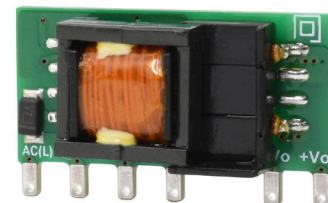


SERIES: PBO-3C | **DESCRIPTION:** INTERNAL AC-DC POWER SUPPLY

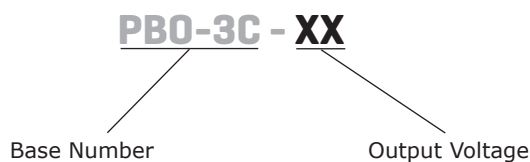
FEATURES

- wide input range (85 ~ 305 Vac)
- wide operating temperature range (-40 to +85 C)
- IEC/EN/UL 62368 certified
- designed to meet 61558 & 60335 safety standards
- 1,000,000 hour MTBF
- flexible implementations to power a wide array of applications



| MODEL | output voltage (Vdc) | output current | | output power max (W) | ripple and noise ¹ typ (mVp-p) | efficiency ² typ (%) |
|-----------|-------------------------|----------------|------------|----------------------------|---|---------------------------------------|
| | | min (A) | max (A) | | | |
| PBO-3C-3 | 3.3 | 0.06 | 0.6 | 1.98 | 150 | 67.0 |
| PBO-3C-5 | 5.0 | 0.06 | 0.6 | 3.0 | 150 | 72.0 |
| PBO-3C-9 | 9.0 | 0.033 | 0.333 | 3.0 | 150 | 76.0 |
| PBO-3C-12 | 12.0 | 0.025 | 0.25 | 3.0 | 150 | 77.0 |
| PBO-3C-15 | 15.0 | 0.02 | 0.2 | 3.0 | 150 | 78.0 |
| PBO-3C-24 | 24.0 | 0.013 | 0.125 | 3.0 | 150 | 80.0 |

Note: 1. At full load, nominal input, 20 MHz bandwidth oscilloscope, see Application Circuit 10% -100% load.
 2. At 230 Vac input.

PART NUMBER KEY


INPUT

| parameter | conditions/description | min | typ | max | units |
|---------------------------|------------------------|-----|-----|------|-------|
| voltage | ac input | 85 | | 305 | Vac |
| | dc input | 70 | | 430 | Vdc |
| frequency | | 47 | | 63 | Hz |
| current | at 115 Vac | | | 0.12 | A |
| | at 230 Vac | | | 0.06 | A |
| inrush current | at 115 Vac | | 13 | | A |
| | at 230 Vac | | 23 | | A |
| no load power consumption | at 230 Vac | | | 0.15 | W |

OUTPUT

| parameter | conditions/description | min | typ | max | units |
|----------------------------|------------------------|-----|-------|-----|-------|
| capacitive load | 3.3 Vdc output models | | | 820 | μF |
| | 5 Vdc output models | | | 680 | μF |
| | 9 Vdc output models | | | 470 | μF |
| | 12 Vdc output models | | | 470 | μF |
| | 15 Vdc output models | | | 330 | μF |
| | 24 Vdc output models | | | 200 | μF |
| initial set point accuracy | 10% ~ 100% load | | ±5 | | % |
| line regulation | at rated load | | ±1.5 | | % |
| load regulation | 10% ~ 100% load | | ±3 | | % |
| temperature coefficient | | | ±0.15 | | %/°C |

PROTECTIONS

| parameter | conditions/description | min | typ | max | units |
|--------------------------|-----------------------------------|-----|-----|-----|-------|
| over current protection | auto recovery | 110 | | | % |
| short circuit protection | continuous, auto recovery, hiccup | | | | |

