# 0RQB-30Y05S

## Isolated DC-DC Converter

The 0RQB-30Y05S is an isolated DC/DC converter providing 25 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.


RoHS Compliant

### Key Features & Benefits

- 24 / 48 / 72 / 96 / 110 VDC Input
- 5.1 VDC / 5 A Output
- Reinforced Isolation
- 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)
- Approved to EN 62368-1
- 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-30Y05SG | 5.1 VDC | 24 / 48 / 72 / 96 / 110 VDC | 5 A | 25 W | 82% |

### PART NUMBER EXPLANATION

| 0 | R | QB | - | 30 | Y | 05 | S | 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 | | 25 W | 24 / 48 / 72 / 96 / 110 V | 5.1 V | Active Low, with Baseplate | 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<br>48<br>72<br>96<br>110 | 137.5 | V |
| Operating Input Voltage Range 2 | Fully functioning for 0.1 s operation.<br>Full function is not guaranteed but undamaged for 1 s operation. | 12.9<br>137.5 | -<br>- | 16.8<br>154 | V |
| Input Current | | - | - | 2.5 | 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 µH, 5 Hz to 20 MHz. Use two 100 µF/250 V electrolytic capacitors with ESR = 0.5 R max, at 200 kHz @ 25°C. | - | - | 300 | mA |
| Input Reflected Ripple Current (rms) | | - | - | 100 | mA |
| Under-voltage Turn on Threshold | Lockout turn on | 15 | 15.6 | 16.2 | 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 | | - | 6 | - | A |

**CAUTION:** This converter is not internally fused. An input line fuse must be used in application.

## 4. OUTPUT SPECIFICATIONS

| PARAMETER | DESCRIPTION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| Output Voltage Set Point | | 5 | 5.1 | 5.2 | V |
| Line Regulation | | - | - | 10 | mV |
| Load Regulation | | - | - | 20 | mV |
| Regulation Over Temperature | | - | - | ±100 | mV |
| Output Current Range | | 0 | - | 5 | 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. | 5 | - | 7 | 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 |
| ***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 | 250 | mV |
| Settling Time | | - | 0.5 | 0.75 | ms |
| △V 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 = 5 A | 79 | 81 | - | % |
| | Vin = 48 V, Iout = 5 A | 82 | 83 | - | |
| | Vin = 72 V, Iout = 5 A | 82 | 83 | - | |
| | Vin = 96 V, Iout = 5 A | 82 | 83 | - | |
| | Vin = 110 V, Iout = 5 A | 83 | 84 | - | |
| Switching Frequency | 1st stage | - | 140 | - | kHz |
| | 2nd stage | - | 250 | - | |
| FIT* | Calculated Per IEC 62380 TR 1 (UTEC 80-810) (Vin=24 V, Vo=5.1V, Io=5A, Tac = 50°C, Tae=35°C | - | 176.66 | - | Mhours |
| MTBF* | | - | 5.66 | - | |
| Dimensions (L × W ×H) | | | 2.30 x 1.45 x 0.59 | | inch |
| | | | 58.42 x 36.83 x 15.00 | | mm |
| Weight | | - | 62 | - | g |
| Over Temperature Protection | | - | 125 | - | °C |
| Over Voltage Protection (Static) | | - | 6.2 | - | 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 |

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

## 6. EFFICIENCY DATA

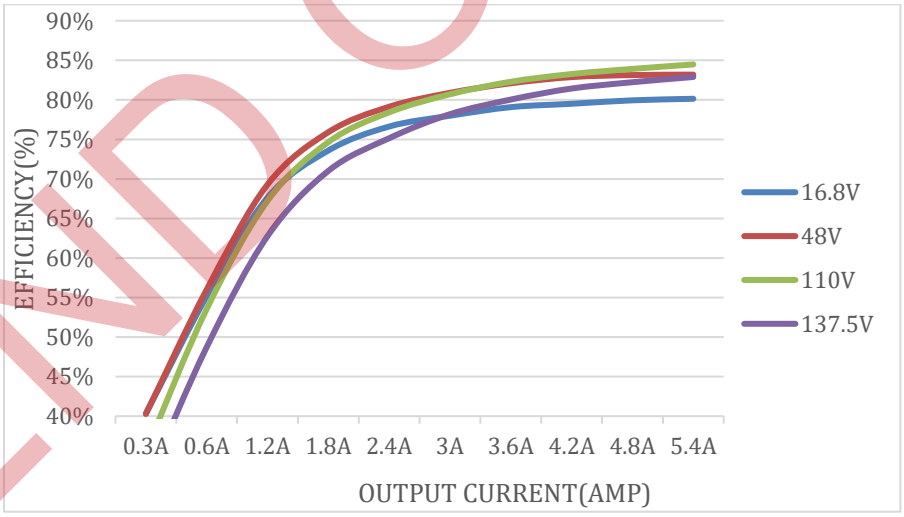


*Figure 1. Efficiency*





 

