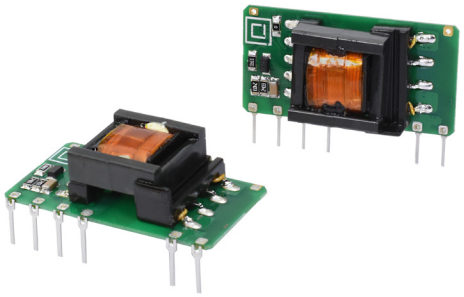
# **SERIES:** PBO-15C | **DESCRIPTION:** INTERNAL AC-DC POWER SUPPLY

## FEATURES

- wide input range (85~305 VAC or 100 – 430 VDC)
- available in straight-pin and bent-pin configurations
- wide operating temperature range (-40 to +85 C)
- over-voltage, over-current, short-circuit protection
- IEC/EN/UL 62368 certified
- designed to meet IEC/EN/UL 60335 requirements
- safety class II
- ideal for Industrial Control & Smart Home applications

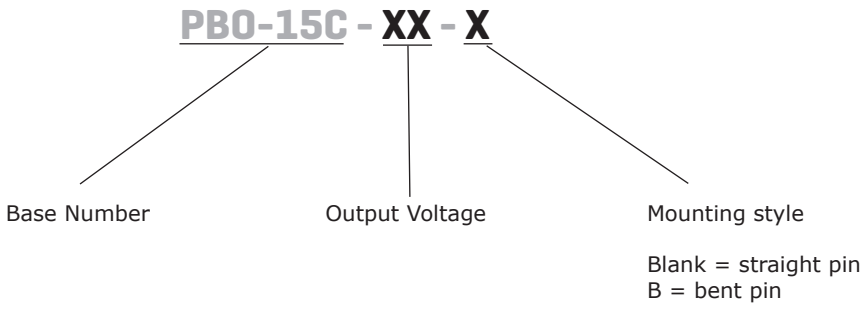


## MODEL

| MODEL | output voltage (Vdc) | output current max (A) | output power max (W) | ripple and noise[1] typ (mVp-p) | efficiency[2] typ (%) |
|---|---|---|---|---|---|
| PBO-15C-3 | 3.3 | 3.0 | 9.9 | 150 | 75.0 |
| PBO-15C-5 | 5.0 | 2.8 | 14.0 | 150 | 77.0 |
| PBO-15C-9 | 9.0 | 1.67 | 15.0 | 150 | 82.0 |
| PBO-15C-12 | 12.0 | 1.25 | 15.0 | 150 | 82.0 |
| PBO-15C-15 | 15.0 | 1.0 | 15.0 | 150 | 84.0 |
| PBO-15C-24 | 24.0 | 0.625 | 15.0 | 150 | 85.0 |

Note: 1. At full load, nominal input, 20 MHz bandwidth oscilloscope, see Application Circuit.
2. At 230 Vac input.

## PART NUMBER KEY



## INPUT

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| voltage | AC input<br>DC input | 85<br>100 | | 305<br>430 | Vac<br>Vdc |
| frequency | | 47 | | 63 | Hz |
| current | at 115 Vac<br>at 230 Vac | | | 0.4<br>0.25 | A<br>A |
| inrush current | at 115 Vac<br>at 230 Vac | | 18<br>35 | | A<br>A |
| no load power consumption | at 230 Vac | | | 0.25 | W |

## OUTPUT

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| capacitive load | 3.3 Vdc output models<br>5 Vdc output models<br>9 Vdc output models<br>12 Vdc output models<br>15 Vdc output models<br>24 Vdc output models | | | 20,000<br>15,000<br>5,000<br>4,000<br>2,000<br>1,000 | µF<br>µF<br>µF<br>µF<br>µF<br>µF |
| initial set point accuracy | 3.3 Vdc output<br>other outputs | | ±3<br>±2 | | %<br>% |
| line regulation | at full load | | ±0.5 | | % |
| load regulation | 0% ~ 100% load, 3.3 Vdc output<br>0% ~ 100% load, 5 Vdc output<br>0% ~ 100% load, other outputs | | ±2<br>±1.5<br>±1 | | %<br>%<br>% |
| hold-up time | at 115 Vac<br>at 230 Vac | | 10<br>40 | | ms<br>ms |
| switching frequency | | | 65 | | kHz |
| temperature coefficient | | | ±0.02 | | %/°C |

