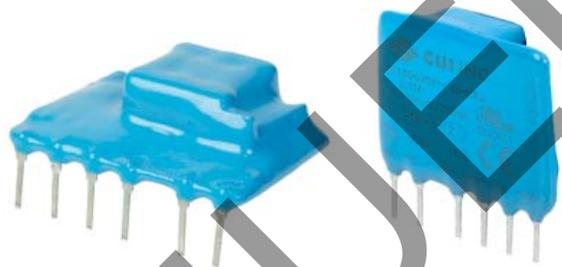


**SERIES:** PBK-3 | **DESCRIPTION:** AC-DC POWER SUPPLY

**FEATURES**

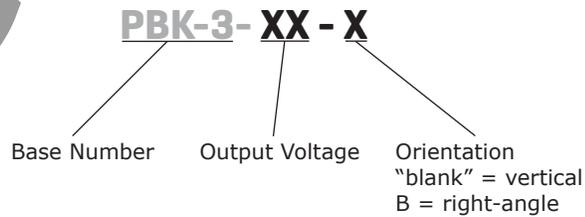
- up to 3 W continuous output
- compact SIP package
- single regulated outputs from 3.3~24 V
- 3,000 Vac isolation
- over current and short circuit protections
- CE, UL60950-1 safety approval
- wide input voltage: 100~400 Vdc (85~264 Vac)
- efficiency up to 78%



| <b>MODEL</b>         | <b>output voltage</b><br>(Vdc) | <b>output current max</b><br>(mA) | <b>output power max</b><br>(W) | <b>ripple and noise<sup>2</sup> max</b><br>(mVp-p) | <b>efficiency typ</b><br>(%) |
|----------------------|--------------------------------|-----------------------------------|--------------------------------|--|------------------------------|
| PBK-3-3 <sup>1</sup> | 3.3                            | 500                               | 1.65                           | 150  | 66                           |
| PBK-3-5              | 5                              | 500                               | 2.5                            | 150  | 69                           |
| PBK-3-9              | 9                              | 333                               | 3                              | 120  | 76                           |
| PBK-3-12             | 12                             | 250                               | 3                              | 120  | 78                           |
| PBK-3-15             | 15                             | 200                               | 3                              | 120  | 78                           |
| PBK-3-24             | 24                             | 125                               | 3                              | 120  | 78                           |

Note: 1. The PBK-3-3 & PBK-3-3-B do not meet UL and CE standards.  
2. Measured at 20 MHz bandwidth, see Test Configuration section.

**PART NUMBER KEY**



**INPUT**

| parameter                 | conditions/description                         | min | typ | max | units |
|---------------------------|--|-----|-----|-----|-------|
| voltage                   |  | 85  |     | 264 | Vac   |
|                           |  | 100 |     | 400 | Vdc   |
| frequency                 |  | 47  |     | 440 | Hz    |
| current                   | at 115 Vac                                     |     |     | 120 | mA    |
|                           | at 230 Vac                                     |     |     | 60  | mA    |
| inrush current            | at 115 Vac                                     |     | 20  |     | A     |
|                           | at 230 Vac                                     |     | 40  |     | 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         | 3.3 Vdc output models              |     |            | 2300    | $\mu$ F |
|                         | 5 Vdc output models                |     |            | 470     | $\mu$ F |
|                         | 9 Vdc output models                |     |            | 150     | $\mu$ F |
|                         | all other models                   |     |            | 100     | $\mu$ F |
| line regulation         | 3.3 Vdc models, at full load       |     | $\pm 0.5$  |         | %       |
|                         | all other models, at full load     |     | $\pm 1.5$  |         | %       |
| load regulation         | 3.3 Vdc models, at 10%~100% load   |     | $\pm 1.5$  |         | %       |
|                         | all other models, at 10%~100% load |     | $\pm 2.5$  |         | %       |
| voltage set accuracy    | 3.3 Vdc output models              |     |            | $\pm 3$ | %       |
|                         | 9 & 12 Vdc output models           |     |            | $\pm 8$ | %       |
|                         | all other models                   |     |            | $\pm 5$ | %       |
| hold-up time            | at 115 Vac                         | 60  |            |         | ms      |
|                         | at 230 Vac                         | 300 |            |         | ms      |
| switching frequency     | 3.3 Vdc output models              |     | 100        |         | kHz     |
|                         | all other models                   |     |            | 50      | kHz     |
| temperature coefficient |                                    |     | $\pm 0.15$ |         | %/°C    |

