


**CUI INC**

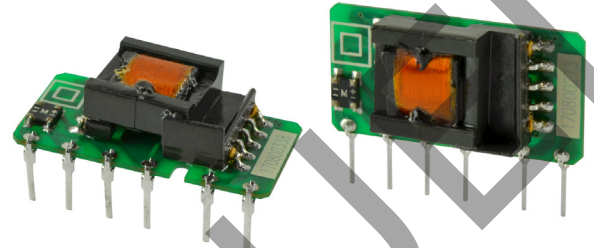
a bel group

date 05/25/2022

page 1 of 13

**SERIES: PBO-1 | DESCRIPTION: AC-DC POWER SUPPLY**
**FEATURES**

- up to 1 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



| MODEL     | output<br>voltage<br>(Vdc) | output<br>current |             | output<br>power<br>max<br>(W) | ripple<br>and noise <sup>1</sup><br>max<br>(mVp-p) | efficiency <sup>2</sup><br>typ<br>(%) |
|-----------|----------------------------|-------------------|-------------|-------------------------------|----------------------------------------------------|---------------------------------------|
|           |                            | min<br>(mA)       | max<br>(mA) |                               |                                                    |                                       |
| PBO-1-S5  | 5                          | 10                | 200         | 1                             | 120                                                | 66                                    |
| PBO-1-S9  | 9                          | 5.55              | 111         | 1                             | 120                                                | 67                                    |
| PBO-1-S12 | 12                         | 4.15              | 83          | 1                             | 120                                                | 70                                    |
| PBO-1-S15 | 15                         | 3.35              | 67          | 1                             | 120                                                | 69                                    |
| PBO-1-S24 | 24                         | 2.1               | 42          | 1                             | 120                                                | 68                                    |

Notes: 1. At full load, nominal input, 20 MHz bandwidth oscilloscope, see Application Circuit.  
 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**
**PBO-1 - S XX - X**

Base Number

Output Voltage

Orientation  
"blank" = vertical  
B = right-angle

## 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             |     | 9   |      | A     |
|                           | at 277 Vac             |     | 15  |      | A     |
| no load power consumption | 24 Vdc output models   |     |     | 0.3  | W     |
|                           | all other models       |     |     | 0.25 | W     |

## OUTPUT

| parameter                  | conditions/description | min | typ   | max | units |
|----------------------------|------------------------|-----|-------|-----|-------|
| capacitive load            | 5 Vdc output models    |     |       | 220 | μF    |
|                            | all other models       |     |       | 100 | μF    |
| initial set point accuracy | 5 Vdc output models    |     |       | ±8  | %     |
|                            | all other models       |     |       | ±5  | %     |
| line regulation            | at full load           |     | ±1.5  |     | %     |
| load regulation            | from 5~100% load       |     | ±6    |     | %     |
|                            | 24 Vdc output models   |     | ±3    |     | %     |
| all other models           |                        |     |       |     |       |
|                            |                        |     |       |     |       |
| hold-up time               | at 230 Vac             | 150 | 180   |     | ms    |
| switching frequency        |                        |     |       | 100 | kHz   |
| temperature coefficient    |                        |     | ±0.15 |     | %/°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<br>certified to 60950: UL/cUL                                            |       |     |     |       |
| safety class        | Class II                                                                                            |       |     |     |       |
| conducted emissions | CISPR32/EN55032, Class A (recommended circuit 1,2,6)                                                |       |     |     |       |
|                     | CISPR32/EN55032, Class B (recommended circuit 3,4,5)                                                |       |     |     |       |
| radiated emissions  | CISPR32/EN55032, Class A (recommended circuit 1,2,6)                                                |       |     |     |       |
|                     | CISPR32/EN55032, 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, Class B (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   |       |     |     |       |
| conducted immunity  | IEC/EN61000-4-5, line to line ±2 kV/line to ground ±4 kV (recommended circuit 4,5) perf. Criteria B |       |     |     |       |
|                     | 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               | 200,000 |     |     | hours |
| RoHS                         | 2011/65/EU                                 |         |     |     |       |

