



# P-DUKE POWER

## PDL06W Series

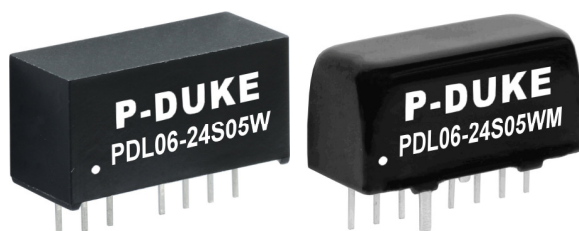
DC-DC Converter  
Up to 6 Watts

### 3

YEARS  
WARRANTY

ROHS  
COMPLIANT

REACH  
COMPLIANT



Automation



Datacom



IPC



Industry



Measurement



Telecom



Automobile



Boat



Charger



Medical



PV



Railway

c us

CB CE

3000  
VDC  
Isolation  
Voltage

1600  
VDC  
Isolation  
Voltage

4 : 1  
Wide  
Input  
Range

LOW  
Standby  
Power

NO  
Min. Load  
Required

REMOTE  
ON  
OFF

OCP

SCP

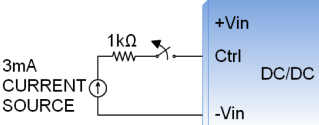
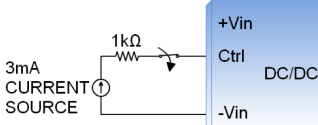
### PART NUMBER STRUCTURE

| PDL06       | - | 48                        | S                  | 05                                                 | W              | H                                                                                                                                                                           | - | M3                                                                                                                                                                              |
|-------------|---|---------------------------|--------------------|----------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Series Name |   | Input<br>Voltage<br>(VDC) | Output<br>Quantity | Output<br>Voltage<br>(VDC)                         | Input<br>Range | Case & Isolation<br>Option                                                                                                                                                  |   | Operating Temp<br>Option                                                                                                                                                        |
|             |   | 24:9~36<br>48:18~75       | S: Single          | 3P3:3.3<br>05:5<br>09:9<br>12:12<br>15:15<br>24:24 | 4 : 1          | <input type="checkbox"/> : Standard type<br>Plastic case<br>1600VDC isolation<br><b>H</b> : Plastic case<br>3000VDC isolation<br><b>M</b> : Metal case<br>1600VDC isolation |   | <input type="checkbox"/> : Standard<br>-40~+100°C With derating<br><b>M3</b> : M3 Version<br>Plastic case<br>-55~+100°C With derating<br>Metal case<br>-55~+100°C With derating |
|             |   |                           | D: Dual            | 05:±5<br>12:±12<br>15:±15                          |                |                                                                                                                                                                             |   |                                                                                                                                                                                 |

**TECHNICAL SPECIFICATION** All specifications are typical at nominal input, full load and 25°C 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                     |
| PDL06-24S3P3W | 9 ~ 36      | 3.3            | 1500                      | 4                       | 81         | 2200                   |
| PDL06-24S05W  | 9 ~ 36      | 5              | 1200                      | 4                       | 84         | 1100                   |
| PDL06-24S09W  | 9 ~ 36      | 9              | 666                       | 4                       | 86         | 680                    |
| PDL06-24S12W  | 9 ~ 36      | 12             | 500                       | 4                       | 87         | 470                    |
| PDL06-24S15W  | 9 ~ 36      | 15             | 400                       | 4                       | 88         | 470                    |
| PDL06-24S24W  | 9 ~ 36      | 24             | 250                       | 4                       | 87         | 180                    |
| PDL06-24D05W  | 9 ~ 36      | ±5             | ±600                      | 6                       | 84         | ±680                   |
| PDL06-24D12W  | 9 ~ 36      | ±12            | ±250                      | 6                       | 87         | ±330                   |
| PDL06-24D15W  | 9 ~ 36      | ±15            | ±200                      | 8                       | 87         | ±180                   |
| PDL06-48S3P3W | 18 ~ 75     | 3.3            | 1500                      | 4                       | 81         | 2200                   |
| PDL06-48S05W  | 18 ~ 75     | 5              | 1200                      | 4                       | 84         | 1100                   |
| PDL06-48S09W  | 18 ~ 75     | 9              | 666                       | 4                       | 85         | 680                    |
| PDL06-48S12W  | 18 ~ 75     | 12             | 500                       | 4                       | 87         | 470                    |
| PDL06-48S15W  | 18 ~ 75     | 15             | 400                       | 4                       | 87         | 470                    |
| PDL06-48S24W  | 18 ~ 75     | 24             | 250                       | 4                       | 87         | 180                    |
| PDL06-48D05W  | 18 ~ 75     | ±5             | ±600                      | 6                       | 84         | ±680                   |
| PDL06-48D12W  | 18 ~ 75     | ±12            | ±250                      | 6                       | 87         | ±330                   |
| PDL06-48D15W  | 18 ~ 75     | ±15            | ±200                      | 8                       | 87         | ±180                   |

