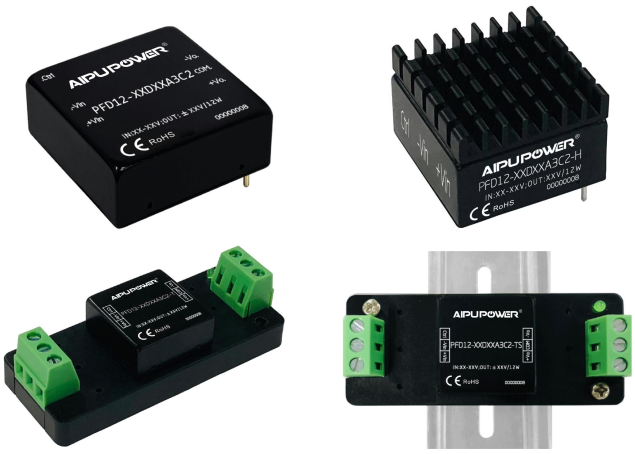
# DC/DC Converter
## PFD12-XXDXXA3(C)2(-XXX) Series

## Typical Features

- Wide input voltage range (4:1), output power 12W
- Efficiency up to 88% (Typ.)
- Stand-by power consumption 0.15W (Typ.)
- Output fast start-up
- Continuous short circuit protection, self-recovery
- Input under-voltage protection, output over-voltage, short-circuit & over-current protections
- Isolation voltage 1500VDC
- Operating temperature from -40°C to +105°C
- Good EMI performance
- Standard pin-out alignment



## Application Field

***PFD12-XXDXXA3(C)2(-XXX) Series -----*** *PCB DIP mounted standard 1"X1" size modular DC-DC converters with wide input range 4:1, low stand-by power consumption, isolated & regulated output 12W. This series of products can be widely used in the fields of Industrial control, Instrument, Communication, Electric power, Internet of things, etc. The additional circuit diagram for EMC is recommended for the application with high EMC requirement.*

## Typical Product List

| Certificate | Part No. | Input Voltage Ramge (VDC) | | Output Voltage/Current (Vo/Io) | | Input Current (mA) Typ. @ Nominal volt. | | Max. Capacitive Load | Ripple & Noise (mVp-p) | | Efficiency @full load (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Nom. | Range | Vo (VDC) | Io(mA) Max/Min | Full load | No load | uF | Typ. | Max | Min | Typ. |
| CE | PFD12-18D05A3(C)2 | 24 | 9-36 | ±5 | 1200/0 | 595 | 10 | 3000 | 50 | 100 | 82 | 84 |
| | PFD12-18D09A3(C)2 | 24 | 9-36 | ±9 | 667/0 | 588 | 10 | 2000 | 50 | 100 | 83 | 85 |
| | PFD12-18D12A3(C)2 | 24 | 9-36 | ±12 | 500/0 | 574 | 10 | 1500 | 50 | 100 | 85 | 87 |
| | PFD12-18D15A3(C)2 | 24 | 9-36 | ±15 | 400/0 | 568 | 10 | 1000 | 50 | 100 | 86 | 88 |
| | PFD12-18D24A3(C)2 | 24 | 9-36 | ±24 | 250/0 | 574 | 10 | 300 | 50 | 100 | 85 | 87 |
| | PFD12-36D05A3(C)2 | 48 | 18-75 | ±5 | 1200/0 | 297 | 10 | 3000 | 50 | 100 | 82 | 84 |
| | PFD12-36D09A3(C)2 | 48 | 18-75 | ±9 | 667/0 | 294 | 10 | 2000 | 50 | 100 | 83 | 85 |
| | PFD12-36D12A3(C)2 | 48 | 18-75 | ±12 | 500/0 | 287 | 10 | 1500 | 50 | 100 | 85 | 87 |
| | PFD12-36D15A3(C)2 | 48 | 18-75 | ±15 | 400/0 | 284 | 10 | 1000 | 50 | 100 | 86 | 88 |
| | PFD12-36D24A3(C)2 | 48 | 18-75 | ±24 | 250/0 | 287 | 10 | 500 | 50 | 100 | 85 | 87 |

Note 1: In the part numbers C indicates the part with ON/OFF Control function, N indicates without Control.

Note 2: The suffix -H indicates the part with Heat sink, -T (H) indicates the chassis package (with heat sink), -TS (H) indicates the package of DIN Rail (with heat sink) which width is 35mm.

