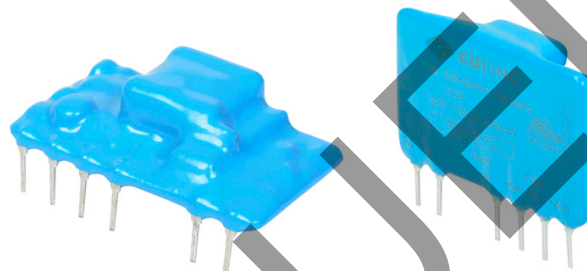


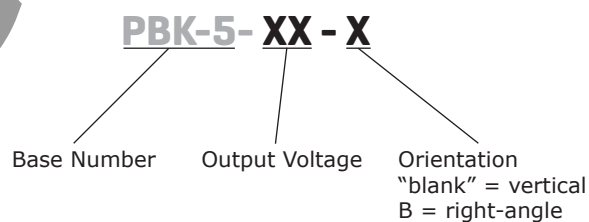
**SERIES: PBK-5 | DESCRIPTION: AC-DC POWER SUPPLY**
**FEATURES**

- up to 5 W continuous output
- ultra compact SIP package
- universal input voltage: (85~264 Vac / 100~400 Vdc)
- single regulated outputs from 3.3~24 Vdc
- 3,000 Vac isolation
- over current, short circuit, and over voltage protections
- UL 60950-1 safety approval
- efficiency up to 75%



| MODEL    | output voltage | output current max | output power max | ripple and noise <sup>1</sup> max | efficiency typ |
|----------|----------------|--------------------|------------------|-----------------------------------|----------------|
|          | (Vdc)          | (A)                | (W)              | (mVp-p)                           | (%)            |
| PBK-5-3  | 3.3            | 1                  | 3.3              | 150                               | 65             |
| PBK-5-5  | 5              | 1                  | 5                | 120                               | 70             |
| PBK-5-9  | 9              | 0.56               | 5                | 120                               | 72             |
| PBK-5-12 | 12             | 0.42               | 5                | 120                               | 74             |
| PBK-5-15 | 15             | 0.34               | 5                | 120                               | 75             |
| PBK-5-24 | 24             | 0.21               | 5                | 150                               | 75             |

Note: 1. Measured at 20 MHz bandwidth, see Test Configuration section.

**PART NUMBER KEY**


## INPUT

| parameter                 | conditions/description                            | min       | typ      | max        | units      |
|---------------------------|---------------------------------------------------|-----------|----------|------------|------------|
| voltage                   |                                                   | 85<br>100 |          | 264<br>400 | Vac<br>Vdc |
| frequency                 |                                                   | 47        |          | 440        | Hz         |
| current                   | at 115 Vac<br>at 230 Vac                          |           |          | 200<br>100 | mA<br>mA   |
| inrush current            | at 115 Vac<br>at 230 Vac                          |           | 20<br>30 |            | A<br>A     |
| leakage current           | CY0 is 1nF/400Vac                                 |           |          | 0.25       | mA         |
| no load power consumption |                                                   |           |          | 0.5        | W          |
| input fuse                | 1 A/250 V, slow-blow type (external, recommended) |           |          |            |            |

## OUTPUT

| parameter               | conditions/description | min | typ   | max  | units |
|-------------------------|------------------------|-----|-------|------|-------|
| output current          |                        | 10  |       |      | %     |
| capacitive load         | 3.3 Vdc output models  |     |       | 2200 | μF    |
|                         | 5 Vdc output models    |     |       | 1500 | μF    |
|                         | 9 Vdc output models    |     |       | 680  | μF    |
|                         | 12 Vdc output models   |     |       | 470  | μF    |
|                         | 15 Vdc output models   |     |       | 330  | μF    |
|                         | 24 Vdc output models   |     |       | 100  | μF    |
| line regulation         | at full load           |     | ±0.1  | ±0.5 | %     |
| load regulation         | at 10%~100% load       |     | ±1.0  | ±1.5 | %     |
| voltage set accuracy    | PBK-5-3                |     | ±2    | ±3   | %     |
|                         | all other models       |     | ±1    | ±2   | %     |
| hold-up time            | at 115 Vac             | 20  |       |      | ms    |
|                         | at 230 Vac             | 80  |       |      | ms    |
| switching frequency     |                        |     | 100   |      | kHz   |
| temperature coefficient |                        |     | ±0.02 |      | %/°C  |

