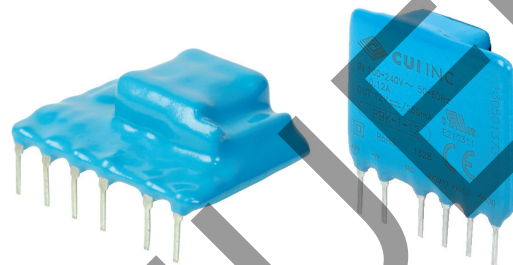



**SERIES: PBK-1 | DESCRIPTION: AC-DC POWER SUPPLY**
**FEATURES**

- up to 1 W continuous output
- compact SIP package
- single regulated outputs from 5~24 V
- 3,000 Vac isolation
- over current and short circuit protections
- CE, UL60950-1 safety approval
- wide input voltage: 70~400 Vdc (85~264 Vac)
- efficiency up to 68%



| MODEL    | output voltage<br>(Vdc) | output current max<br>(mA) | output power max<br>(W) | ripple and noise <sup>1</sup><br>max<br>(mVp-p) | efficiency <sup>2</sup><br>typ<br>(%) |
|----------|-------------------------|----------------------------|-------------------------|-------------------------------------------------|---------------------------------------|
| PBK-1-5  | 5                       | 200                        | 1                       | 150                                             | 61                                    |
| PBK-1-9  | 9                       | 111                        | 1                       | 150                                             | 66                                    |
| PBK-1-12 | 12                      | 83                         | 1                       | 150                                             | 67                                    |
| PBK-1-15 | 15                      | 67                         | 1                       | 150                                             | 67                                    |
| PBK-1-24 | 24                      | 42                         | 1                       | 150                                             | 68                                    |

Note: 1. Measured at 20 MHz bandwidth, see Test Configuration section.  
2. At 230 Vac.

**PART NUMBER KEY**
**PBK-1-XX-X**

Base Number

Output Voltage

Orientation  
"blank" = vertical  
B = right-angle

## INPUT

| parameter                 | conditions/description                         | min      | typ      | max        | units      |
|---------------------------|------------------------------------------------|----------|----------|------------|------------|
| voltage                   |                                                | 85<br>70 |          | 264<br>400 | Vac<br>Vdc |
| frequency                 |                                                | 47       |          | 63         | Hz         |
| current                   | at 115 Vac<br>at 230 Vac                       |          |          | 120<br>60  | mA<br>mA   |
| inrush current            | at 115 Vac<br>at 230 Vac                       |          | 10<br>20 |            | A<br>A     |
| no load power consumption |                                                |          |          | 0.5        | W          |
| input fuse                | 1 A/250 V, slow-blow type (external, required) |          |          |            |            |

## OUTPUT

| parameter               | conditions/description                                         | min       | typ       | max                 | units                         |
|-------------------------|----------------------------------------------------------------|-----------|-----------|---------------------|-------------------------------|
| output current          |                                                                | 10        |           |                     | %                             |
| capacitive load         | 5 Vdc output models<br>9 Vdc output models<br>all other models |           |           | 470<br>150<br>100   | $\mu$ F<br>$\mu$ F<br>$\mu$ F |
| line regulation         | at full load                                                   |           | $\pm 1.5$ | $\pm 2$             | %                             |
| load regulation         | at 10%~100% load                                               |           | $\pm 2.5$ | $\pm 3$             | %                             |
| voltage set accuracy    | 5 Vdc output models<br>all other models                        |           |           | $\pm 10$<br>$\pm 5$ | %<br>%                        |
| hold-up time            | at 115 Vac<br>at 230 Vac                                       | 80<br>300 |           |                     | ms<br>ms                      |
| switching frequency     |                                                                |           |           | 50                  | kHz                           |
| temperature coefficient |                                                                |           | $\pm 0.1$ |                     | %/°C                          |

