

# 0RQB-30Y05L Series

## Isolated DC-DC Converter

The 0RQB-30Y05L is an isolated DC/DC converter providing 30 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 / 6 A Output
- Isolated
- Input under-voltage protection
- High Efficiency
- Output over-voltage protection
- Hold-up function
- Over current and short circuit protection
- Remote ON/OFF
- Over temperature protection
- Conformal coated
- 5V auxiliary supply at primary side
- Wide input range (24 V, 48 V, 72 V, 96 V, 110 V typical)
- Class II, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)
- Approved to EN60950-1, 2nd +A2 version

### Applications

- Industrial
- Railway



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## 1. MODEL SELECTION

| OUTPUT VOLTAGE | INPUT VOLTAGE       | MAX. OUTPUT CURRENT | MAX. OUTPUT POWER | TYPICAL EFFICIENCY | MODEL NUMBER ACTIVE LOW |
|----------------|---------------------|---------------------|-------------------|--------------------|-------------------------|
| 5 VDC          | 24/48/72/96/110 VDC | 6 A                 | 30 W              | 82%                | ORQB-30Y05L             |

**NOTE:** Add “G” suffix at the end of the model number to indicate Tray Packaging.

### PART NUMBER EXPLANATION

| 0                  | R           | QB                 | -            | 30                   | Y              | 05                         | L                | 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 | 30 W         | 24/48/72/96/110V 5 V |                | 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     |
| Thermal Resistance                     | Baseplate to heatsink, flat greased surface                    | -    | 0.24 | -    | °C/W  |
|                                        | Baseplate to ambient                                           | -    | 4    | -    |       |
| Operating Temperature                  | Temperature measured at the center of the baseplate, full load | -40  | -    | 105  | °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

| PARAMETER                                          | DESCRIPTION                                                                                                                                           | MIN           | TYP  | MAX   | UNIT |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|-------|------|
| Operating Input Voltage Range 1                    | Fully functioning for long term operation.                                                                                                            | 16.8          | 24   | 137.5 | V    |
|                                                    |                                                                                                                                                       |               | 48   |       |      |
|                                                    |                                                                                                                                                       |               | 72   |       |      |
|                                                    |                                                                                                                                                       |               | 96   |       |      |
|                                                    |                                                                                                                                                       |               | 110  |       |      |
| Operating Input Voltage Range 2                    | Fully functioning for 0.1s operation. Full function is not guaranteed but undamaged for 1s operation.                                                 | 12.9<br>137.5 | -    | 16.8  | V    |
|                                                    |                                                                                                                                                       |               | -    | 154   |      |
| Input Current                                      |                                                                                                                                                       | -             | -    | 3.0   | A    |
| Input Voltage Rising Slope                         |                                                                                                                                                       | -             | -    | 2     | V/ms |
| Input Current (no load)                            |                                                                                                                                                       | -             | 100  | 150   | mA   |
| Remote Off Input Current                           |                                                                                                                                                       | -             | -    | 40    | mA   |
| Input Reflected Ripple Current (pk-pk)             | With simulated source impedance of 10 $\mu$ H, 5Hz to 20 MHz. Use two 100 $\mu$ F/250 V electrolytic capacitors with ESR=0.5R max, at 200 kHz @ 25°C. | -             | -    | 300   | mA   |
| Input Reflected Ripple Current (rms)               |                                                                                                                                                       | -             | -    | 100   | mA   |
| Under-voltage Turn on Threshold                    | Lockout turn on                                                                                                                                       | 14.5          | 15.2 | 16    | V    |
| Under-voltage Turn off Threshold                   | Lockout turn off, non-latching                                                                                                                        | 11.7          | 12.2 | 12.7  | V    |
| Recommended input fast-acting fuse on system board | <b>CAUTION:</b> This converter is not internally fused. An input line fuse must be used in application.                                               | -             | 6    | -     | V    |

#### 4. OUTPUT SPECIFICATIONS

| PARAMETER                          | DESCRIPTION                                                                                         | MIN | TYP | MAX  | UNIT |
|------------------------------------|-----------------------------------------------------------------------------------------------------|-----|-----|------|------|
| Output Voltage Set Point           |                                                                                                     | 4.9 | 5   | 5.1  | V    |
| Line Regulation                    |                                                                                                     | -   | -   | 10   | mV   |
| Load Regulation                    |                                                                                                     | -   | -   | 20   | mV   |
| Regulation Over Temperature        |                                                                                                     | -   | -   | ±100 | mV   |
| Output Current Range               |                                                                                                     | 0   | -   | 6    | A    |
| Output Ripple and Noise (pk-pk)    | With a 100 µF ceramic and a 100 µF electrolytic capacitors at output.                               | -   | 50  | 80   | mV   |
| Output Ripple and Noise (rms)      |                                                                                                     | -   | 10  | 15   | mV   |
| Output DC Current Limit            | Enter a hiccup mode, non-latching.                                                                  | 7   | -   | 10   | A    |
| Turn on Time                       | Enable from Vin                                                                                     | -   | -   | 1500 | ms   |
|                                    | Enable from ON/OFF                                                                                  | -   | -   | 200  |      |
| Rise Time                          |                                                                                                     | -   | 25  | 50   | ms   |
| Overshoot at Turn on               |                                                                                                     | -   | 0   | 3    | %    |
| Undershoot at Turn off             |                                                                                                     | -   | 0   | 3    | %    |
| Output Capacitance                 | Typically 50% ceramic and 50% electrolytic capacitors.                                              | 200 | -   | 1000 | µF   |
| 5V Auxiliary Supply Source Current |                                                                                                     | -   | -   | 5    | mA   |
| <b>Transient Response</b>          |                                                                                                     |     |     |      |      |
| ΔV 50% ~ 75% of Max Load           |                                                                                                     | -   | 200 | 250  | mV   |
| Settling Time                      | di/dt = 0.1 A/µs, with a 100 µF ceramic and a 100 µF electrolytic capacitors near the brick output. | -   | 0.5 | 0.75 | ms   |
| ΔV 75% ~ 50% of Max Load           |                                                                                                     | -   | 200 | 250  | mV   |
| Settling Time                      |                                                                                                     | -   | 0.5 | 0.75 | ms   |