**PROTECTIONS**

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

**SAFETY & COMPLIANCE**

| parameter            | conditions/description  | min   | typ | max | units      |
|----------------------|---|-------|-----|-----|------------|
| isolation voltage    | input to output, for 1 minute   | 3,000 |     |     | Vac        |
| isolation resistance |   | 100   |     |     | M $\Omega$ |
| safety approvals     | UL60950-1, CE   |       |     |     |            |
| safety class         | Class II  |       |     |     |            |
| conducted emissions  | CISPR22/EN55022 external circuit required, Class A (see figure 2); Class B (see figure 3) |       |     |     |            |
| radiated emissions   | CISPR22/EN55022 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)               |       |     |     |            |
| PFM                  | IEC/EN61000-4-8 Class A, 10 A/m   |       |     |     |            |

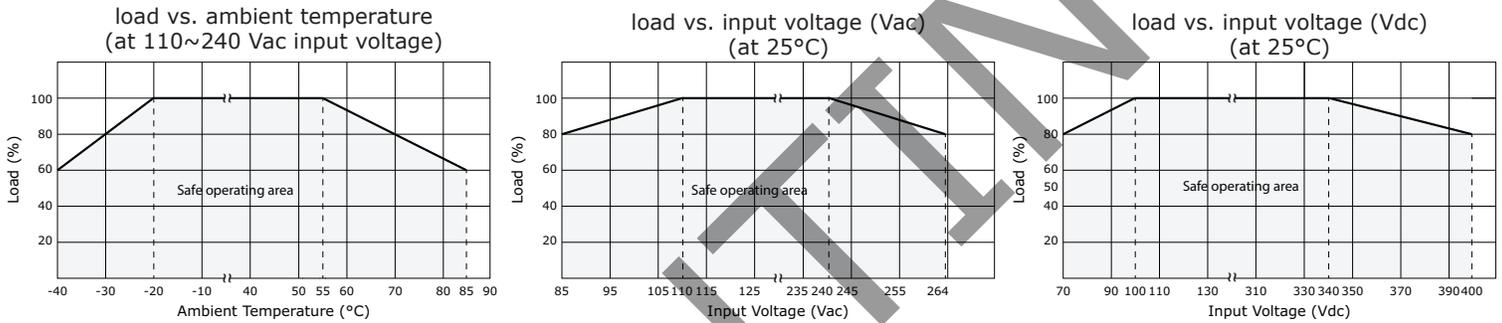
## SAFETY & COMPLIANCE (CONTINUED)

| parameter                    | conditions/description           | min     | typ | max | units |
|------------------------------|----------------------------------|---------|-----|-----|-------|
| voltage dips & interruptions | IEC/EN61000-4-11 Class B, 0%-70% |         |     |     |       |
| MTBF                         | at 25°C, max. load               | 300,000 |     |     | hours |
| RoHS                         | 2011/65/EU                       |         |     |     |       |