## PROTECTIONS

| parameter                | conditions/description           | min | typ | max | units |
|--------------------------|----------------------------------|-----|-----|-----|-------|
| short circuit protection | hiccup, continuous, auto restart |     |     |     |       |
| over current protection  | auto restart                     | 120 |     |     | %     |

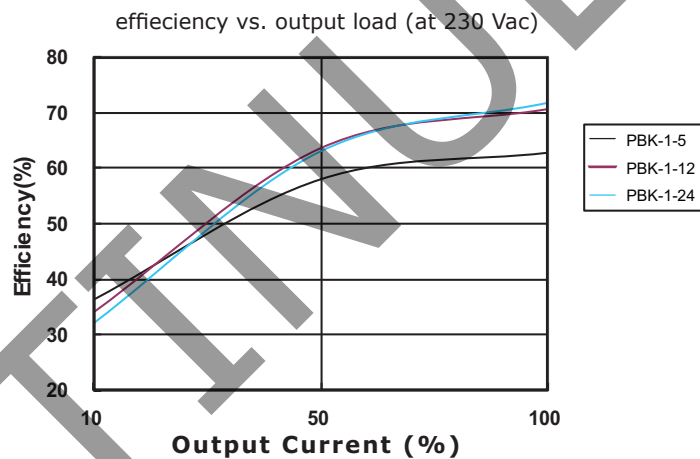
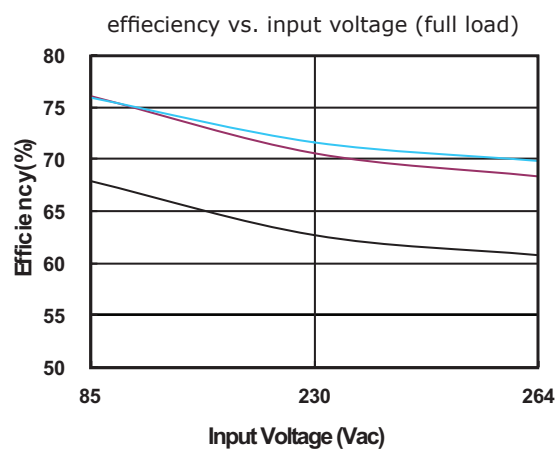
## SAFETY & COMPLIANCE

| parameter                    | conditions/description                                                                    | min     | typ | max | units |
|------------------------------|-------------------------------------------------------------------------------------------|---------|-----|-----|-------|
| isolation voltage            | input to output, for 1 minute                                                             | 3,000   |     |     | Vac   |
| safety approvals             | UL60950-1, CE                                                                             |         |     |     |       |
| safety class                 | Class II                                                                                  |         |     |     |       |
| conducted emissions          | CISPR32/EN55032 external circuit required, Class A (see figure 2); Class B (see figure 3) |         |     |     |       |
| radiated emissions           | CISPR32/EN55032 external circuit required, Class A (see figure 2); Class B (see figure 3) |         |     |     |       |
| ESD                          | IEC/EN61000-4-2 Class B, contact $\pm 4$ kV                                               |         |     |     |       |
| radiated immunity            | IEC/EN61000-4-3 Class A, 10V/m (external circuit required, see figure 3)                  |         |     |     |       |
| EFT/burst                    | IEC/EN61000-4-4 Class B, $\pm 2$ kV (external circuit required, see figure 2)             |         |     |     |       |
|                              | IEC/EN61000-4-4 Class B, $\pm 4$ kV (external circuit required, see figure 3)             |         |     |     |       |
| surge                        | IEC/EN61000-4-5 Class B, $\pm 1$ kV/ $\pm 2$ kV (external circuit required, see figure 3) |         |     |     |       |
| conducted immunity           | IEC/EN61000-4-6 Class A, 3 Vr.m.s (external circuit required, see figure 3)               |         |     |     |       |
| voltage dips & interruptions | IEC/EN61000-4-11 Class B, 0%-70% (external circuit required, see figure 3)                |         |     |     |       |
| MTBF                         | as per MIL-HDBK-217F, 25°C                                                                | 300,000 |     |     | hours |
| RoHS                         | 2011/65/EU                                                                                |         |     |     |       |