SAFETY & COMPLIANCE

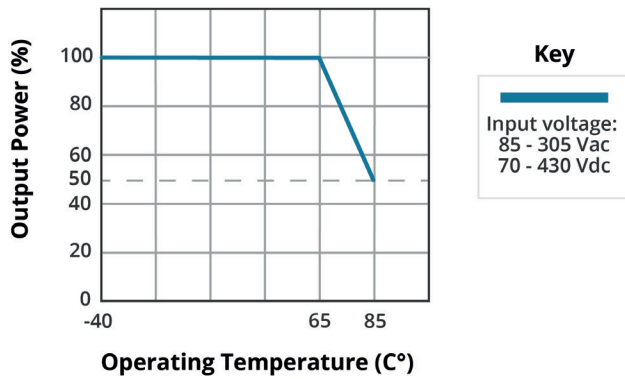
| parameter | conditions/description | min | typ | max | units |
|--------------------------------|--|------------------------|-----|-----|-------|
| isolation voltage | input to output for 1 minute, leakage current <5mA | 3,000 | | | Vac |
| safety approvals | certified to | 62368: IEC, EN, UL/cUL | | | |
| | designed to meet | 61558: IEC, EN | | | |
| | designed to meet | 60335: IEC, EN | | | |
| safety class | class II | | | | |
| EMI/EMC | CISPR32/EN55032 CLASS A (Recommended circuit 1, 4) 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 | | | | |
| EFT/burst | IEC/EN61000-4-4 ±2KV (Recommended circuit 1, 2) perf. Criteria B | | | | |
| | 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 | | | | |
| | 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

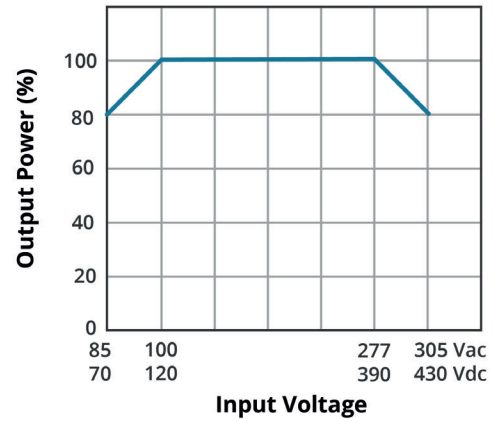
| parameter | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature | | -40 | | 85 | °C |
| storage temperature | | -40 | | 105 | °C |
| storage humidity | | | | 95 | % |

DERATING CURVES

TEMPERATURE DERATING CURVE

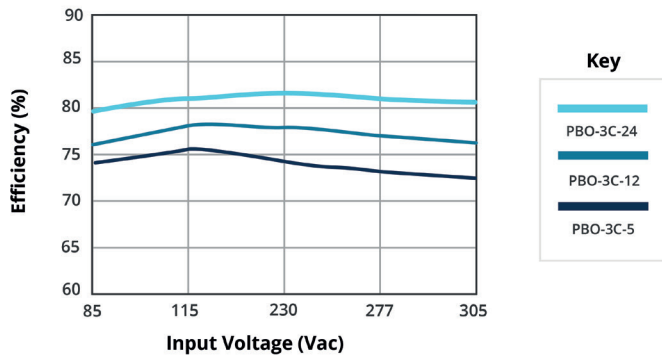


INPUT VOLTAGE DERATING CURVE (25°C)

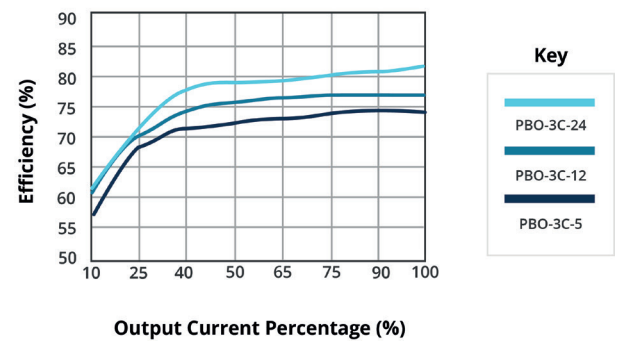


EFFICIENCY CURVES

EFFICIENCY VS INPUT VOLTAGE (FULL LOAD)