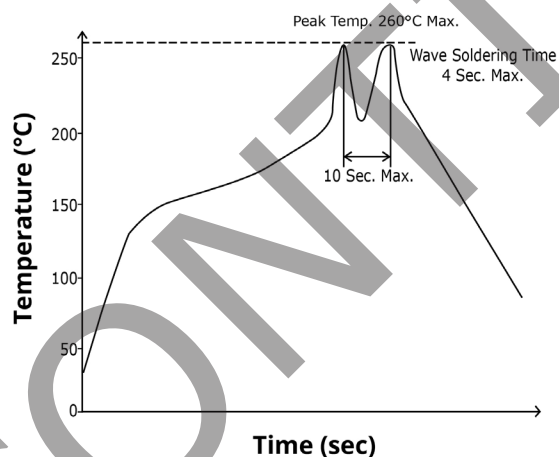
Notes: 1. The power supply is considered a component which will be installed into final equipment. The final equipment still must be tested to meet the necessary EMC directives.

**ENVIRONMENTAL**

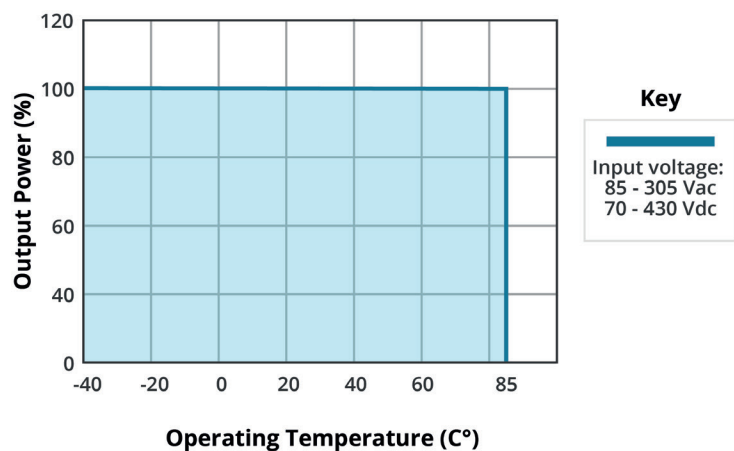
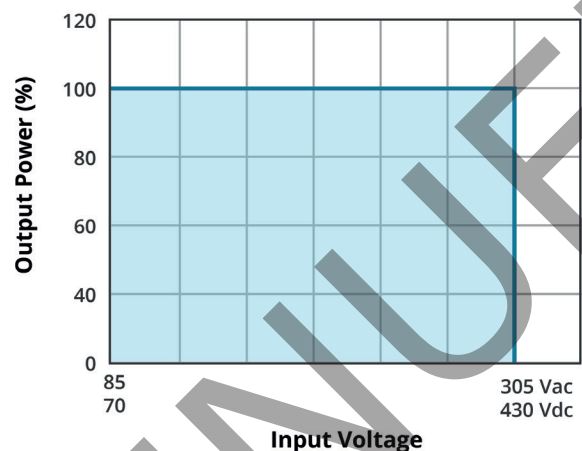
| parameter             | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature | see derating curves    | -40 |     | 85  | °C    |
| storage temperature   |                        | -40 |     | 105 | °C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

