P-DUKE POWER

# PDL09 Series

DC-DC Converter
Up to 9 Watts

3 YEARS WARRANTY

RoHS COMPLIANT

REACH COMPLIANT




Automation
Datacom
IPC
Industry
Measurement
Telecom
Automobile
Boat
Charger
Medical
PV
Railway

1600 VDC Isolation Voltage
2 : 1 Input Range
LOW Standby Power
NO Min. Load Required
REMOTE ON OFF
OCP
SCP

## PART NUMBER STRUCTURE

PDL09 - 48 S 05 M

| Series Name | Input Voltage (VDC) | Output Quantity | Output Voltage (VDC) | Case Options |
|---|---|---|---|---|
| | **12:** 9~18<br>**24:** 18~36<br>**48:** 36~75 | **S:** Single | **3P3:** 3.3<br>**05:** 5<br>**09:** 9<br>**12:** 12<br>**15:** 15<br>**24:** 24 | **M:** Standard type Metal case<br>**□:** Plastic case |
| | | **D:** Dual | **05:** ±5<br>**12:** ±12<br>**15:** ±15 | |

**TECHNICAL SPECIFICATION** All specifications are typical at nominal input, full load and 25℃ unless otherwise noted

| Model Number | Input Range | Output Voltage | Output Current @ Full Load | Input Current @ No Load | Efficiency | Maximum Capacitor Load |
|---|---|---|---|---|---|---|
| | VDC | VDC | mA | mA | % | μF |
| PDL09-12S3P3M | 9 ~ 18 | 3.3 | 2000 | 7 | 81 | 2600 |
| PDL09-12S05M | 9 ~ 18 | 5 | 1600 | 7 | 85 | 1300 |
| PDL09-12S09M | 9 ~ 18 | 9 | 1000 | 10 | 87 | 800 |
| PDL09-12S12M | 9 ~ 18 | 12 | 750 | 10 | 88 | 560 |
| PDL09-12S15M | 9 ~ 18 | 15 | 600 | 10 | 89 | 560 |
| PDL09-12S24M | 9 ~ 18 | 24 | 375 | 13 | 89 | 200 |
| PDL09-12D05M | 9 ~ 18 | ±5 | ±800 | 13 | 85 | ±800 |
| PDL09-12D12M | 9 ~ 18 | ±12 | ±375 | 13 | 88 | ±390 |
| PDL09-12D15M | 9 ~ 18 | ±15 | ±300 | 14 | 89 | ±200 |
| PDL09-24S3P3M | 18 ~ 36 | 3.3 | 2000 | 5 | 82 | 2600 |
| PDL09-24S05M | 18 ~ 36 | 5 | 1600 | 5 | 85 | 1300 |
| PDL09-24S09M | 18 ~ 36 | 9 | 1000 | 5 | 88 | 800 |
| PDL09-24S12M | 18 ~ 36 | 12 | 750 | 5 | 89 | 560 |
| PDL09-24S15M | 18 ~ 36 | 15 | 600 | 5 | 90 | 560 |
| PDL09-24S24M | 18 ~ 36 | 24 | 375 | 7 | 90 | 200 |
| PDL09-24D05M | 18 ~ 36 | ±5 | ±800 | 7 | 86 | ±800 |
| PDL09-24D12M | 18 ~ 36 | ±12 | ±375 | 7 | 89 | ±390 |
| PDL09-24D15M | 18 ~ 36 | ±15 | ±300 | 10 | 87 | ±200 |
| PDL09-48S3P3M | 36 ~ 75 | 3.3 | 2000 | 3 | 82 | 2600 |
| PDL09-48S05M | 36 ~ 75 | 5 | 1600 | 3 | 85 | 1300 |
| PDL09-48S09M | 36 ~ 75 | 9 | 1000 | 3 | 88 | 800 |
| PDL09-48S12M | 36 ~ 75 | 12 | 750 | 3 | 89 | 560 |
| PDL09-48S15M | 36 ~ 75 | 15 | 600 | 3 | 89 | 560 |
| PDL09-48S24M | 36 ~ 75 | 24 | 375 | 3 | 89 | 200 |
| PDL09-48D05M | 36 ~ 75 | ±5 | ±800 | 3 | 86 | ±800 |
| PDL09-48D12M | 36 ~ 75 | ±12 | ±375 | 3 | 87 | ±390 |
| PDL09-48D15M | 36 ~ 75 | ±15 | ±300 | 4 | 87 | ±200 |