**INPUT SPECIFICATIONS**

| Parameter                                                                                                                                                                                                          | Conditions                                                                            | Min.    | Typ.     | Max.           | Unit     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------|----------|----------------|----------|
| Operating input voltage range                                                                                                                                                                                      | 24Vin(nom)<br>48Vin(nom)                                                              | 9<br>18 | 24<br>48 | 36<br>75       | VDC      |
| Start up time                                                                                                                                                                                                      | Constant resistive load<br>Power up<br>Remote ON/OFF                                  |         | 30<br>30 |                | ms       |
| Input surge voltage                                                                                                                                                                                                | 1 second, max.<br>24Vin(nom)<br>48Vin(nom)                                            |         |          | 50<br>100      | VDC      |
| Input filter                                                                                                                                                                                                       |                                                                                       |         |          | Capacitor type |          |
| Remote ON/OFF                                                                                                                                                                                                      | Ctrl pin applied current via 1kΩ<br>DC-DC ON<br>DC-DC OFF<br>Remote off input current | 2       | 3        | 4<br>2.5       | mA<br>mA |
| Application circuit<br>DC-DC ON  DC-DC OFF  |                                                                                       |         |          |                |          |

**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               | -0.5  |      | +0.5  | %                              |
|                                  | Single                             | -1.0  |      | +1.0  | %                              |
|                                  | Dual                               |       |      |       |                                |
| Cross regulation                 | Asymmetrical load 25%/100% FL      | -5.0  |      | +5.0  | %                              |
| Ripple and noise                 | 20MHz bandwidth                    |       | 50   |       | mVp-p                          |
|                                  | 3.3Vout 5Vout, 9Vout               |       | 75   |       |                                |
|                                  | 12Vout, 15Vout 24Vout              |       |      |       |                                |
| Temperature coefficient          |                                    | -0.02 |      | +0.02 | %/°C                           |
| Transient response recovery time | 25% load step change               |       | 250  |       | µs                             |
| Over load protection             | % of Iout rated; Hiccup mode       |       | 180  |       | %                              |
| Short circuit protection         |                                    |       |      |       | Continuous, automatic recovery |

**GENERAL SPECIFICATIONS**

| Parameter             | Conditions               | Min. | Typ. | Max.                        | Unit                                                                   |
|-----------------------|--------------------------|------|------|-----------------------------|------------------------------------------------------------------------|
| Isolation voltage     | 1 minute Input to Output | 1600 |      |                             | VDC                                                                    |
|                       | Standard Type            | 3000 |      |                             |                                                                        |
|                       | Suffix "H"               | 1600 |      |                             |                                                                        |
|                       | Suffix "M"               | 1000 |      |                             |                                                                        |
|                       | Input (Output) to Case   |      |      |                             |                                                                        |
| Isolation resistance  | 500VDC                   | 1    |      |                             | GΩ                                                                     |
| Isolation capacitance |                          |      |      | 50                          | pF                                                                     |
|                       | Standard Type            |      |      | 50                          |                                                                        |
|                       | Suffix "H"               |      |      | 50                          |                                                                        |
|                       | Suffix "M"               |      |      | 50                          |                                                                        |
| Switching frequency   |                          | 522  | 580  | 638                         | kHz                                                                    |
| Safety approvals      | IEC /UL/ EN60950-1       |      |      |                             | UL:E193009<br>CB:UL(Demko)                                             |
| Case material         |                          |      |      |                             | Non-conductive black plastic<br>Non-conductive black plastic<br>Copper |
|                       | Standard Type            |      |      |                             |                                                                        |
|                       | Suffix "H"               |      |      |                             |                                                                        |
|                       | Suffix "M"               |      |      |                             |                                                                        |
| Base material         |                          |      |      |                             | None                                                                   |
| Potting material      |                          |      |      |                             | Silicone (UL94 V-0)                                                    |
| Weight                |                          |      |      | 4.8g (0.17oz)               |                                                                        |
|                       | Standard Type            |      |      | 4.8g (0.17oz)               |                                                                        |
|                       | Suffix "H"               |      |      | 5.9g (0.21oz)               |                                                                        |
|                       | Suffix "M"               |      |      |                             |                                                                        |
| MTBF                  | MIL-HDBK-217F            |      |      | 2.928 x 10 <sup>6</sup> hrs |                                                                        |
|                       | Standard Type            |      |      | 2.928 x 10 <sup>6</sup> hrs |                                                                        |
|                       | Suffix "H"               |      |      | 3.161 x 10 <sup>6</sup> hrs |                                                                        |
|                       | Suffix "M"               |      |      |                             |                                                                        |