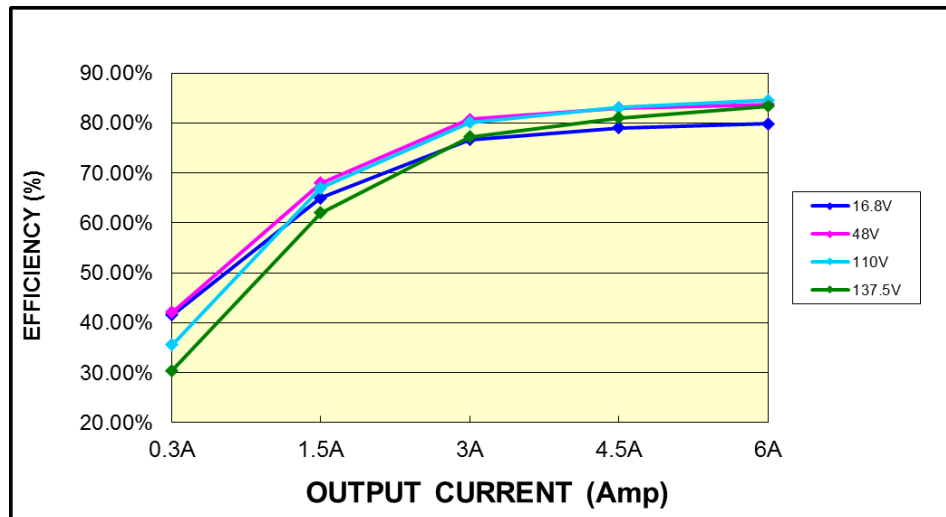
**NOTE:** All specifications are typical at nominal input, full load at 25°C unless noted.

## 5. GENERAL SPECIFICATIONS

| PARAMETER                        | DESCRIPTION                                    | MIN               | TYP    | MAX  | UNIT   |
|----------------------------------|------------------------------------------------|-------------------|--------|------|--------|
| Efficiency                       | Vin = 24 V, Iout = 6 A                         | 81                | 82     | -    | %      |
|                                  | Vin = 48 V, Iout = 6 A                         | 82                | 83     | -    |        |
|                                  | Vin = 72 V, Iout = 6 A                         | 82                | 83     | -    |        |
|                                  | Vin = 96 V, Iout = 6 A                         | 82                | 83     | -    |        |
|                                  | Vin = 110 V, Iout = 6 A                        | 83                | 84     | -    |        |
| Switching Frequency              | 1st stage                                      | -                 | 150    | -    | kHz    |
|                                  | 2nd stage                                      | -                 | 250    | -    |        |
| FIT*                             | Calculated Per IEC 62380 TR 1 (UTEC 80-810)    | -                 | 176.66 | -    | Mhours |
| MTBF*                            | (Vin=24 V, Vo=5V, Io=6A, Tac = 50°C, Tae=35°C) | -                 | 5.66   | -    |        |
| Over Temperature Protection      |                                                | -                 | 125    | -    | °C     |
| Over Voltage Protection (Static) |                                                | -                 | 6      | -    | V      |
| Isolation Characteristics        |                                                |                   |        |      |        |
| Isolation Capacitance            |                                                | -                 | -      | 2200 | pF     |
| Isolation Resistance             |                                                | 10M               | -      | -    | ohm    |
| Input to Output                  |                                                | -                 | -      | 2250 | V      |
| Input to Heatsink                |                                                | -                 | -      | 2250 | V      |
| Output to Heatsink               |                                                | -                 | -      | 2250 | V      |
| Dimensions (L × W ×H)            |                                                | 2.30 x1.45 x 0.59 |        |      | inch   |
|                                  |                                                | 58.42 x36.83 x15  |        |      | mm     |
| Weight                           |                                                | -                 | 62     | -    | g      |

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

## 6. EFFICIENCY DATA



## 7. THERMAL DERATING CURVES

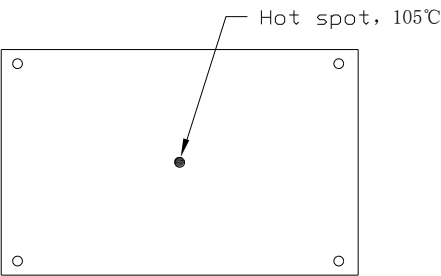
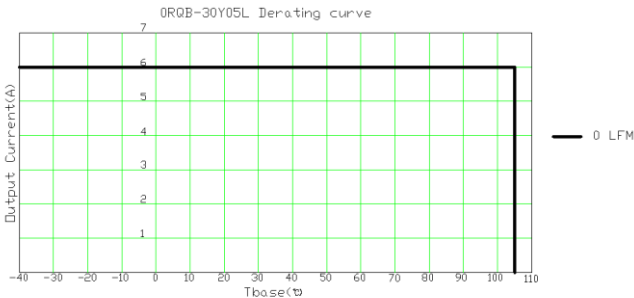


