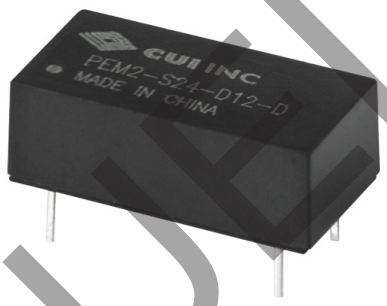
# SERIES: PEM2-D | DESCRIPTION: DC-DC CONVERTER

DISCONTINUED

## FEATURES

- 2 W isolated output
- smaller package
- single/dual unregulated output
- 3,000 Vdc isolation
- short circuit protection
- extended temperature range (-40~105°C)
- antistatic protection up to 8kV
- high efficiency at light load
- efficiency up to 85%
- designed to meet EN/BS EN 62368-1

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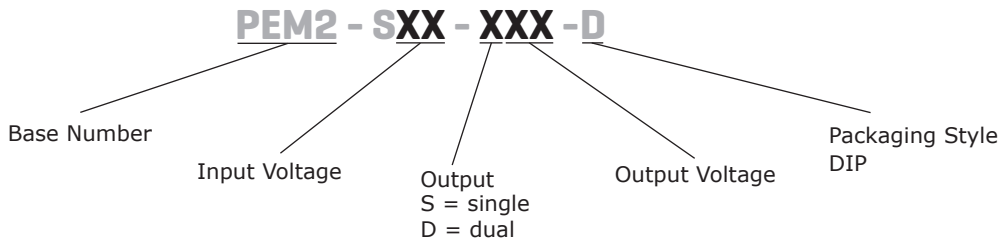
## MODEL

| MODEL | input voltage typ (Vdc) | input voltage range (Vdc) | output voltage (Vdc) | output current min (mA) | output current max (mA) | output power max (W) | ripple and noise[2] typ (mVp-p) | efficiency typ (%) |
|---|---|---|---|---|---|---|---|---|
| PEM2-S5-S5-D[1,*] | 5 | 4.5~5.5 | 5 | 40 | 400 | 2 | 75 | 80 |
| PEM2-S5-S12-D[1] | 5 | 4.5~5.5 | 12 | 17 | 167 | 2 | 75 | 84 |
| PEM2-S5-S15-D[1,*] | 5 | 4.5~5.5 | 15 | 13 | 133 | 2 | 75 | 84 |
| PEM2-S5-D5-D[1,*] | 5 | 4.5~5.5 | ±5 | ±20 | ±200 | 2 | 75 | 80 |
| PEM2-S5-D12-D[1] | 5 | 4.5~5.5 | ±12 | ±8 | ±83 | 2 | 75 | 84 |
| PEM2-S5-D15-D[1,*] | 5 | 4.5~5.5 | ±15 | ±7 | ±67 | 2 | 75 | 84 |
| PEM2-S12-S5-D[1,*] | 12 | 10.8~13.2 | 5 | 40 | 400 | 2 | 75 | 80 |
| PEM2-S12-S15-D* | 12 | 10.8~13.2 | 15 | 13 | 133 | 2 | 75 | 84 |
| PEM2-S12-D15-D[1,*] | 12 | 10.8~13.2 | ±15 | ±7 | ±67 | 2 | 75 | 85 |
| PEM2-S15-D15-D* | 15 | 13.5~16.5 | ±15 | ±7 | ±67 | 2 | 75 | 84 |
| PEM2-S24-S5-D[1,*] | 24 | 21.6~26.4 | 5 | 40 | 400 | 2 | 75 | 80 |
| PEM2-S24-S9-D[1,*] | 24 | 21.6~26.4 | 9 | 22 | 222 | 2 | 75 | 85 |
| PEM2-S24-S15-D[1,*] | 24 | 21.6~26.4 | 15 | 13 | 133 | 2 | 75 | 84 |
| PEM2-S24-D12-D[1,*] | 24 | 21.6~26.4 | ±12 | ±8 | ±83 | 2 | 75 | 83 |
| PEM2-S24-D15-D[1,*] | 24 | 21.6~26.4 | ±15 | ±7 | ±67 | 2 | 75 | 84 |

Notes:
1. Model is UL approved.
2. Ripple and noise are measured at 20 MHz BW by "parallel cable" method with 1 µF ceramic and 10 µF electrolytic capacitors on the output.
3. * Discontinued model.

## PART NUMBER KEY






Please read our datasheet & drawing disclaimer here.

