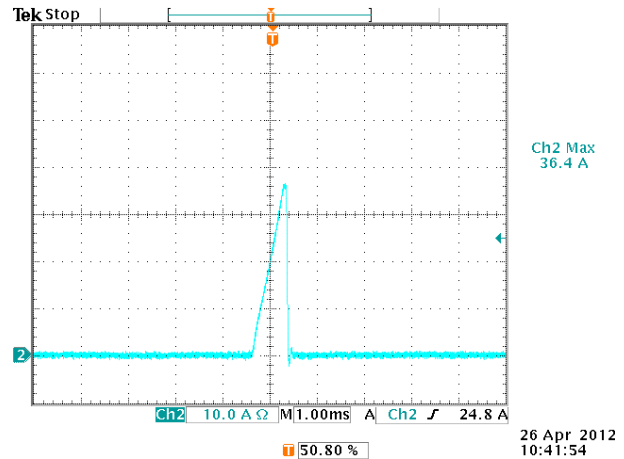


Figure 18. Expansion of on time portion of above figure  
CH2: Output current waveform

### 14. INPUT UNDER-VOLTAGE LOCKOUT

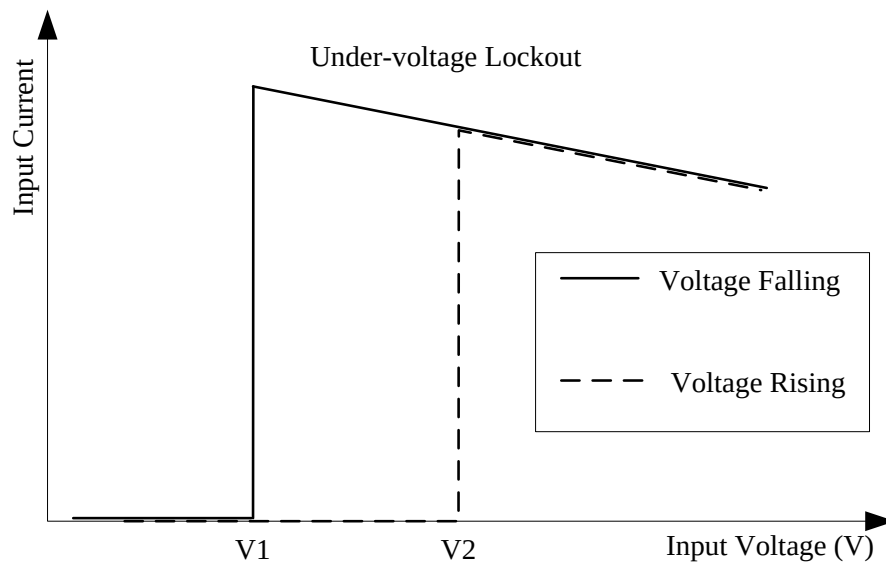


Figure 19. Input under-voltage lockout

$$V1 = 33\text{ V}$$

$$V2 = 34.5\text{ V}$$

## 15. THERMAL DERATING CURVE

Maximum FET junction temperature derated to 120 °C

The OTP is achieved by temperature sensor U10 and it's in non-latch mode when the hottest component U7 reaches 115°C with 200LFM air flow correspondingly. It will restart automatically when the temperature falls to 105°C. The protecting point will be varied a little under different conditions (air flow, ambient temperature, input voltage, load...).

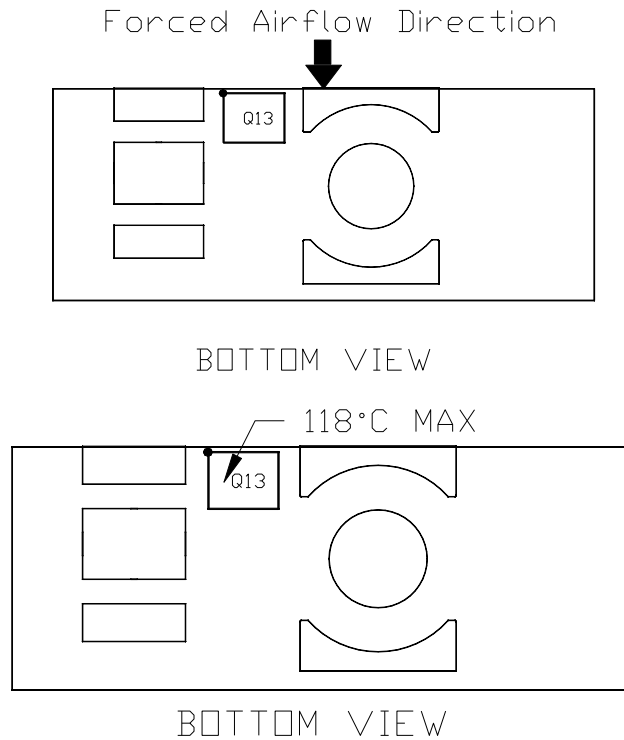


Figure 20. Temperature reference point and forced airflow direction on bottom side