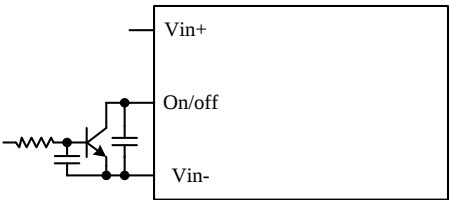
Figure 1. Module top view



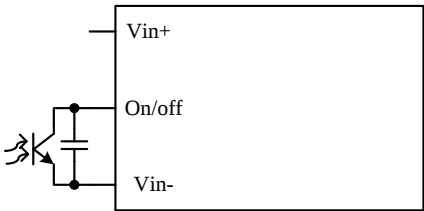
## 8. REMOVE ON/OFF

| 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  |      |
| Current Sink           |            |                                               | 0    | -   | 1   | mA   |

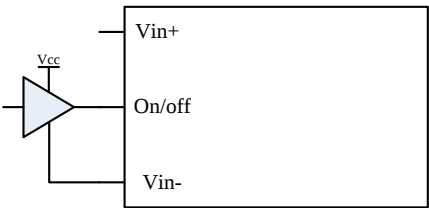
Recommended Remote On/Off Circuit for Active Low



Control with open collector/drain circuit



Control with coupler circuit



Control with logic circuit



Permanently on



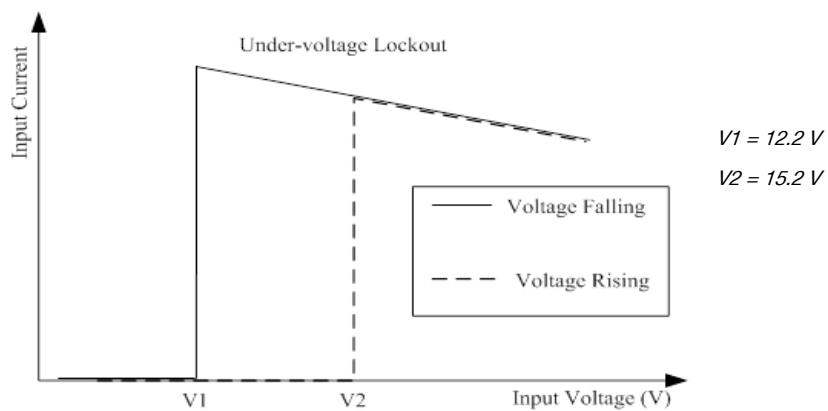
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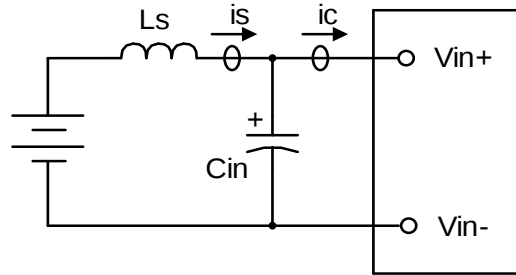
## 9. INPUT UNDER-VOLTAGE LOCKOUT



## 10. INPUT NOISE

Input Reflected Ripple Current

Testing set up



Notes and values in testing.

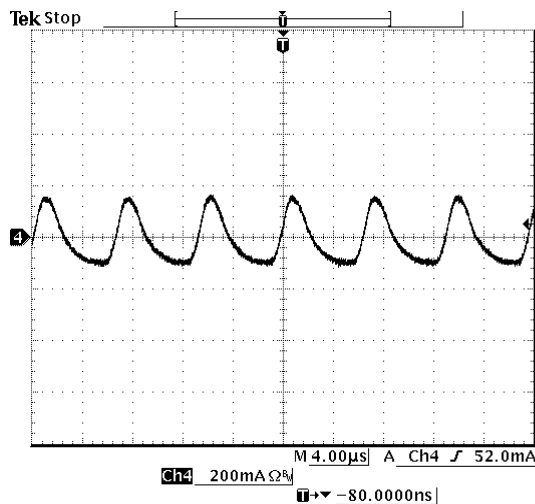
is: Input Reflected Ripple Current

ic: Input Terminal Ripple Current

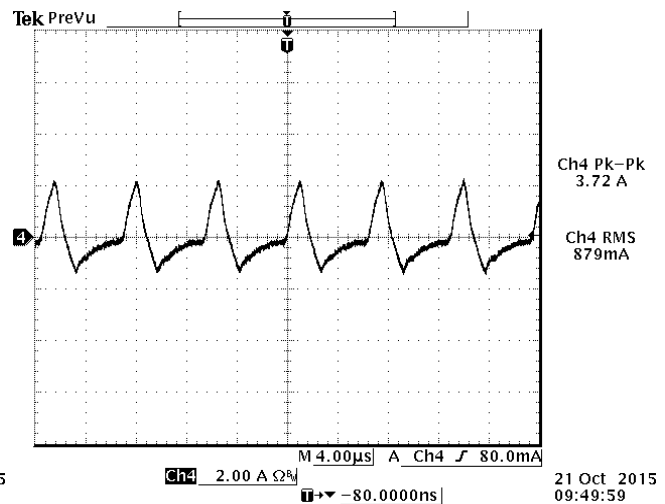
Ls: Simulated Source Impedance (10 $\mu$ H)