## INPUT

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| operating input voltage | 5 Vdc input models | 4.5 | 5 | 5.5 | Vdc |
| | 12 Vdc input models | 10.8 | 12 | 13.2 | Vdc |
| | 15 Vdc input models | 13.5 | 15 | 16.5 | Vdc |
| | 24 Vdc input models | 21.6 | 24 | 26.4 | Vdc |
| surge voltage | for maximum of 1 second | | | | |
| | 5 Vdc input models | -0.7 | | 9 | Vdc |
| | 12 Vdc input models | -0.7 | | 18 | Vdc |
| | 15 Vdc input models | -0.7 | | 21 | Vdc |
| | 24 Vdc input models | -0.7 | | 30 | Vdc |
| filter | capacitance filter | | | | |

## OUTPUT

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| line regulation | for Vin change of 1% | | | ±1.2 | % |
| load regulation | measured from 10%~100% load | | | | |
| | 5 Vdc output models | | 10 | | % |
| | 9 Vdc output models | | 9 | | % |
| | 12 Vdc output models | | 8 | | % |
| | 15 Vdc output models | | 7 | | % |
| voltage accuracy | see tolerance envelope curve | | | | |
| switching frequency | 100% load, nominal input voltage | | 100 | | kHz |
| temperature coefficient | at 100% load | | | ±0.03 | %/°C |

## PROTECTIONS

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| short circuit protection[1] | | | | 1 | s |

Note: 1. The supply voltage must be discontinued at the end of the short circuit duration

## SAFETY AND COMPLIANCE

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| isolation voltage | input to output for 1 minute at 1 mA max. | 3,000 | | | Vdc |
| isolation resistance | input to output at 500 Vdc | 1,000 | | | MΩ |
| safety approvals[2] | certified to 60950-1: UL<br>designed to meet 62368-1: EN/BS EN | | | | |
| conducted emissions | CISPR22/EN55022, class B, external circuit required | | | | |
| radiated emissions | CISPR22/EN55022, class B, external circuit required | | | | |
| ESD | IEC/EN61000-4-2, class B, contact ± 8kV for single outputs<br>IEC/EN61000-4-2, class B, contact ± 6kV for dual outputs | | | | |
| MTBF | as per MIL-HDBK-217F @ 25°C | 3,500,000 | | | hours |
| RoHS | 2011/65/EU | | | | |

Note: 2. See specific models noted on page 1

## ENVIRONMENTAL

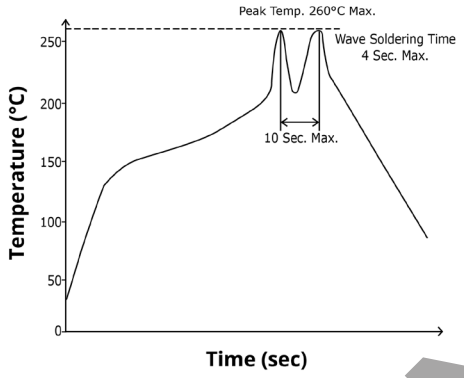
| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| operating temperature | see derating curve | -40 | | 105 | °C |
| storage temperature | | -55 | | 125 | °C |
| storage humidity | non-condensing | | | 95 | % |
| temperature rise | Ta=25°C | | 25 | | °C |

DISCONTINUED

## SOLDERABILITY

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| hand soldering | 1.5 mm from case for 10 seconds | | | 300 | °C |
| wave soldering | see wave soldering profile | | | 260 | °C |

**WAVE SOLDERING PROFILE**



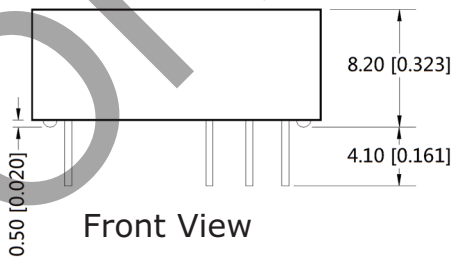

## MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| dimensions | 20.32 x 10.16 x 8.2 (0.800 x 0.400 x 0.323 inch) | | | | mm |
| case material | epoxy resin (UL94-V0) | | | | |
| weight | | | 2.8 | | g |

