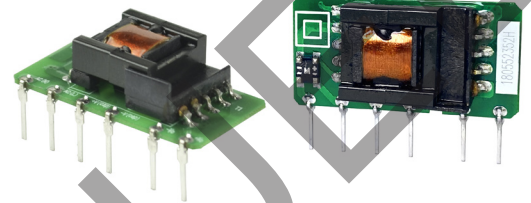


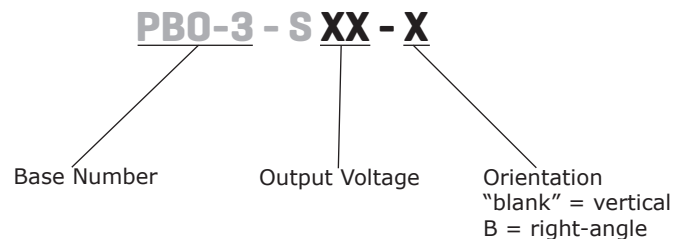
SERIES: PBO-3 | **DESCRIPTION:** AC-DC POWER SUPPLY**FEATURES**

- 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
- IEC, EN, UL 62368 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 ^{4,5} | 3.3 | 60 | 600 | 1.98 | 150 | 65 |
| PBO-3-S5 ^{4,5} | 5 | 60 | 600 | 3 | 150 | 70 |
| PBO-3-S9 ⁴ | 9 | 33.3 | 333 | 3 | 150 | 73 |
| PBO-3-S12 ^{4,5} | 12 | 25 | 250 | 3 | 150 | 74 |
| PBO-3-S15 ⁵ | 15 | 20 | 200 | 3 | 150 | 75 |
| PBO-3-S24 ^{4,5} | 24 | 12.5 | 125 | 3 | 150 | 77 |

- Notes:
1. At full load, nominal input, 20 MHz bandwidth oscilloscope, with a 1 μ F ceramic and 10 μ F electrolytic capacitor on the output.
 2. At 230 Vac input.
 3. All specifications are measured at $T_a=25^\circ\text{C}$, humidity <75%, 115 or 230 Vac input voltage, and rated output load unless otherwise specified.
 4. Discontinued model - vertical pin version.
 5. Discontinued model - right-angle pin version.

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 | | | | |
| | 24 Vdc output models all other models | | ± 6 ± 3 | | % % |
| 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 | certified to 62368: IEC, EN, UL | | | | |
| safety class | class II | | | | |
| conducted emissions | CISPR22/EN55022 Class A, (recommended circuit 1,2,6) | | | | |
| | CISPR22/EN55022 Class B, (recommended circuit 3,4,5) | | | | |
| radiated emissions | CISPR22/EN55022 Class A, (recommended circuit 1,2,6) | | | | |
| | CISPR22/EN55022 Class B, (recommended circuit 3,4,5) | | | | |
| ESD | IEC/EN61000-4-2, contact ± 4 kV, perf. Criteria B | | | | |
| radiated immunity | IEC/EN61000-4-3, 10V/m, perf. Criteria A | | | | |
| EFT/burst | IEC/EN61000-4-4, ± 2 kV (recommended circuit 1,2,3), perf. Criteria B | | | | |
| | IEC/EN61000-4-4, ± 4 kV (recommended circuit 4,5,6), perf. Criteria B | | | | |
| surge | IEC/EN61000-4-5, line to line ± 1 kV (recommended circuit 1,2), perf. Criteria B | | | | |
| | IEC/EN61000-4-5, line to line ± 2 kV (recommended circuit 6), perf. Criteria B | | | | |
| | IEC/EN61000-4-5, line to line ± 1 kV/line to ground ± 2 kV (recommended circuit 3) perf. Criteria B | | | | |
| | IEC/EN61000-4-5, line to line ± 2 kV/line to ground ± 4 kV (recommended circuit 4,5) perf. Criteria B | | | | |
| conducted immunity | IEC/EN61000-4-6 Class A, 10 Vr.m.s, perf. Criteria A | | | | |

SAFETY & COMPLIANCE (CONTINUED)

| parameter | conditions/description | min | typ | max | units |
|------------------------------|--|---------|-----|-----|-------|
| voltage dips & interruptions | IEC/EN61000-4-11, 0%-70%, perf. Criteria B | | | | |
| MTBF | as per MIL-HDBK-217F at 25 °C | 300,000 | | | hours |
| RoHS | 2011/65/EU | | | | |