**SOLDERABILITY**

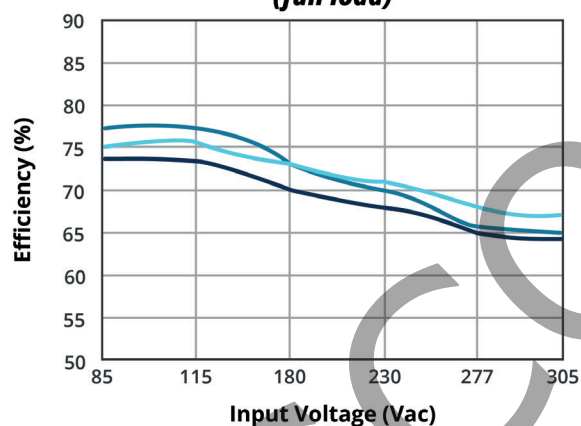
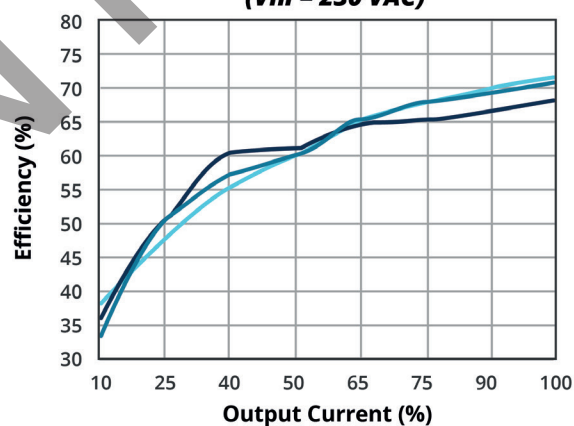
| parameter      | conditions/description | min | typ | max | units |
|----------------|------------------------|-----|-----|-----|-------|
| hand soldering | for 3~5 seconds        | 350 | 360 | 370 | °C    |
| wave soldering | for 5~10 seconds       | 255 | 260 | 265 | °C    |

**WAVE SOLDERING PROFILE**

## DERATING CURVES

**TEMPERATURE DERATING CURVE****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)    |     |     |     | mm    |
|            | right-angle models: 35.00 x 18.00 x 11.00 (1.38 x 0.71 x 0.43 inches) |     |     |     | mm    |
| weight     |                                                                       |     | 6   |     | g     |

## MECHANICAL DRAWING

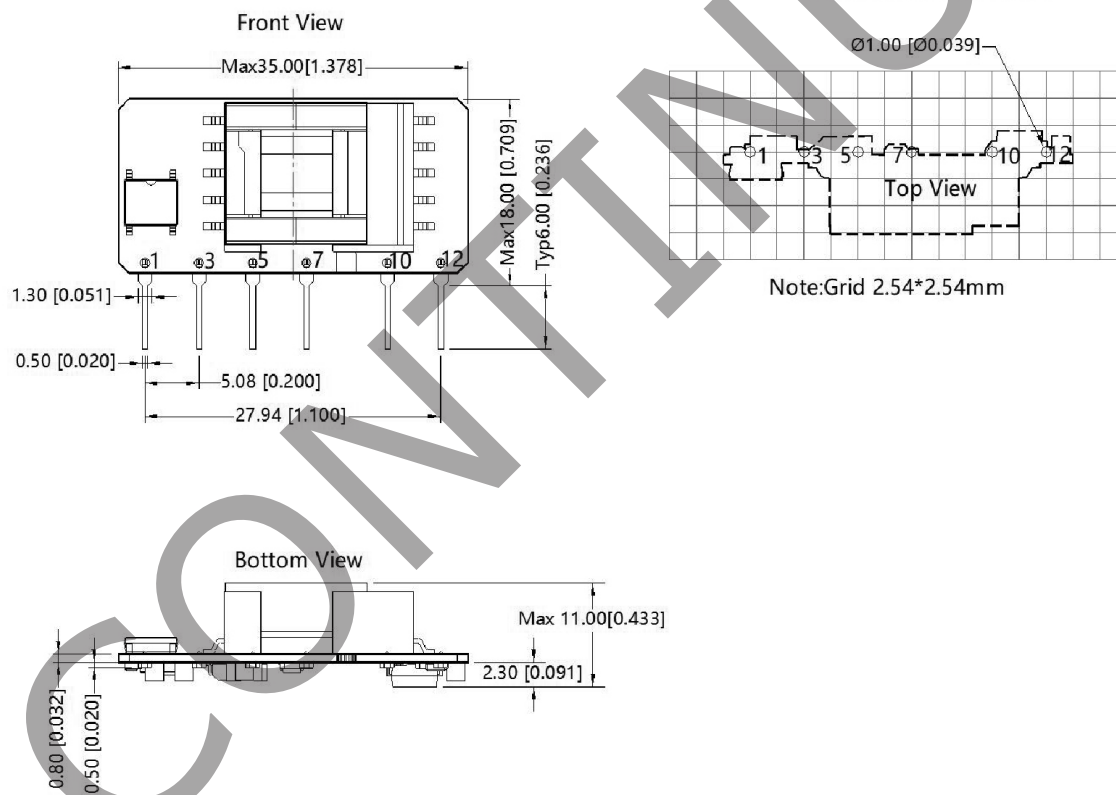
### Vertical Orientation

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).