**ENVIRONMENTAL SPECIFICATIONS**

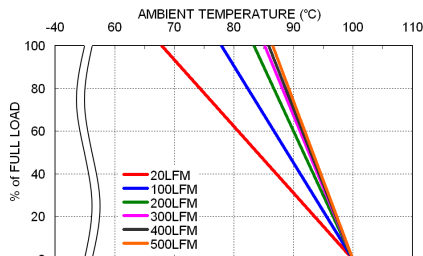
| Parameter                     | Conditions    | Min. | Typ. | Max. | Unit         |
|-------------------------------|---------------|------|------|------|--------------|
| Operating ambient temperature | Standard type | -40  |      | +100 | °C           |
|                               | With derating | -40  |      | +100 |              |
|                               | Suffix "H"    | -40  |      | +100 |              |
|                               | Suffix "M"    |      |      |      |              |
|                               | M3 Version    |      |      |      |              |
|                               | With derating | -55  |      | +100 |              |
|                               | Suffix "H"    | -55  |      | +100 |              |
|                               | Suffix "M"    |      |      |      |              |
| Storage temperature range     |               | -55  |      | +125 | °C           |
| Thermal shock                 |               |      |      |      | MIL-STD-810F |
| Vibration                     |               |      |      |      | MIL-STD-810F |
| Relative humidity             |               |      |      |      | 5% to 95% RH |

## EMC SPECIFICATIONS

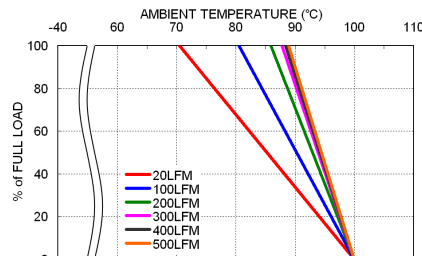
| Parameter                      | Conditions   |                                                                                                                                                                  | Level             |
|--------------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| EMI                            | EN55032      | With external components                                                                                                                                         | Class A + Class B |
| ESD                            | EN61000-4-2  | Air $\pm 8\text{kV}$ and Contact $\pm 6\text{kV}$                                                                                                                | Perf. Criteria A  |
| Radiated immunity              | EN61000-4-3  | 20 V/m                                                                                                                                                           | Perf. Criteria A  |
| Fast transient                 | EN61000-4-4  | $\pm 2\text{kV}$                                                                                                                                                 | Perf. Criteria A  |
|                                | PDL06-24□□□W | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 220 $\mu\text{F}$ /100V) and a TVS (SMDJ70A, 70V, 3000Watt peak pulse power) in parallel    |                   |
|                                | PDL06-48□□□W | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 220 $\mu\text{F}$ /100V) and a TVS (SMDJ120A, 120V, 3000Watt peak pulse power) in parallel. |                   |
| Surge                          | EN61000-4-5  | $\pm 2\text{kV}$                                                                                                                                                 | Perf. Criteria A  |
|                                | PDL06-24□□□W | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 220 $\mu\text{F}$ /100V) and a TVS (SMDJ70A, 70V, 3000Watt peak pulse power) in parallel    |                   |
|                                | PDL06-48□□□W | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 220 $\mu\text{F}$ /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.

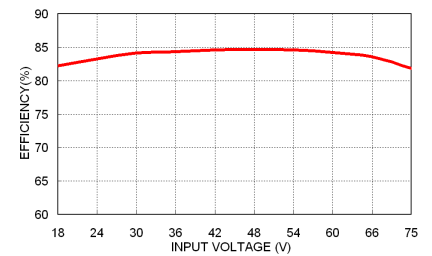
## CHARACTERISTIC CURVE



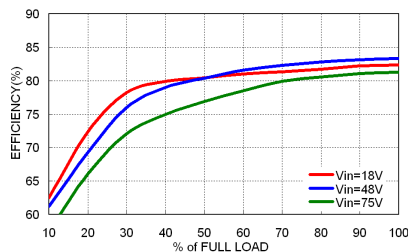
PDL06-48S05W Derating Curve



PDL06-48S05WM Derating Curve



PDL06-48S05W Efficiency vs. Input Voltage



PDL06-48S05W 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.