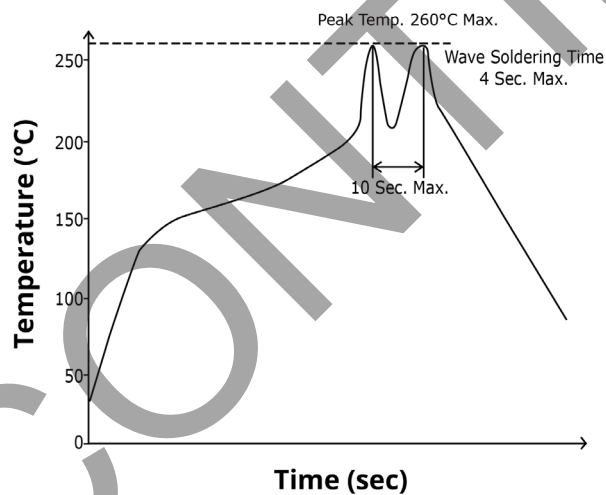
Notes: 1. The power supply is considered a component which will be installed into final equipment. The final equipment still must be tested to meet the necessary EMC directives.

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 | % |

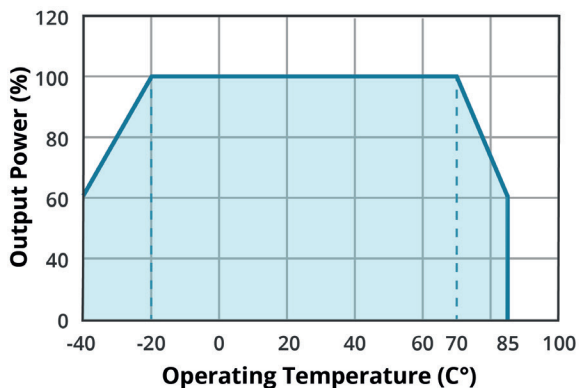
SOLDERABILITY

| 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 |

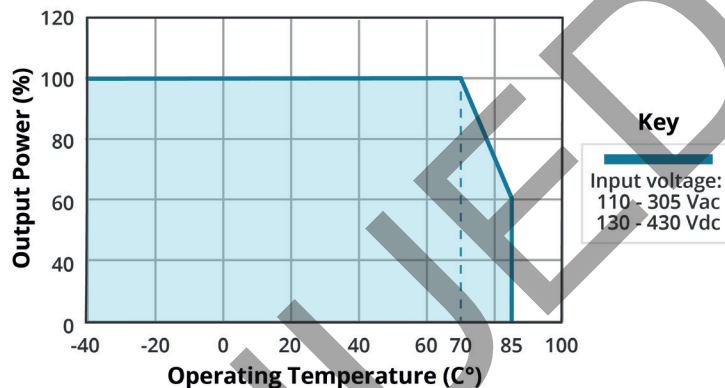
WAVE SOLDERING PROFILE

DERATING CURVES

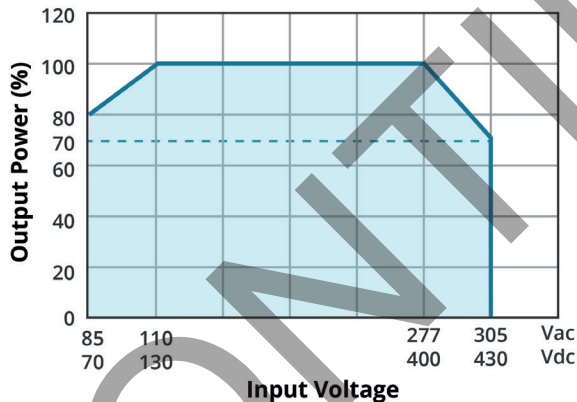
TEMPERATURE DERATING CURVE



TEMPERATURE DERATING CURVE

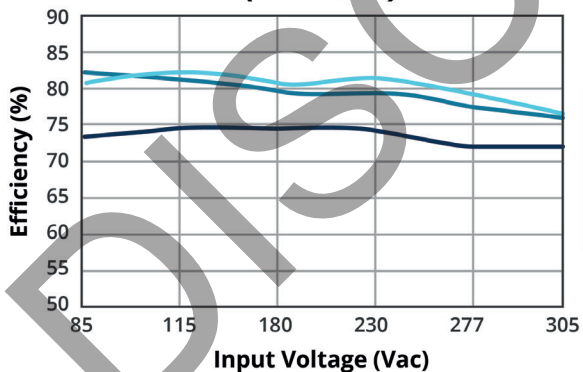


INPUT VOLTAGE DERATING CURVE (25°C)