## INPUT SPECIFICATIONS

| Parameter | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Operating input voltage range | | 12Vin(nom) | 9 | 12 | 18 | |
| | | 24Vin(nom) | 18 | 24 | 36 | VDC |
| | | 48Vin(nom) | 36 | 48 | 75 | |
| Start up time | Constant resistive load | Power up | | 50 | | ms |
| | | Remote ON/OFF | | 50 | | |
| Input surge voltage | 1 second, max. | 12Vin(nom) | | | 36 | |
| | | 24Vin(nom) | | | 50 | VDC |
| | | 48Vin(nom) | | | 100 | |
| Input filter | | | | Capacitor type | | |
| Remote ON/OFF | Referred to –Vin pin | DC-DC ON | | Open or 0 ~ 0.5VDC | | |
| | | DC-DC OFF | | 3 ~ 12VDC | | |
| | | Input current of Ctrl pin | 0.5 | | 2.5 | mA |
| | | Remote off input current | | 2.5 | | mA |

## OUTPUT SPECIFICATIONS

| Parameter | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Voltage accuracy | | | -1.0 | | +1.0 | % |
| Line regulation | Low Line to High Line at Full Load | | -0.2 | | +0.2 | % |
| Load regulation | No Load to Full Load | Single | -1.0 | | +1.0 | % |
| | | Dual | -1.0 | | +1.0 | |
| Cross regulation | Asymmetrical load 25%/100% FL | Dual | -5.0 | | +5.0 | % |
| Ripple and noise | 20MHz bandwidth | 3.3Vout, 5Vout, 9Vout | | 50 | | mVp-p |
| | With a 1μF/50V X7R MLCC | 12Vout, 15Vout, 24Vout | | 75 | | |
| Temperature coefficient | | | -0.02 | | +0.02 | %/℃ |
| Transient response recovery time | 25% load step change | | | 250 | | μs |
| Over load protection | % of Iout rated; Hiccup mode | | | 180 | | % |
| Short circuit protection | | | Continuous, automatics recovery | | | |

## GENERAL SPECIFICATIONS

| Parameter | Conditions | | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Isolation voltage | 1 minute | Input to Output | Metal Case | 1600 | | | VDC |
| | | | Plastic Case | 1600 | | | |
| | Input (Output) to Case | | Metal Case | 1000 | | | |
| Isolation resistance | 500VDC | | | 1 | | | GΩ |
| Isolation capacitance | | | Metal Case | | | 50 | pF |
| | | | Plastic Case | | | 50 | |
| Switching frequency | | | Single | | 400 | | kHz |
| | | | Dual | | 500 | | |
| Safety approvals | IEC/ EN/ UL62368-1 | | | | | UL:E193009<br>CB:UL(Demko) | |
| Case material | | | Metal Case | | | | Copper |
| | | | Plastic Case | | | | Non-conductive black plastic |
| Base material | | | | | | | None |
| Potting material | | | | | | | Silicone (UL94 V-0) |
| Weight | | | Metal Case | | | | 5.9g (0.21oz) |
| | | | Plastic Case | | | | 4.8g (0.17oz) |
| MTBF | MIL-HDBK-217F, Full load | | Metal Case | | | | $2.939 \times 10^6$ hrs |
| | | | Plastic Case | | | | $2.696 \times 10^6$ hrs |

