# SERIES: PDS1-S | DESCRIPTION: DC-DC CONVERTER

## FEATURES

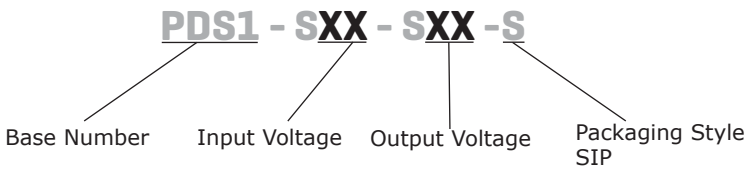
- 1 W isolated output
- smaller package
- single unregulated output
- 1,500 Vdc isolation
- short circuit protection
- extended temperature range (-40~105°C)
- antistatic protection up to 8kV
- UL 60950-1 approval
- high efficiency at light load
- efficiency up to 82%




| MODEL | input voltage | | output voltage | output current | | output power | ripple and noise[2] | efficiency |
|---|---|---|---|---|---|---|---|---|
| | typ (Vdc) | range (Vdc) | (Vdc) | min (mA) | max (mA) | max (W) | typ (mVp-p) | typ (%) |
| PDS1-S3-S3-S | 3.3 | 2.97~3.63 | 3.3 | 30 | 303 | 1 | 30 | 75 |
| PDS1-S3-S5-S[1] | 3.3 | 2.97~3.63 | 5 | 20 | 200 | 1 | 30 | 80 |
| PDS1-S5-S3-S | 5 | 4.5~5.5 | 3.3 | 30 | 303 | 1 | 30 | 76 |
| PDS1-S5-S5-S[1] | 5 | 4.5~5.5 | 5 | 20 | 200 | 1 | 30 | 80 |
| PDS1-S5-S9-S[1] | 5 | 4.5~5.5 | 9 | 12 | 111 | 1 | 30 | 80 |
| PDS1-S5-S12-S[1] | 5 | 4.5~5.5 | 12 | 9 | 84 | 1 | 30 | 81 |
| PDS1-S5-S15-S[1] | 5 | 4.5~5.5 | 15 | 7 | 67 | 1 | 60 | 81 |
| PDS1-S5-S24-S[1] | 5 | 4.5~5.5 | 24 | 4 | 42 | 1 | 60 | 81 |
| PDS1-S12-S3-S | 12 | 10.8~13.2 | 3.3 | 30 | 303 | 1 | 30 | 76 |
| PDS1-S12-S5-S[1] | 12 | 10.8~13.2 | 5 | 20 | 200 | 1 | 30 | 80 |
| PDS1-S12-S9-S[1] | 12 | 10.8~13.2 | 9 | 12 | 111 | 1 | 30 | 80 |
| PDS1-S12-S12-S[1] | 12 | 10.8~13.2 | 12 | 9 | 83 | 1 | 30 | 81 |
| PDS1-S12-S15-S[1] | 12 | 10.8~13.2 | 15 | 7 | 67 | 1 | 60 | 80 |
| PDS1-S15-S5-S | 15 | 13.5~16.5 | 5 | 20 | 200 | 1 | 30 | 80 |
| PDS1-S15-S12-S | 15 | 13.5~16.5 | 12 | 9 | 83 | 1 | 60 | 80 |
| PDS1-S15-S15-S | 15 | 13.5~16.5 | 15 | 7 | 67 | 1 | 60 | 81 |
| PDS1-S24-S3-S | 24 | 21.6~26.4 | 3.3 | 30 | 303 | 1 | 30 | 76 |
| PDS1-S24-S5-S[1] | 24 | 21.6~26.4 | 5 | 20 | 200 | 1 | 30 | 80 |
| PDS1-S24-S9-S[1] | 24 | 21.6~26.4 | 9 | 12 | 111 | 1 | 30 | 80 |
| PDS1-S24-S12-S[1] | 24 | 21.6~26.4 | 12 | 9 | 84 | 1 | 30 | 81 |
| PDS1-S24-S15-S[1] | 24 | 21.6~26.4 | 15 | 7 | 67 | 1 | 60 | 82 |
| PDS1-S24-S24-S[1] | 24 | 21.6~26.4 | 24 | 4 | 42 | 1 | 60 | 82 |

Notes: 1. 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.