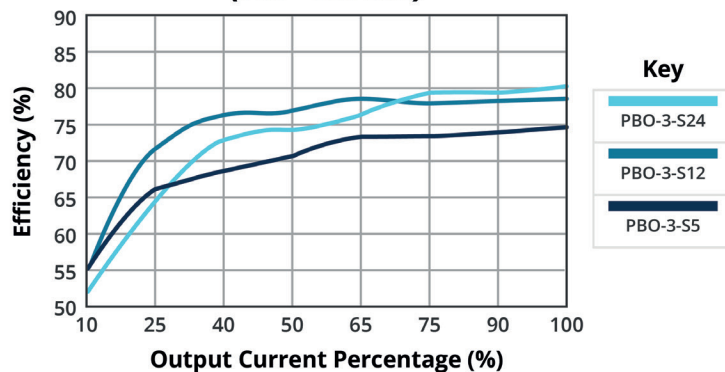


EFFICIENCY CURVES

EFFICIENCY VS INPUT VOLTAGE (FULL LOAD)



EFFICIENCY VS OUTPUT LOAD (VIN = 230 VAC)



MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|------------|---|-----|-----|-----|----------|
| dimensions | 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

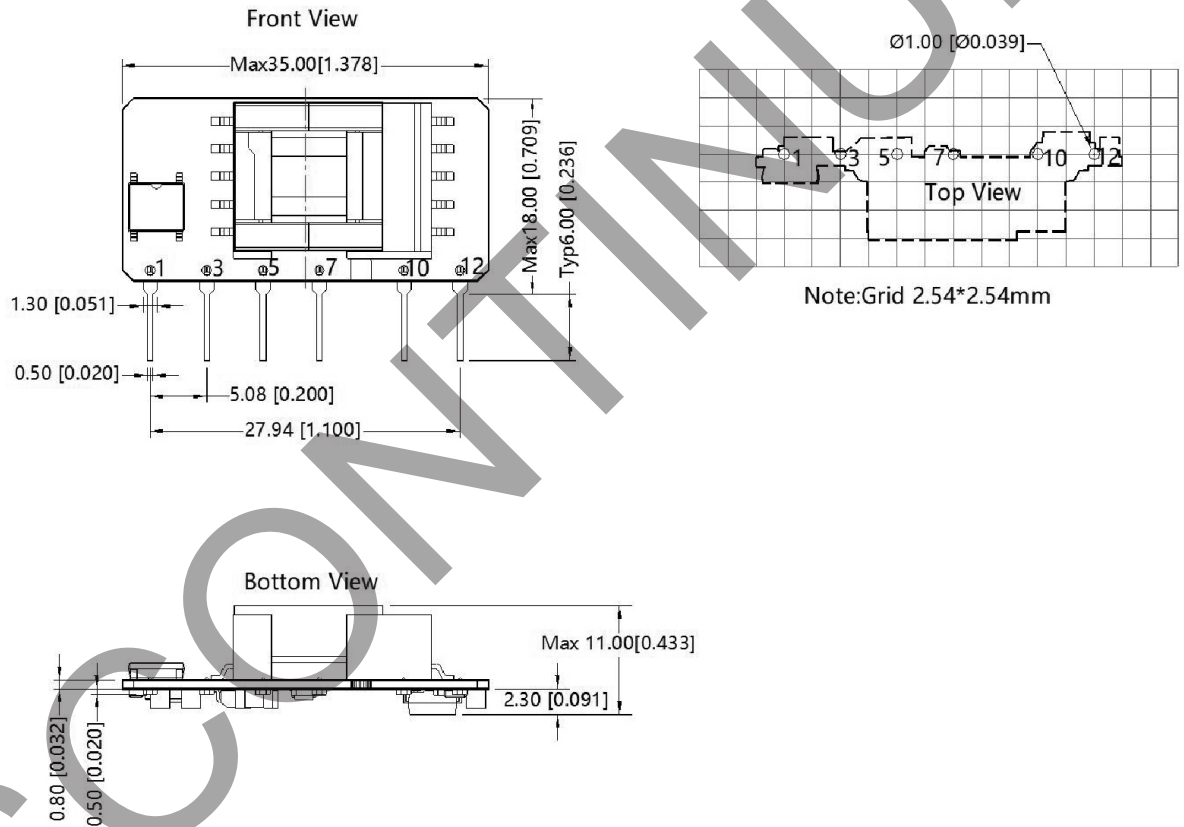
units: mm[inch]

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

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

| 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).