Note 3: The maximum capacitive load is the capacitance allowed to be used when the power supply starts at full load. The converter may not start if the capacitor exceeds this value.

Note 4: The typical value of efficiency is tested at nominal input voltage and rated load.

Note 5: Please contact Aipu sales for other output voltages requirement in this series but not listed in this table.

## Input Specifications

| Item | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|
| Standby Power Consumption | Full input voltage range | / | 0.15 | / | W |
| Reflected Ripple Current | 24V input series, nominal input voltage | / | 40 | / | mA |
| | 48V input series, nominal input voltage | / | 30 | / | |
| Under-voltage Protection | 24V input series | 5.5 | 6.5 | / | VDC |
| | 48V input series | 12 | 13 | / | |
| Input Inrush Voltage (1sec.max) | 24V input series | -0.7 | / | 50 | |
| | 48V input series | -0.7 | / | 100 | |
| Hot Plug | / | Unavailable | | | |
| Input Filter | / | Pi filter | | | |
| ON/OFF Control (Ctrl*) | Turn ON the converter | No connection or connected to high level (3.3V-12VDC) | | | |
| | Turn OFF the converter | Connected to -Vin or the low voltage level (0-1.2VDC) | | | |
| | Current value for switching off | 2mA (Typ.) | | | |

*Note: The voltage of Ctrl is relative to the input -Vin.

## Output Specifications

| Item | Test Conditions | | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | Full input voltage range, rated load | | / | ±1 | ±3 | % |
| Voltage Regulation | Full voltage range, Full load | Positive output | / | ±0.2 | ±0.5 | % |
| | | Negative output | / | ±0.5 | ±1 | % |
| Load Regulation | 5% ~ 100% load | Positive output | / | ±0.5 | ±1 | % |
| | | Negative output | / | ±0.5 | ±1.5 | % |
| Ripple & Noise | 10% ~ 100% load, 20MHz bandwidth | | / | 50 | 100 | mVp-p |
| Dynamic Response Time | 25% of rated load step, nominal input voltage | | / | 300 | 500 | uS |
| Dynamic Response Deviation | | | / | ±3 | ±5 | % |
| Cross Regulation | +Vo at 50% load, -Vo at 10~100% load | | / | / | ±5 | % |
| Turn-on Delay Time | Nominal input voltage | | / | 10 | / | mS |
| Over-voltage Protection | Full input voltage range | | 110 | 130 | 160 | %Vo |
| Over-current Protection | | | 110 | 150 | 300 | %Io |
| Short Circuit Protection | | | Continuous, self-recovery | | | |

Note: Ripple & noise ≤5%Vo at 0% - 5% load, it is tested by the twisted pair method (please refer to the following test instruction)

## General Specifications

| Item | Test Conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|
| Switching Frequency | Operating mode (PWM) | / | 330 | / | KHz |
| Operating Temperature | Refer to the temperature derating graph | -40 | / | +105 | ℃ |
| Storage Temperature | / | -55 | / | +125 | |
| Case Temperature | Within the operating derating range | / | / | +105 | |
| Pin Soldering Temperature | 1.5mm from the case, 10S | / | / | 300 | |
| Relative Humidity | No condensation | 5 | / | 95 | %RH |
| Isolation Voltage | I/P-O/P, test 1min, leakage current ≤0.5mA | 1500 | / | / | VDC |
| Isolation Capacitance | I/P-O/P, 100KHz/0.1V | / | 1000 | / | pF |
| Insulation Resistance | I/P-O/P, @500VDC | 1000 | / | / | MΩ |
| MBTF | MIL-HDBK-217F@25℃ | 1000 | / | / | K hours |
| Cooling Method | Natural air | | | | |
| Case Material | Aluminum | | | | |