## PART NUMBER KEY




## INPUT

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| operating input voltage | 3.3 Vdc input models | 2.97 | 3.3 | 3.63 | Vdc |
| | 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 | | | | |
| | 3.3 Vdc input models | -0.7 | | 5 | Vdc |
| | 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% | | | | |
| | 3.3 Vdc output models | | | ±1.5 | % |
| | all other models | | | ±1.2 | % |
| load regulation | measured from 10% load to full load | | | | |
| | 3.3 Vdc output models | | 18 | | % |
| | 5 Vdc output models | | 12 | | % |
| | 9 Vdc output models | | 8 | | % |
| | 12 Vdc output models | | 7 | | % |
| | 15 Vdc output models | | 6 | | % |
| | 24 Vdc output models | | 5 | | % |
| voltage accuracy | see tolerance envelope curve | | | | |
| switching frequency | 100% load, nominal input voltage | | 100 | 300 | kHz |
| temperature coefficient | 100% load | | | ±0.03 | %/°C |

## PROTECTIONS

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| short circuit protection | automatic recovery | | | | |

## SAFETY AND COMPLIANCE

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| isolation voltage | input to output for 1 minute at 1 mA max. | 1,500 | | | Vdc |
| isolation resistance | input to output at 500 Vdc | 1,000 | | | MΩ |
| safety approvals[1] | UL 60950-1 | | | | |
| conducted emissions | CISPR22/EN55022, class B (external circuit required, see Figure 1) | | | | |
| radiated emissions | CISPR22/EN55022, class B (external circuit required, see Figure 1) | | | | |
| ESD | IEC/EN61000-4-2, class B, contact ±8kV | | | | |
| MTBF | as per MIL-HDBK-217F @ 25°C | 3,500,000 | | | hours |
| RoHS | 2011/65/EU | | | | |

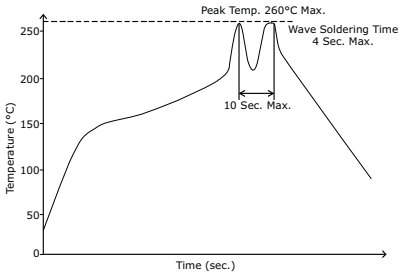
Note: 1. See specific models noted on page 1

## 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 | at full load, Ta = 25°C | | 25 | | °C |

## 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 |



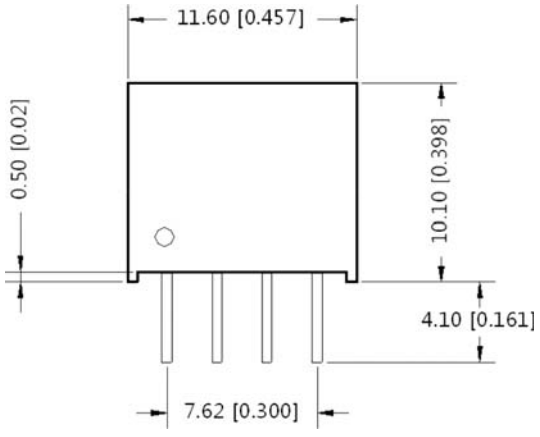

## MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|---|---|---|---|---|---|
| dimensions | 11.60 x 6.00 x 10.10 (0.457 x 0.236 x 0.398 inch) | | | | mm |
| case material | plastic (UL94-V0) | | | | |
| weight | | | 1.2 | | g |

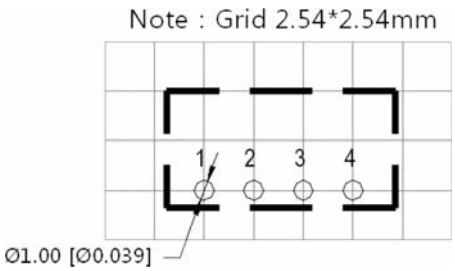
## MECHANICAL DRAWING

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

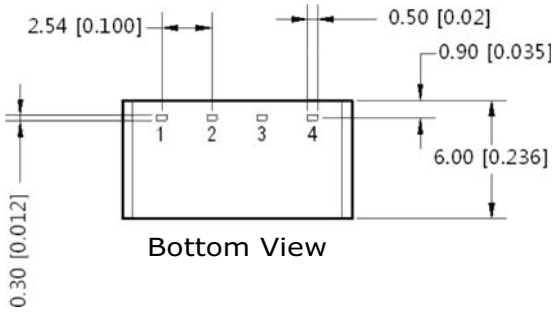
| PIN CONNECTIONS | |
|---|---|
| PIN | Function |
| 1 | GND |
| 2 | Vin |
| 3 | 0V |
| 4 | +Vo |