## PROTECTIONS

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| | | | | | |
| over voltage protection | output voltage clamp<br>3.3 & 5 Vdc output models<br>9 Vdc output models<br>12 Vdc output models<br>15 Vdc output models<br>24 Vdc output models | | | <br>9.0<br>12.0<br>16.0<br>20.0<br>30.0 | <br>Vdc<br>Vdc<br>Vdc<br>Vdc<br>Vdc |
| over current protection | auto recovery | 110 | | | % |
| short circuit protection | continuous, auto recovery | | | | |

## SAFETY & COMPLIANCE

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| isolation voltage | input to output for 1 minute, leakage current <5mA | 3,000 | | | Vac |
| safety approvals | certified to 62368: IEC, EN, UL<br>designed to meet 60335: IEC, EN, UL | | | | |
| safety class | class II | | | | |
| EMI/EMC | CISPR32/EN55032 CLASS A (Recommended circuit 1, 4)<br>CISPR32/EN55032 CLASS B (Recommended circuit 2, 3) | | | | |
| ESD | IEC/EN 61000-4-2 Contact ±6kV perf. criteria B | | | | |
| radiated immunity | IEC/EN61000-4-3 10V/m perf. criteria A | | | | |

## SAFETY & COMPLIANCE (CONTINUED)

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| EFT/burst | IEC/EN61000-4-4 ±2KV (Recommended circuit 1, 2) perf. criteria B<br>IEC/EN61000-4-4 ±4KV (Recommended circuit 3, 4) perf. criteria B | | | | |
| surge | IEC/EN61000-4-5 line to line ±1KV (Recommended circuit 1, 2) perf. criteria B<br>IEC/EN61000-4-5 line to line±2KV (Recommended circuit 3, 4) perf. criteria B | | | | |
| conducted immunity | IEC/EN61000-4-6 10Vr.m.s perf. criteria A | | | | |
| voltage dips and interruptions | IEC/EN61000-4-11 0%, 70% perf. criteria B | | | | |
| MTBF | as per MIL-HDBK-217F at 25 °C | 1,000,000 | | | hours |
| RoHS | yes | | | | |