## MECHANICAL DRAWING (CONTINUED)

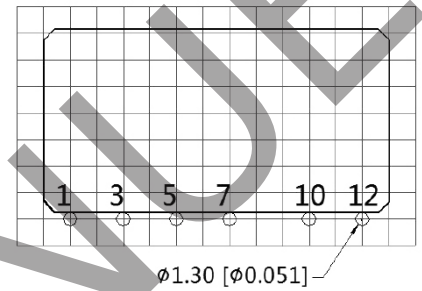
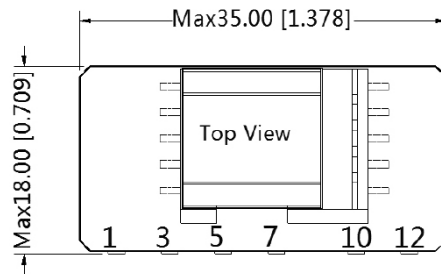
### Right-angle Orientation

units: mm[inch]

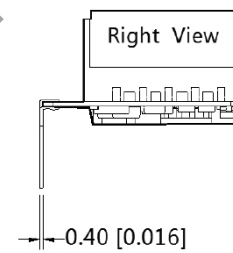
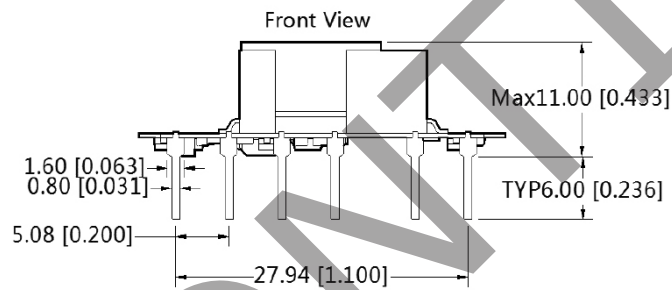
tolerance:  $\pm 0.50$  [ $\pm 0.020$ ]pin section tolerance:  $\pm 0.10$  [ $\pm 0.004$ ]

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

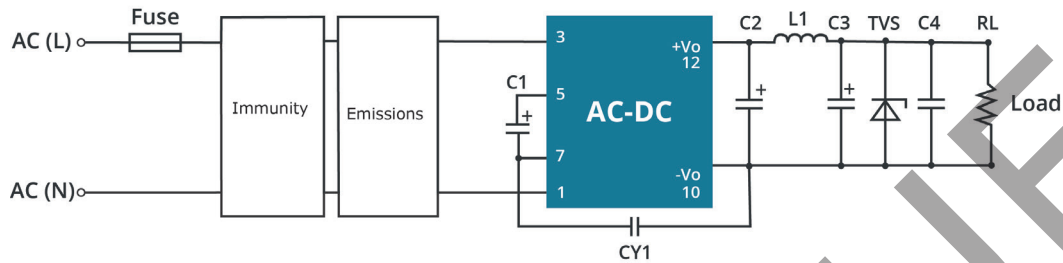
Note: 1. It is required to add C1 between pins 5 & 7 (see application circuits).



Note: Grid 2.54\*2.54mm



## APPLICATION DESIGN REFERENCE



PBO-1 series additional circuits design reference

| Immunity design circuits for reference |          | Emissions design circuits for reference |         |
|----------------------------------------|----------|-----------------------------------------|---------|
| Class III                              | Class IV | Class A                                 | Class B |
|                                        |          |                                         |         |