## 7. 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**

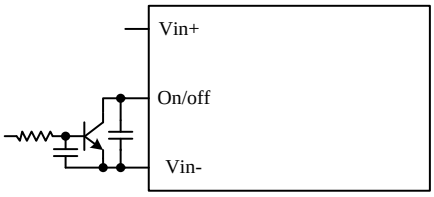


*Figure 2. Control with open collector/drain circuit*

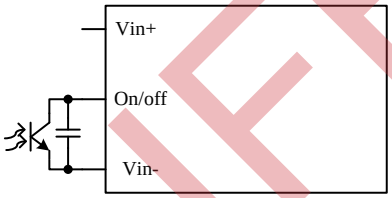


*Figure 3. Control with photocoupler circuit*

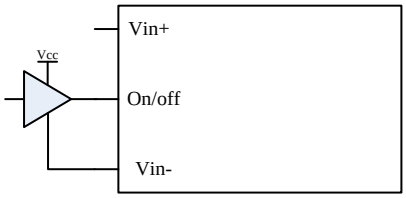


*Figure 4. Control with logic circuit*

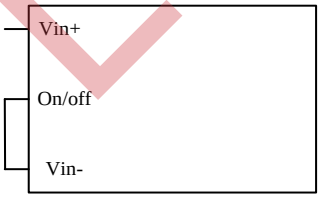


*Figure 5. Permanently on*

## 8. RIPPLE AND NOISE WAVEFORM

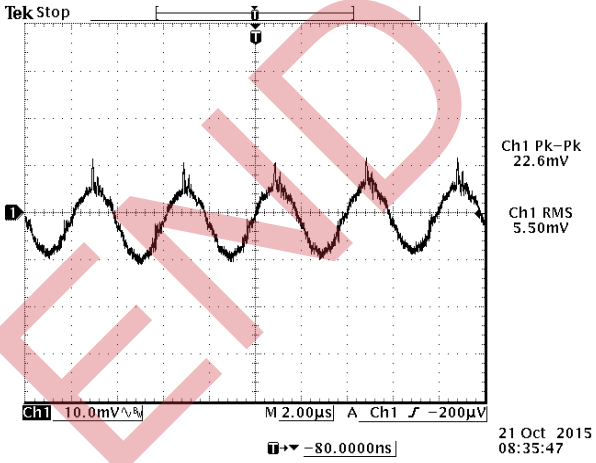


*Figure 6.*

**NOTE:** Ripple and noise, 48 VDC input, 5.1 VDC / 5 A output and Ta = 25 ˚C, with 100 µF ceramic capacitor and 100 µF AL. cap at output.

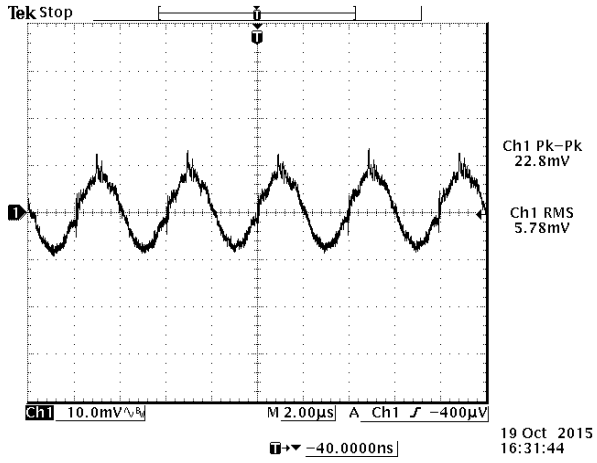


*Figure 7.*

**NOTE**: Ripple and noise, 110 VDC input, 5.1 VDC / 5 A output and Ta = 25 ˚C, with 100 µF ceramic capacitor and 100 µF AL. cap at output.

## 9. INPUT NOISE

Input Reflected Ripple Current

Testing setup:

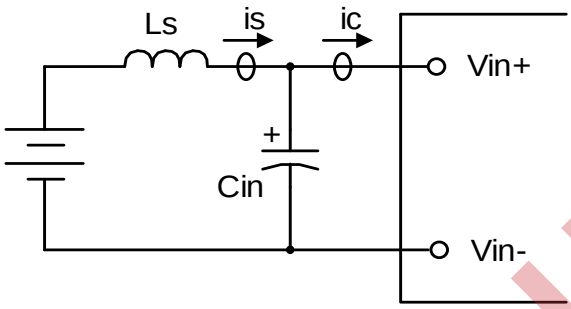


*Figure 8.*

Notes and values in testing:

Is: Input Reflected Ripple Current

ic: Input Terminal Ripple Current

Ls: Simulated Source Impedance (10 µH)