Cin: Electrolytic capacitor, should be as closed as possible to the power module to swallow ic ripple current and help with stability.  
Recommendation: 2\* 100 $\mu$ F, ESR<0.5R @ 100 kHz, 20C

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



21 Oct 2015  
08:46:07



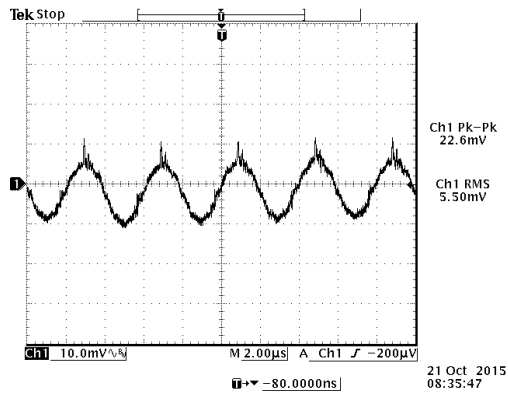
21 Oct 2015  
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Figure 2. is (input reflected ripple current), AC component

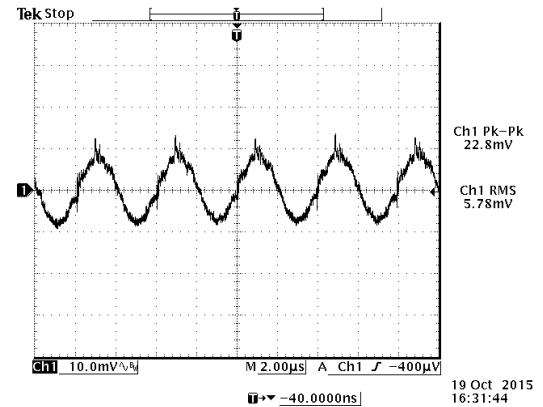
Figure 3. ic (input terminal ripple current), AC component

**NOTE:** 48 VDC input, 5 VDC/6A output and Ta=25 °C, with 100 $\mu$ F ceramic capacitor and 100 $\mu$ F AL. cap at output.

## 11. RIPPLE AND NOISE WAVEFORM



**NOTE:** Ripple & noise at full load, 48 V input, with a 1μF ceramic capacitor and a 10 μF tantalum capacitor at the output, and Ta=25°C.



**NOTE:** Ripple and noise, 110VDC input, 5VDC/6A output and Ta=25 °C, with 100μF ceramic capacitor and 100μF AL. cap at output.