PBO-1 Series additional component selection guide

| Part no.  | FUSE<br>(required) | C1<br>(required)                                        | C2<br>(required)                     | L1<br>(required)    | C3<br>(required) | C4        | CY1<br>(required) | TVS      |
|-----------|--------------------|---------------------------------------------------------|--------------------------------------|---------------------|------------------|-----------|-------------------|----------|
| PBO-1-S5  | 1A/300V            | 4.7μF/450V<br>(-20°C~85°C)<br>10μF/450V<br>(-40°C~85°C) | 270μF/16V<br>(solid-state capacitor) | 2.2μH<br>(max 60mΩ) | 68μF/35V         | 0.1μF/50V | 1.0nF/400 Vac     | SMBJ7.0A |
| PBO-1-S9  |                    |                                                         | 100μF/16V<br>(solid-state capacitor) |                     |                  |           |                   | SMBJ12A  |
| PBO-1-S12 |                    |                                                         | 100μF/35V                            |                     |                  |           |                   | SMBJ20A  |
| PBO-1-S15 |                    |                                                         |                                      |                     |                  |           |                   | SMBJ20A  |
| PBO-1-S24 |                    |                                                         |                                      |                     |                  |           |                   | SMBJ30A  |

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-1 Series Enviromental and EMC selection guide