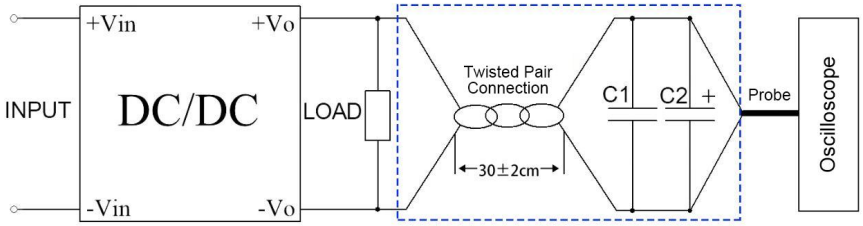
| Weight/Dimensions | Part No. | Weight (Typ.) | Dimensions L x W x H | |
|---|---|---|---|---|
| | PFD12-XXDXXA3(C)2 | 18g | 25.40X 25.40X11.00 mm | 1.000X1.000X0.433 inch |
| | PFD12-XXDXXA3(C)2-H | 21g | 25.40X 25.40X16.00 mm | 1.000X1.000X0.630 inch |
| | PFD12-XXDXXA3(C)2-T | 39g | 76.00X31.50X21.30 mm | 2.992X1.240X0.838 inch |
| | PFD12-XXDXXA3(C)2-TH | 42g | 76.00X31.50X26.00 mm | 2.992X1.240X1.023 inch |
| | PFD12-XXDXXA3(C)2-TS | 59g | 76.00X31.50X26.00 mm | 2.992X1.240X1.023 inch |
| | PFD12-XXDXXA3(C)2-TSH | 62g | 76.00X31.50X30.80 mm | 2.992X1.240X1.212 inch |

## EMC Performance

| Total Items | | Sub Items | Test Standard | Performance/Class |
|---|---|---|---|---|
| EMC | EMI | CE | CISPR32/EN55032 | CLASS B (with the Recommended EMC Circuit) |
| | | RE | CISPR32/EN55032 | CLASS B (with the Recommended EMC Circuit) |
| | EMS | RS | IEC/EN61000-4-3 | 10V/m Perf.Criteria A (with the Recommended EMC Circuit) |
| | | CS | IEC/EN61000-4-6 | 3Vr.m.s Perf.Criteria A (with the Recommended EMC Circuit) |
| | | ESD | IEC/EN61000-4-2 | Contact ±4KV Perf.Criteria B |
| | | Surge | IEC/EN61000-4-5 | ±2KV Perf.Criteria B (with the Recommended EMC Circuit) |
| | | EFT | IEC/EN61000-4-4 | ±2KV Perf.Criteria B (with the Recommended EMC Circuit) |
| | | CE | IEC/EN61000-4-11 | 0% ~70% Perf.Criteria B |

## Ripple & Noise Test Instruction (Twisted Pair Method, 20MHz Bandwidth)

Test diagram



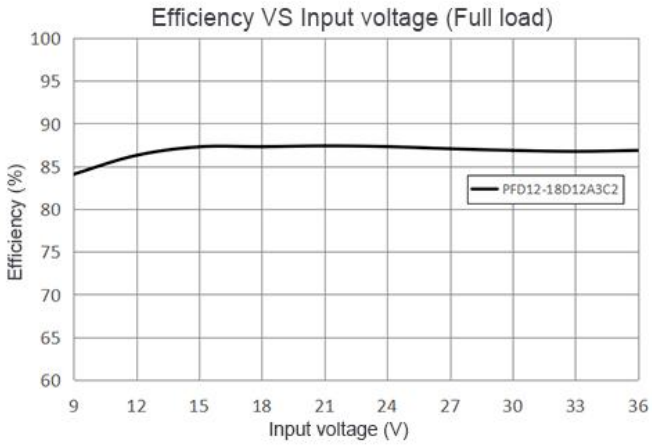

1) The Ripple & noise test needs 12# twisted pair cables, an oscilloscope which should be set at the Sample Mode, bandwidth 20MHz. 100M bandwidth probe with cap and ground removed. C1(0.1uF) polypropylene capacitor and C2(10uF) high-frequency low-resistance electrolytic capacitor are connected in parallel with the probes and one side of the twisted pair.

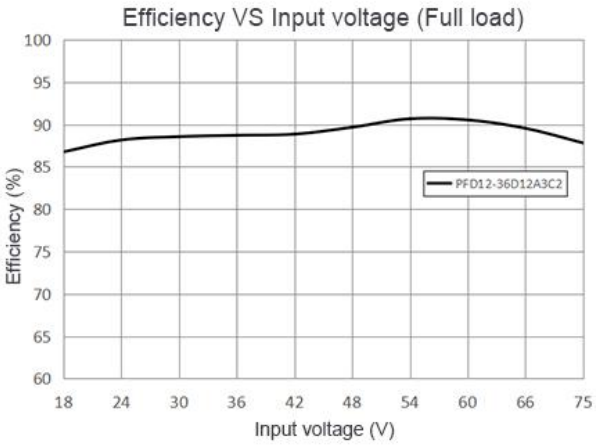
2)The power supply output connects to the load by the cables. The other side of the twisted pair (length 30cm±2 cm) should be connected in parallel with the load, the polarity of the output and the oscilloscope probe should not be reversed. The test can be start after input power on.