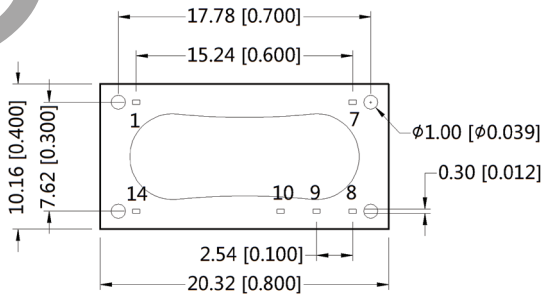
## MECHANICAL DRAWING

units: mm[inch]
tolerance: ±0.25[±0.010]
pin section tolerance: ±0.10[±0.004]

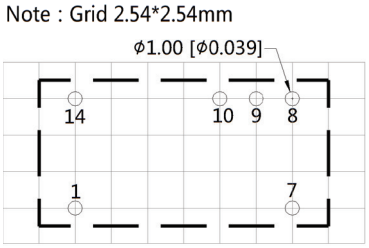
| PIN CONNECTIONS | | |
|---|---|---|
| PIN | Single Output | Dual Output |
| 1 | GND | GND |
| 7 | NC | NC |
| 8 | +Vo | +Vo |
| 9 | NO PIN | 0V |
| 10 | 0V | -Vo |
| 14 | Vin | Vin |




Front View




Bottom View




Top View
PCB Layout

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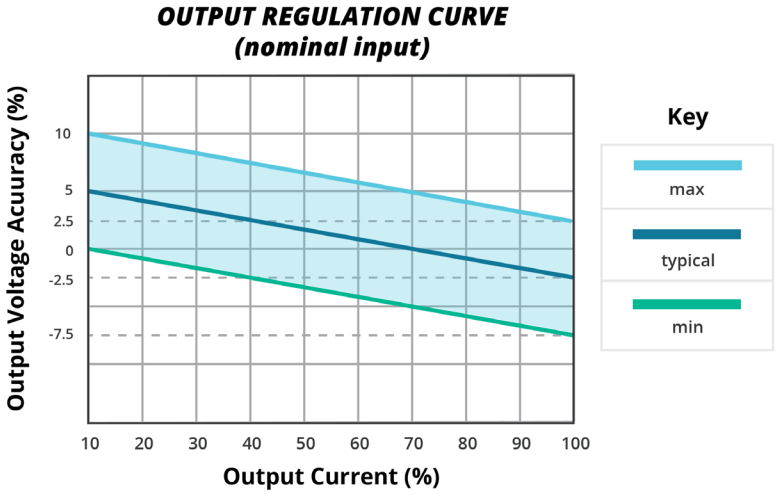
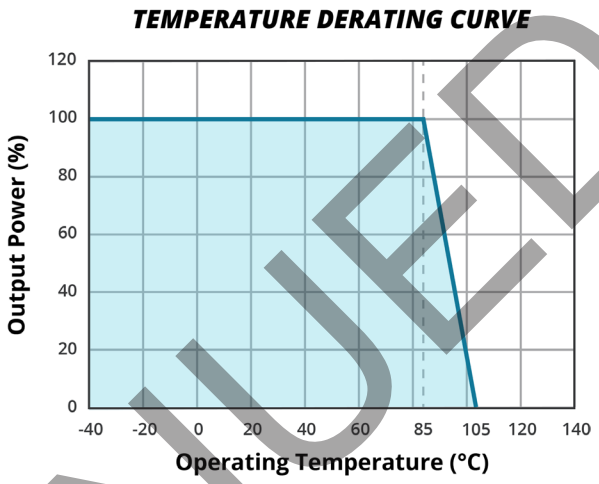
## DERATING CURVES




## EMC RECOMMENDED CIRCUIT

**Figure 1**

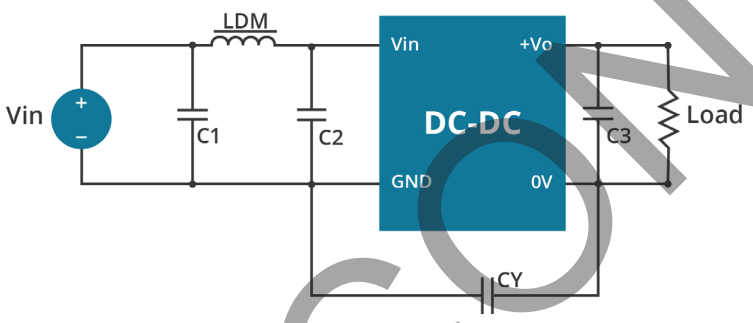



**Table 1**

| Recommended external circuit components | | | |
|---|---|---|---|
| Vin (Vdc) | C1,C2 | CY | LDM |
| 5 | 4.7μF/50V | - | 6.8μH |
| 12 | 4.7μF/50V | - | 6.8μH |
| 15 | 4.7μF/50V | - | 6.8μH |
| 24 | 4.7μF/50V | 1nF/3KV | 6.8μH |

Note: 1. See Table 2 for Cout values.

