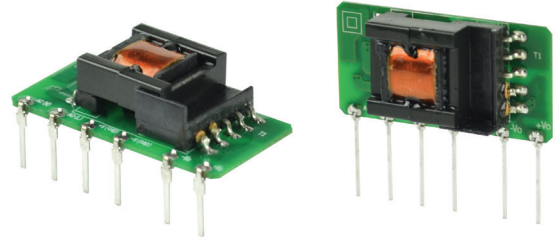




SERIES: PBO-3 | **DESCRIPTION:** AC-DC POWER SUPPLY

FEATURES

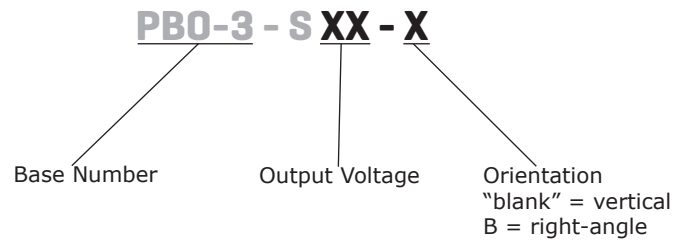
- up to 3 W continuous power
- ultra-compact SIP package
- available in straight-pin and bent-pin configurations
- wide input voltage range
- over current and short circuit protections
- 3,000 Vac isolation
- UL 60950-1, CE safety approvals
- efficiency up to 77%



| MODEL | output voltage (Vdc) | output current | | output power max (W) | ripple and noise ¹ max (mVp-p) | efficiency ² typ (%) |
|------------|-------------------------|----------------|-------------|----------------------------|---|---------------------------------------|
| | | min (mA) | max (mA) | | | |
| PBO-3-S3.3 | 3.3 | 60 | 600 | 1.98 | 150 | 65 |
| PBO-3-S5 | 5 | 60 | 600 | 3 | 150 | 70 |
| PBO-3-S9 | 9 | 33.3 | 333 | 3 | 150 | 73 |
| PBO-3-S12 | 12 | 25 | 250 | 3 | 150 | 74 |
| PBO-3-S15 | 15 | 20 | 200 | 3 | 150 | 75 |
| PBO-3-S24 | 24 | 12.5 | 125 | 3 | 150 | 77 |

Notes: 1. At full load, nominal input, 20 MHz bandwidth oscilloscope, with a 1 µF ceramic and 10 µF electrolytic capacitor on the output.
 2. At 230 Vac input.
 3. All specifications are measured at Ta=25°C, humidity <75%, 115 or 230 Vac input voltage, and rated output load unless otherwise specified.

PART NUMBER KEY



INPUT

| parameter | conditions/description | min | typ | max | units |
|---------------------------|------------------------|-----|-----|------|-------|
| voltage | | 85 | | 305 | Vac |
| | | 70 | | 430 | Vdc |
| frequency | | 47 | | 63 | Hz |
| current | at 115 Vac | | | 0.12 | A |
| | at 277 Vac | | | 0.06 | A |
| inrush current | at 115 Vac | | 13 | | A |
| | at 277 Vac | | 23 | | 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 | | | 820 | μ F |
| | 5 Vdc output models | | | 680 | μ F |
| | 9/12 Vdc output models | | | 470 | μ F |
| | 15 Vdc output models | | | 330 | μ F |
| | 24 Vdc output models | | | 100 | μ F |
| initial set point accuracy | 3.3 Vdc output models | | | ± 6 | % |
| | all other models | | | ± 5 | % |
| line regulation | at full load | | | | |
| | 3.3 Vdc output models all other models | | ± 2.5 ± 1.5 | | % % |
| load regulation | from 10~100% load | | ± 2.5 | | % |
| switching frequency | | | | 65 | kHz |
| temperature coefficient | | | ± 0.15 | | %/ $^{\circ}$ C |

PROTECTIONS

| parameter | conditions/description | min | typ | max | units |
|--------------------------|---------------------------|-----|-----|-----|-------|
| over current protection | auto recovery | 110 | | 500 | % |
| short circuit protection | continuous, auto recovery | | | | |