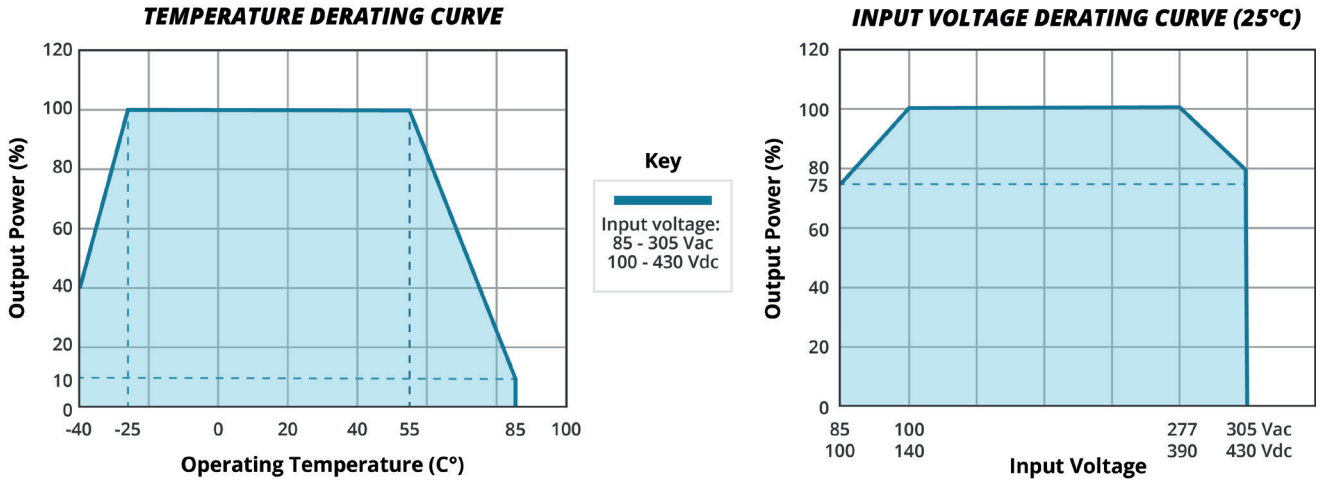
## ENVIRONMENTAL

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| operating temperature | | -40 | | 85 | °C |
| storage temperature | | -40 | | 105 | °C |
| storage humidity | | | | 95 | % |

## SOLDERABILITY

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| wave soldering | for 5~10 seconds | 255 | 260 | 265 | °C |
| manual welding | for 3~5 seconds | 350 | 360 | 370 | °C |

## DERATING CURVE

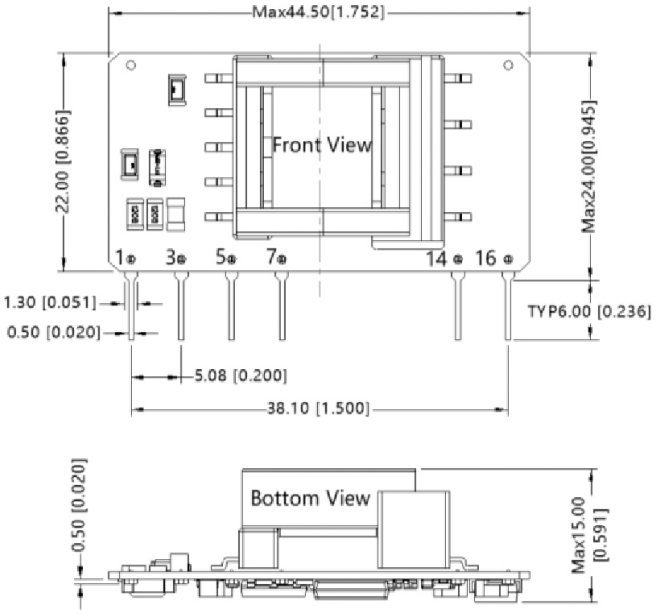


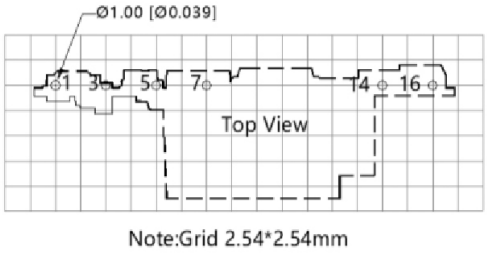

## MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| dimensions | 44.50 x 24.00 x 15.00 mm (1.751 x 0.944 x 0.590 inches) | | | | inch |
| weight | | | 11 | | g |
| cooling | free air convection | | | | |