## 12. TRANSIENT RESPONSE

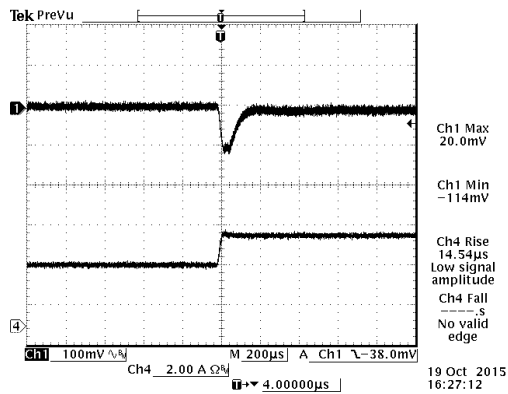


Figure 4. 50%-75% Load Transients at Vin=48V@Ta=25°C

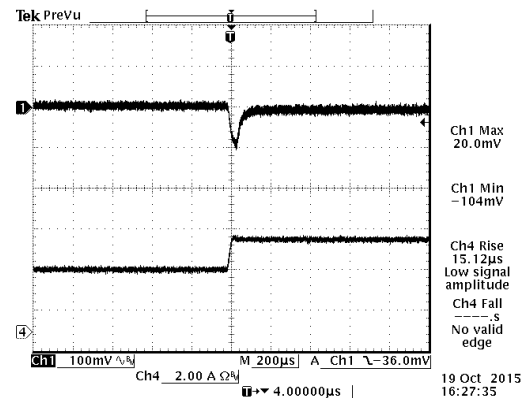


Figure 5. 50%-75% Load Transients at Vin=110V@Ta=25°C

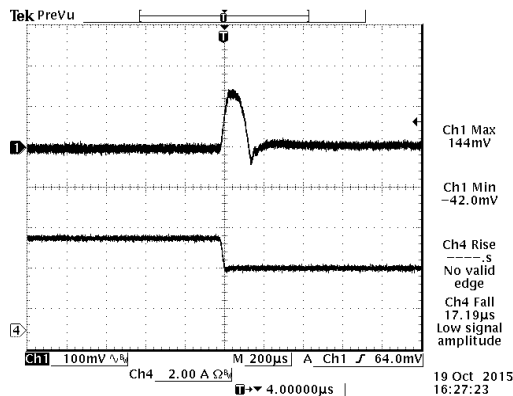


Figure 6. 75%-50% Load Transients at Vin=48V@Ta=25°C

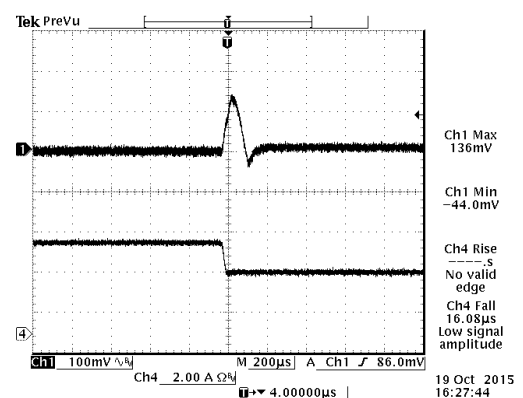


Figure 7. 75%-50% Load Transients at Vin=110V@Ta=25°C

## 13. STARTUP & SHUTDOWN

### Turn on rise time

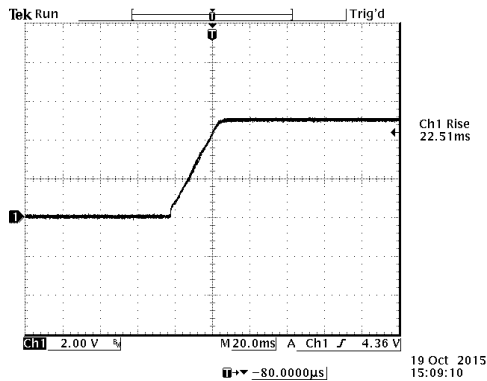


Figure 8.  $V_{in}=48V$ ,  $I_o=6A$ ,  $V_o=5V$

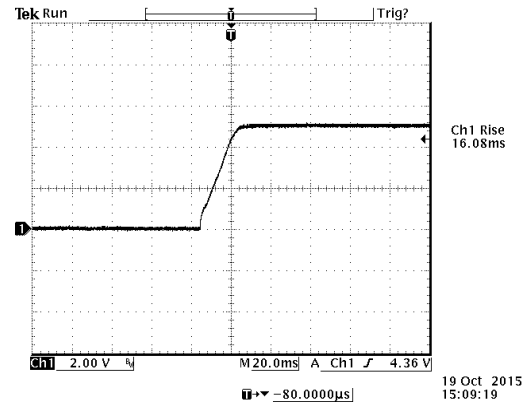


Figure 9.  $V_{in}=110V$ ,  $I_o=6A$ ,  $V_o=5V$

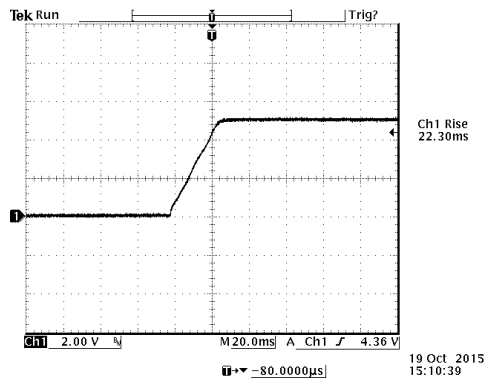


Figure 10.  $V_{in}=48V$ ,  $I_o=6A$ ,  $V_o=5V$ , with  $C_{ext}=1000\mu F$

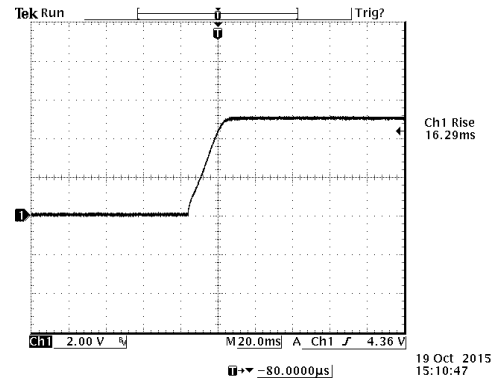


Figure 11.  $V_{in}=48V$ ,  $I_o=6A$ ,  $V_o=5V$ , with  $C_{ext}=1000\mu F$

### Turn on delay time

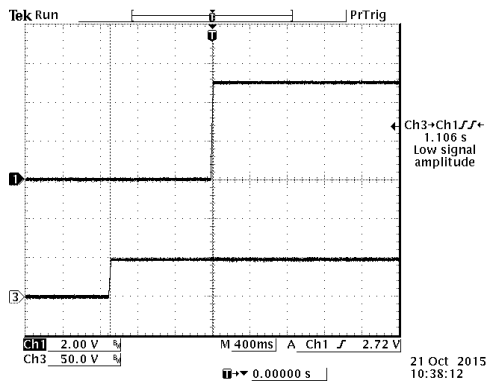


Figure 12. Startup from  $V_{in}$   
Ch1:  $V_o$   
Ch3:  $V_{in}$   
 $V_{in}=48V$ ,  $I_o=6A$ ,  $V_o=5V$

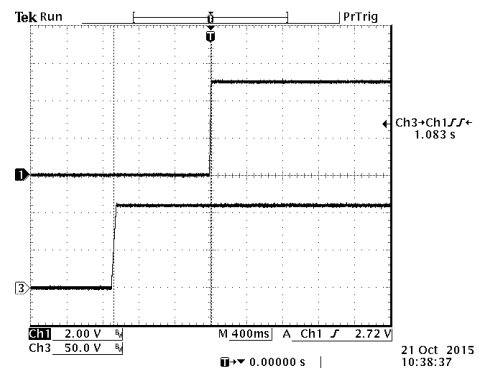


Figure 13. Startup from  $V_{in}$   
Ch1:  $V_o$   
Ch3:  $V_{in}$   
 $V_{in}=110V$ ,  $I_o=6A$ ,  $V_o=5V$