SAFETY & COMPLIANCE

| parameter | conditions/description | min | typ | max | units |
|---------------------|--|-------|-----|-----|-------|
| isolation voltage | input to output for 1 minute | 3,000 | | | Vac |
| safety approvals | UL 60950-1, EN 60950-1 | | | | |
| safety class | class II | | | | |
| conducted emissions | CISPR22/EN55022 Class A, (external circuit required, see figure 1) | | | | |
| | CISPR22/EN55022 Class B, (external circuit required, see figure 2) | | | | |
| radiated emissions | CISPR22/EN55022 Class A, (external circuit required, see figure 1) | | | | |
| | CISPR22/EN55022 Class B, (external circuit required, see figure 2) | | | | |
| ESD | IEC/EN61000-4-2 Class B, contact ± 4 kV | | | | |
| radiated immunity | IEC/EN61000-4-3 Class A, 10V/m (external circuit required, see figure 2) | | | | |
| EFT/burst | IEC/EN61000-4-4 Class B, ± 2 kV (external circuit required, see figure 1) | | | | |
| | IEC/EN61000-4-4 Class B, ± 4 kV (external circuit required, see figure 2) | | | | |
| surge | IEC/EN61000-4-5 Class B, line to line ± 1 kV (external circuit required, see figure 1) | | | | |
| | IEC/EN61000-4-5 Class B, line to line ± 1 kV/line to ground ± 2 kV (external circuit required, see figure 2) | | | | |
| conducted immunity | IEC/EN61000-4-6 Class A, 10 Vr.m.s (external circuit required, see figure 2) | | | | |

Notes: 1. The power supply is considered a component which will be installed into final equipment. The final equipment still must be tested to meet the necessary EMC directives.

SAFETY & COMPLIANCE (CONTINUED)

| parameter | conditions/description | min | typ | max | units |
|------------------------------|--|---------|-----|-----|-------|
| voltage dips & interruptions | IEC/EN61000-4-11 Class B, 0%-70% (external circuit required, see figure 2) | | | | |
| MTBF | as per MIL-HDBK-217F at 25 °C | 300,000 | | | hours |
| RoHS | 2011/65/EU | | | | |

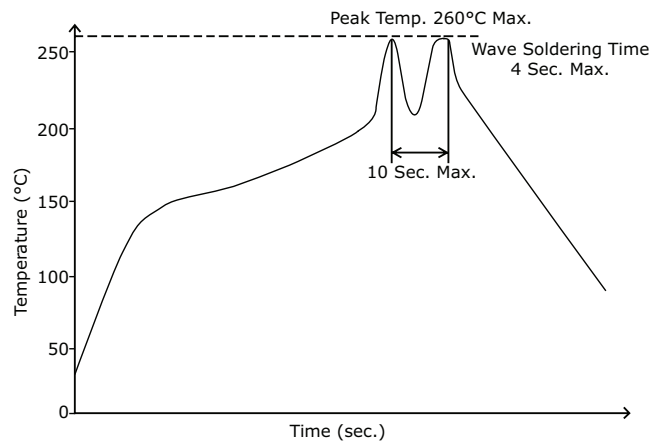
Notes: 1. The power supply is considered a component which will be installed into final equipment. The final equipment still must be tested to meet the necessary EMC directives.

ENVIRONMENTAL

| parameter | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature | see derating curves | -40 | | 85 | °C |
| storage temperature | | -40 | | 105 | °C |
| storage humidity | non-condensing | | | 85 | % |