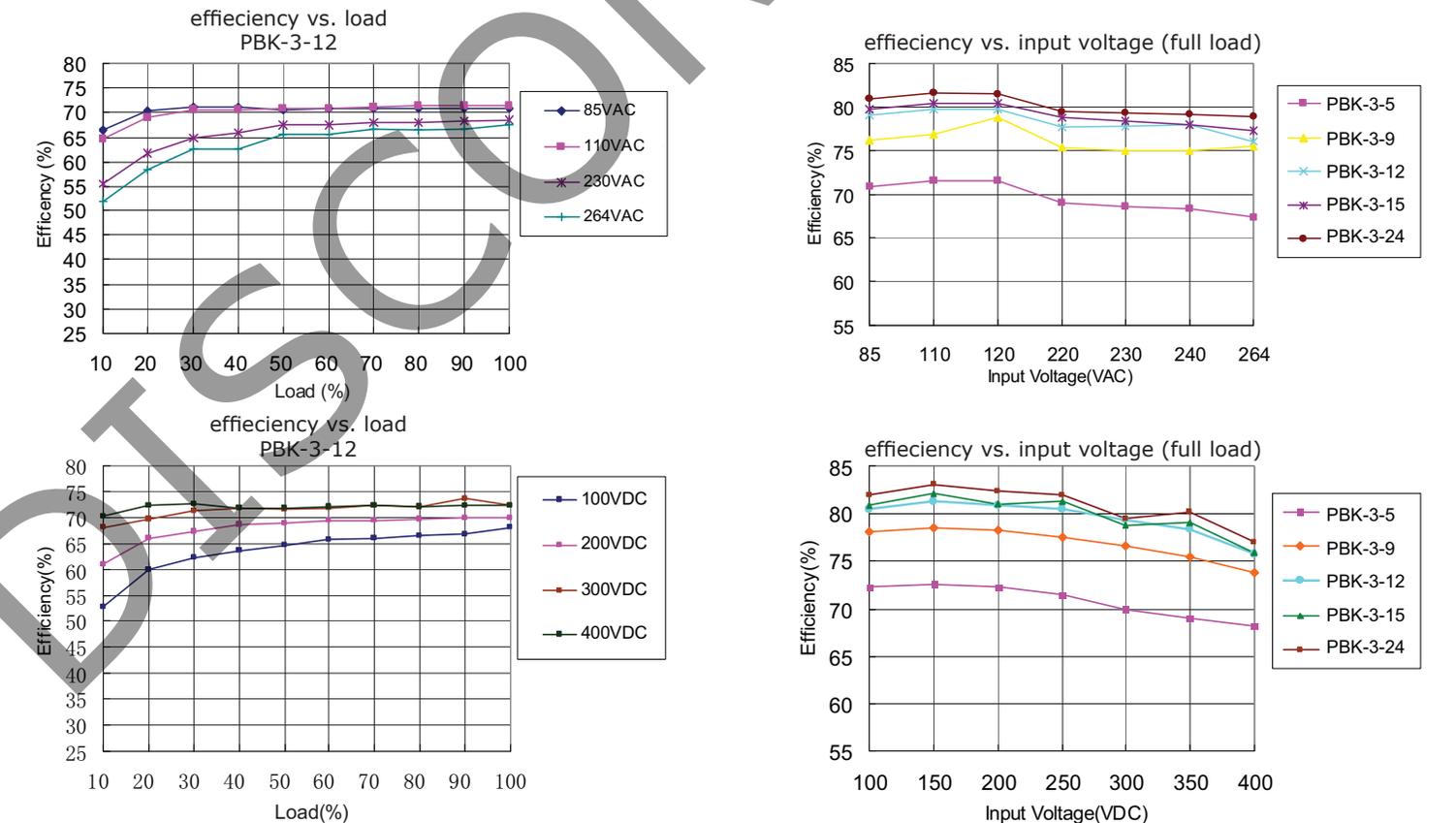
## ENVIRONMENTAL

| parameter             | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature | see derating curves    | -40 |     | 85  | °C    |
| storage temperature   |                        | -40 |     | 105 | °C    |
| case temperature      |                        |     |     | 90  | °C    |
| humidity              | non-condensing         |     |     | 85  | %     |

## DERATING CURVES



## 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 | PBK-3-3 vertical model: 37 x 11 x 25<br>all other vertical models: 35 x 11 x 25<br>PBK-3-3 right-angle model: 37 x 13 x 25<br>all other right-angle models: 35 x 13 x 25 |     |     |     | mm<br>mm<br>mm<br>mm |
| material   | UL94V-0  |     |     |     |                      |
| weight     |  |     | 8   |     | g                    |