EFFICIENCY VS OUTPUT LOAD (VIN = 230 VAC)



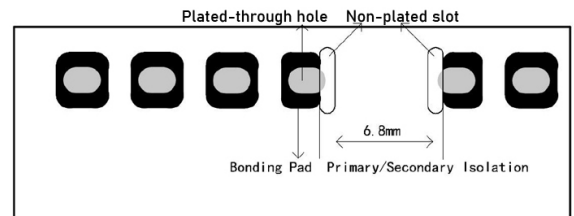
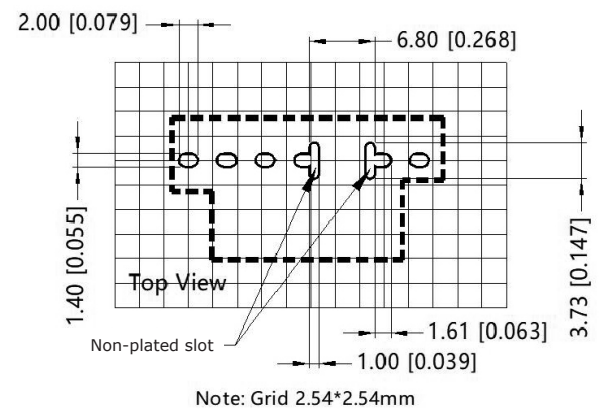
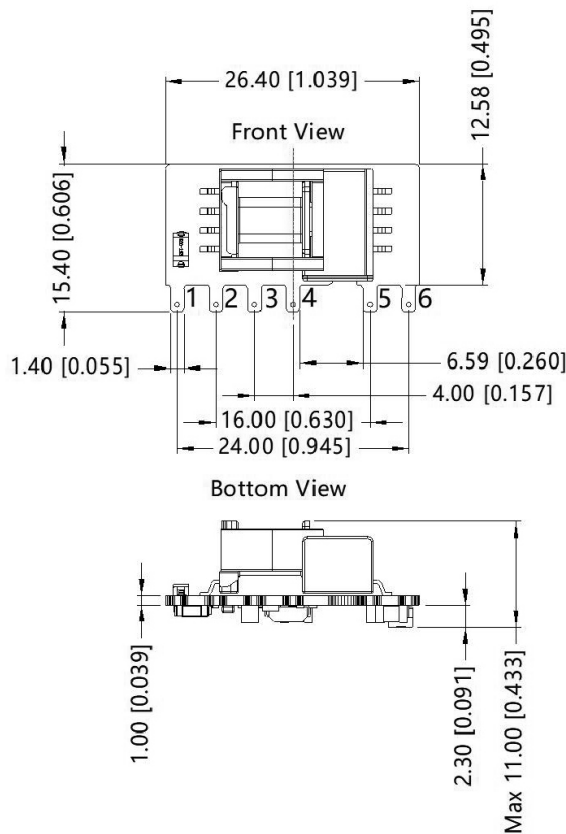
MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|------------|--|-----|-----|-----|-------|
| dimensions | 26.40 x 12.58 x 11.00 (1.039 x 0.495 x 0.433 inches) | | | | mm |
| weight | | | 3.5 | | g |
| cooling | free air convection | | | | |

MECHANICAL DRAWING

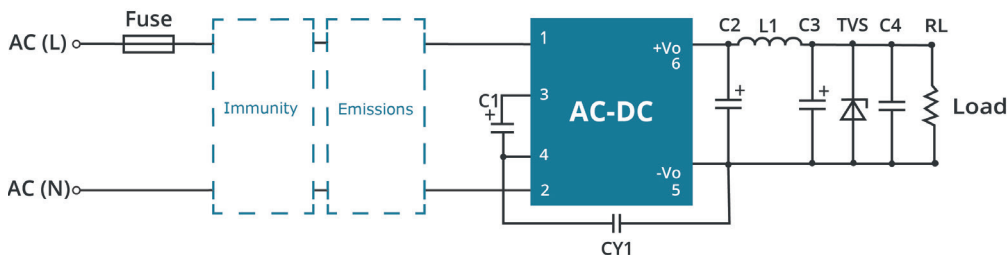
units: mm [inch]
 general tolerance: ±1.00 [±0.039]

| PIN CONNECTIONS | |
|-----------------|----------|
| PIN | Function |
| 1 | AC (L) |
| 2 | AC (N) |
| 3 | +V (cap) |
| 4 | -V (cap) |
| 5 | -Vo |
| 6 | +Vo |