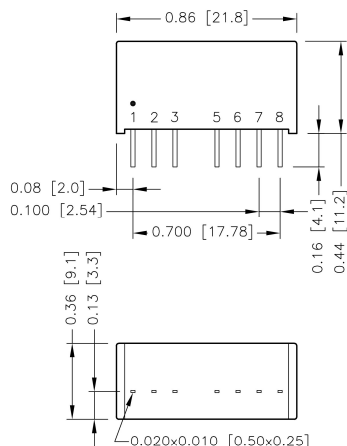
The input line fuse suggest as below :

| Model                     | Fuse Rating (A) | Fuse Type |
|---------------------------|-----------------|-----------|
| PDL06-24S□□W・PDL06-24D□□W | 1.6             | Slow-Blow |
| PDL06-48S□□W・PDL06-48D□□W | 1               | Slow-Blow |

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

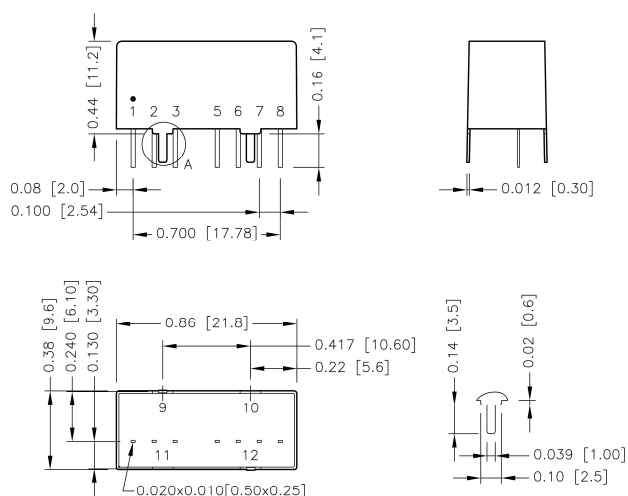
## MECHANICAL DRAWING

**Standard type, Suffix “H”**



BOTTOM VIEW

### Suffix “M”



BOTTOM VIEW

## A VIEW

## PIN CONNECTION

| PIN | SINGLE       | DUAL         |
|-----|--------------|--------------|
| 1   | -Vin         | -Vin         |
| 2   | +Vin         | +Vin         |
| 3   | Ctrl         | Ctrl         |
| 5   | NC*/No pin** | NC*/No pin** |
| 6   | +Vout        | +Vout        |
| 7   | -Vout        | Common       |
| 8   | NC           | -Vout        |

\*NC pin for standard type model.

\*\*No pin for 3kVDC isolation model (suffix "H").

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 pitch tolerance ±0.01 [0.25]
4. Pin dimension tolerance ±0.004 [0.10]

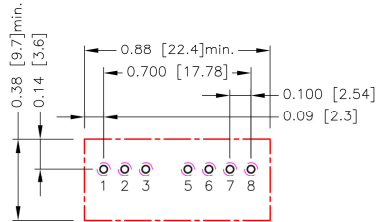
## PIN CONNECTION

| PIN | SINGLE    | DUAL      |
|-----|-----------|-----------|
| 1   | -Vin      | -Vin      |
| 2   | +Vin      | +Vin      |
| 3   | Ctrl      | Ctrl      |
| 5   | NC        | NC        |
| 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 pitch tolerance ±0.01 [0.25]
4. Pin dimension tolerance ±0.004 [0.10]

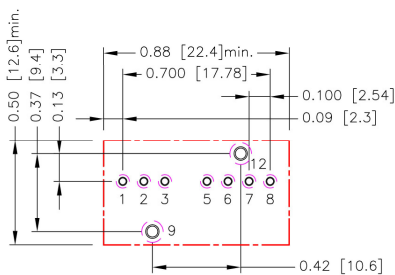
## RECOMMENDED PAD LAYOUT

### Standard type, Suffix "H"



All dimensions in inch[mm]  
 Pad size(lead free recommended)  
 Through hole 1.2.3.5.6.7.8:  $\Phi 0.031$ [0.80]  
 Top view pad 1.2.3.5.6.7.8:  $\Phi 0.039$ [1.00]  
 Bottom view pad 1.2.3.5.6.7.8:  $\Phi 0.063$ [1.60]

### Suffix "M"



All dimensions in inch[mm]  
 Pad size(lead free recommended)  
 Through hole 1.2.3.5.6.7.8:  $\Phi 0.031$ [0.80]  
 Through hole 9.12:  $\Phi 0.051$ [1.30]  
 Top view pad 1.2.3.5.6.7.8:  $\Phi 0.039$ [1.00]  
 Top view pad 9.12:  $\Phi 0.064$ [1.63]  
 Bottom view pad 1.2.3.5.6.7.8:  $\Phi 0.063$ [1.60]  
 Bottom view pad 9.12:  $\Phi 0.102$ [2.60]

## 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.

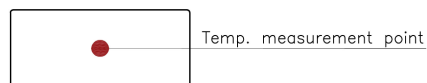
Proper cooling can be verified by measuring the point as the figure below.

The temperature at this location should not exceed 100°C.

When Operating, adequate cooling must be provided to maintain the test point temperature at or below 100°C.

Although the maximum point Temperature of the power modules is 100°C, 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