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

Recommendation: 2* 10 0µF, ESR<0.5R @ 100 kHz, 20 ˚C

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

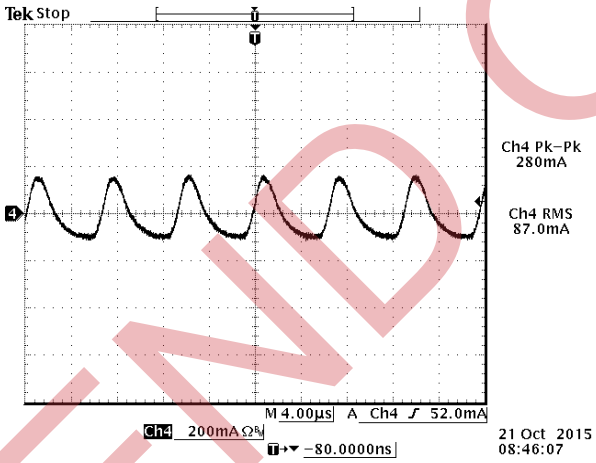


*Figure 9. is (input reflected ripple current), AC component*

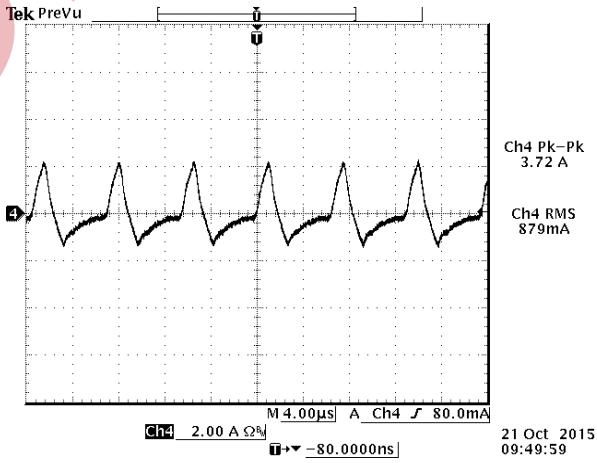


*Figure 10. ic (input reflected ripple current), AC component*

**NOTE:** 48 VDC input, 5.1 VDC / 5 A output and Ta = 25 ˚C, with 100 µF ceramic capacitor and 100 µF AL. cap at output.

## 10. TRANSIENT RESPONSE

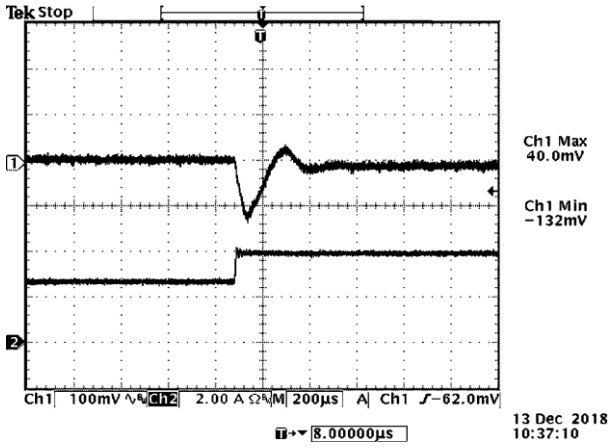


*Figure 11. 50%-75% Load Transients at Vin = 48 V @ Ta = 25℃*

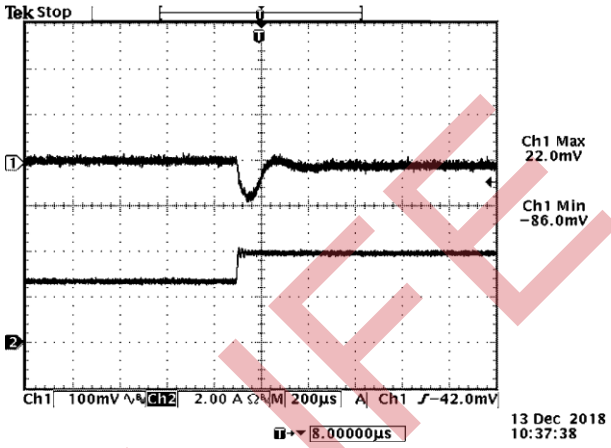


*Figure 12. 50%-75% Load Transients at Vin = 110 V @ Ta = 25℃*

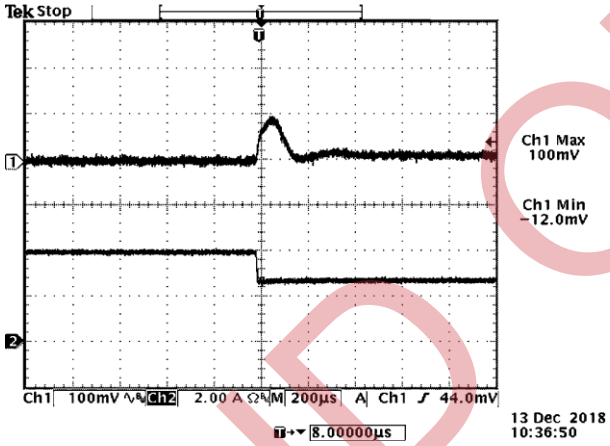


*Figure 13. 75%-50% Load Transients at Vin = 48 V @ Ta = 25℃*