## ENVIRONMENTAL SPECIFICATIONS

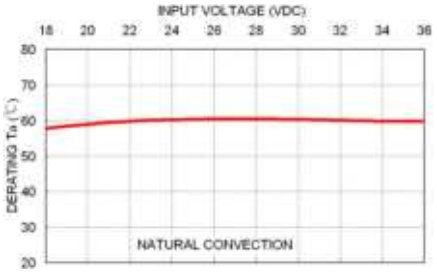
| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Operating ambient temperature | With derating | -40 | | +100 | ℃ |
| Maximum case temperature | | | | 100 | ℃ |
| Storage temperature range | | -55 | | +125 | ℃ |
| Thermal shock | | | | MIL-STD-810F | |
| Vibration | | | | MIL-STD-810F | |
| Relative humidity | | | | 5% to 95% RH | |

## EMC SPECIFICATIONS

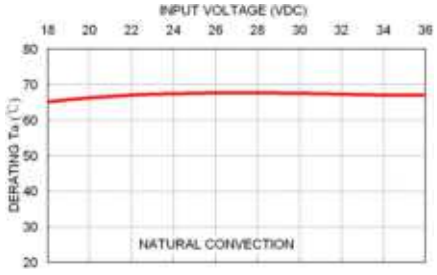
| Parameter | Conditions | | Level |
|---|---|---|---|
| EMI | EN55032 | With external components | Class A，Class B |
| EMS | EN55035 | | |
| ESD | EN61000-4-2 | Air ± 8kV and Contact ± 6kV | Perf. Criteria A |
| Radiated immunity | EN61000-4-3 | 20 V/m | Perf. Criteria A |
| Fast transient | EN61000-4-4 | ± 2kV | Perf. Criteria A |
| | PDL09-12□□□<br>PDL09-24□□□ | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 220μF/100V) and a TVS (SMDJ70A, 70V, 3000Watt peak pulse power) in parallel. | |
| | PDL09-48□□□ | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 220μF/100V) and a TVS (SMDJ120A, 120V, 3000Watt peak pulse power) in parallel. | |
| Surge | EN61000-4-5 | ± 2kV | Perf. Criteria A |
| | PDL09-12□□□<br>PDL09-24□□□ | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 220μF/100V) and a TVS (SMDJ70A, 70V, 3000Watt peak pulse power) in parallel. | |
| | PDL09-48□□□ | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 220μF/100V) and a TVS (SMDJ120A, 120V, 3000Watt peak pulse power) in parallel. | |
| Conducted immunity | EN61000-4-6 | 10 Vr.m.s | Perf. Criteria A |
| Power frequency magnetic field | EN61000-4-8 | 100A/m continuous; 1000A/m 1 second | Perf. Criteria A |

**CAUTION:** This power module is not internally fused. An input line fuse must always be used.

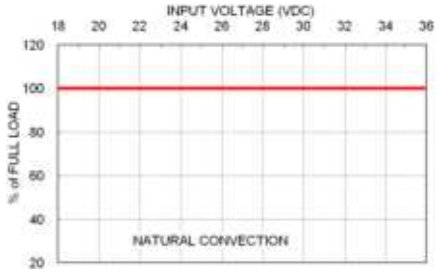
## CHARACTERISTIC CURVE



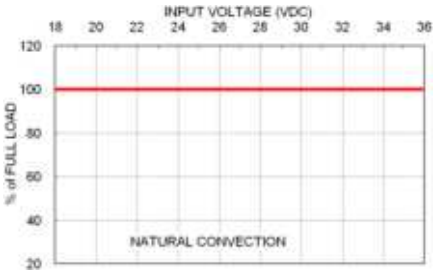

PDL09-24S12 Derating Ta v.s. Input Voltage (at Full Load)



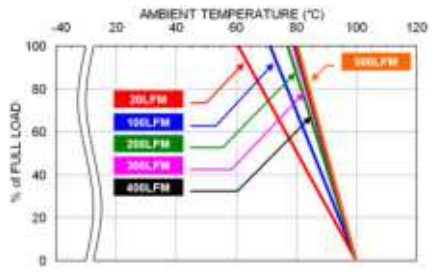

PDL09-24S12M Derating Ta v.s. Input Voltage (at Full Load)



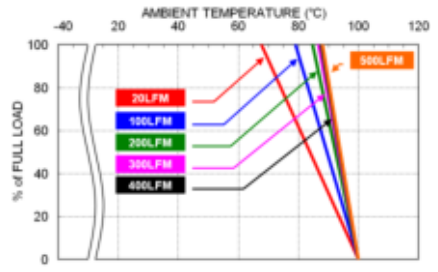

PDL09-24S12 Load Derating v.s. Input Voltage (at Ta=55℃)