Note: There are two, non-metallic/non-plated, slots located between pins 4 and 5 that are required to maintain proper creepage distance and isolation between primary and secondary circuits.

APPLICATION DESIGN REFERENCE



PBO-3C Series additional component selection guide (no EMC devices)

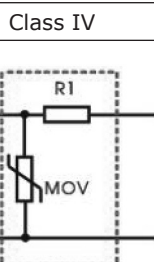
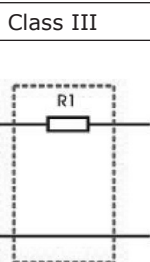
| Part no. | C1 ¹ (required) | C2 (required) | L1 (required) | C3 ² (required) | C4 | CY1 (required) | TVS ³ |
|-----------|---|---------------------------------------|----------------------------|-------------------------------|---|-------------------|------------------|
| PBO-3C-3 | 22µF/450V (-40°C to 85°C with 85-305 Vac input) | 470µF/6.3V (solid-state capacitor) | 4.7µH max 60mΩ/ 2.2A | 150µF/ 35V | 0.1µF/ 50V (ceramic capacitor) | 1.0nF/ 400Vac | SMBJ7.0A |
| PBO-3C-5 | | 270µF/16V (solid-state capacitor) | | | | | SMBJ7.0A |
| PBO-3C-9 | 10µF/450V (-25°C to 85°C with 85-305 Vac input, or -40°C to 85°C with 165-305 Vac input) | 220µF/35V | | 47µF/ 35V | | | SMBJ12A |
| PBO-3C-12 | | | | | | | SMBJ20A |
| PBO-3C-15 | | | | | | | SMBJ20A |
| PBO-3C-24 | | | | | | | SMBJ30A |

- Note:
1. Recommended to use a capacitor with ripple current >200 mA at 100 kHz.
 2. Recommended to use a high frequency, low ESR, electrolytic capacitor (<= 1.1Ω at -40 C) with at least 20% margin on voltage rating.
 3. A suppressor diode (TVS) is recommended to protect the downstream application in case of converter failure and should be rated for a minimum of 1.2 times the converter's output voltage.

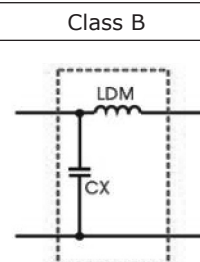
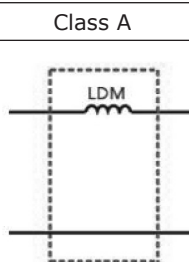
PBO-3C Series Enviromental and EMC selection guide

| Recommended circuit | Application enviromental | Typical industry | Input voltage range | Enviroment temperature | Emissions | Immunity |
|---------------------|------------------------------|---|---------------------|------------------------|-----------|-----------|
| 1 | Basic application | None | 85~305Vac | -40°C to 85°C | Class A | Class III |
| 2 | Indoor civil enviroment | Smart home/Home appliances (2Y-caps) | | -25°C to 55°C | Class B | Class III |
| | Indoor general enviroment | Intelligent building/ Intelligent agriculture | | -25°C to 55°C | Class B | Class IV |
| 3 | Indoor industrial enviroment | Manufacturing workshope | | -40°C to 85°C | Class A | Class IV |
| 4 | Outdoor general enviroment | ITS/Video monitoring/ Charging point/ Communication/Security and protection | | | | |