MECHANICAL DRAWING (CONTINUED)

Right-angle Orientation

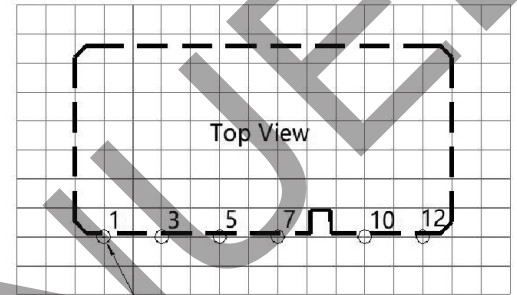
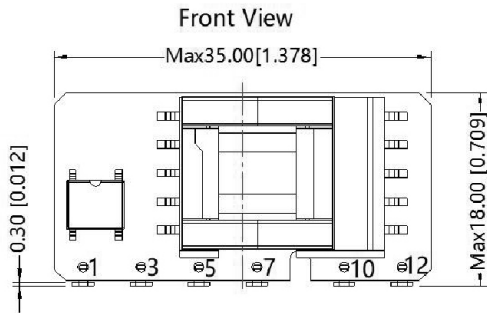
units: mm[inch]

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

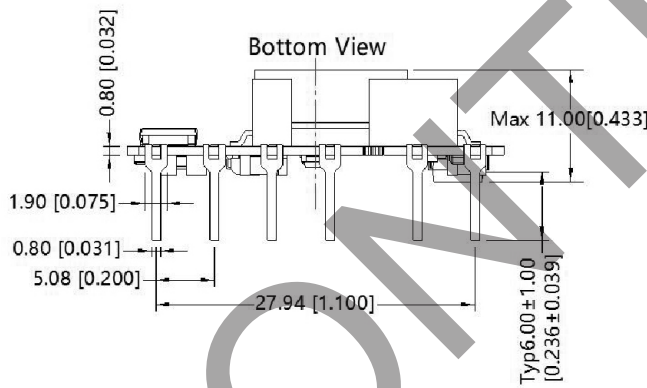
tolerance: $\pm 0.50[\pm 0.020]$

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

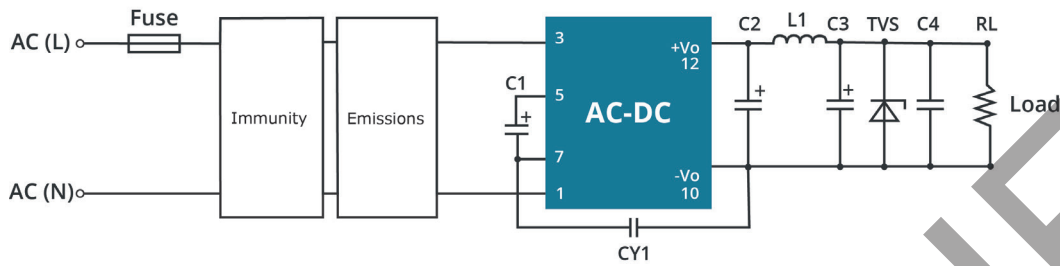
Note: 1. It is required to add C1 between pins 5 & 7 (see application circuits).



Note: Grid 2.54*2.54mm



APPLICATION DESIGN REFERENCE



| PBO-3 series additional circuits design reference | | | |
|---|----------|---|---------|
| Immunity design circuits for reference | | Emissions design circuits for reference | |
| Class III | Class IV | Class A | Class B |
| | | | |

| PBO-3 Series additional component selection guide | | | | | | | |
|---|-----------------|--|-----------------------------------|------------------|---------------|-----------|----------------|
| Part no. | FUSE (required) | C1 (required) | C2 (required) | L1 (required) | C3 (required) | C4 | CY1 (required) |
| PBO-3-S3.3 | 1A/300V | 10μF/450V (-20°C~85°C) 22μF/450V (-40°C~85°C) | 270μF/16V (solid-state capacitor) | 4.7μH (max 60mΩ) | 120μF/25V | 0.1μF/50V | 1.0nF/400 Vac |
| PBO-3-S5 | | | | | 68μF/35V | | |
| PBO-3-S9 | | | | | 47μF/35V | | |
| PBO-3-S12 | | | | | 47μF/35V | | |
| PBO-3-S15 | | | | | 47μF/35V | | |
| PBO-3-S24 | | | | | 220μF/35V | | |