## MECHANICAL DRAWING

### PBK-3-3 VERTICAL ORIENTATION

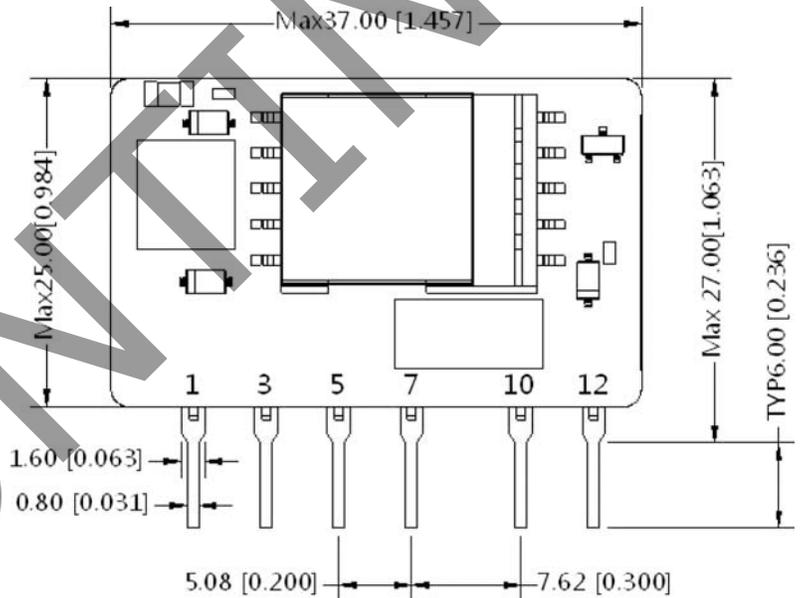
units: mm[inch]

tolerance:  $\pm 0.5[\pm 0.020]$

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

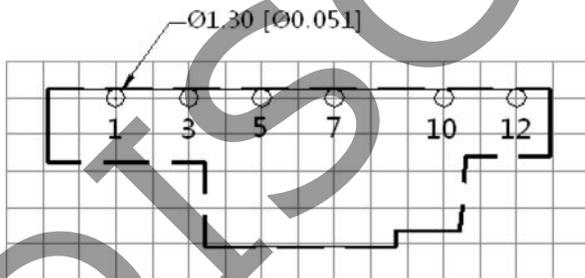
| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | FUNCTION |
| 1               | -Vin (N) |
| 3               | +Vin (L) |
| 5               | +V(CAP)  |
| 7               | -V(CAP)  |
| 10              | -Vo      |
| 12              | +Vo      |