## MECHANICAL DRAWING

**Straight-pin configuration**
units: mm [inch]
pin section tolerance: ±0.10 [±0.004]
general tolerance: ±0.50 [±0.020]

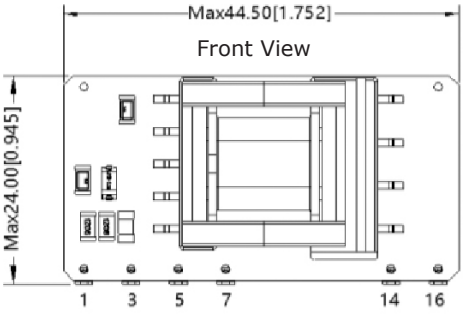


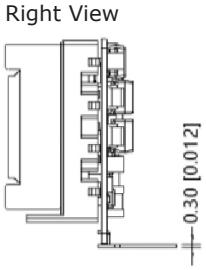



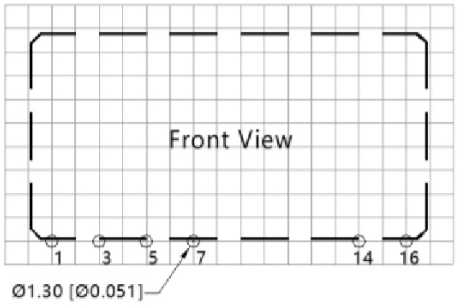

Note: The separation between all primary and secondary circuits must be maintained as follows to maintain the safety requirements:
Creepage: >6.4 mm
Clearance: >4.0 mm

| PIN CONNECTIONS | |
|---|---|
| PIN | Function |
| 1 | AC (N) |
| 3 | AC (L) |
| 5 | +V (cap) |
| 7 | -V (cap) |
| 14 | -Vo |
| 16 | +Vo |

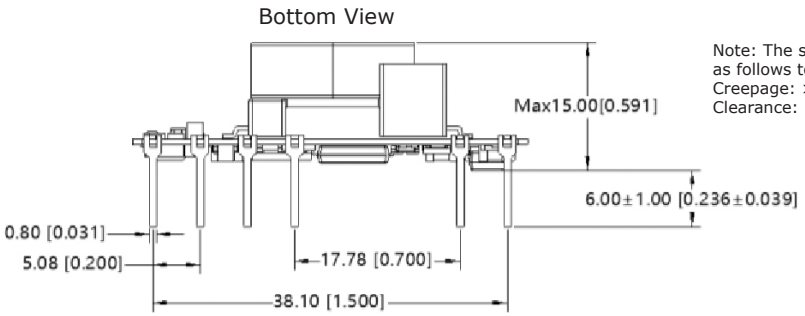
**Bent-pin configuration**
units: mm [inch]
pin section tolerance: ±0.10 [±0.004]
general tolerance: ±0.50 [±0.020]



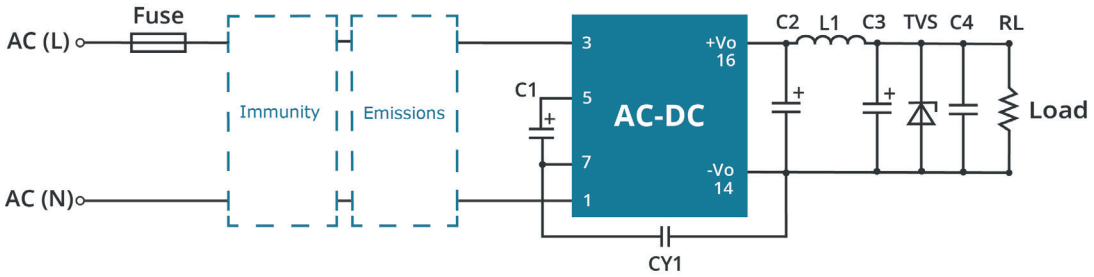

Note:Grid 2.54*2.54mm




Note: The separation between all primary and secondary circuits must be maintained as follows to maintain the safety requirements:
Creepage: >6.4 mm
Clearance: >4.0 mm

| PIN CONNECTIONS | |
|---|---|
| PIN | Function |
| 1 | AC (N) |
| 3 | AC (L) |
| 5 | +V (cap) |
| 7 | -V (cap) |
| 14 | -Vo |
| 16 | +Vo |