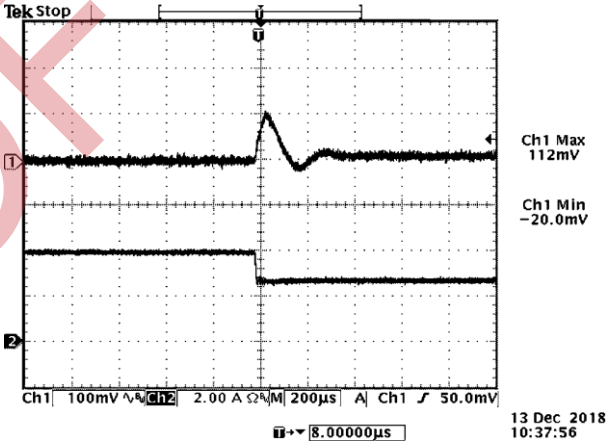


*Figure 14. 75%-50% Load Transients at Vin = 110 V @ Ta = 25℃*

## 11. STARTUP & SHUTDOWN

**Turn on rise time:**

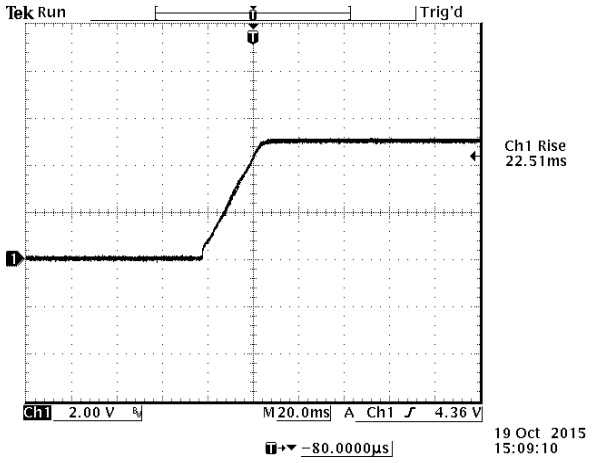


*Figure 15. Vin = 48 V, Io = 5 A, Vo = 5.1 V*

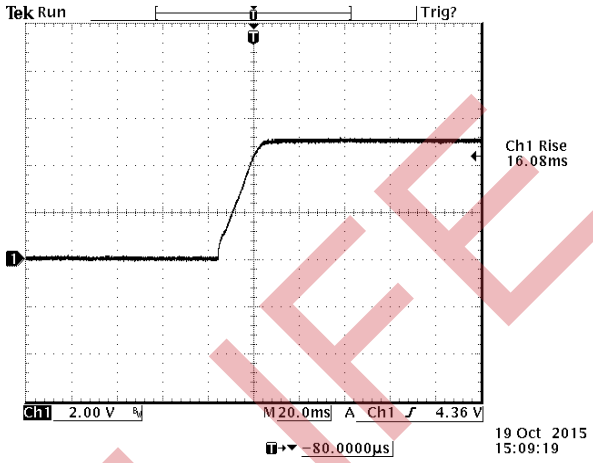


*Figure 16. Vin = 110 V, Io = 5 A, Vo = 5.1 V*

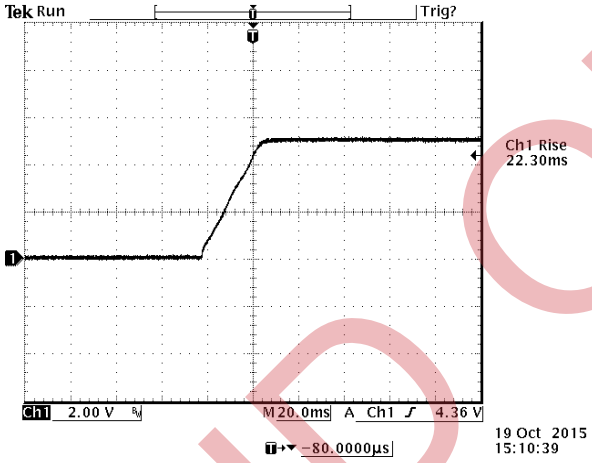


*Figure 17. Vin = 48 V, Io = 5 A, Vo = 5.1 V, with Cext = 1000 µF*

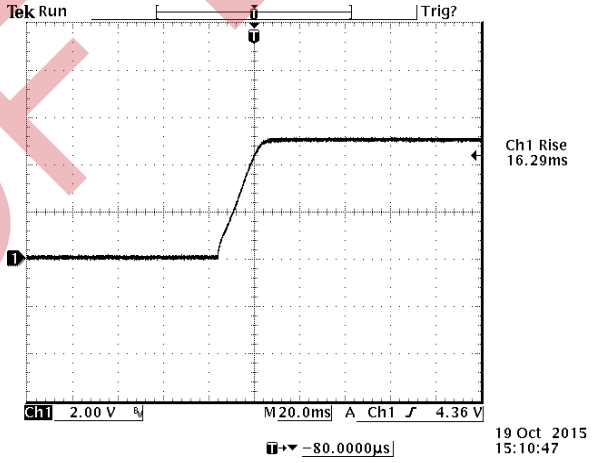


*Figure 18. Vin = 48 V, Io = 5 A, Vo = 5.1 V, with Cext = 1000 µF*

**Turn on delay time:**

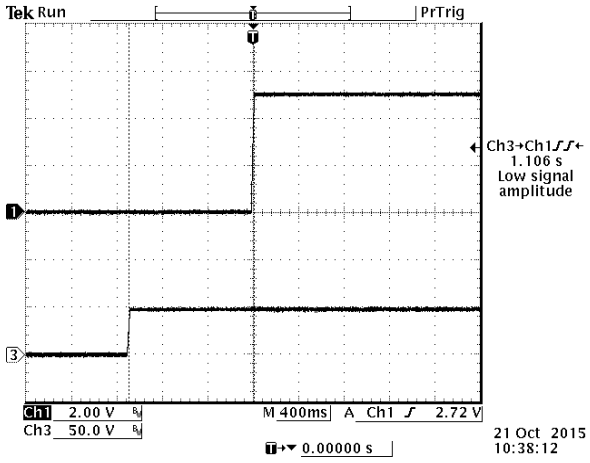


*Figure 19. Startup from Vin*
*Ch1: Vo*
*Ch3: Vin*
*Vin = 48 V, Io = 5 A, Vo = 5.1 V*

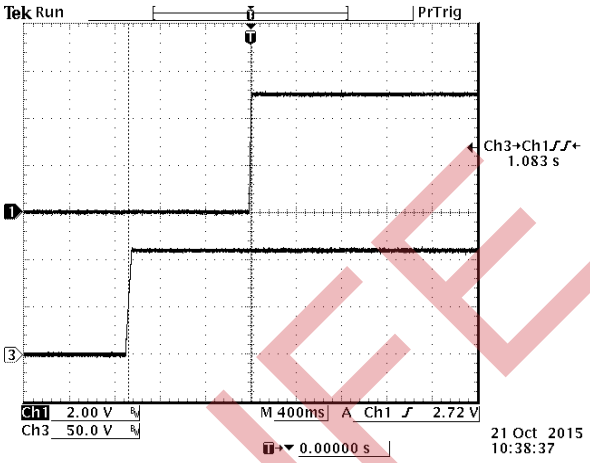


*Figure 20. Startup from Vin*
*Ch1: Vo*
*Ch3: Vin*
*Vin = 110 V, Io = 5 A, Vo = 5.1 V*