## ENVIRONMENTAL

| parameter             | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature |                        | -25 |     | 85  | °C    |
| storage temperature   |                        | -25 |     | 105 | °C    |
| humidity              | non-condensing         |     |     | 85  | %     |

## EFFICIENCY CURVES



## 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    |

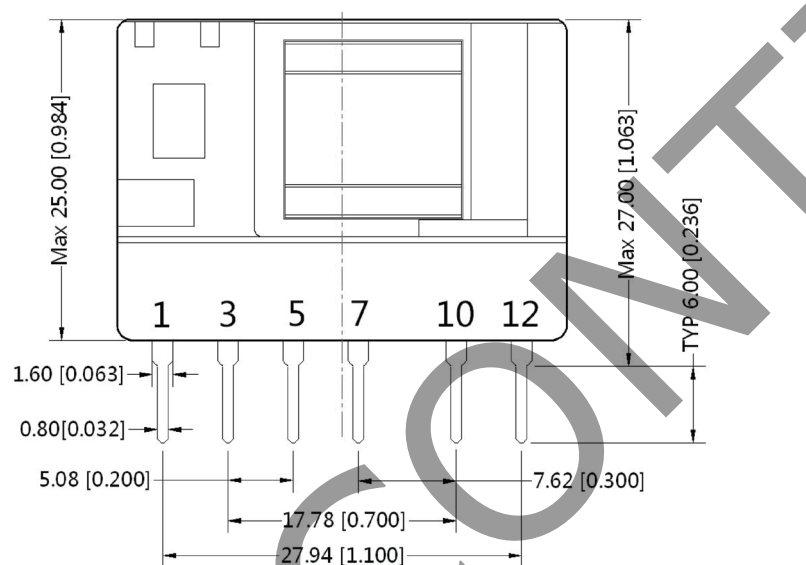
## MECHANICAL

| parameter  | conditions/description                              | min | typ | max | units    |
|------------|-----------------------------------------------------|-----|-----|-----|----------|
| dimensions | vertical: 35 x 11 x 25<br>right-angle: 35 x 13 x 25 |     |     |     | mm<br>mm |
| material   | UL94V-0                                             |     |     |     |          |
| weight     |                                                     |     | 8   |     | g        |

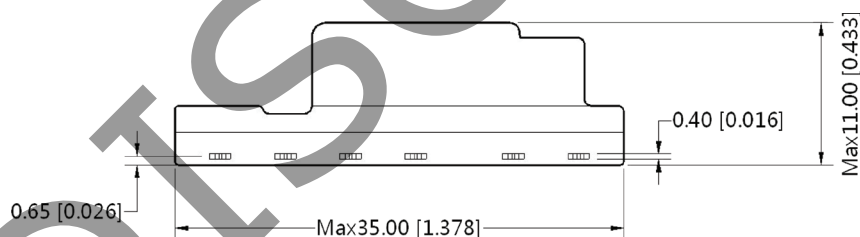
## MECHANICAL DRAWING

### VERTICAL ORIENTATION

units: mm[inch]

tolerance:  $\pm 0.5$  [ $\pm 0.020$ ]pin tolerance:  $\pm 0.1$  [ $\pm 0.004$ ]

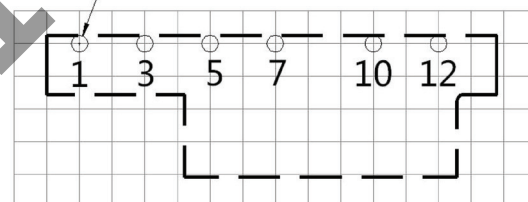
Front View



Bottom View

Note: Grid 2.54\*2.54mm

Ø1.30 [Ø0.051]