## PROTECTIONS

| parameter                | conditions/description   | min | typ | max | units |
|--------------------------|--------------------------|-----|-----|-----|-------|
| short circuit protection | continuous, auto restart |     |     |     |       |
| over current protection  | auto restart             | 110 |     |     | %     |
| over voltage protection  | zener diode clamp        |     |     |     |       |

## SAFETY & COMPLIANCE

| parameter            | conditions/description                                                                    | min   | typ | max | units |
|----------------------|-------------------------------------------------------------------------------------------|-------|-----|-----|-------|
| isolation voltage    | input to output for 1 minute at 5mA                                                       | 3,000 |     |     | Vac   |
| isolation resistance |                                                                                           | 100   |     |     | MΩ    |
| safety approvals     | UL 60950-1                                                                                |       |     |     |       |
| safety standards     | UL 60950-1                                                                                |       |     |     |       |
| 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 B (see figures 2 or 3)                   |       |     |     |       |
| ESD                  | IEC/EN61000-4-2 Class B, contact ±4 kV                                                    |       |     |     |       |
| radiated immunity    | IEC/EN61000-4-3 Class A, 10V/m                                                            |       |     |     |       |
| EFT/burst            | IEC/EN61000-4-4 Class B, ±2 kV (external circuit required, see figure 2)                  |       |     |     |       |
|                      | IEC/EN61000-4-4 Class B, ±4 kV (external circuit required, see figure 3)                  |       |     |     |       |

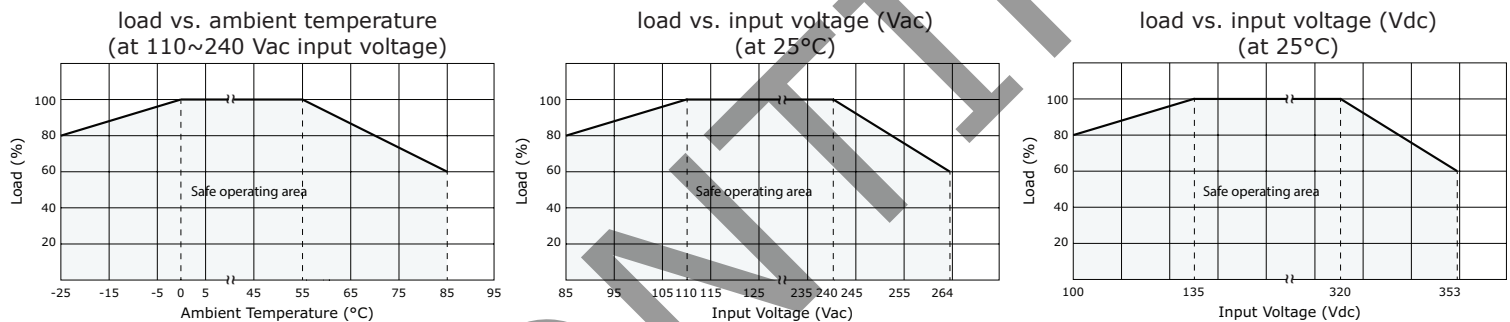
## SAFETY & COMPLIANCE (CONTINUED)