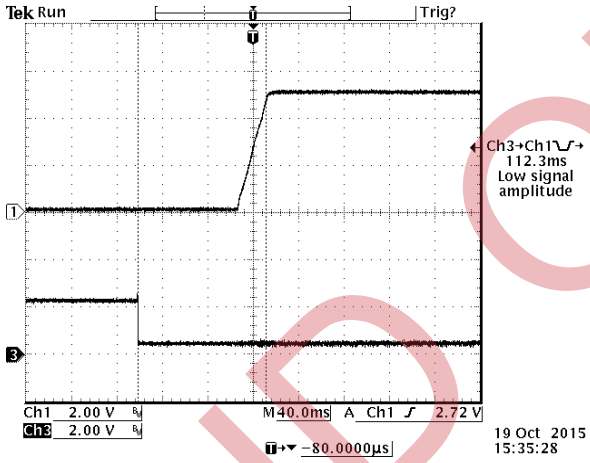


*Figure 21. Startup from on/off*
*Ch1: Vo*
*Ch3: on/off*
*Vin = 48 V, Io = 5 A, Vo = 5.1 V*

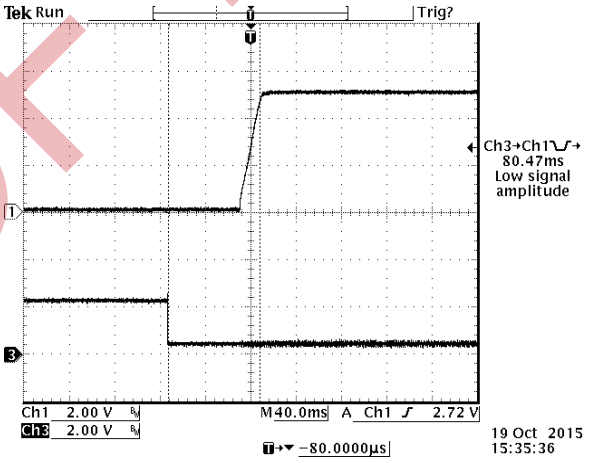


*Figure 22. Startup from on/off*
*Ch1: Vo*
*Ch3: on/off*
*Vin = 110 V, Io = 5 A, Vo = 5.1 V*