## APPLICATION DESIGN REFERENCE



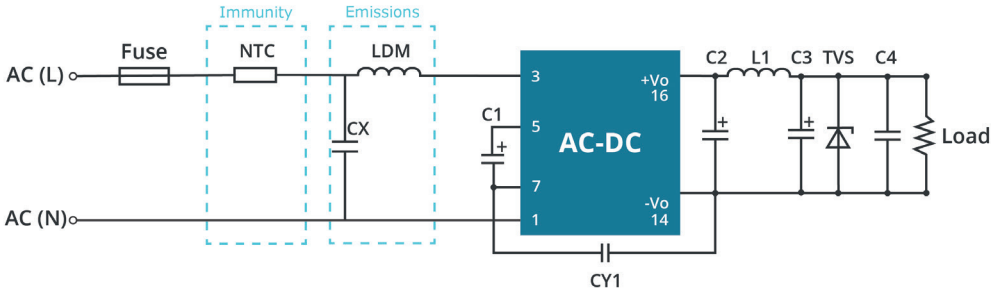

Note: All applications must follow this minimum circuit implementation. Additional enviromental and application-specific variations are listed in the following pages.

| PBO-15C Series additional component selection guide | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Part no. | FUSE (required) | C1 (required) | C2 (required) | L1 (required) | C3[1] (required) | C4 | CY1 (required) | TVS |
| PBO-15C-3 | 1A/300V | 33μF/450V | 470μF/16V (solid-state capacitor) | 2.2μH (Max 22mΩ) | 220μF/16V | 0.1μF/50V | 2.2nF/400Vac | SMBJ7.0A |
| PBO-15C-5 | | | | | | | | SMBJ7.0A |
| PBO-15C-9 | | | | | | | | SMBJ12A |
| PBO-15C-12 | | | | | | | | SMBJ20A |
| PBO-15C-15 | | | 680uF/25V | | 220μF/35V | | | SMBJ20A |
| PBO-15C-24 | | | 470uF/35V | | | | | SMBJ30A |

Note: 1. C3 is recommended to be a high frequency electrolytic capacitor with low ESR.

| PBO-15C Series Enviromental and EMC selection guide | | | | | |
|---|---|---|---|---|---|
| Recommended circuit | Typical application | Input voltage range | Enviroment temperature | Emissions | Immunity |
| 1 | General purpose | 85~305Vac | -40°C to 85°C | Class A | Class III |
| 2 | Smart home, home appliances, intelligent building, intelligent agriculture | | -25°C to 55°C | Class B | Class III |
| 3 | Indoor industrial | | -25°C to 55°C | Class B | Class IV |
| 4 | Outdoor, video monitoring, charging point, communications, security | | -40°C to 85°C | Class A | Class IV |

## Circuit 1

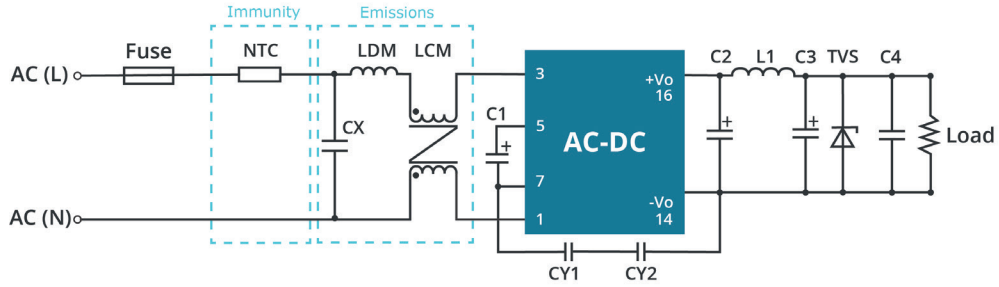



## Table 1

| Ambient temperature range | Imunity Class | Emissions Class |
|---|---|---|
| -40°C ~ 85°C | Class III | Class A |

| Component | Recommended value |
|---|---|
| NTC | 10D - 10 |
| LDM | 1.2mH (min: 0.4A, max: 4Ω) |
| CX | 0.1μF/310Vac |
| FUSE (required) | 1A/300V, slow blow |