Note: 1. C1: Input capacitors, C2: output storage capacitors, must be connected externally.
 2. It is recommended using an electrolytic capacitor with high frequency and low ESR rating for C3. Combined with C2, L1, they form a pi-type filter circuit. Choose a capacitor voltage rating with at least 20% margin, in other words not exceeding 80%. C4 is a ceramic capacitor, used for filtering high frequency noise. A suppressor diode (TVS) is a recommended to protect the application in case of a converter failure and specification should be 1.2 times of the output voltage.

| PBO-3 Series Environmental and EMC selection guide | | | | | | |
|--|-------------------------------|---|---------------------|-------------------------|-----------|-----------|
| Recommended circuit | Application environmental | Typical industry | Input voltage range | Environment temperature | Emissions | Immunity |
| 1/2 | Basic application | None | 85 ~ 305 Vac | -40° ~ 88°C | Class A | Class III |
| 3 | Indoor civil environment | Smart home / Home appliances (2Y) | | -25° ~ 55°C | Class B | Class III |
| | Indoor general environment | Intelligent building / Intelligent agriculture | | -25° ~ 55°C | Class B | Class IV |
| 4/5 | Indoor industrial environment | Manufacturing workshop | | -25° ~ 55°C | Class B | Class IV |
| 6 | Outdoor general environment | ITS / Video monitoring / Charging point / Communication / Security and protection | | -40° ~ 85°C | Class A | Class IV |

EMC RECOMMENDED CIRCUIT

Circuit 1

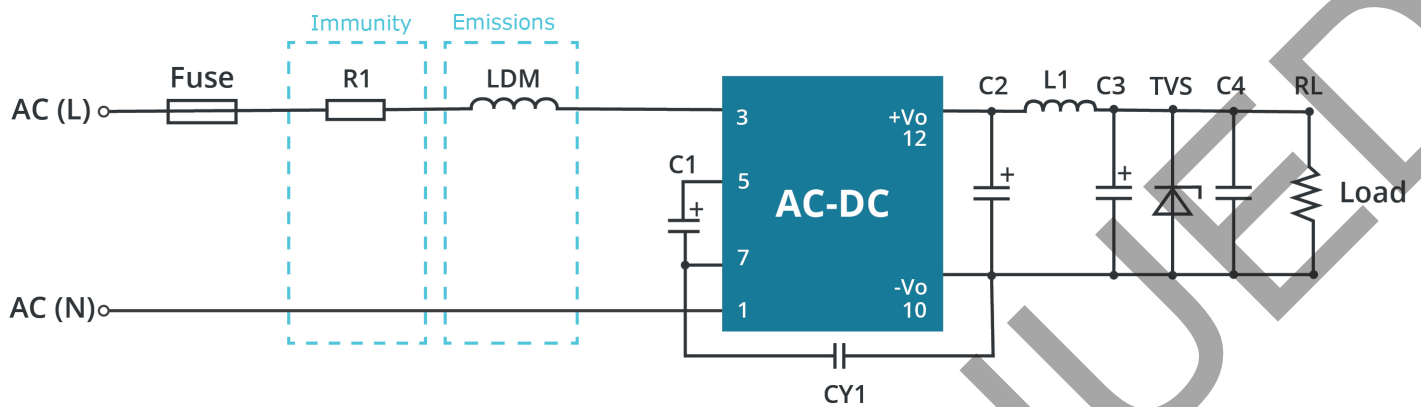


Table 1

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

| Component | Recommended value |
|-----------------|--------------------|
| R1 | 12Ω/3W |
| LDM | 4.7mH |
| FUSE (required) | 1A/300V, slow-blow |