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

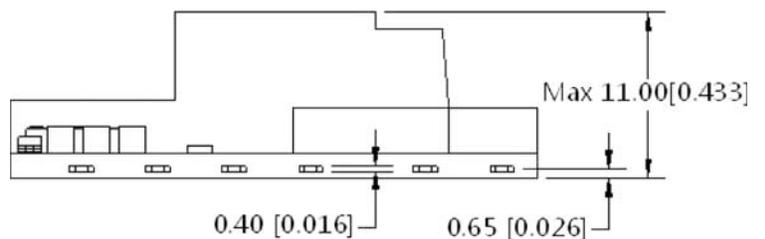


Front View

Note: Grid 2.54\*2.54mm



Top View  
PCB Layout



Bottom View

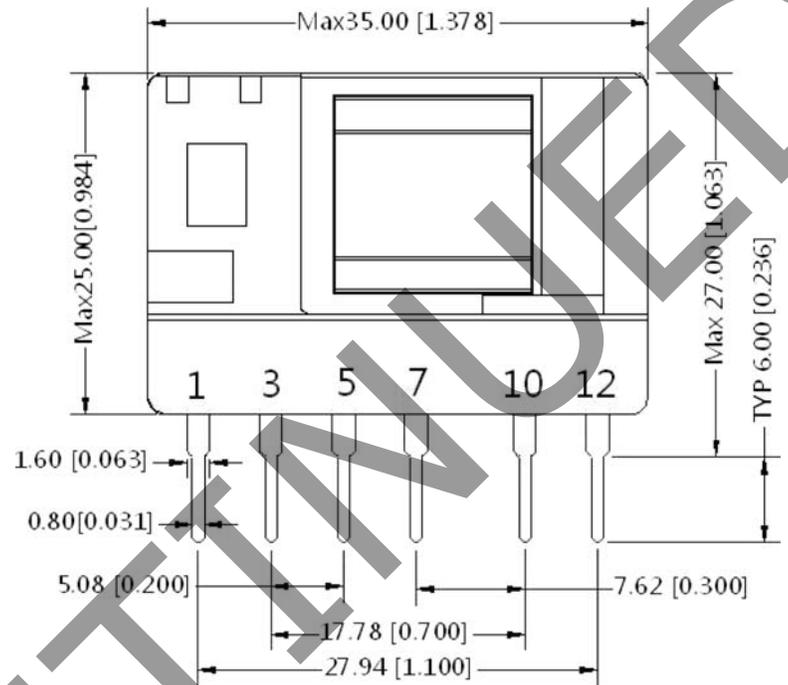
## MECHANICAL DRAWING (CONTINUED)

### VERTICAL ORIENTATION (ALL OTHER MODELS)

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

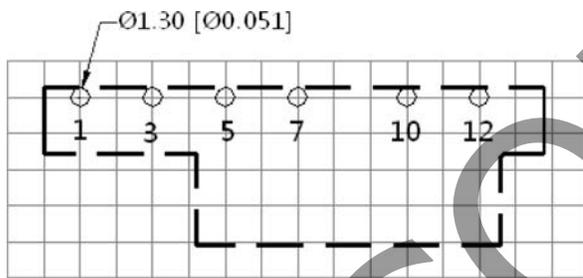
| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | FUNCTION |
| 1               | -Vin (N) |
| 3               | +Vin (L) |
| 5               | +V(CAP)  |
| 7               | -V(CAP)  |
| 10              | -Vo      |
| 12              | +Vo      |

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

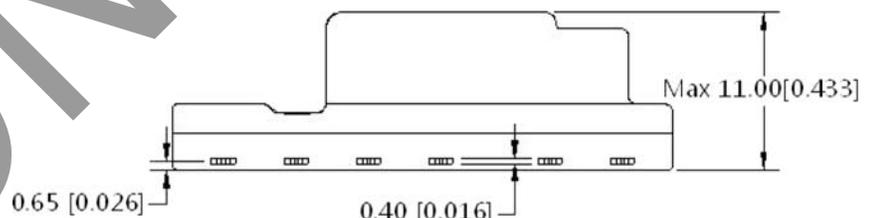


Front View

Note: Grid 2.54\*2.54mm



Top View  
PCB Layout



Bottom View

## MECHANICAL DRAWING (CONTINUED)

### PBK-3-3 RIGHT-ANGLE ORIENTATION

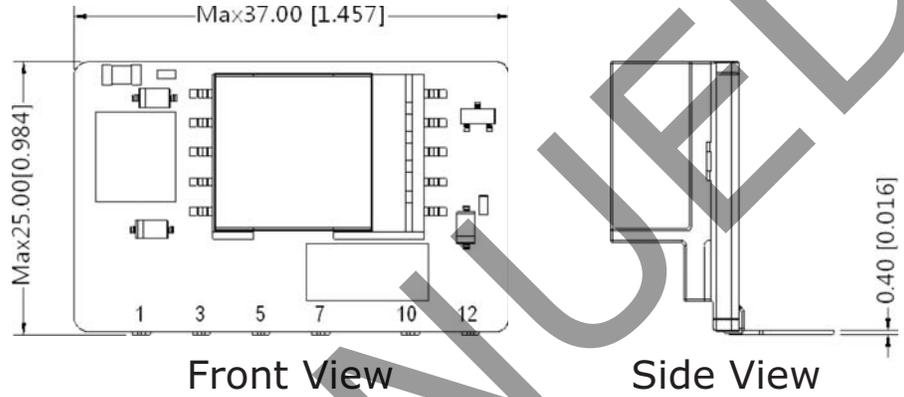
units: mm[inch]