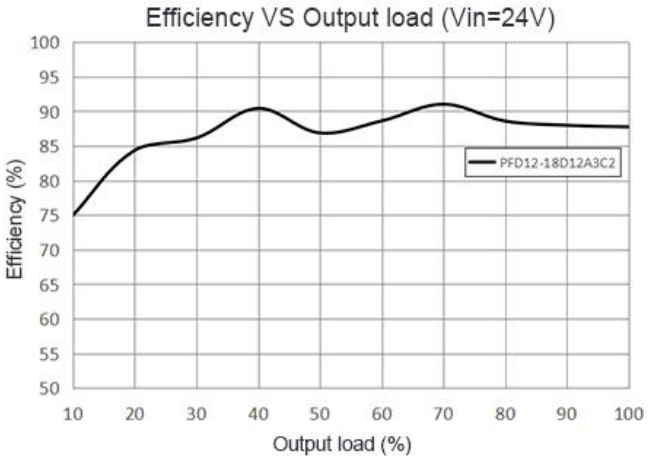
3) A ≥10% load or a high-frequency low resistance E-cap(≥470uF) load is recommended to avoid the output ripple increasing.

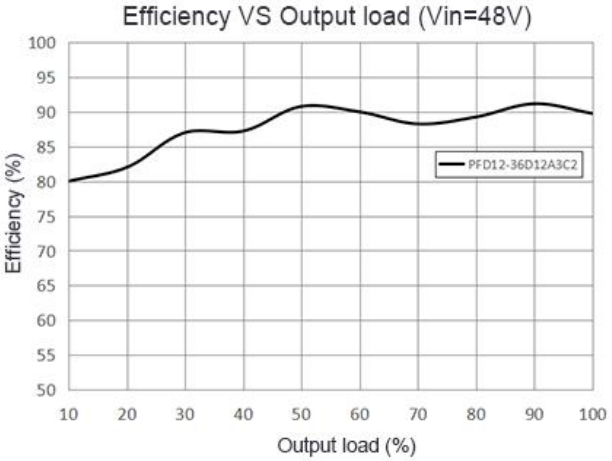
4) The dual output loads balance deviation should be less than ±5%.

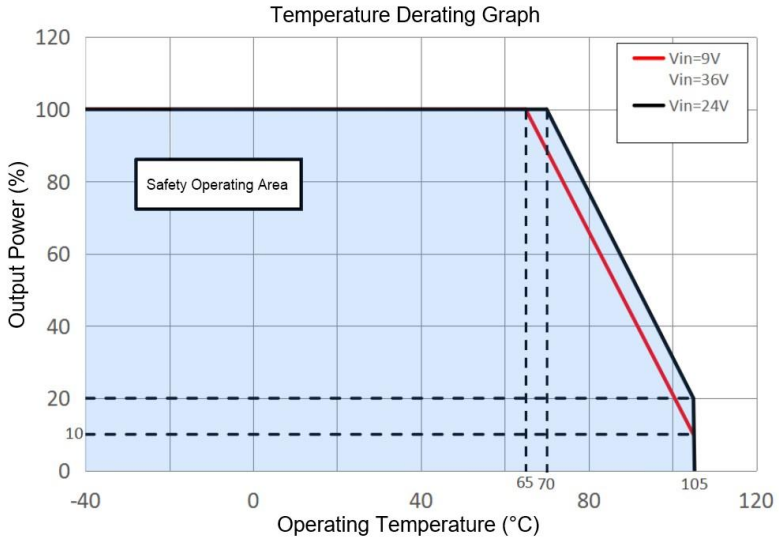
## Product Characteristics Graphs



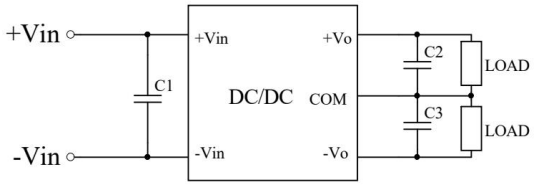





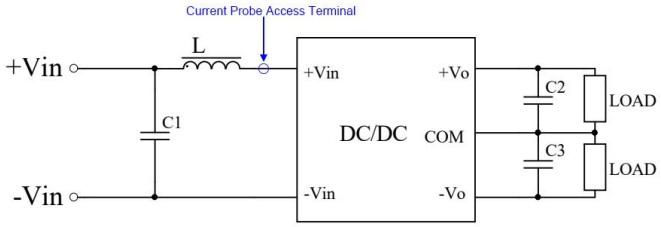

## Recommended Circuits for Application

1. This series of converters will be tested according to this circuit diagram below before shipping. Increasing the capacitance of C2 and C3 can decrease the output ripple, but the capacitances must be less than the maximum capacitive load.