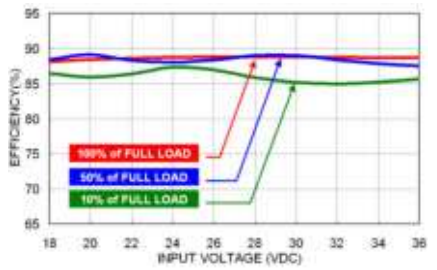

PDL09-24S12M Load Derating v.s. Input Voltage (at Ta=60℃)



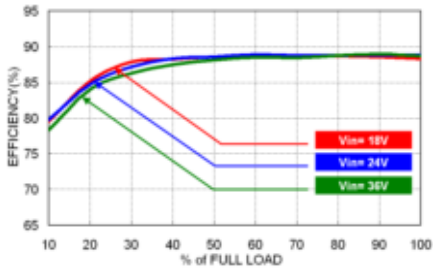

PDL09-24S12 Derating Curve




PDL09-24S12M Derating Curve




PDL09-24S12 Efficiency vs. Input Voltage




PDL09-24S12 Efficiency vs. Output Load

## FUSE CONSIDERATION

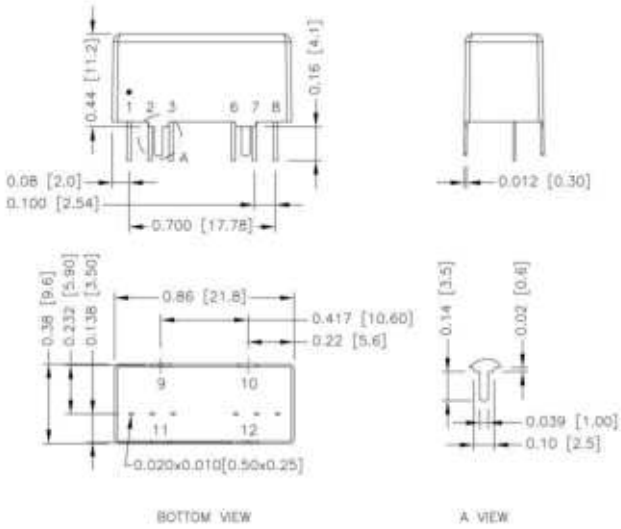
This power module is not internally fused. An input line fuse must always be used.
This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture.
To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.
The input line fuse suggest as below：

| Model | Fuse Rating (A) | Fuse Type |
|---|---|---|
| PDL09-12S□□、PDL09-12D□□ | 3.15 | Slow-Blow |
| PDL09-24S□□、PDL09-24D□□ | 2.5 | Slow-Blow |
| PDL09-48S□□、PDL09-48D□□ | 1.25 | Slow-Blow |

The table based on the information provided in this data sheet on inrush energy and maximum DC input current at low Vin.

## MECHANICAL DRAWING

**Standard type Metal Case**



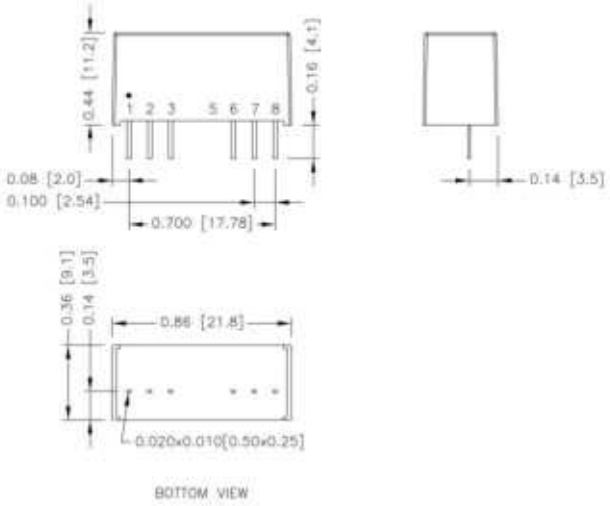

* Case pins should not be connected to any circuit.