tolerance:  $\pm 0.5[\pm 0.020]$

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

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

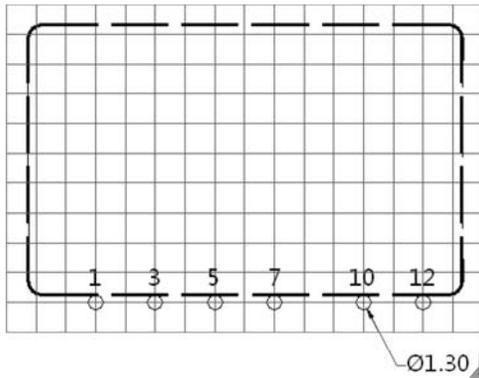
Note: 1. It is required to add C1 between pins 5 & 7 (see application circuits).



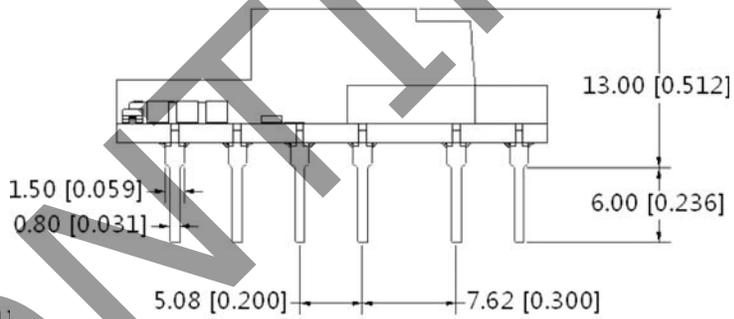
Front View

Side View

Note: Grid 2.54\*2.54mm



Top View  
PCB Layout



Bottom View

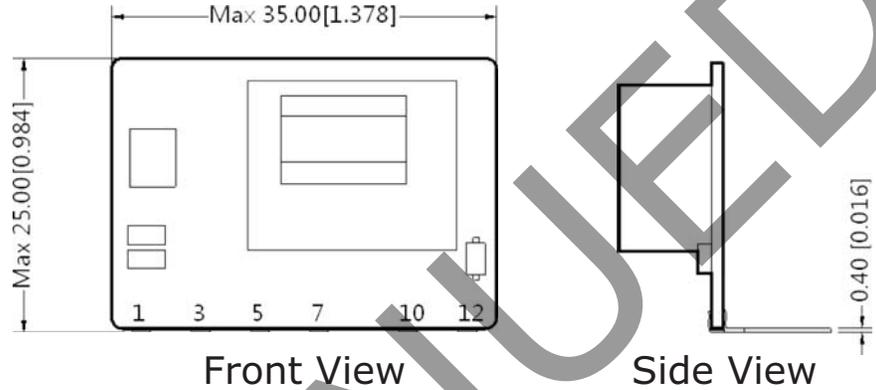
## MECHANICAL DRAWING (CONTINUED)