Front View

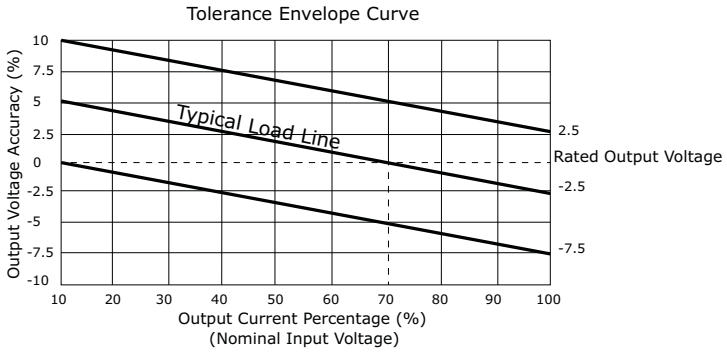


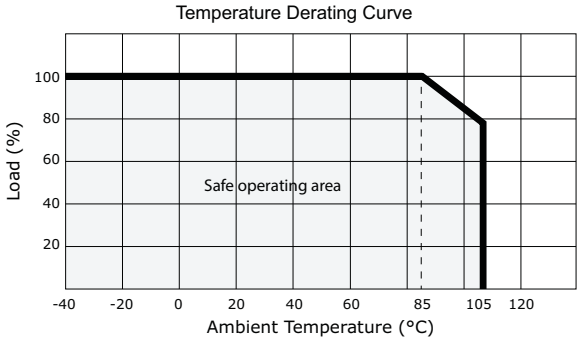

PCB Layout
Top View




Bottom View

## DERATING CURVES




## EMC RECOMMENDED CIRCUIT

**Figure 1**

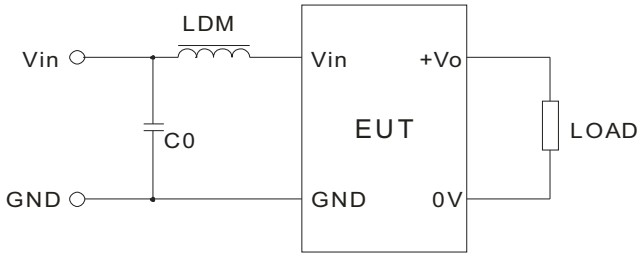



**Table 1**

| Recommended external circuit components | | |
|---|---|---|
| Vin (Vdc) | C0 | LDM |
| 3.3 | 4.7μF/50V | 6.8μH |
| 5 | 4.7μF/50V | 6.8μH |
| 12 | 4.7μF/50V | 6.8μH |
| 15 | 4.7μF/50V | 6.8μH |
| 24 | 4.7μF/50V | 6.8μH |

## TEST CONFIGURATION

**Figure 2**

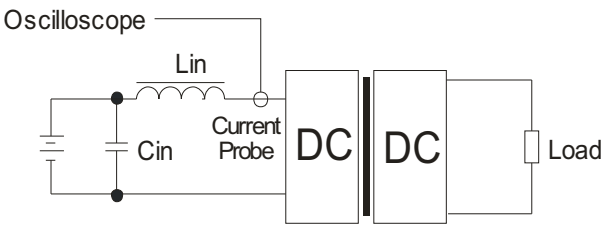



**Table 2**

| External components | |
|---|---|
| Lin | 4.7μH |
| Cin | 220μF, ESR < 1.0Ω at 100 kHz |

Note: Input reflected-ripple current is measured with an inductor Lin and Capacitor Cin to simulate source impedance.

## 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**
   This series has been tested according to the following recommended testing circuit before leaving the factory. This series should be tested under load (see Figure 3 & Table 3). If you want to further decrease the input/output ripple, you can increase the capacitance accordingly or choose capacitors with low ESR. 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 4).

**Figure 3**

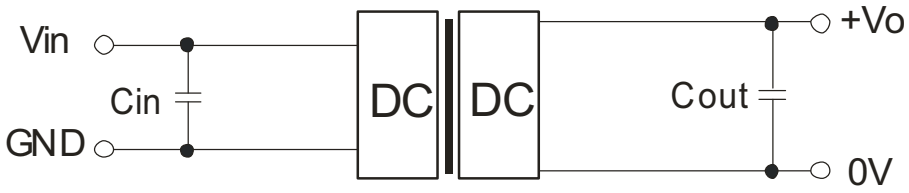



**Table 3**

| Vin (Vdc) | Cin (μF) | Vo (Vdc) | Cout (μF) |
|---|---|---|---|
| 3.3 | 4.7 | 3.3 | 10 |
| 5 | 4.7 | 5 | 10 |
| 12 | 2.2 | 9 | 4.7 |
| 15 | 1 | 12 | 2.2 |
| 24 | 1 | 15 | 1 |
| -- | -- | 24 | 0.47 |

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

**Table 4**

| Vout (Vdc) | Max. Capacitive Load (μF) |
|---|---|
| 3.3 | 220 |
| 5 | 220 |
| 9 | 220 |
| 12 | 220 |
| 15 | 220 |
| 24 | 220 |

Note:
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 | 03/19/2013 |
| 1.01 | added model PDS1-S15-S12-S | 07/29/2013 |
| 1.02 | added model PDS1-S12-S3-S, updated spec | 03/07/2014 |
| 1.03 | added UL approval to some models | 10/28/2014 |

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

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