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

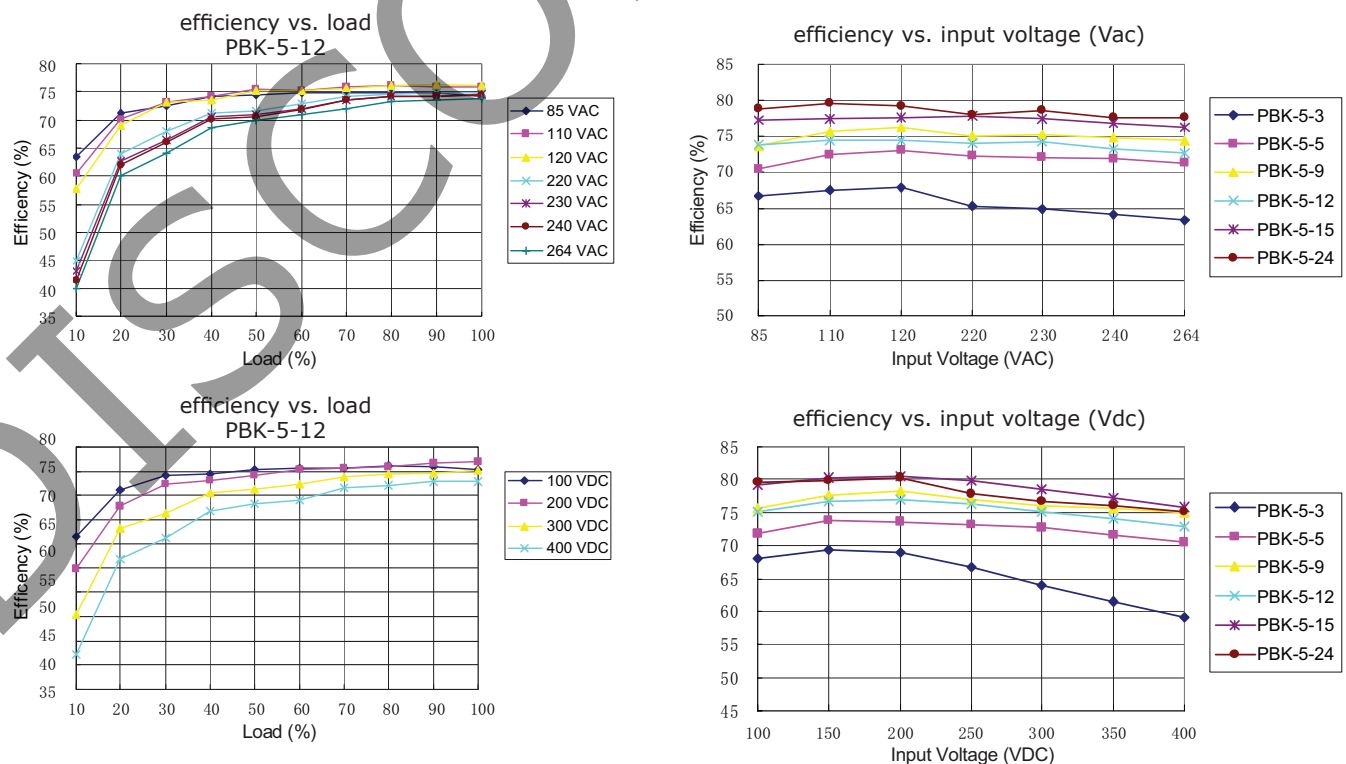
## ENVIRONMENTAL

| parameter             | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature | see derating curves    | -25 |     | 85  | °C    |
| storage temperature   |                        | -40 |     | 105 | °C    |
| case temperature      |                        |     |     | 100 | °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 | vertical models: 42 x 11 x 27<br>right-angle models: 42 x 25 x 13 |     |     |     | mm<br>mm |
| material   | UL94V-0                                                           |     |     |     |          |
| weight     |                                                                   |     | 10  |     | g        |

## MECHANICAL DRAWING

### VERTICAL ORIENTATION

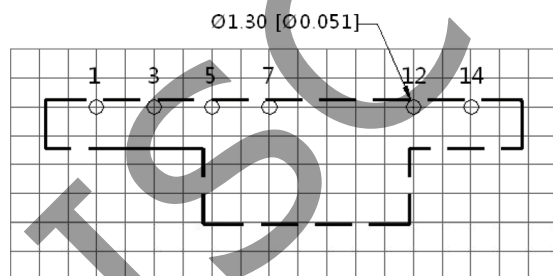
units: mm[inch]