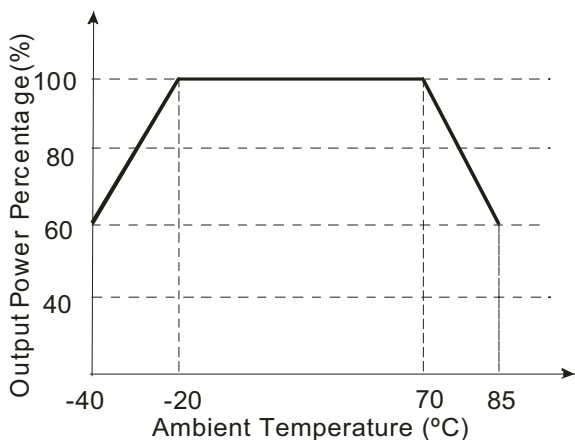
SOLDERABILITY

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

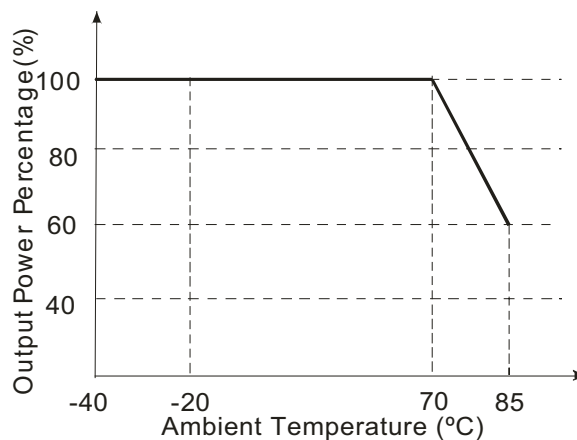


DERATING CURVES

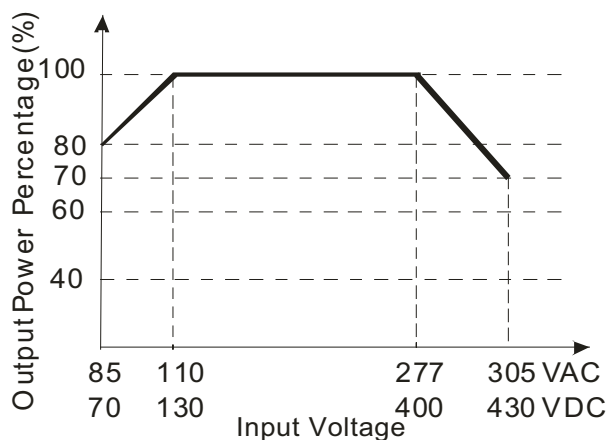
load vs. ambient temperature
(at 85~110 Vac / 70~130 Vdc input voltage)



load vs. ambient temperature
(at 110~305 Vac / 130~430 Vdc input voltage)

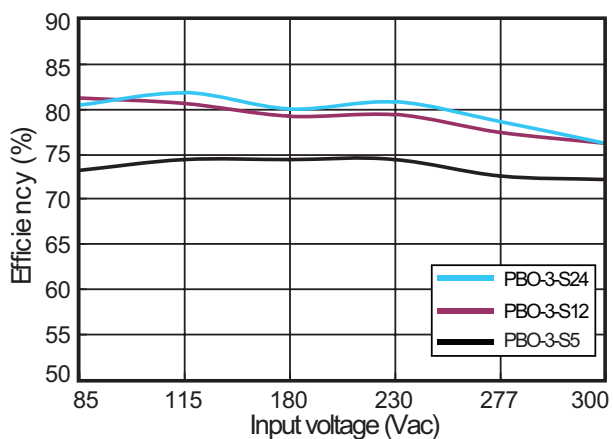


load vs. input voltage
(at 25°C)

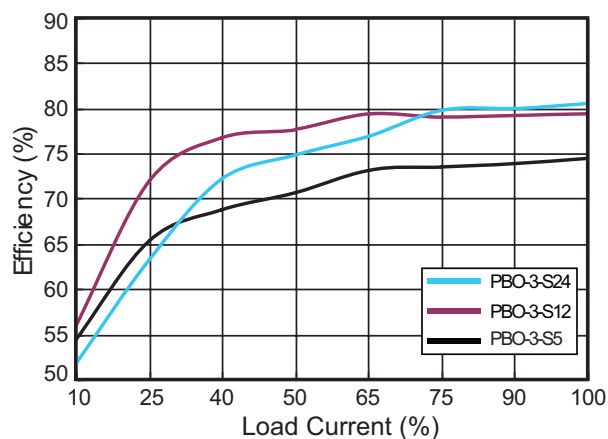


EFFICIENCY CURVES

Efficiency Curve
(Efficiency vs. Input Voltage)



Efficiency Curve
(Efficiency vs. Load Current)



MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|------------|---|-----|-----|-----|----------|
| dimensions | vertical models: 35.00 x 11.00 x 18.00 (1.38 x 0.43 x 0.71 inches) right-angle models: 35.00 x 18.00 x 11.00 (1.38 x 0.71 x 0.43 inches) | | | | mm mm |
| weight | | | 6 | | g |