Top View  
PCB Layout

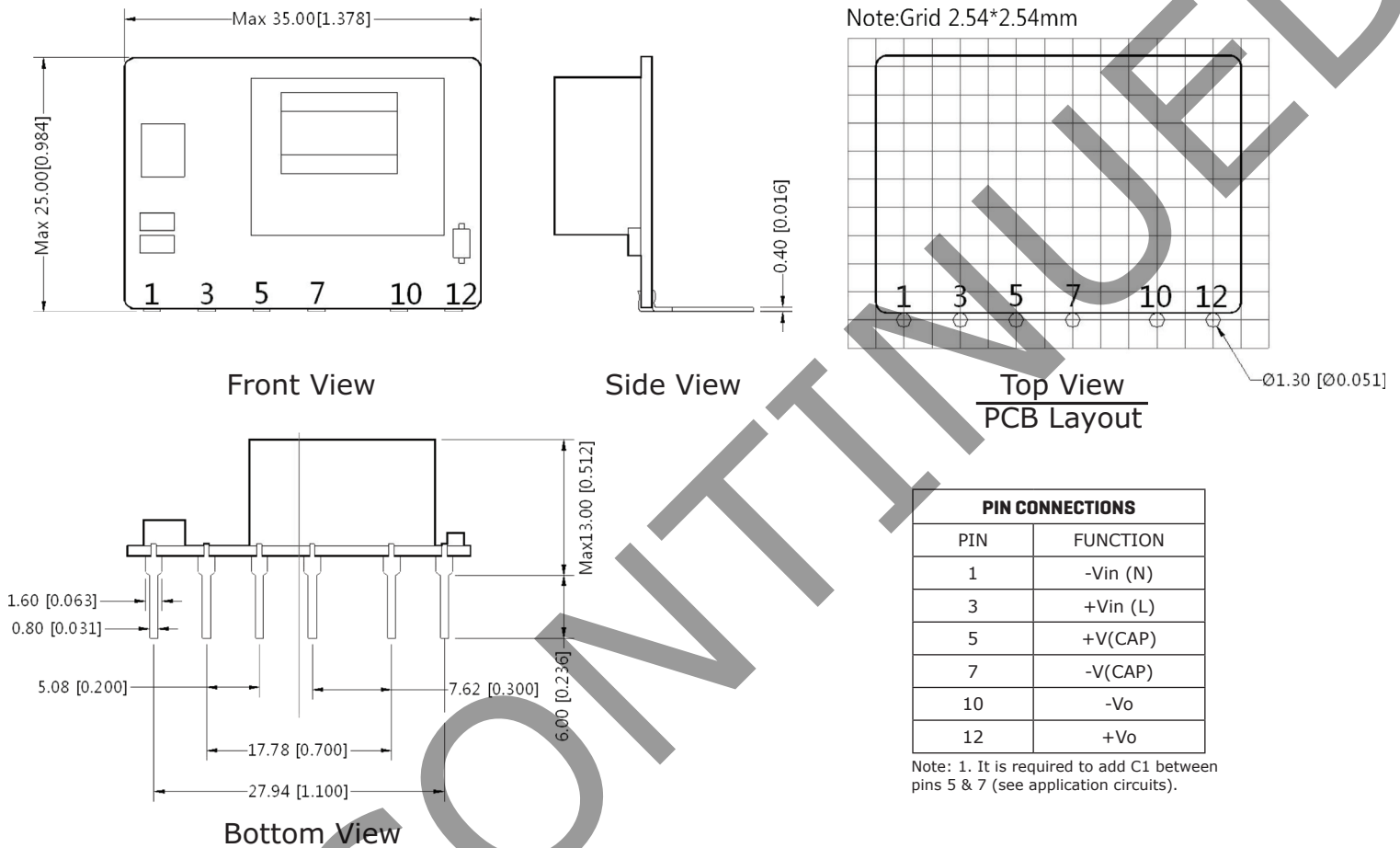
| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | FUNCTION |
| 1               | -Vin (N) |
| 3               | +Vin (L) |
| 5               | +V(CAP)  |
| 7               | -V(CAP)  |
| 10              | -Vo      |
| 12              | +Vo      |