## STARTUP &amp; SHUTDOWN(CONTINUED)

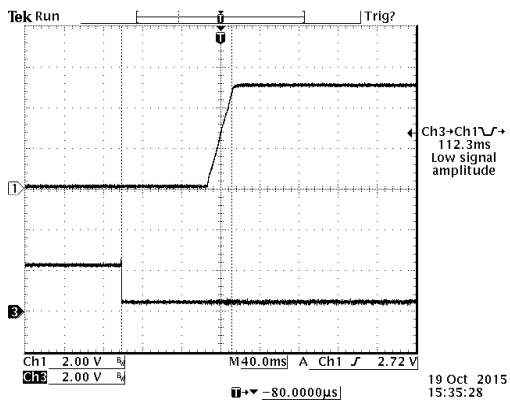


Figure 14. Startup from on/off

Ch1: Vo  
Ch3: on/off  
Vin=48V, Io=6A, Vo=5V

## Shutdown

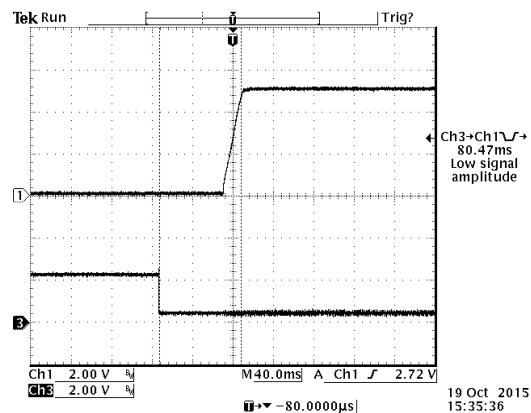


Figure 15. Startup from on/off

Ch1: Vo  
Ch3: on/off  
Vin=110V, Io=6A, Vo=5V

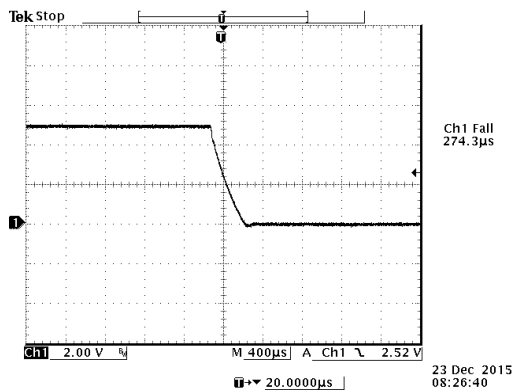


Figure 16. Vin=48V, Io=6A, Vo=5V

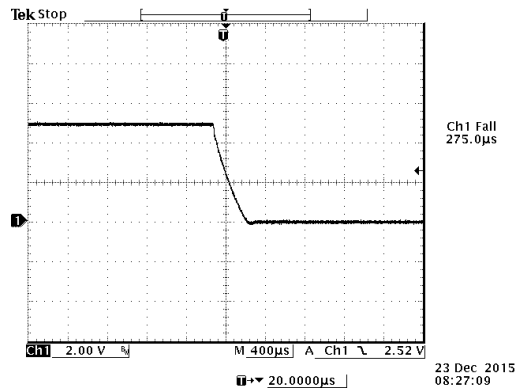


Figure 17. Vin=48V, Io=6A, Vo=5V

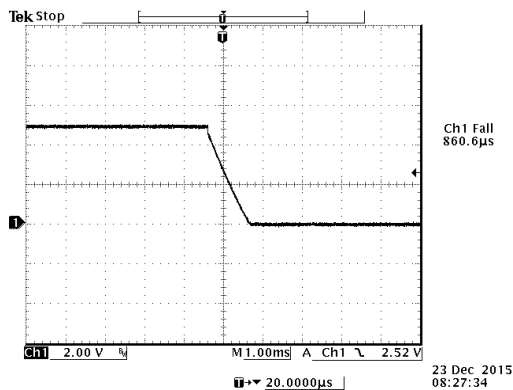


Figure 18. Vin=48V, Io=6A, Vo=5V, with Cext=1000µF

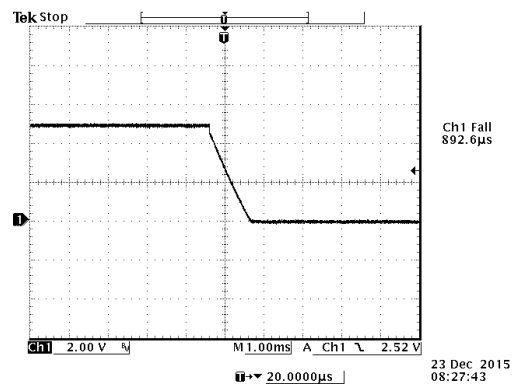
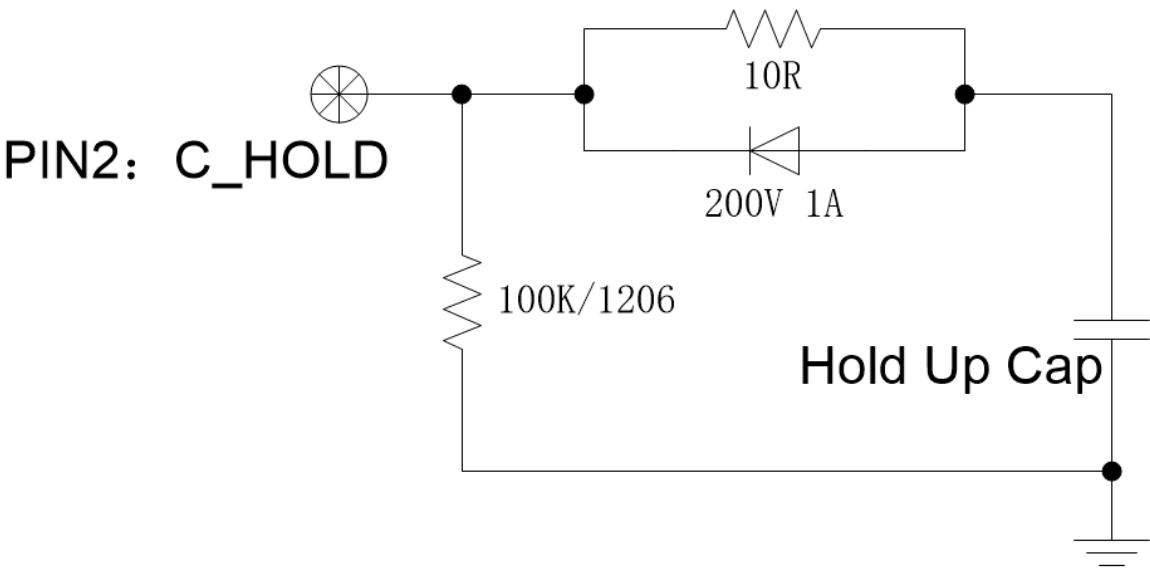