### RIGHT-ANGLE ORIENTATION (ALL OTHER MODELS)

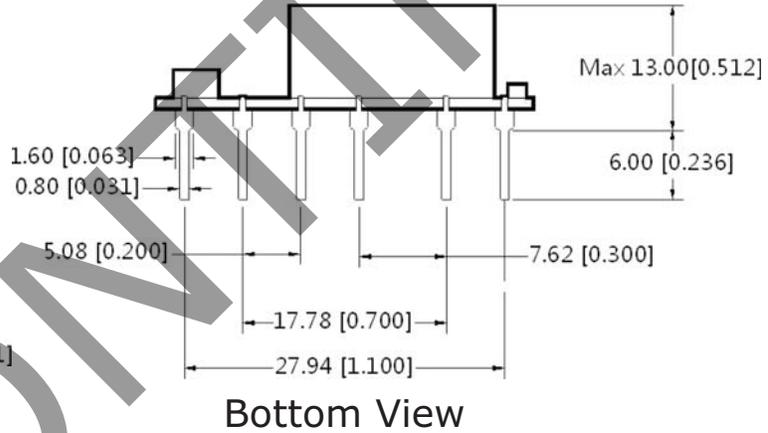
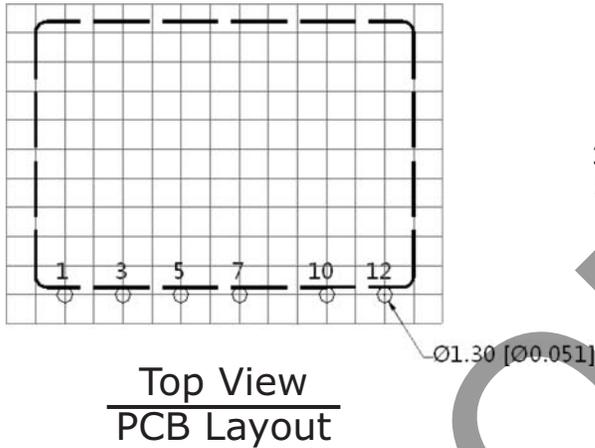
units: mm[inch]  
 tolerance:  $\pm 0.5[\pm 0.020]$   
 pin tolerance:  $\pm 0.1[\pm 0.004]$

| 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 & 7 (see application circuits).



Note: Grid 2.54\*2.54mm



## TEST CONFIGURATION

Figure 1

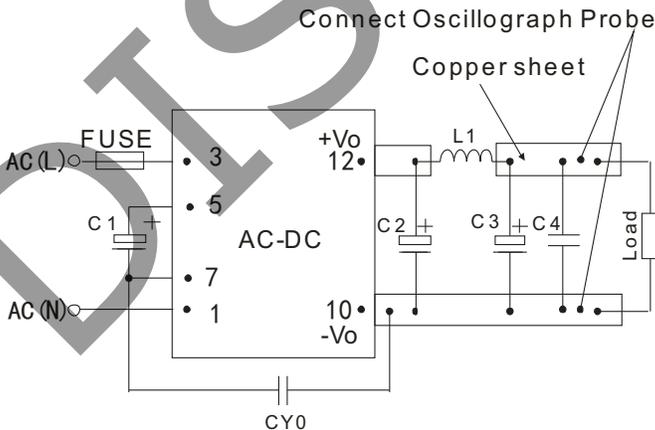


Table 1

| $V_{OUT}$ (Vdc) | Recommended External Circuit Components |                 |                 |                 |                 |                    |
|-----------------|---|-----------------|-----------------|-----------------|-----------------|--------------------|
|                 | C1 <sup>1</sup>                         | C2 <sup>1</sup> | L1 <sup>1</sup> | C3 <sup>1</sup> | C4              | CY0 (Y1 capacitor) |
| 3.3             | 22 $\mu$ F/400V                         | 330 $\mu$ F/25V | 2.2 $\mu$ H     | 120 $\mu$ F/25V | 0.1 $\mu$ F/50V | 1nF/400Vac         |
| 5               | 22 $\mu$ F/400V                         | 330 $\mu$ F/25V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac         |
| 9               | 22 $\mu$ F/400V                         | 330 $\mu$ F/25V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac         |
| 12              | 22 $\mu$ F/400V                         | 150 $\mu$ F/35V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac         |
| 15              | 22 $\mu$ F/400V                         | 150 $\mu$ F/35V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac         |
| 24              | 22 $\mu$ 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