Circuit 2

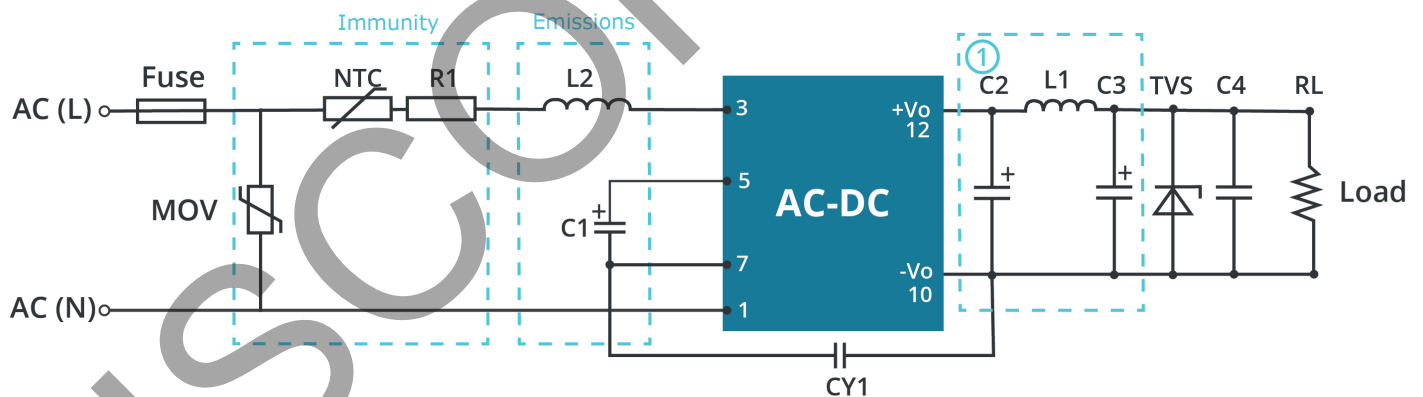


Table 2

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

| Component | Recommended value |
|-----------------|--------------------|
| R1 | 12Ω/2W |
| L2 | 4.7mH |
| NTC | 13D-5 |
| MOV | S14K350 |
| FUSE (required) | 1A/300V, slow-blow |

EMC RECOMMENDED CIRCUIT (CONTINUED)

Circuit 3

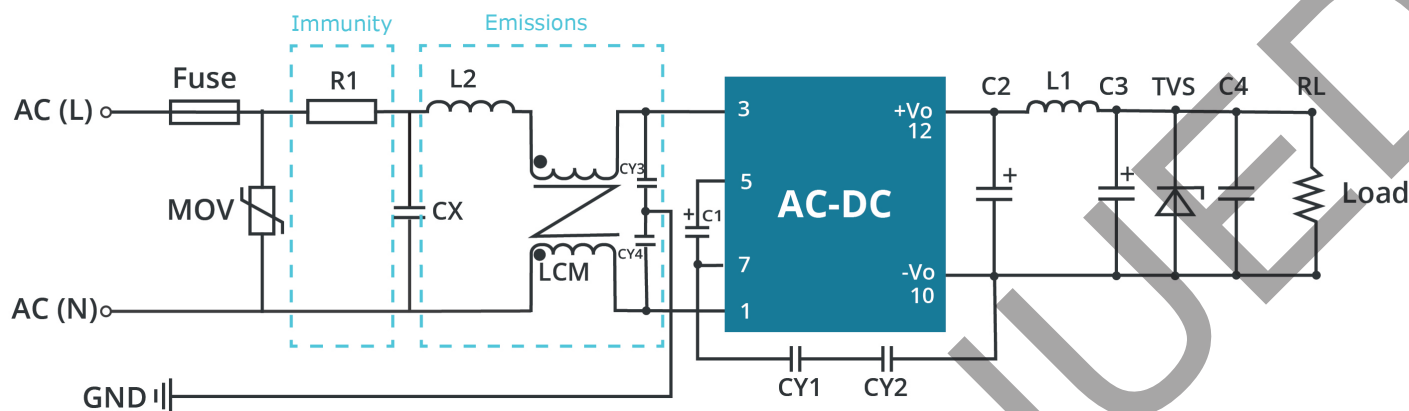
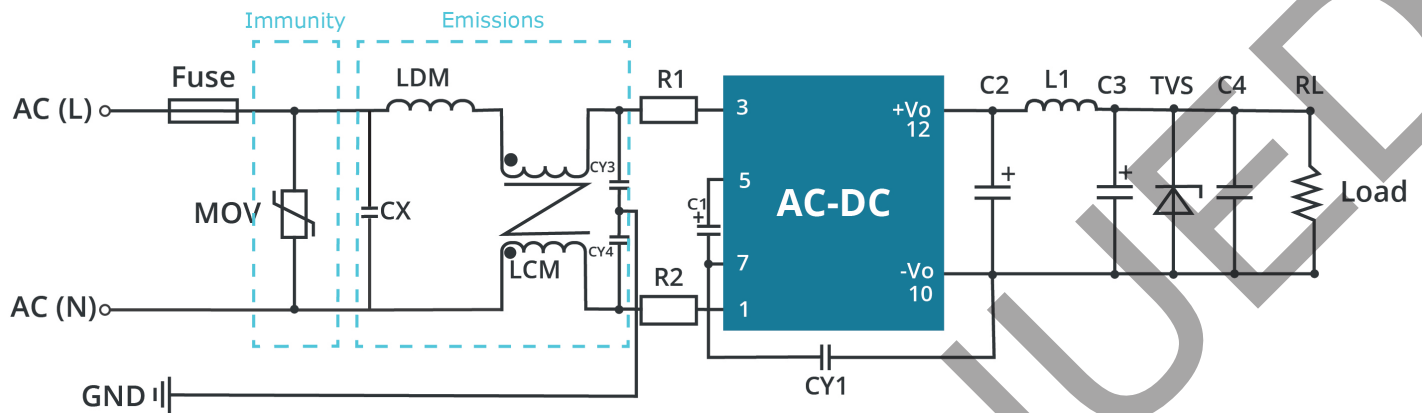