Figure 19. Vin=48V, Io=6A, Vo=5V, with Cext=1000µF

14. HOLD UP CIRCUIT

| PARAMETER         | DESCRIPTION                                                                                                           | SYMBOL | MIN | TYP | MAX | UNITS |
|-------------------|-----------------------------------------------------------------------------------------------------------------------|--------|-----|-----|-----|-------|
| Hold up Capacitor | Working voltage rating should be 200V.<br>Caution: This capacitor is necessary for both normal and hold up operation. | C_HOLD | 220 | -   | 330 | μF    |
| Hold up Voltage   | Normal operation.                                                                                                     | V_HOLD | 45  | 85  | 154 | V     |
| Hold up Time      | 16.8-137.5V input and all lout range.                                                                                 | T_HOLD | 12  | -   | -   | ms    |

Recommended External Hold up Circuit



**NOTE:** the power of the current-limiting resistance is determined by the rise slope of the input voltage.

## 15. SAFETY & EMC

### Safety:

TUV certificated to EN60950-1, 2nd edition+ A2 version

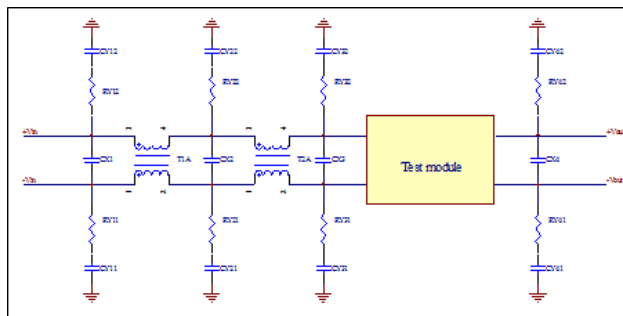
CE certificated to Low Voltage Directive 2014/35/EU

### EMC:

Conductive EMI: EN55022 class A

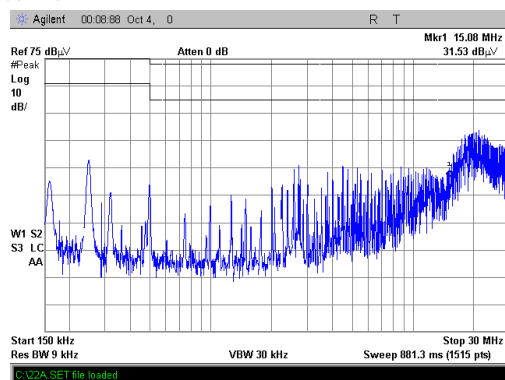
Compliance to EN55022 class A (both peak and average) with the following inductive and capacitive filter

### Setup:

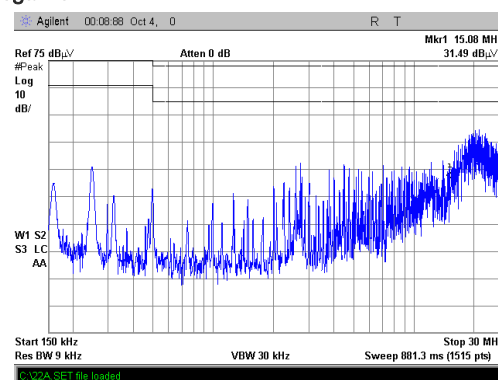


| ITEM | DESIGNATOR                                                         | PARAMETER             | VENDOR | VENDOR P/N |
|------|--------------------------------------------------------------------|-----------------------|--------|------------|
| 1    | CX1                                                                | 100µF/200V, AL cap    |        |            |
| 2    | CX2                                                                | 220µF/200V, AL cap    |        |            |
| 2    | CX3                                                                | 220µF/200V, AL cap    |        |            |
| 3    | CX4                                                                | 220µF/200V, AL cap    |        |            |
| 3    | CY21                                                               | 0.22µF/1000V, ceramic |        |            |
| 4    | CY22                                                               | 0.22µF/1000V, ceramic |        |            |
| 7    | RY21                                                               | 1206,0 R, Resistor    |        |            |
| 8    | RY22                                                               | 1206,0 R, Resistor    |        |            |
| 11   | T2A                                                                | 0.45mH, common mode   |        |            |
| 12   | T1A                                                                | 0.9mH, common mode    |        |            |
| 12   | RY11,RY12,CY11,CY21,<br>RY31,RY32,CY31,CY32<br>RY41,RY42,CY41,CY42 | NIL                   |        |            |