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

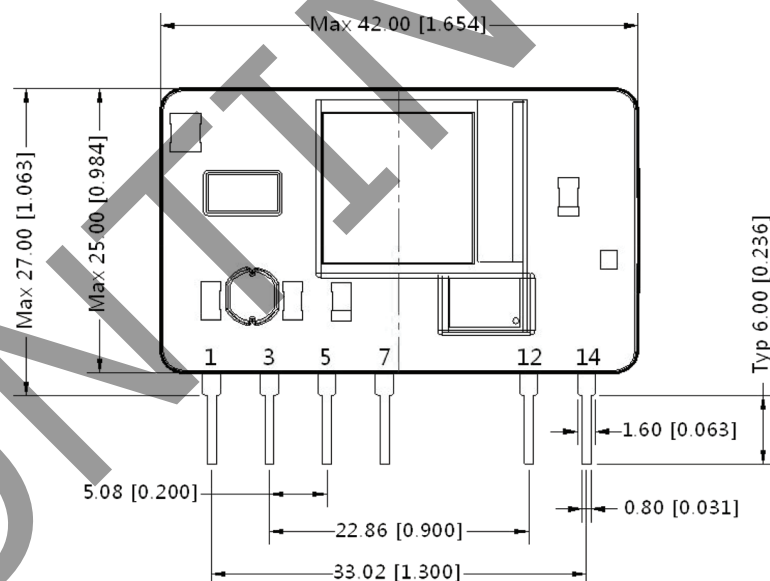
| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | FUNCTION |
| 1               | -Vin (N) |
| 3               | +Vin (L) |
| 5               | +V(CAP)  |
| 7               | -V(CAP)  |
| 12              | -Vo      |
| 14              | +Vo      |

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

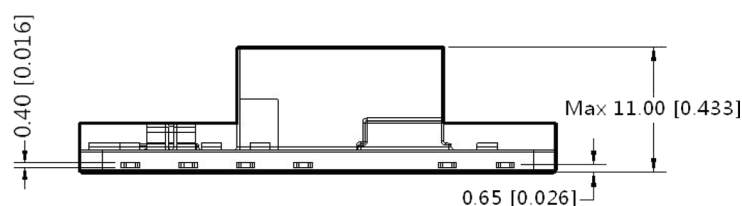
Note: Grid 2.54\*2.54mm



Top View  
PCB Layout



Front View



Bottom View

## MECHANICAL DRAWING (CONTINUED)

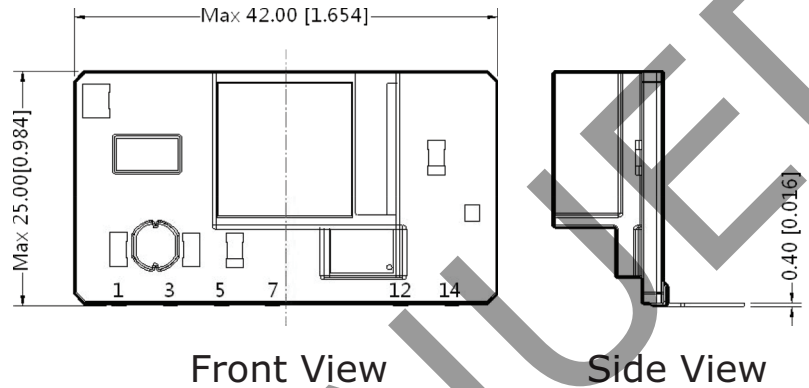
### RIGHT-ANGLE ORIENTATION

units: mm[inch]