## Circuit 2




## Table 2

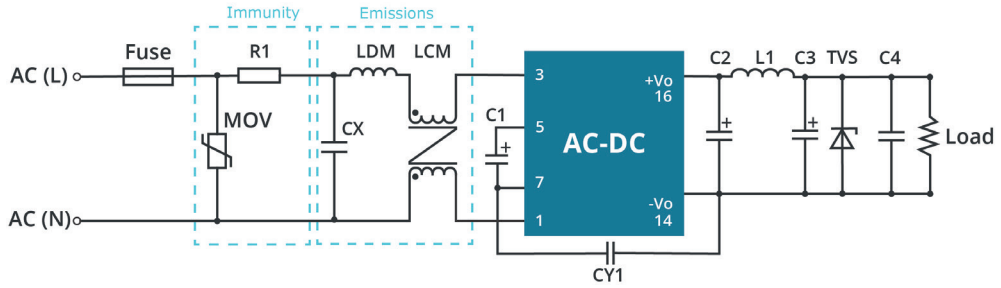
| Ambient temperature range | Imunity Class | Emissions Class |
|---|---|---|
| -25°C ~ 55°C | Class III | Class B |

| Component | Recommended value |
|---|---|
| NTC | 10D - 10 |
| CY1 (CY2) | 2.2nF/400Vac |
| LCM | 10mH (min: 0.4A, max: 600mΩ) |
| LDM | 0.33mH (min: 0.4A, max: 1Ω) |
| CX | 0.22μF/310Vac |
| FUSE (required) | 1A/300V, slow blow |

Note: When designing applications for household use (e.g. Smart Home or Home Appliance application), two Y-Caps (CY1 & CY2 valued at 2.2nF/400Vac each) are required in series to satisfy 60335 household safety requirements. Non-household applications can use one Y-Cap (CY1 valued at 2.2 nF/400Vac).

## APPLICATION DESIGN REFERENCE (CONTINUED)

### Circuit 3

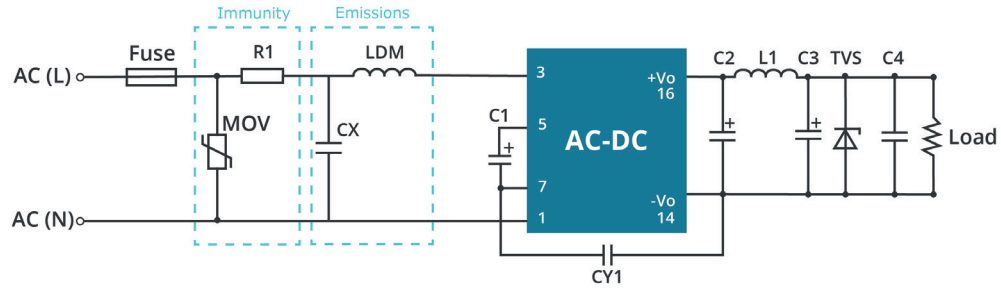



### Table 3

| Ambient temperature range | Imunity Class | Emissions Class |
|---|---|---|
| -25°C ~ 55°C | Class IV | Class B |

| Component | Recommended value |
|---|---|
| MOV | S14K350 |
| CY1 | 2.2nF/400Vac |
| CX | 0.22µF/310Vac |
| LCM | 10mH (min: 0.4A, max: 600mΩ) |
| LDM | 0.33mH (min: 0.4A, max: 1Ω) |
| R1 | 12Ω/3W |
| FUSE (required) | 2A/300V, slow blow |

### Circuit 4




### Table 4

| Ambient temperature range | Imunity Class | Emissions Class |
|---|---|---|
| -40°C ~ 85°C | Class IV | Class A |

| Component | Recommended value |
|---|---|
| MOV | S14K350 |
| LDM | 1.2mH (min: 0.4A, max: 4Ω) |
| CX | 0.1µF/310Vac |
| R1 | 12Ω/3W |
| FUSE (required) | 2A/300V, slow blow |

## REVISION HISTORY

| rev. | description | date |
|---|---|---|
| 1.0 | initial release | 08/25/2020 |
| 1.01 | datasheet update | 12/14/2020 |
| 1.02 | derating curves and circuit figures updated | 01/24/2022 |

The revision history provided is for informational purposes only and is believed to be accurate.

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