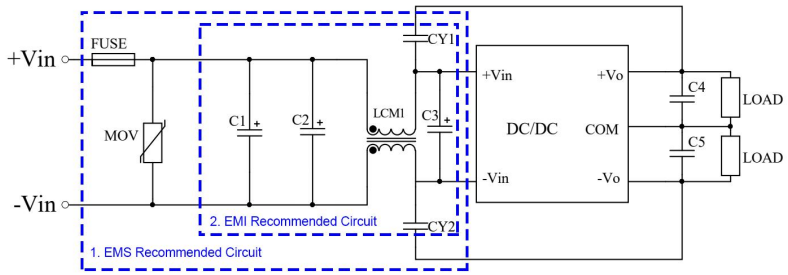

| Components | Parameter |
|---|---|
| C1 | 100uF/100V |
| C2, C3 | 100uF/50V |

2. Input reflected ripple current test circuit diagram




| Components | Parameter |
|---|---|
| C1 | 220uF/100V |
| L | 4.7uH |
| C2, C3 | 100uF/50V |

3. Recommended EMC circuit

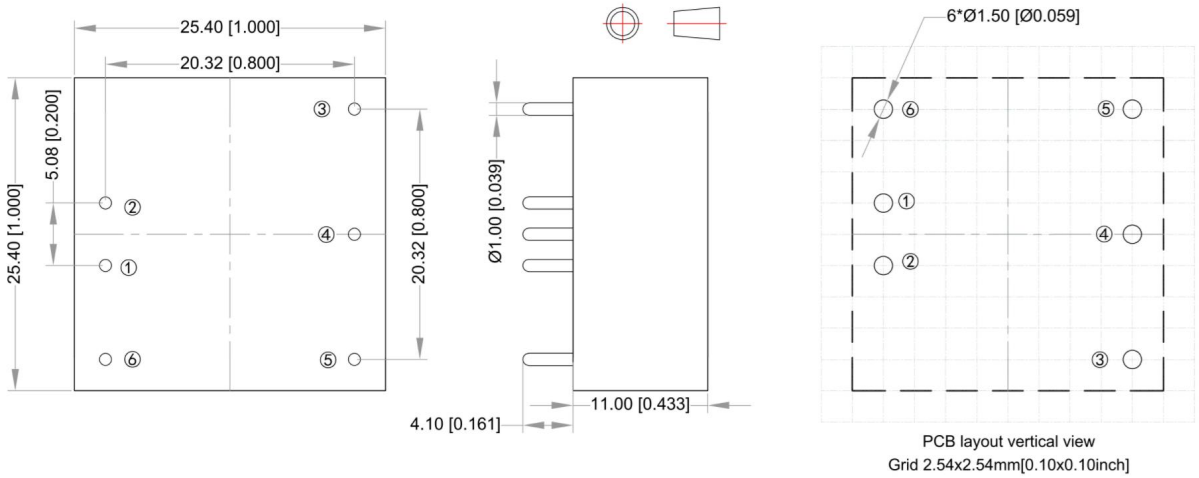



| Components | 24V Input | 48V Input |
|---|---|---|
| FUSE | TBD by the customer | |
| MOV | 14D560K | 14D101K |
| LCM1 | 5mH | 5mH |
| C1, C2, C3 | 330uF/50V | 330uF/100V |
| C4, C5 | 47uF/50V | 47uF/50V |
| CY1, CY2 | 2.2nF/2000V | |

Note:

Circuit part 1 is for EMS testing, part 2 for EMI filtering, both can be adjusted according to the actual situation.