MECHANICAL DRAWING

Vertical Orientation

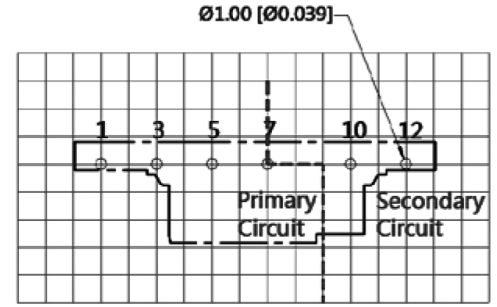
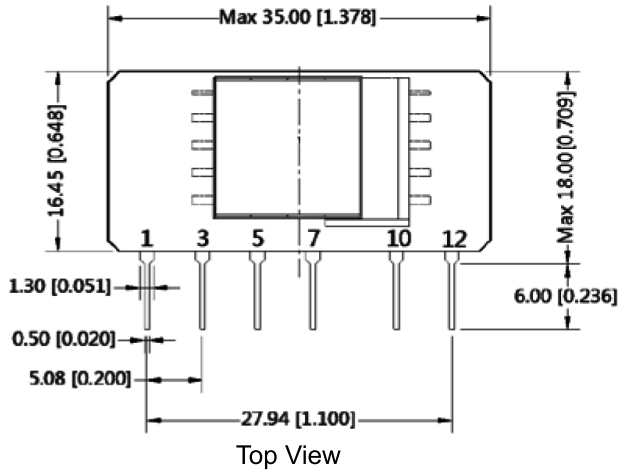
units: mm[inch]

tolerance: $\pm 0.50[\pm 0.020]$

pin section tolerance: $\pm 0.10[\pm 0.004]$

| PIN CONNECTIONS | |
|-----------------|----------|
| PIN | Function |
| 1 | AC (N) |
| 3 | AC (L) |
| 5 | +V(CAP) |
| 7 | -V(CAP) |
| 10 | -Vo |
| 12 | +Vo |

Note: 1. It is required to add C1 between pins 5 & 7 (see application circuits).



Note: Grid 2.54*2.54mm

Top View
PCB Layout



Bottom View

MECHANICAL DRAWING (CONTINUED)

Right-angle Orientation

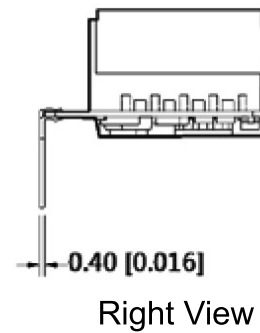
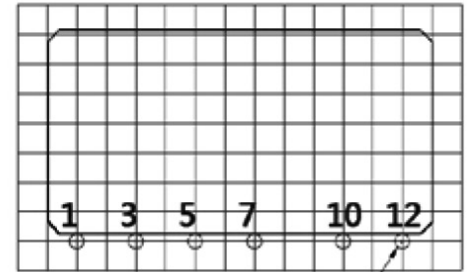
units: mm[inch]

tolerance: ± 0.50 [± 0.020]

pin section tolerance: ± 0.10 [± 0.004]

| PIN CONNECTIONS | |
|-----------------|----------|
| PIN | Function |
| 1 | AC (N) |
| 3 | AC (L) |
| 5 | +V(CAP) |
| 7 | -V(CAP) |
| 10 | -Vo |
| 12 | +Vo |

Note: 1. It is required to add C1 between pins 5 & 7 (see application circuits).