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

## EMC RECOMMENDED CIRCUIT

Circuit 1

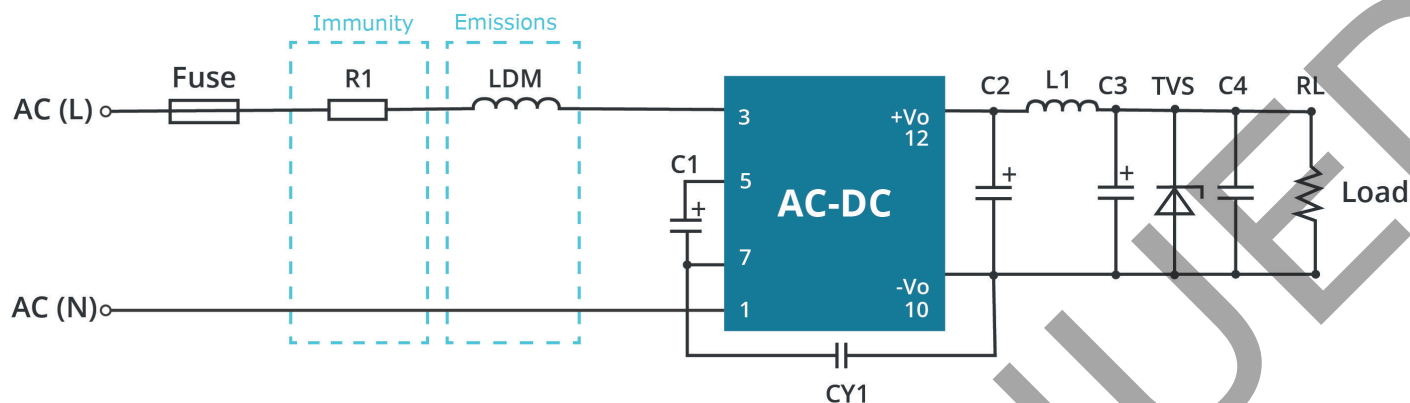


Table 1

| 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

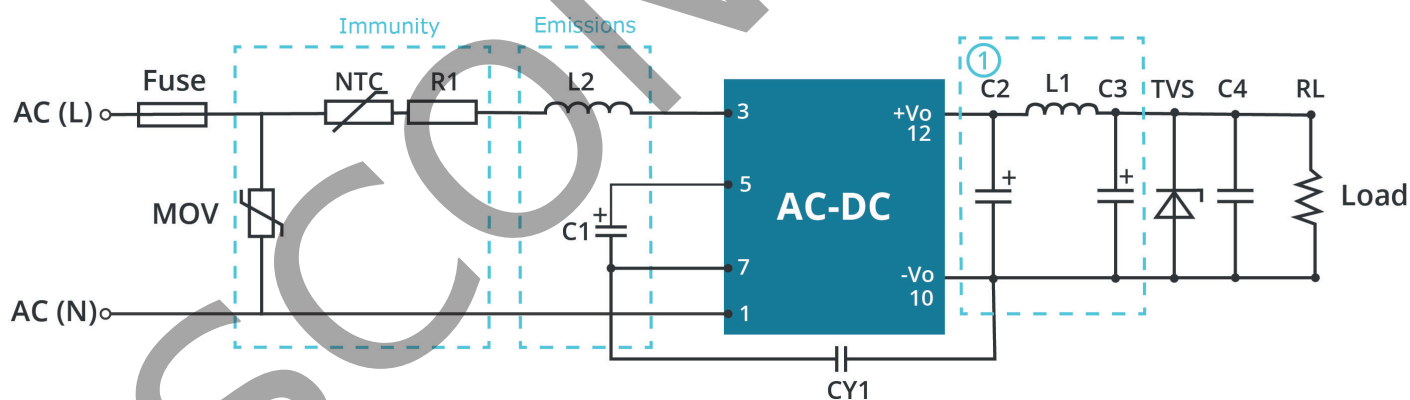


Table 2

| Application enviromental | Ambient temperature range | Immunity Class | Emissions Class |
|--------------------------|---------------------------|----------------|-----------------|
| Basic 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

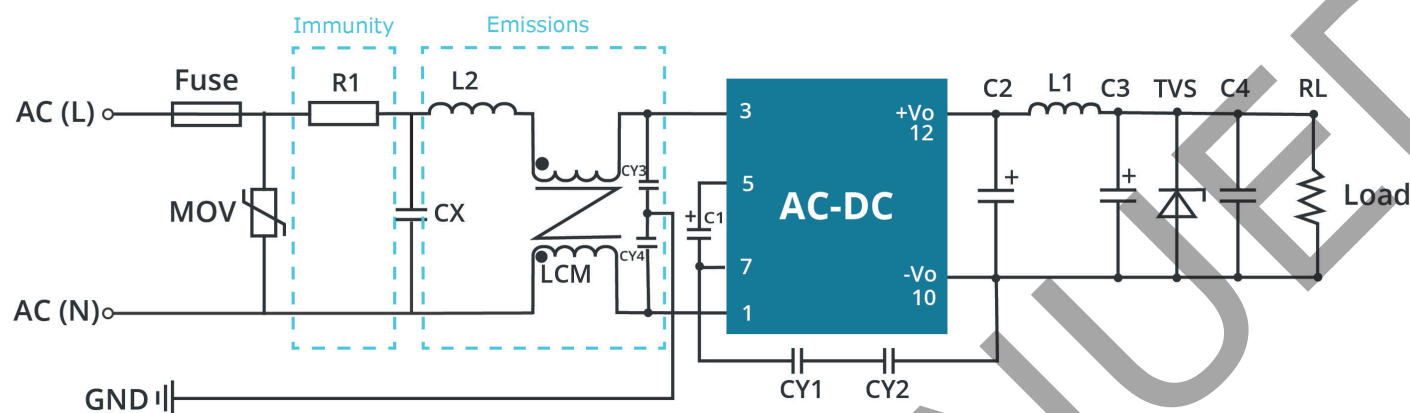
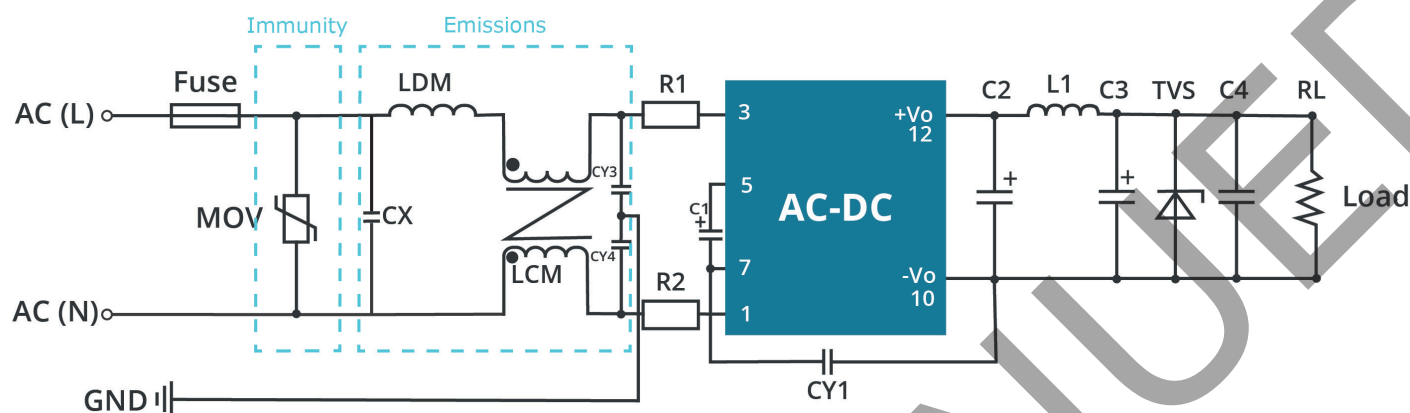