**Shutdown:**

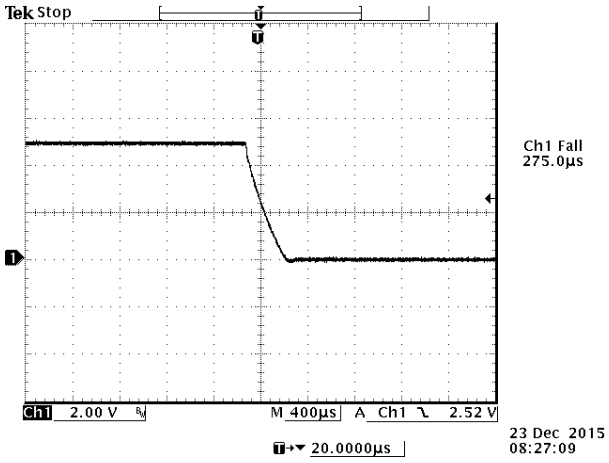


*Figure 23. Vin = 48 V, Io = 5 A, Vo = 5.1 V*

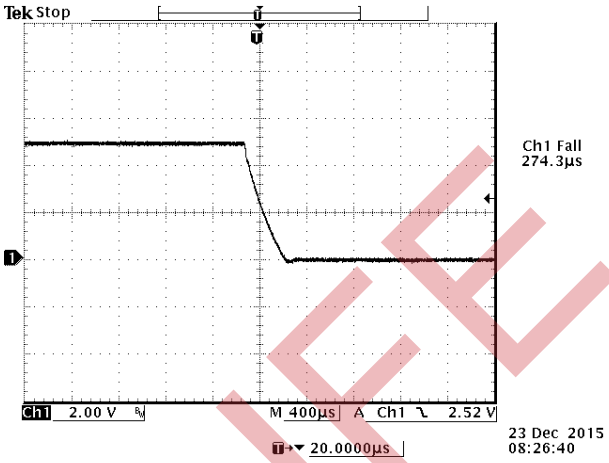


*Figure 24. Vi = 48 V, Io = 5 A, Vo = 5.1 V*

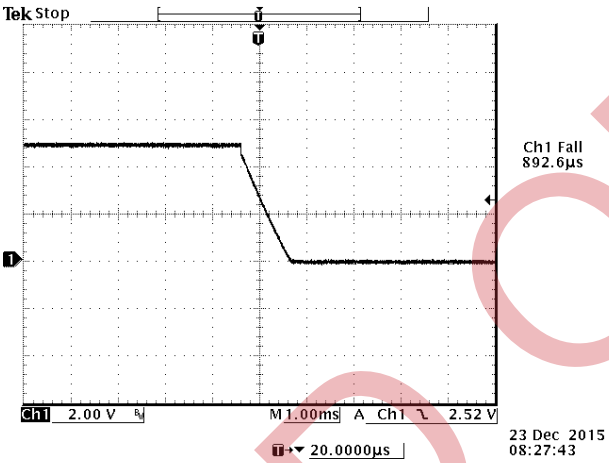


*Figure 25. Vin = 48 V, Io = 5 A, Vo = 5.1 V, with Cext = 1000 µF*

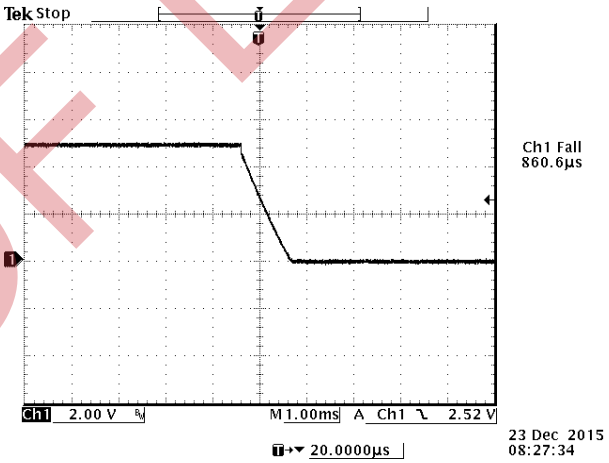


*Figure 26. Vin = 48 V, Io = 5 A, Vo = 5.1 V, with Cext = 1000 µF*

## 12. HOLD UP CIRCUIT

| PARAMETER | DESCRIPTION | SYMBOL | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Hold up Capacitor | Working voltage rating should be 200 V.<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 - 137.5 V input and all Iout range. | T_HOLD | 12 | - | - | ms |

Recommended External Hold up Circuit

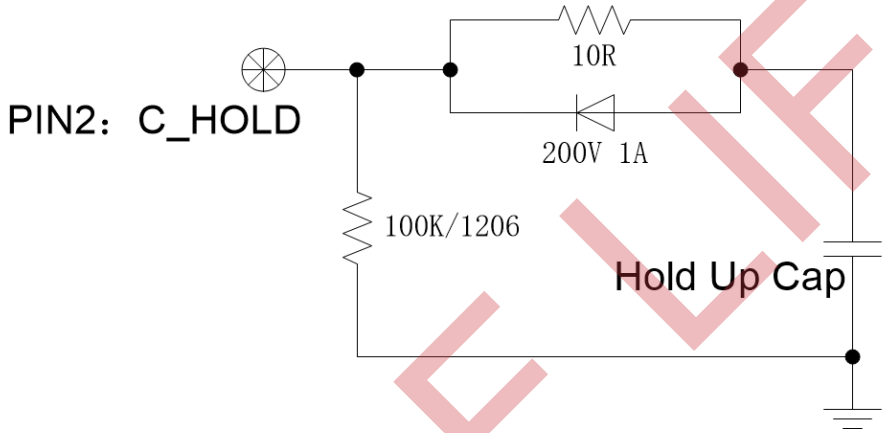


*Figure 27.*

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

## 13. INPUT UNDER-VOLTAGE LOCKOUT

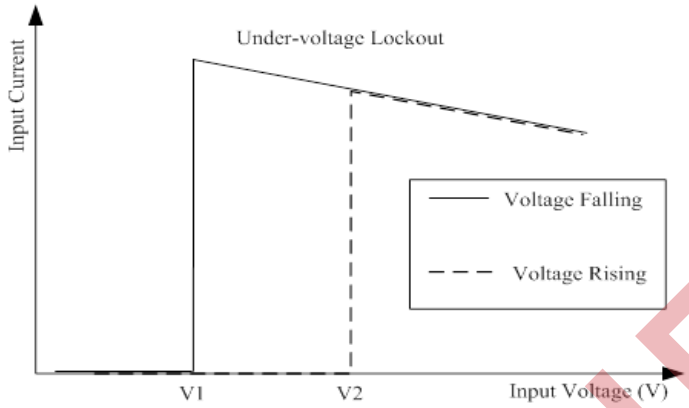


*Figure 28. Input under voltage lockout*

## 14. THERMAL DERATING CURVES

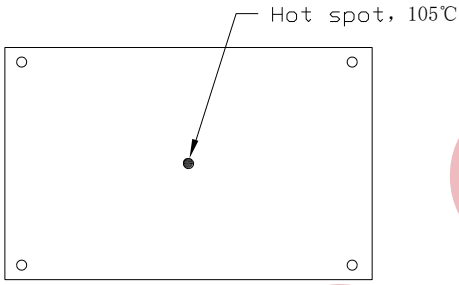


*Figure 29. Module top view*

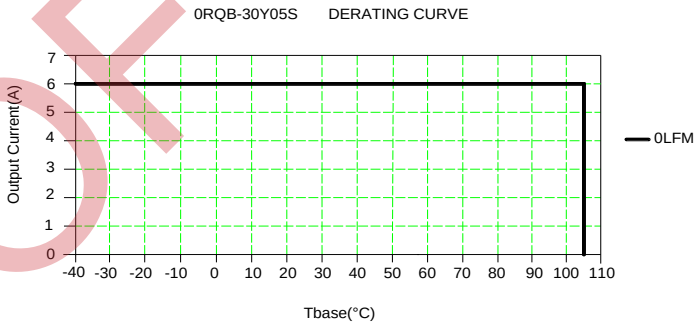


*Figure 30. Derating curve*





 

## 15. SAFETY & EMC

**Safety:**

safety certificated to EN 62368-1

CE certificated to Low Voltage Directive 2014/35/EU

**EMC:**

Conductive EMI: EN 55032 class A

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

Test Setup:

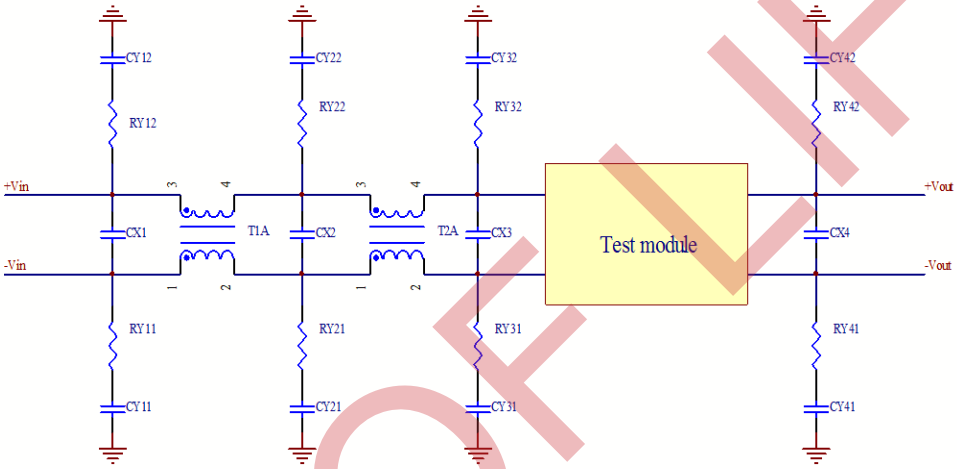


*Figure 31.*

| ITEM | DESIGNATOR | PARAMETER | VENDOR | VENDOR P/N |
|---|---|---|---|---|
| 1 | CX1 | Cap X2 1uF +/-20% 310VAC | Vishay | BFC233924105 |
| 2 | CX2 | AL-EL CAP 100uF+/-20% 200V -40 to 105C 18X40mm | Nichicon | UPJ2D101MHD |
| 3 | CX3 | AL-EL CAP 100uF+/-20% 200V -40 to 105C 18X40mm | Nichicon | UPJ2D101MHD |
| 4 | CY21 | CAP Y2 4700PF +/-20% 250VAC 7.5mm CTRS | MURATA | DE2E3KH472MB3B |
| 5 | CY22 | CAP Y2 4700PF +/-20% 250VAC 7.5mm CTRS | MURATA | DE2E3KH472MB3B |
| 6 | CX4 | AL-EL CAP 330UF 20% 100V 100YXH330M-EFC-18*20 Lead Type | NCC | EKY-101ELL331MM20S |
| 7 | T1A | 5.0uH, 70mOhm, 3.7Amp Max. DIP Common Mode Chokes | ITG Electronics | C20200-06 |
| 8 | RY21 | CHIP RES TKF 0R +/-5% 0.25W 1206 | SEI | RMCF1206ZT0R00 |
| 9 | RY22 | CHIP RES TKF 0R +/-5% 0.25W 1206 | SEI | RMCF1206ZT0R00 |
| 10 | T2A,RY12, RY11,CY11, CY12,RY32, RY31,CY32 CY31,RY42,RY41,CY41, CY42 | NIL | | |

**Positive:**

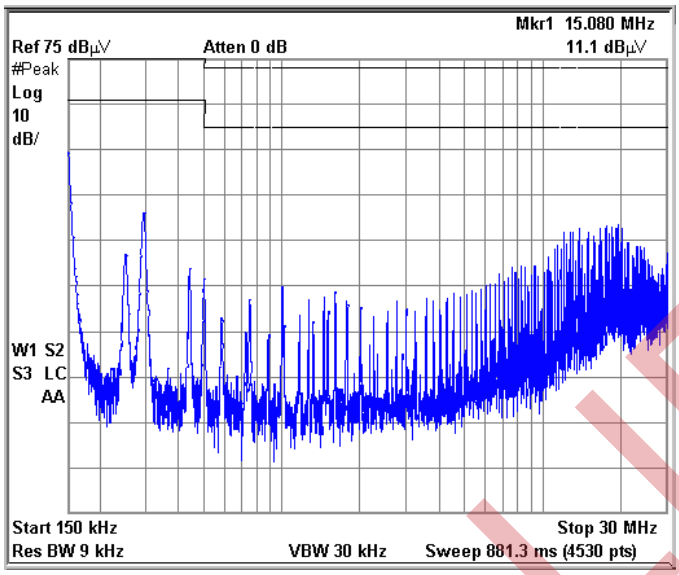


*Figure 32. Positive*

**Negative:**

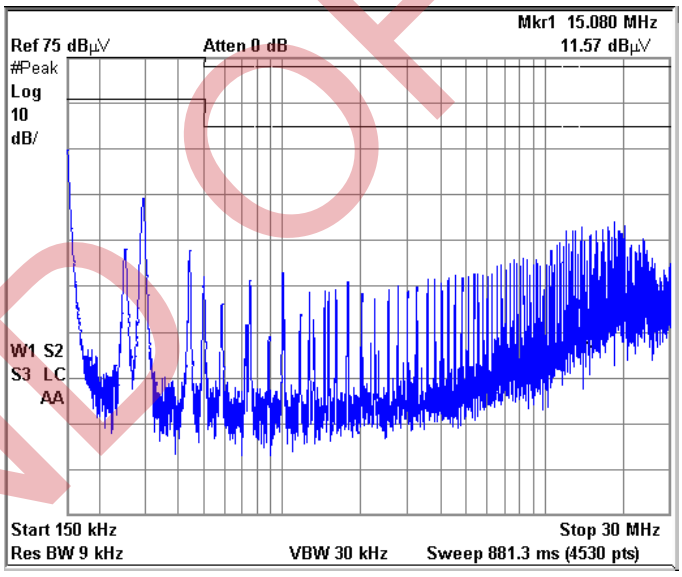


*Figure 33. Negative*





 