**PIN CONNECTION**

| PIN | SINGLE | DUAL |
|---|---|---|
| 1 | -Vin | -Vin |
| 2 | +Vin | +Vin |
| 3 | Ctrl | Ctrl |
| 6 | +Vout | +Vout |
| 7 | -Vout | Common |
| 8 | NC | -Vout |
| 9 | Case | Case |
| 10 | Stand off | Stand off |
| 11 | Stand off | Stand off |
| 12 | Case | Case |

1. All dimensions in inch [mm]
2. Tolerance :x.xx±0.02 [x.x±0.5]
   x.xxx±0.01 [x.xx±0.25]
3. Pin dimension tolerance ±0.004[0.10]

**Plastic Case**



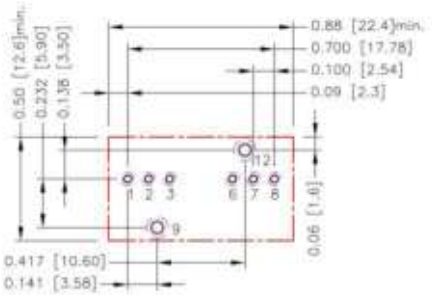

**PIN CONNECTION**

| PIN | SINGLE | DUAL |
|---|---|---|
| 1 | -Vin | -Vin |
| 2 | +Vin | +Vin |
| 3 | Ctrl | Ctrl |
| 6 | +Vout | +Vout |
| 7 | -Vout | Common |
| 8 | NC | -Vout |

1. All dimensions in inch [mm]
2. Tolerance :x.xx±0.02 [x.x±0.5]
   x.xxx±0.01 [x.xx±0.25]
3. Pin dimension tolerance ±0.004[0.10]

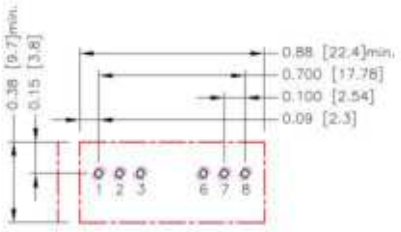
## RECOMMENDED PAD LAYOUT

**Standard Type Metal Case**




All dimensions in inch[mm]
Pad size(lead free recommended)
Through hole 1.2.3.6.7.8: Φ0.031[0.80]
Through hole 9.12: Φ0.051[1.30]
Top view pad 1.2.3.6.7.8: Φ0.039[1.00]
Top view pad 9.12: Φ0.064[1.63]
Bottom view pad 1.2.3.6.7.8: Φ0.063[1.60]
Bottom view pad 9.12: Φ0.102[2.60]

**Plastic Case**

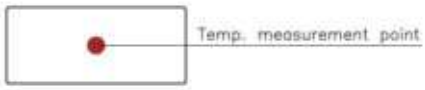



All dimensions in inch[mm]
Pad size(lead free recommended)
Through hole 1.2.3.6.7.8: Φ0.031[0.80]
Top view pad 1.2.3.6.7.8: Φ0.039[1.00]
Bottom view pad 1.2.3.6.7.8: Φ0.063[1.60]

## THERMAL CONSIDERATIONS

The power module operates in a variety of thermal environments.
However, sufficient cooling should be provided to help ensure reliable operation of the unit.
Heat is removed by conduction, convection, and radiation to the surrounding environment.
Proper cooling can be verified by measuring the point as the figure below.
The temperature at this location should not exceed “Maximum case temperature”.
When operating, adequate cooling must be provided to maintain the test point temperature at or below “Maximum case temperature”.
You can limit this temperature to a lower value for extremely high reliability.

■ Thermal test condition with vertical direction by natural convection (20LFM).




TOP VIEW

P-DUKE Technology Co., Ltd.
Tel +886-4-2359-0668
Fax +886-4-2359-1337
Email sales@pduke.com
Web www.pduke.com
Add No. 36, 22nd Rd., Taichung Industrial Park, Taichung, Taiwan, R.O.C.