### Positive:

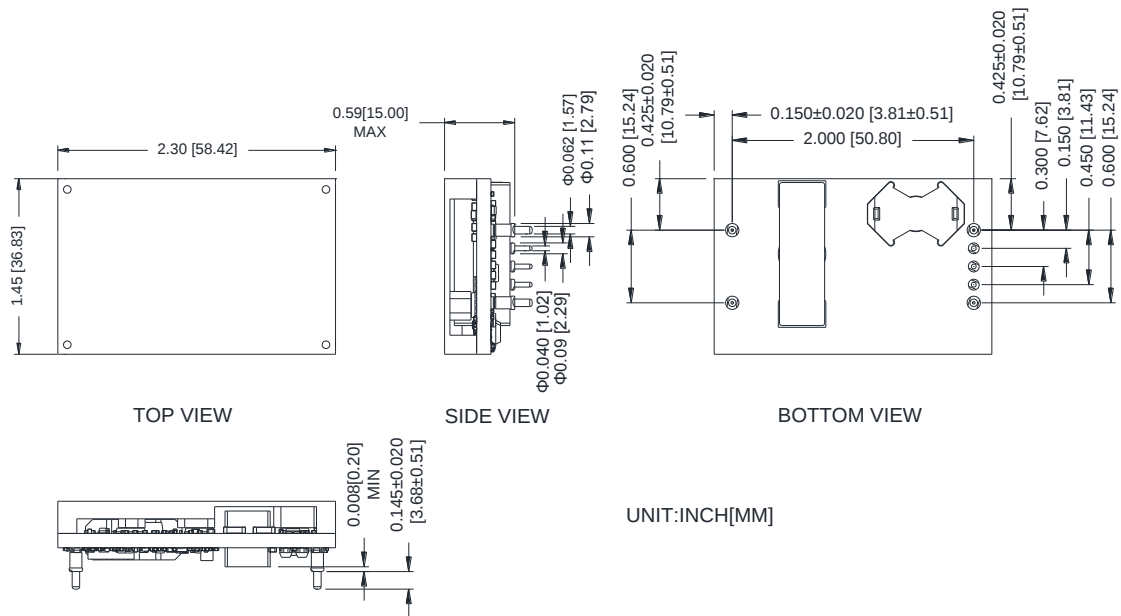


### Negative:



## 16. MECHANICAL OUTLINE

### 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) Undimensioned components are shown for visual reference only.

3) All dimensions in inches (mm); Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm) x.xxx +/-0.010 in. (x.xx +/-0.25mm).



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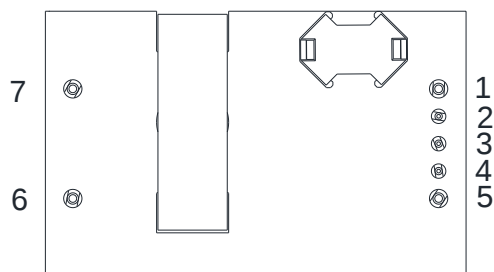
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## MECHANICAL OUTLINE(CONTINUED)

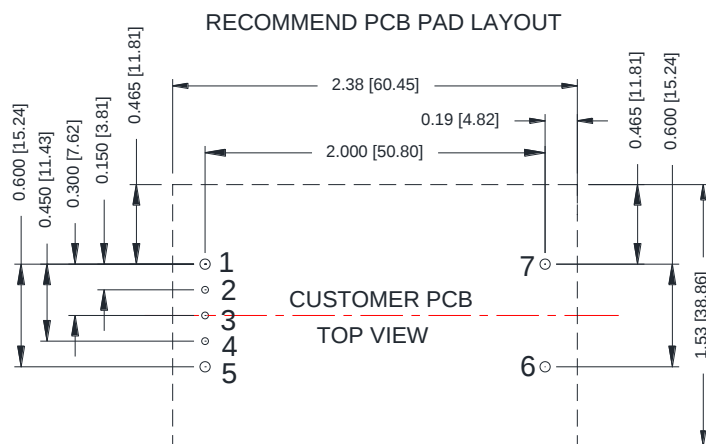
## PIN DEFINITIONS



BOTTOM VIEW

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

## RECOMMENDED PAD LAYOUT

2 3 4 HOLES SIZE  $\Phi 0.050$  & PAD SIZE  $\Phi 0.100$  MIN1 5 6 7 HOLES SIZE  $\Phi 0.074$  & PAD SIZE  $\Phi 0.120$  MIN

## 17. REVISION HISTORY

| DATE       | REVISION | CHANGES DETAIL                                                                                                           | APPROVAL |
|------------|----------|--------------------------------------------------------------------------------------------------------------------------|----------|
| 2014-11-12 | A        | First release                                                                                                            | S.Wang   |
| 2015-12-23 | B        | 1. Update rise time and turn on time<br>2. Update Efficiency value<br>3. Update waveform of electrical performance       | S.Wang   |
| 2016-02-26 | C        | 1. Change the operation temperature in Absolute Maximum Ratings<br>2. Add thermal resistance in Absolute Maximum Ratings | S.Wang   |
| 2016-04-21 | D        | Update Safety Certification, MTBF, Thermal Derating Curve, MD.                                                           | S.Wang   |
| 2018-04-28 | AE       | Update Operating Input Voltage Range 2, Under-voltage, MD, Turn off Threshold and Transient Response                     | S.Wang   |
| 2018-10-10 | AF       | Update hold-up circuit                                                                                                   | S.Wang   |

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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