DISCONTINUED

## APPLICATION NOTES

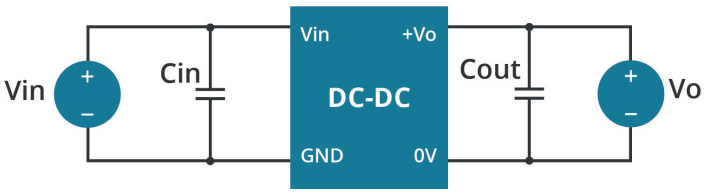
1. **Output load requirement**
   To ensure this module can operate efficiently and reliably, the minimum output load may not be less than 10% of the full load during operation. If the actual output power is low, connect a resistor at the output end in parallel to increase the load.

2. **Overload Protection**
   Under normal operating conditions, the output circuit of this product has no protection against overload. The simplest method to add this is to add a circuit breaker to the circuit.

3. **Recommended circuit**
   If you want to further decrease the input/output ripple, you can increase the capacitance accordingly or choose capacitors with low ESR(see Figure 2 & Table 2). However, the capacitance of the output filter capacitor must be appropriate. If the capacitance is too high, a startup problem might arise. For every channel of the output, to ensure safe and reliable operation, the maximum capacitance must be less than the maximum capacitive load (see Table 3).

**Figure 2**

**Single output**




**Dual output**

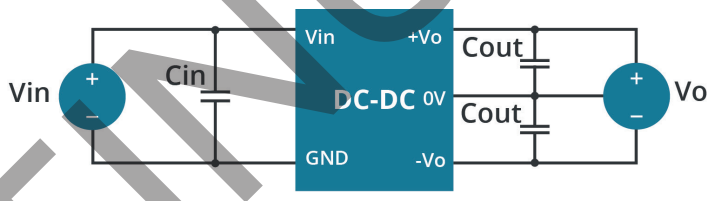



**Table 2**

| Vin (Vdc) | Cin (µF) | Single Vo (Vdc) | Cout (µF) | Dual Vo (Vdc) | Cout (µF) |
|---|---|---|---|---|---|
| 5 | 4.7 | 5 | 10 | ±5 | 4.7 |
| 12 | 2.2 | 9 | 4.7 | ±12 | 1 |
| 15 | 2.2 | 12 | 2.2 | ±15 | 0.47 |
| 24 | 1 | 15 | 1 | -- | -- |

Note: It's not recommended to connect any external capacitors in applications with less than 0.5 watt output.

**Table 3**

| Single Vout (Vdc) | Max. Capacitive Load (µF) | Dual Vout (Vdc) | Max. Capacitive Load[1] (µF) |
|---|---|---|---|
| 5 | 220 | 5 | 100 |
| 9 | 220 | -- | -- |
| 12 | 220 | 12 | 100 |
| 15 | 220 | 15 | 100 |

Note: 1. For each output.

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Notes:
1. Operation under minimum load will not damage the converter; however, they may not meet all specifications listed.
2. Max. capacitive load tested at input voltage range and full load.
3. It is recommended to use either ceramic capacitors or electrolytic capacitors on the input and the output. Using tantalum capacitors may increase the risk of failure.
4. All specifications measured at: Ta=25°C, humidity<75%, nominal input voltage and rated output load, unless otherwise specified.

## REVISION HISTORY

| rev. | description | date |
|---|---|---|
| 1.0 | initial release | 08/30/2013 |
| 1.01 | added UL approval to some models | 01/29/2015 |
| 1.02 | updated tolerance envelope curves | 06/02/2015 |
| 1.03 | safeties updated in features and safety line | 01/18/2021 |
| 1.04 | derating curves and circuit figures updated | 07/12/2021 |
| 1.05 | CE certification removed | 11/09/2022 |
| 1.06 | discontinued models PEM2-S12-D15-D, PEM2-S12-S15-D, PEM2-S12-S5-D, PEM2-S15-D15-D, PEM2-S24-D12-D, PEM2-S24-D15-D, PEM2-S24-S15-D, PEM2-S24-S5-D, PEM2-S24-S9-D, PEM2-S5-D15-D, PEM2-S5-D5-D, PEM2-S5-S15-D & PEM2-S5-S5-D | 09/26/2023 |

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

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