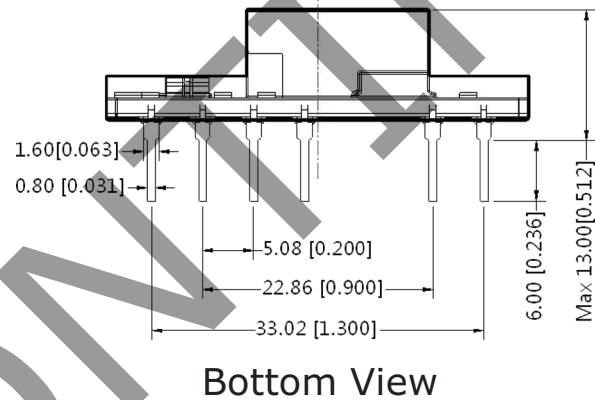
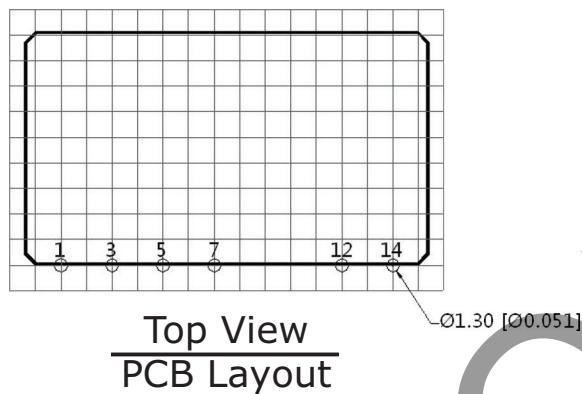
tolerance:  $\pm 0.5[\pm 0.020]$ pin tolerance:  $\pm 0.1[\pm 0.004]$ 

| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | FUNCTION |
| 1               | -Vin (N) |
| 3               | +Vin (L) |
| 5               | +V(CAP)  |
| 7               | -V(CAP)  |
| 12              | -Vo      |
| 14              | +Vo      |

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



Note: Grid 2.54\*2.54mm



## TEST CONFIGURATION

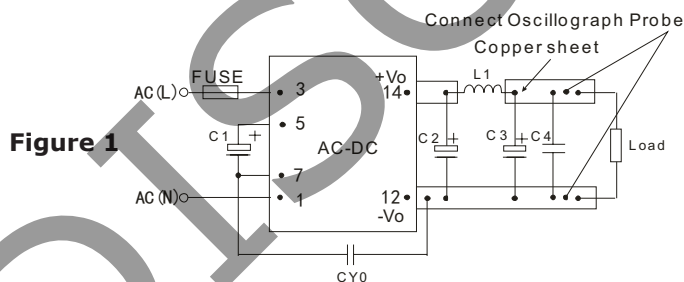
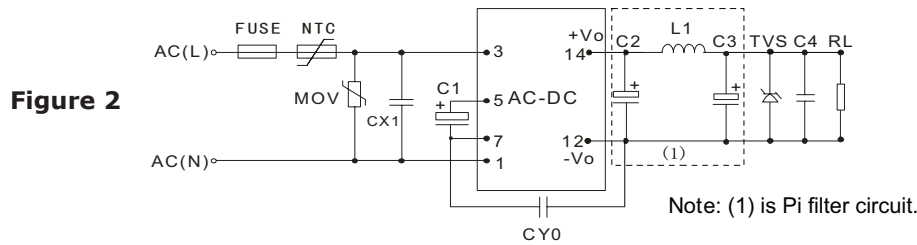


Table 1

| Recommended External Circuit Components |                 |                 |                 |                 |           |                    |
|-----------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------|--------------------|
| $V_{OUT}$ (Vdc)                         | 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 | 470 $\mu$ F/10V | 0.47 $\mu$ H    | 150 $\mu$ F/35V | 100nF/50V | 1nF/400Vac         |
| 5                                       | 22 $\mu$ F/400V | 470 $\mu$ F/16V | 0.47 $\mu$ H    | 150 $\mu$ F/35V | 100nF/50V | 1nF/400Vac         |
| 9                                       | 22 $\mu$ F/400V | 330 $\mu$ F/25V | 1 $\mu$ H       | 150 $\mu$ F/35V | 100nF/50V | 1nF/400Vac         |
| 12                                      | 22 $\mu$ F/400V | 330 $\mu$ F/25V | 1 $\mu$ H       | 150 $\mu$ F/35V | 100nF/50V | 1nF/400Vac         |
| 15                                      | 22 $\mu$ F/400V | 330 $\mu$ F/25V | 1 $\mu$ H       | 150 $\mu$ F/35V | 100nF/50V | 1nF/400Vac         |
| 24                                      | 22 $\mu$ F/400V | 100 $\mu$ F/35V | 4.7 $\mu$ H     | 47 $\mu$ F/35V  | 100nF/50V | 1nF/400Vac         |