Table 3

| Application enviromental | Ambient temperature range | Immunity Class | Emissions Class |
|--------------------------|---------------------------|----------------|-----------------|
| Indoor civil / general | -40°C ~ 55°C | Class III | Class B |

| Component | Recommended value |
|-----------------|--------------------|
| R1 | 12Ω/3W |
| CY1 (CY2) | 1.0nF/400Vac |
| LCM | 3.5mH |
| LDM | 0.33mH |
| CX | 0.1μF/310Vac |
| CY3, CY4 | 0.56nF/400Vac |
| FUSE (required) | 1A/300V, slow-blow |

Note: In the home appliance application environment, the two Y capacitors of the primary and secondary need to be externally connected (CY1/CY2, value at 2.2nF/400Vac) which can meet the EN60335 certification. In other industries, only one Y capacitor is required.

EMC RECOMMENDED CIRCUIT (CONTINUED)**Circuit 4****Table 4**

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

| Component | Recommended value |
|-----------------|--------------------|
| MOV | S14K350 |
| C1 | 450V/22uF |
| CY1 | 2.2nF/400Vac |
| CX | 0.1μF/310Vac |
| LCM | 3.5mH |
| LDM | 0.33mH |
| R1, R2 | 12Ω/2W |
| CY3, CY4 | 0.56nF/400Vac |
| FUSE (required) | 2A/300V, slow-blow |

EMC RECOMMENDED CIRCUIT (CONTINUED)