Table 3

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

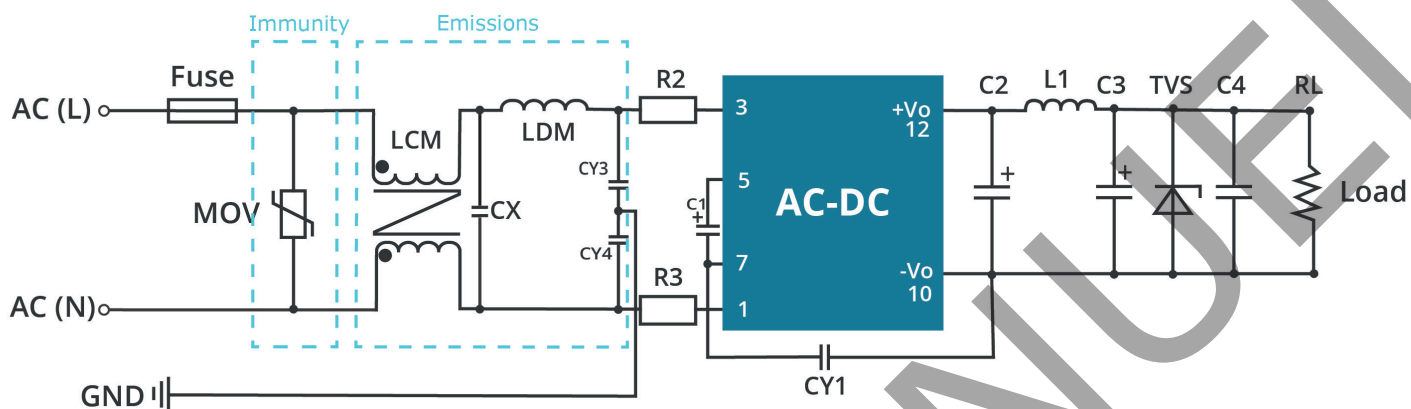
| Component       | Recommended value  |
|-----------------|--------------------|
| R1              | 12Ω/3W             |
| CY1 (CY2)       | 1.0nF/400Vac       |
| LCM             | 3.5mH              |
| LDM             | 0.33mH             |
| CX              | 0.1μF/310Vac       |
| CY3, CY4   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

Note: In the home appliance application enviroment, 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 |



## REVISION HISTORY

| rev. | description                                                                                      | date       |
|------|--------------------------------------------------------------------------------------------------|------------|
| 1.0  | initial release                                                                                  | 12/08/2017 |
| 1.02 | datasheet update,<br>safety approvals updated to match 62368 certification,<br>PCN-656-95022R-01 | 10/12/2020 |
| 1.03 | clarified safety certifications                                                                  | 11/24/2020 |
| 1.04 | derating and efficiency curves updated                                                           | 01/18/2022 |
| 1.05 | UKCA mark added                                                                                  | 05/25/2022 |

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



**CUI INC**  
a bel group

**Headquarters**  
20050 SW 112th Ave.  
Tualatin, OR 97062  
**800.275.4899**

Fax 503.612.2383  
**cui.com**  
techsupport@cui.com

CUI offers a two (2) year limited warranty. Complete warranty information is listed on our website.

CUI reserves the right to make changes to the product at any time without notice. Information provided by CUI is believed to be accurate and reliable. However, no responsibility is assumed by CUI for its use, nor for any infringements of patents or other rights of third parties which may result from its use.

CUI products are not authorized or warranted for use as critical components in equipment that requires an extremely high level of reliability. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.