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

## TYPICAL APPLICATION CIRCUIT

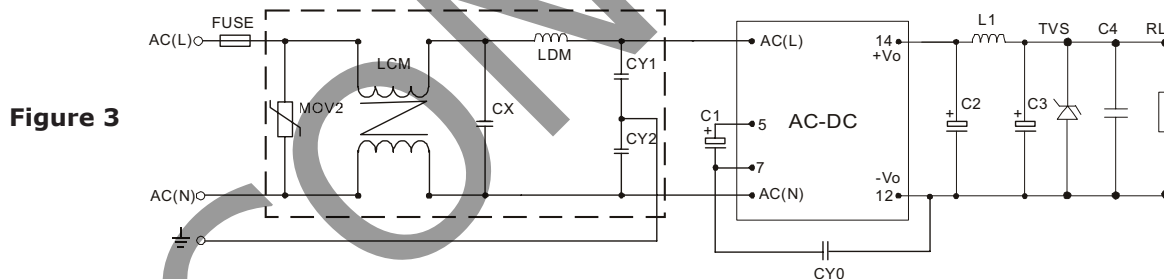


**Table 2**

| 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        | CX1                | CY0        | FUSE    | NTC  | MOV     | TVS      |
| 3.3                                     | 22 $\mu$ F/400V | 470 $\mu$ F/10V | 0.47 $\mu$ H    | 150 $\mu$ F/35V | 100nF/50V | 0.1 $\mu$ F/275Vac | 1nF/400Vac | 1A/250V | 5D-9 | S14K350 | SMBJ7.0A |
| 5                                       | 22 $\mu$ F/400V | 470 $\mu$ F/16V | 0.47 $\mu$ H    | 150 $\mu$ F/35V | 100nF/50V | 0.1 $\mu$ F/275Vac | 1nF/400Vac | 1A/250V | 5D-9 | S14K350 | SMBJ7.0A |
| 9                                       | 22 $\mu$ F/400V | 330 $\mu$ F/25V | 1 $\mu$ H       | 150 $\mu$ F/35V | 100nF/50V | 0.1 $\mu$ F/275Vac | 1nF/400Vac | 1A/250V | 5D-9 | S14K350 | SMBJ12A  |
| 12                                      | 22 $\mu$ F/400V | 330 $\mu$ F/25V | 1 $\mu$ H       | 150 $\mu$ F/35V | 100nF/50V | 0.1 $\mu$ F/275Vac | 1nF/400Vac | 1A/250V | 5D-9 | S14K350 | SMBJ20A  |
| 15                                      | 22 $\mu$ F/400V | 330 $\mu$ F/25V | 1 $\mu$ H       | 150 $\mu$ F/35V | 100nF/50V | 0.1 $\mu$ F/275Vac | 1nF/400Vac | 1A/250V | 5D-9 | S14K350 | SMBJ20A  |
| 24                                      | 22 $\mu$ F/400V | 100 $\mu$ F/35V | 4.7 $\mu$ H     | 47 $\mu$ F/35V  | 100nF/50V | 0.1 $\mu$ F/275Vac | 1nF/400Vac | 1A/250V | 5D-9 | S14K350 | SMBJ30A  |

Note: 1. Required components.

## EMC RECOMMENDED CIRCUIT



**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            |

Note: 1. Also refer to Table 2.

- Notes:
- C1, C2, 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 the current of L1, 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).
  - 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 bent pin model options, updated emc recommendations | 06/20/2014 |
| 1.02 | updated pin connection tables                             | 06/07/2016 |

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

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