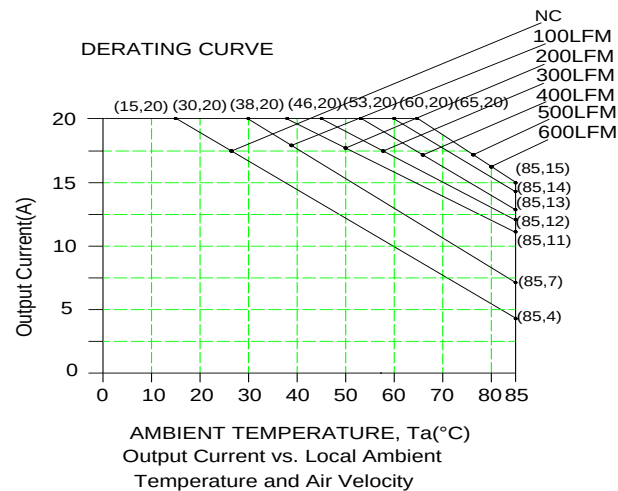


Figure 21. Vin = 48 V thermal derating curve  
Open frame version

## 16. SAFETY & EMC

### SAFETY:

Material flammability: UL94V-0  
 CB certification to IEC/EN 60950-1  
 UL certification to UL/CSA 60950-1  
 CB certification to IEC/EN 62368-1  
 UL certification to UL/CSA 62368-1

### EMC:

Compliance to EN 55032 class A (both peak and average) with the following inductive and capacitive filter.

#### Test setup:

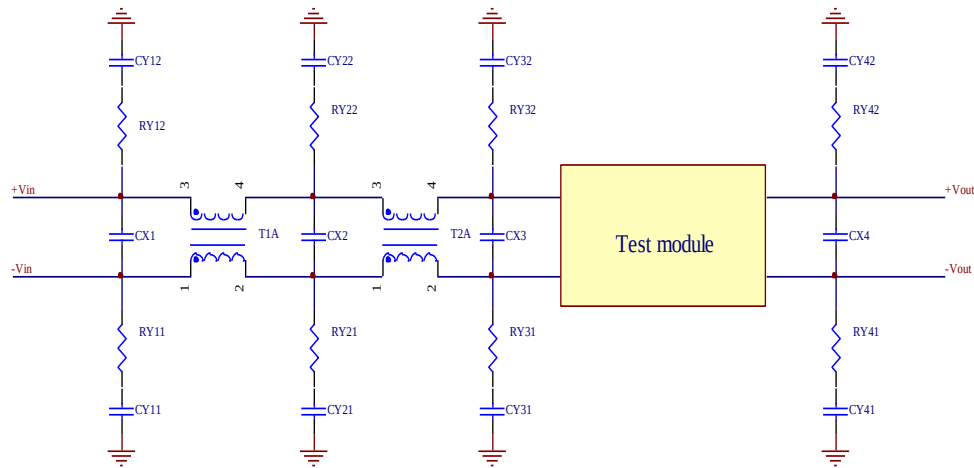


Figure 22. Test setup

| ITEM | DESIGNATOR                                                          | PARAMETER              | VENDOR | VENDOR P/N |
|------|---------------------------------------------------------------------|------------------------|--------|------------|
| 1    | CX2                                                                 | 100μF/100V, AL cap     |        |            |
| 2    | CX3                                                                 | 220μF/100V, AL cap     |        |            |
| 3    | CY31                                                                | 2*6.8nF/1000V, ceramic |        |            |
| 4    | CY32                                                                | 2*6.8nF/1000V, ceramic |        |            |
| 5    | CY41                                                                | 6.8nF/1000V, ceramic   |        |            |
| 6    | CY42                                                                | 6.8nF/1000V, ceramic   |        |            |
| 7    | RY31                                                                | 1206,0R, Resistor      |        |            |
| 8    | RY32                                                                | 1206,0R, Resistor      |        |            |
| 9    | RY41                                                                | 1206,0R, Resistor      |        |            |
| 10   | RY42                                                                | 1206,0R, Resistor      |        |            |
| 11   | T2A                                                                 | 0.81mH, common mode    |        |            |
| 12   | T1A, CX1, CX2<br>RY11, RY21, RY12<br>RY22, CY11, CY21<br>CY12, CY22 | NIL                    |        |            |

Positive:

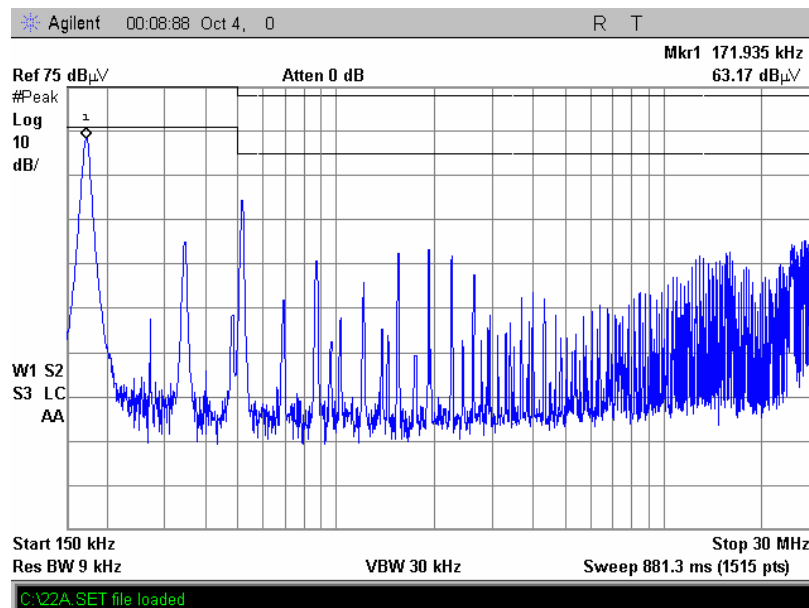


Figure 23.

Negative:

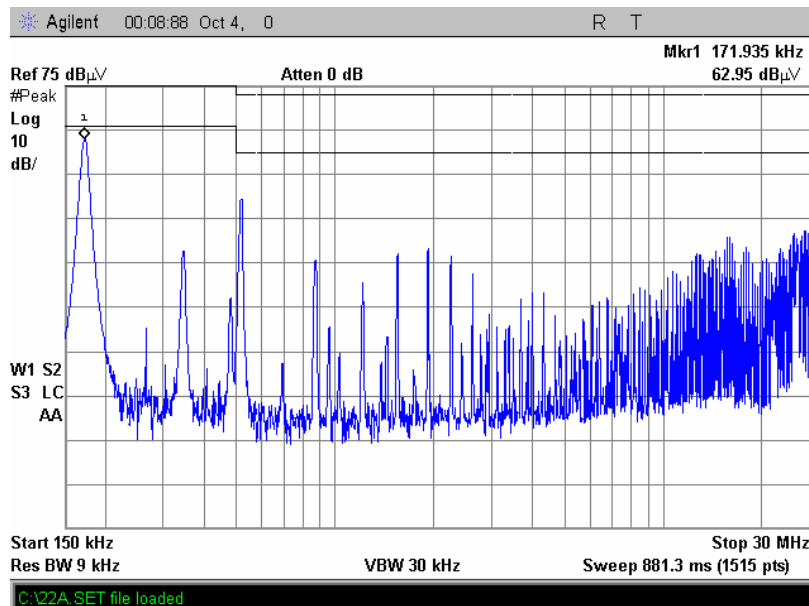


Figure 24.