Immunity design circuits reference



Emissions design circuits reference



APPLICATION DESIGN REFERENCE (CONTINUED)

Circuit 1

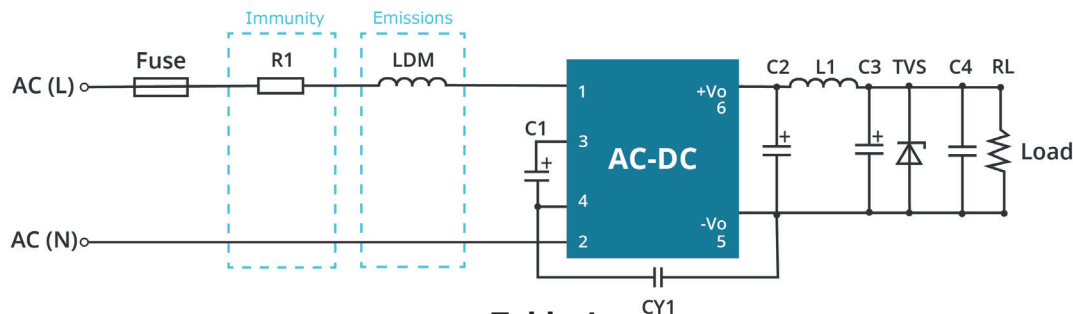


Table 1

| Application enviromental | Ambient temperature range | Imunity Class | Emissions Class |
|--------------------------|---------------------------|---------------|-----------------|
| Basic application | -40°C ~ 85°C | Class III | Class A |

| Component | Recommended value |
|------------------------------------|-----------------------|
| FUSE (required) | 1A/300V, slow blow |
| R1 (wire-wound resistor, required) | 12Ω/3W |
| LDM | 1.2mH/4Ω max/0.2A min |

Note: R1 must be a wire-wound resistor; do not use a chip or carbon film resistor.

Circuit 2

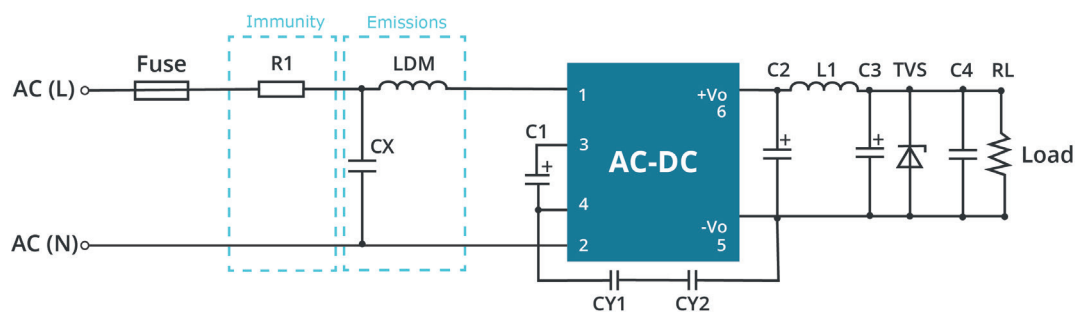


Table 2

| Application enviromental | Ambient temperature range | Imunity Class | Emissions Class |
|--------------------------|---------------------------|---------------|-----------------|
| Indoor civil / general | -25°C ~ 55°C | Class III | Class B |

| Component | Recommended value |
|------------------------------------|--------------------|
| R1 (wire-wound resistor, required) | 12Ω/3W |
| LDM | 1.2mH/ 4Ω/0.2A |
| CX | 0.1μF/310Vac |
| FUSE (required) | 1A/300V, slow-blow |

Note: 1. For Smart Home and Home Appliance applications two Y-capacitors are required in series (2.2 nF/250 Vac each) to meet 60335 household safety requirements.
 2. Many safety standards require a bleeder resistor no greater than 3.8MΩ in parallel with the X-capacitor.
 3. R1 must be a wire-wound resistor; do not use a chip or carbon film resistor.