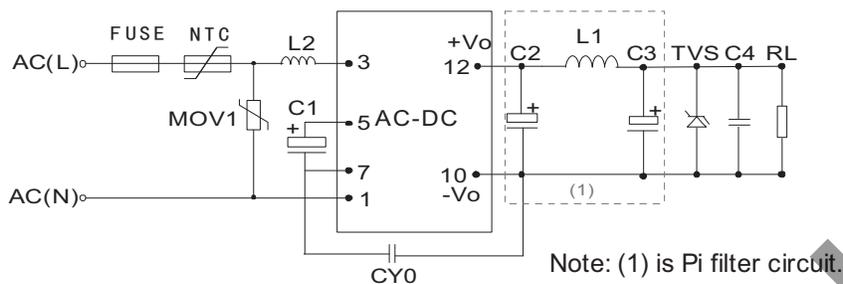


Table 2

| Recommended External Circuit Components |                 |     |                 |                 |                 |                 |            |                   |          |      |         |
|---|-----------------|-----|-----------------|-----------------|-----------------|-----------------|------------|-------------------|----------|------|---------|
| $V_{OUT}$ (Vdc)                         | C1 <sup>1</sup> | L2  | C2 <sup>1</sup> | L1 <sup>1</sup> | C3 <sup>1</sup> | C4              | CY0        | FUSE <sup>1</sup> | TVS      | NTC  | MOV1    |
| 3.3                                     | 22 $\mu$ F/400V | 5mH | 330 $\mu$ F/25V | 2.2 $\mu$ H     | 120 $\mu$ F/25V | 0.1 $\mu$ F/50V | 1nF/400Vac | 1A/250V           | SMBJ7.0A | 5D-9 | S14K350 |
| 5                                       | 22 $\mu$ F/400V | 5mH | 330 $\mu$ F/25V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac | 1A/250V           | SMBJ7.0A | 5D-9 | S14K350 |
| 9                                       | 22 $\mu$ F/400V | 5mH | 330 $\mu$ F/25V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac | 1A/250V           | SMBJ12A  | 5D-9 | S14K350 |
| 12                                      | 22 $\mu$ F/400V | 5mH | 150 $\mu$ F/35V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac | 1A/250V           | SMBJ20A  | 5D-9 | S14K350 |
| 15                                      | 22 $\mu$ F/400V | 5mH | 150 $\mu$ F/35V | 2.2 $\mu$ H     | 68 $\mu$ F/35V  | 0.1 $\mu$ F/50V | 1nF/400Vac | 1A/250V           | SMBJ20A  | 5D-9 | S14K350 |
| 24                                      | 22 $\mu$ F/400V | 5mH | 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.

## EMC RECOMMENDED CIRCUIT

Figure 3

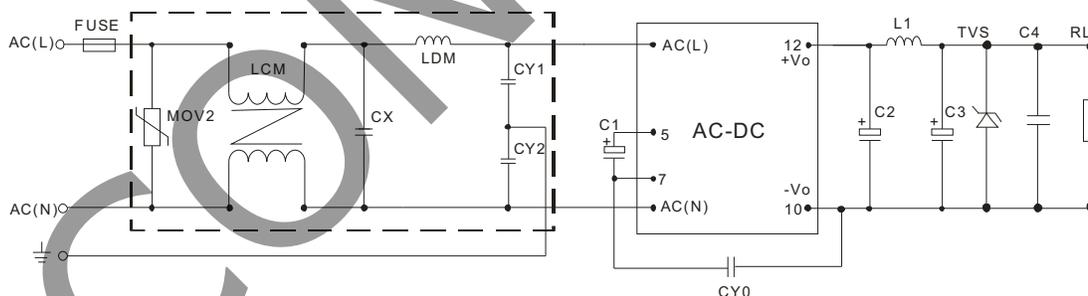


Table 3

| Recommended External Circuit Components |                    |
|---|--------------------|
| MOV2                                    | S10K300            |
| 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:
- C1 and C3 are electrolytic capacitors. They are required for both AC input and DC input.
  - For AC input, C1 is used as a filter capacitor. The recommended C1 value is 22  $\mu$ F/400 V.
  - For DC input, C1 is used as an EMC filter capacitor. The recommended C1 value is 10 $\mu$ F/400V. When the input voltage is above 370VDC, we recommend a 10 $\mu$ F/450V capacitor.
  - 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.
  - 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.
  - For standard EMC requirements, please refer to figure 2. If a higher EMC is required, please refer to figure 3.
  - 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 3.3 Vdc output model, added bent pin model options, updated emc recommendations | 03/25/2014 |

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



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