## 16. MECHANICAL DIMENSIONS

### OUTLINE

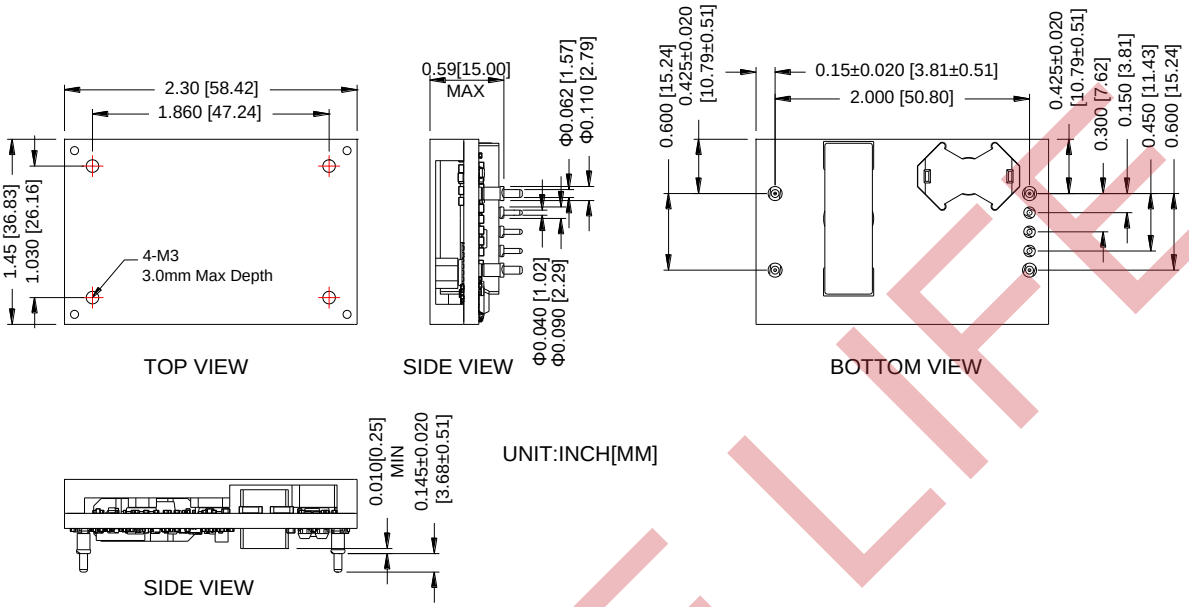


*Figure 34. Outline*

**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.

**Notes:**

1) All Pins: Material - Copper Alloy;
   Finish - Tin plated.
2) Un-dimensioned components are shown for visual reference only.
3) All dimensions in inch [mm]; Tolerances: x.xx +/-0.02 inch [0.5 mm]. x.xxx +/-0.010 inch [0.25 mm]. Unless otherwise stated.

## PIN DEFINITIONS

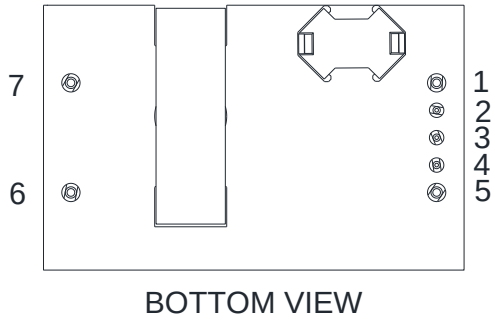


*Figure 35. Pins*

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

## RECOMMENDED PAD LAYOUT

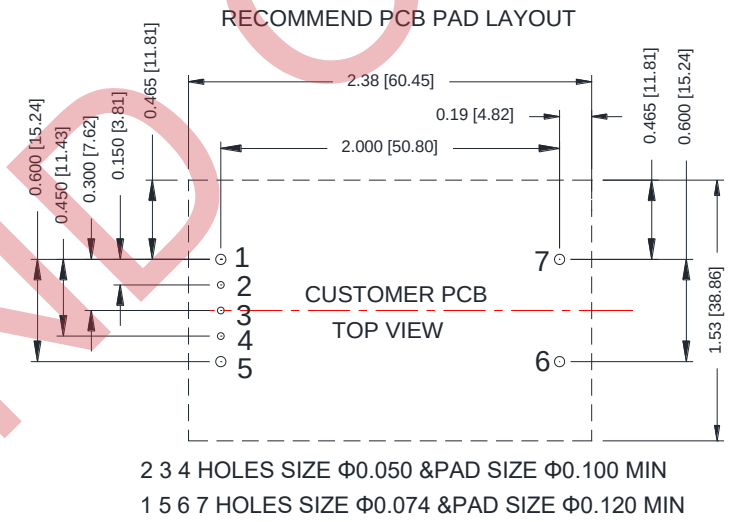


*Figure 36. Recommended pad layout*

## 17. REVISION HISTORY

| DATE | REVISION | CHANGES DETAIL | APPROVAL |
|---|---|---|---|
| 2018-08-09 | AA | First release. | S.Wang |
| 2018-09-13 | AB | Update MD. | S.Wang |
| 2018-10-10 | AC | Update hold-up circuit. | S.Wang |
| 2018-12-13 | AD | Update OCP and Under-voltage Turn on Threshold. | S.Wang |
| 2019-06-17 | AE | Update the Efficiency of 24V 5A; Add safety certification. | S.Wang |
| 2019-10-24 | AF | Add feature reinforced isolation. | S.Wang |
| 2020-10-10 | AG | Delete preliminary watermark. Update outline. | XF.Jiang |
| 2021-05-12 | AH | Add object ID. | XF.Jiang |



**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.

 