## 17. MECHANICAL DIMENSIONS

### OUTLINE

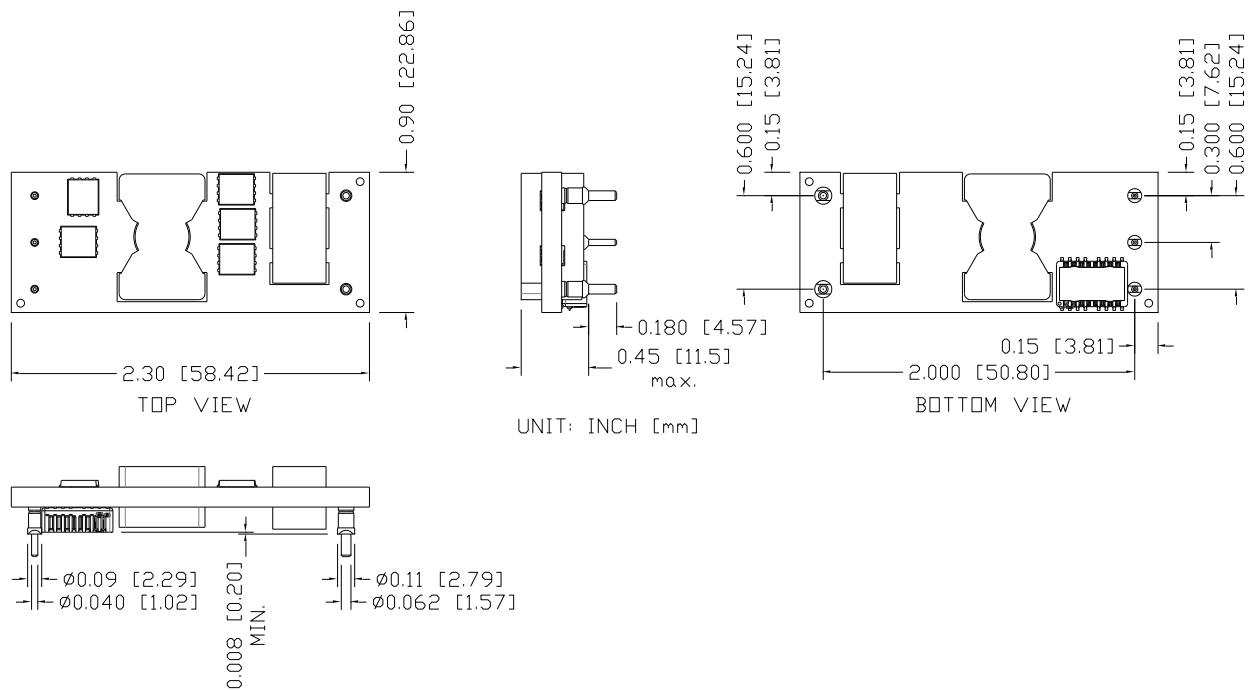


Figure 25. Outline

**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 – 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
- 2) Un-dimensioned components are shown for visual reference only.
- 3) All dimensions in inch [mm]; Tolerances: x.xx +/-0.02 inch [0.51 mm]. x.xxx +/-0.010 inch [0.25 mm].

## PIN DEFINITIONS

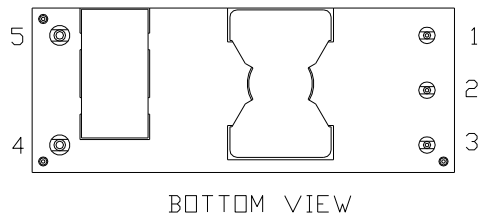


Figure 26. Pins

| PIN | NAME     | PIN SIZE |
|-----|----------|----------|
| 1   | Vin (+)  | 0.04"    |
| 2   | ON/OFF   | 0.04"    |
| 3   | Vin (-)  | 0.04"    |
| 4   | Vout (-) | 0.06"    |
| 5   | Vout (+) | 0.06"    |

## RECOMMENDED PAD LAYOUT

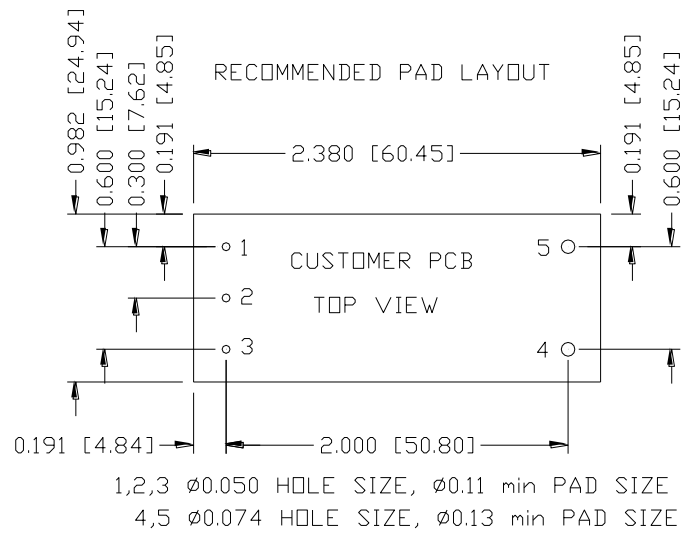


Figure 27. Recommended pad layout



## 18. REVISION HISTORY

| DATE       | REVISION | CHANGES DETAIL                                                                                                   | APPROVAL |
|------------|----------|------------------------------------------------------------------------------------------------------------------|----------|
| 2016-12-16 | AA       | First release.                                                                                                   | XF.Jiang |
| 2018-03-23 | AB       | Update Input Specifications, Output Specifications and General Specifications, add Test Condition and Parameter. | J.Yao    |
| 2018-04-20 | AC       | Update Input Specifications, Output Specifications and General Specifications, and Remote on/off.                | DW.Ren   |
| 2018-05-16 | AD       | Update TD and Input Specs.                                                                                       | DW.Ren   |
| 2021-03-01 | AE       | Update safety certificate.                                                                                       | XF.Jiang |
| 2021-05-05 | AF       | Add object ID.                                                                                                   | XF.Jiang |

For more information on these products consult: [tech.support@psbel.com](mailto: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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