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

## MECHANICAL DRAWING (CONTINUED)

### RIGHT-ANGLE ORIENTATION

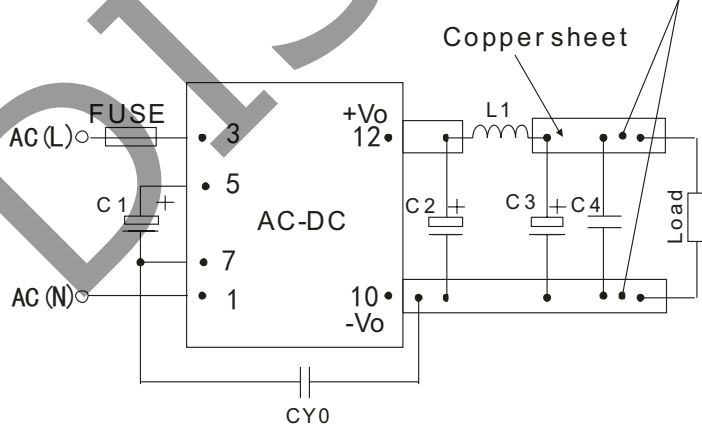
units: mm[inch]

tolerance:  $\pm 0.5[\pm 0.020]$ pin tolerance:  $\pm 0.1[\pm 0.004]$ 

## TEST CONFIGURATION

**Figure 1**

Connect Oscillograph Probe



**Table 1**

| Recommended External Circuit Components |                 |                 |                 |                 |                 |                       |
|-----------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------------|
| $V_{OUT}$<br>(Vdc)                      | C1 <sup>1</sup> | C2 <sup>1</sup> | L1 <sup>1</sup> | C3 <sup>1</sup> | C4              | CY0<br>(Y1 capacitor) |
| 5                                       | 10 $\mu$ F/400V | 150 $\mu$ F/35V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac            |
| 9                                       | 10 $\mu$ F/400V | 150 $\mu$ F/35V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac            |
| 12                                      | 10 $\mu$ F/400V | 100 $\mu$ F/35V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac            |
| 15                                      | 10 $\mu$ F/400V | 100 $\mu$ F/35V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac            |
| 24                                      | 10 $\mu$ F/400V | 100 $\mu$ F/35V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac            |

Note:

1. Required components.
2. 1 A/250 V fuse required.

## TYPICAL APPLICATION CIRCUIT

Figure 2

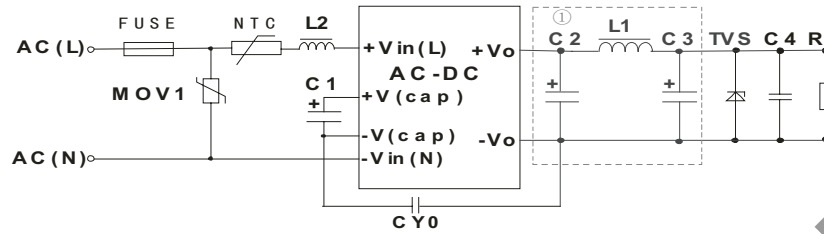


Table 2

| Recommended External Circuit Components |                 |       |                   |                 |                 |                 |            |                   |          |      |         |
|-----------------------------------------|-----------------|-------|-------------------|-----------------|-----------------|-----------------|------------|-------------------|----------|------|---------|
| $V_{OUT}$ (Vdc)                         | C1 <sup>1</sup> | L2    | C2 <sup>1,2</sup> | L1 <sup>1</sup> | C3 <sup>1</sup> | C4              | CY0        | FUSE <sup>1</sup> | TVS      | NTC  | MOV1    |
| 5                                       | 10 $\mu$ F/400V | 4.7mH | 150 $\mu$ F/35V   | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac | 1A/250V           | SMBJ7.0A | 5D-9 | S14K350 |
| 9                                       | 10 $\mu$ F/400V | 4.7mH | 150 $\mu$ F/35V   | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac | 1A/250V           | SMBJ12A  | 5D-9 | S14K350 |
| 12                                      | 10 $\mu$ F/400V | 4.7mH | 100 $\mu$ F/35V   | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac | 1A/250V           | SMBJ20A  | 5D-9 | S14K350 |
| 15                                      | 10 $\mu$ F/400V | 4.7mH | 100 $\mu$ F/35V   | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac | 1A/250V           | SMBJ20A  | 5D-9 | S14K350 |
| 24                                      | 10 $\mu$ F/400V | 4.7mH | 100 $\mu$ F/35V   | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac | 1A/250V           | SMBJ30A  | 5D-9 | S14K350 |

Note: 1. Required components.  
2. When 5 Vdc model is operating in the -25~0C or 55~85C range, C2 needs to be a 270  $\mu$ F/16 V solid capacitor.

## EMC RECOMMENDED CIRCUIT

Figure 3

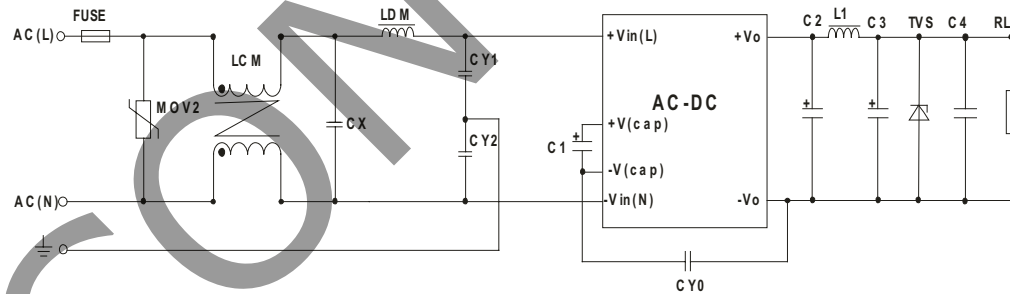


Table 3

| Recommended External Circuit Components |                    |
|-----------------------------------------|--------------------|
| MOV2                                    | S14K350            |
| CY1, CY2                                | 1nF/400Vac         |
| CX                                      | 0.1 $\mu$ F/275Vac |
| LCM                                     | 3.5mH              |
| LDM                                     | 5mH                |
| FUSE                                    | 1A/250V, slow blow |

Note: Also refer to Table 2.

Notes: 1. C1 and C3 are electrolytic capacitors. They are required for both AC input and DC input.  
2. For AC input, C1 is used as a filter capacitor. The recommended C1 value is 10  $\mu$ F/400 V.  
3. For DC input, C1 is used as an EMC filter capacitor. The recommended C1 value is 10 $\mu$ F/450V. When the input voltage is above 370VDC, we recommend a 10 $\mu$ F/450V capacitor.  
4. C2 and C3 are output filter capacitors, we recommend 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. C4 is a ceramic capacitor which is used to filter high frequency noise. C2, C3 and L1 form a pi-type filter circuit. For current of L1 and L2 refer to the datasheets provided by the manufacturers, current derating should be 80% or above. TVS is a recommended component to protect post-circuits (if converter fails). We recommend using a 5D-9 external input NTC.  
6. For standard EMC requirements, please refer to figure 2. If a higher EMC is required, please refer to figure 3.  
7. All specifications measured at Ta=25C, humidity <75%, 115 Vac & 230 Vac input voltage, and rated output load, unless otherwise specified.

## REVISION HISTORY

| rev. | description                                               | date       |
|------|-----------------------------------------------------------|------------|
| 1.0  | initial release                                           | 08/09/2013 |
| 1.01 | added bent pin model options, updated emc recommendations | 03/25/2014 |
| 1.02 | performance updates due to control IC change              | 02/02/2018 |

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

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