APPLICATION CIRCUIT

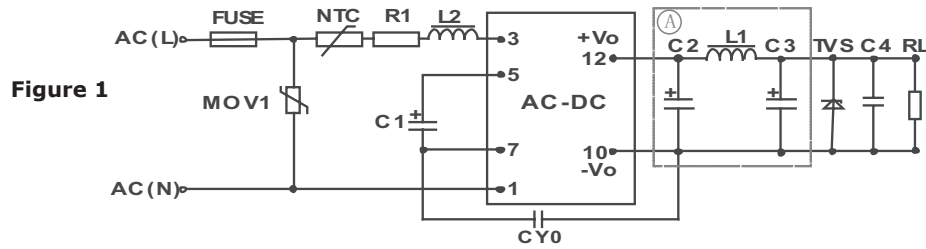


Table 1

| Recommended External Circuit Components | | | | | | | | | | | |
|---|-------------------|---------|-------|-------|-----------------|------------|-------------------|-----------------|-----------------|----------|-----------|
| Vo (Vdc) | FUSE ¹ | MOV1 | NTC | L2 | C1 ¹ | CY0 | C2 ^{1,2} | L1 ¹ | C3 ¹ | TVS | C4 |
| 3.3 | 1A/300V | S14K350 | 13D-5 | 4.7mH | 10μF/450V | 1nF/400Vac | 270μF/16V | 4.7μH | 120μF/25V | SMBJ7.0A | 0.1μF/50V |
| 5 | 1A/300V | S14K350 | 13D-5 | 4.7mH | 10μF/450V | 1nF/400Vac | 270μF/16V | 4.7μH | 68μF/35V | SMBJ7.0A | 0.1μF/50V |
| 9 | 1A/300V | S14K350 | 13D-5 | 4.7mH | 10μF/450V | 1nF/400Vac | 270μF/16V | 4.7μH | 68μF/35V | SMBJ12A | 0.1μF/50V |
| 12 | 1A/300V | S14K350 | 13D-5 | 4.7mH | 10μF/450V | 1nF/400Vac | 270μF/16V | 4.7μH | 68μF/35V | SMBJ20A | 0.1μF/50V |
| 15 | 1A/300V | S14K350 | 13D-5 | 4.7mH | 10μF/450V | 1nF/400Vac | 470μF/35V | 4.7μH | 47μF/35V | SMBJ20A | 0.1μF/50V |
| 24 | 1A/300V | S14K350 | 13D-5 | 4.7mH | 10μF/450V | 1nF/400Vac | 220μF/35V | 4.7μH | 47μF/35V | SMBJ30A | 0.1μF/50V |

Note: 1. Required components.
2. For 3.3, 5, 9, & 12 Vdc outputs, C2 should be a solid-state capacitor.

EMC RECOMMENDED CIRCUIT

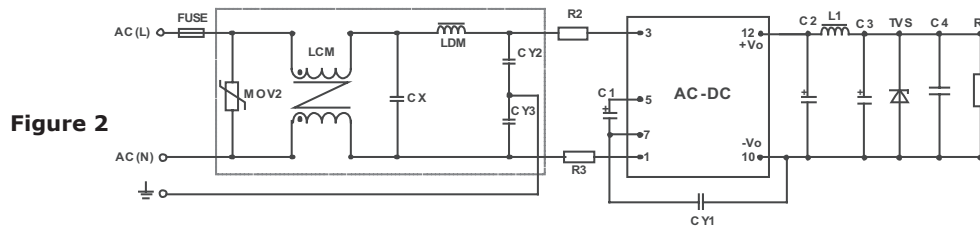


Table 2

| Recommended External Circuit Components | |
|---|----------------------|
| FUSE | 1A/300V, slow fusing |
| MOV2 | S14K350 |
| LCM | 3.50mH |
| CX | 0.1μF/310 Vac |
| LDM | 0.33mH |
| CY2/CY3 | 1nF/400 Vac |
| R2/R3 | 12Ω/2W |
| CY1 | 2.2nF/400 Vac |

Note: Also refer to Table 1.

Notes: 3. C1 is required for both AC and DC inputs.
4. It is required to add pi-type filter circuit (C2, C3, & L1) to the output. The capacitors are recommended to be high frequency and low impedance electrolytic capacitors. For capacitance and rated ripple current of capacitors, refer to the datasheets provided by the manufacturers. Voltage derating of capacitors should be 80% or above.
5. When operating in the -40~20°C temperature range, it is recommended to use a 22 μF / 450 V capacitor for C1.
6. C4 is a ceramic capacitor used to filter high frequency noise.
7. For current of L1 & L2 refer to the datasheets provided by the manufacturers. Current derating should be 80% or above.
8. TVS is a recommended component to protect post-circuits (if converter fails).
9. It is required to have a distance ≥6.4 mm for safety between external components in primary and secondary circuit.
10. It is recommended to add an insulation sheet between the bottom of the right-angle versions and the PCB when mounting.

REVISION HISTORY

| rev. | description | date |
|------|---------------------|------------|
| 1.0 | initial release | 10/18/2016 |
| 1.01 | internal IC changed | 05/11/2017 |

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



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