Circuit 5

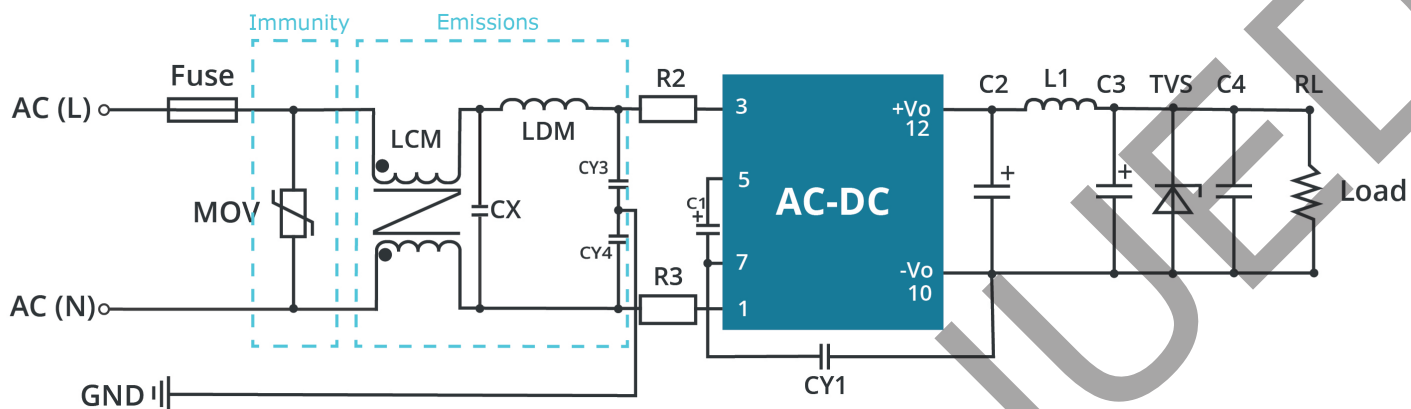


Table 5

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

| Component | Recommended value |
|-----------------|--------------------|
| MOV | S14K350 |
| C1 | 450V/22uF |
| CY1 | 2.2nF/400Vac |
| CY3/CY4 | 0.56µF/400Vac |
| CX | 0.1µF/310Vac |
| LCM | 3.5mH |
| LDM | 0.33mH |
| R2/R3 | 12Ω/2W |
| FUSE (required) | 2A/300V, slow-blow |

EMC RECOMMENDED CIRCUIT (CONTINUED)

Circuit 6

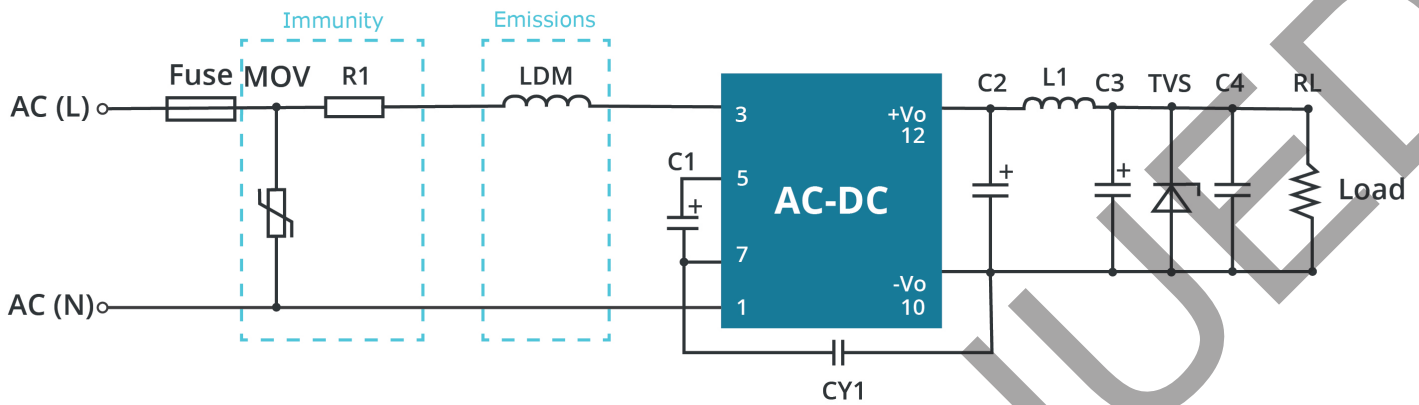


Table 6

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

| Component | Recommended value |
|-----------------|--------------------|
| MOV | S14K350 |
| C1 | 450V/22uF |
| LDM | 4.7mH |
| R1 | 12Ω/3W |
| FUSE (required) | 2A/300V, slow-blow |

REVISION HISTORY

| rev. | description | date |
|------|--|------------|
| 1.0 | initial release | 10/18/2016 |
| 1.01 | internal IC changed | 05/11/2017 |
| 1.02 | updated efficiency curves | 02/05/2018 |
| 1.03 | datasheet update, safety approvals updated to match 62368 certification, PCN-656-95022R-01 | 10/12/2020 |
| 1.04 | product image updated | 09/16/2021 |
| 1.05 | derating curves updated | 01/18/2022 |
| 1.06 | product image updated | 03/10/2022 |
| 1.07 | UKCA mark added | 05/25/2022 |
| 1.08 | discontinued models PBO-3-S3.3, PBO-3-S3.3-B, PBO-3-S5, PBO-3-S5-B, PBO-3-S9, PBO-3-S12, PBO-3-S12-B, PBO-3-S15, PBO-3-S15-B, PBO-3-S24, PBO-3-S24-B | 09/13/2022 |

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



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a bel group

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