APPLICATION DESIGN REFERENCE (CONTINUED)

Circuit 3

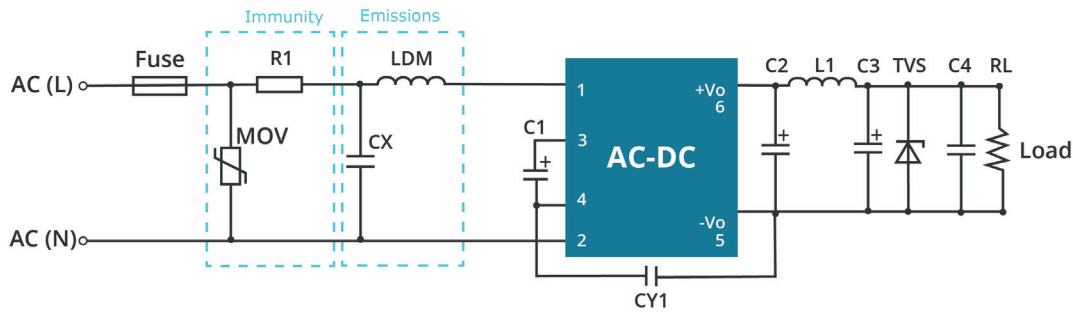


Table 3

| Application environmental | Ambient temperature range | Immunity Class | Emissions Class |
|---------------------------|---------------------------|----------------|-----------------|
| Indoor industrial | -25°C ~ 55°C | Class IV | Class B |

| Component | Recommended value |
|------------------------------------|--------------------|
| MOV | S14K350 |
| CX | 0.1µF/310Vac |
| LDM | 1.2mH/ 4Ω/0.2A |
| R1 (wire-wound resistor, required) | 12Ω/2W |
| FUSE (required) | 2A/300V, slow-blow |

Note: 1. Many safety standards require a bleeder resistor no greater than 3.8MΩ in parallel with the X-capacitor.
 2. R1 must be a wire-wound resistor; do not use a chip or carbon film resistor.

Circuit 4

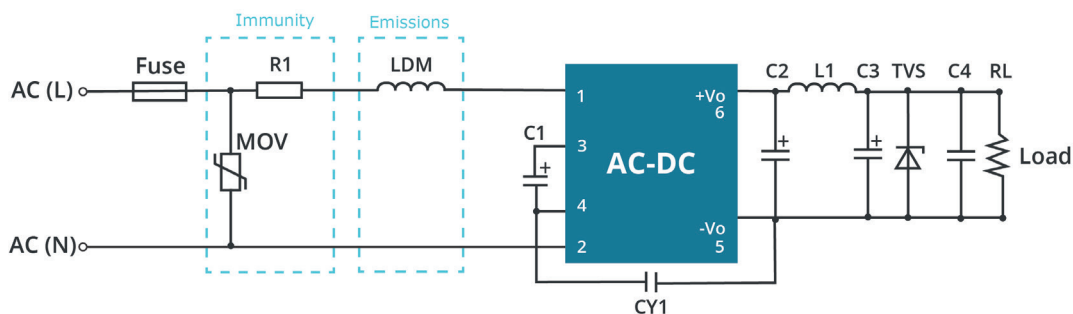


Table 4

| Application environmental | Ambient temperature range | Immunity Class | Emissions Class |
|-----------------------------|---------------------------|----------------|-----------------|
| Outdoor general environment | -40°C ~ 85°C | Class IV | Class A |

| Component | Recommended value |
|------------------------------------|------------------------|
| MOV | S14K350 |
| LDM | 1.2mH/ 4Ω max/0.2A min |
| R1 (wire-wound resistor, required) | 12Ω/2W |
| FUSE (required) | 2A/300V, slow-blow |

Note: R1 must be a wire-wound resistor; do not use a chip or carbon film resistor.

REVISION HISTORY

| rev. | description | date |
|------|-----------------|------------|
| 1.0 | initial release | 11/13/2020 |

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



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