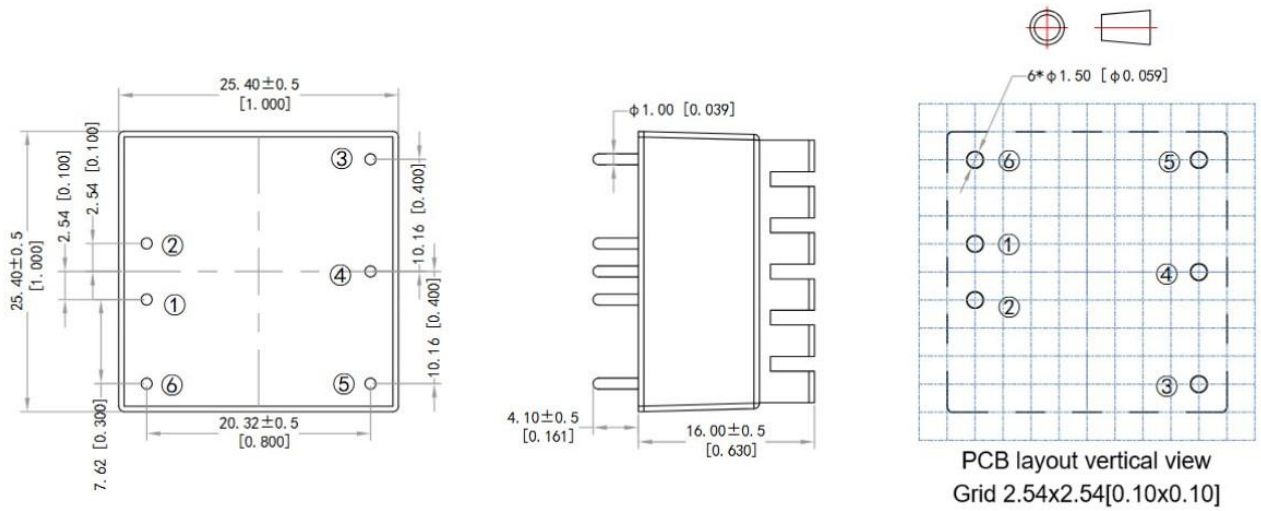
## A3 Package Dimensions




Unit: mm[inch]
General tolerance: ±0.50[±0.020]
Pin diameter tolerance: ±0.10[±0.004]

| Pin No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| PFD12-XXDXXA3C2 | -Vin | +Vin | +Vout | COM | -Vout | Ctrl |

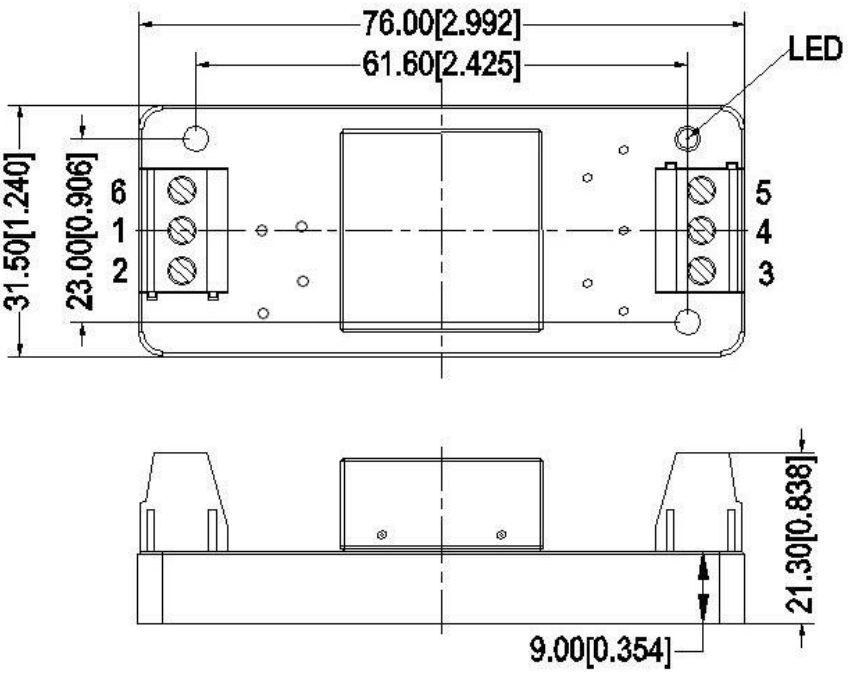
## A3-H Package Dimensions (with heat sink)




Unit: mm[inch]
General tolerance: ±0.50[±0.020]
Pin diameter tolerance: ±0.10[±0.004]

| Pin No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| PFD12-XXDXXA3C2 | -Vin | +Vin | +Vout | COM | -Vout | Ctrl |

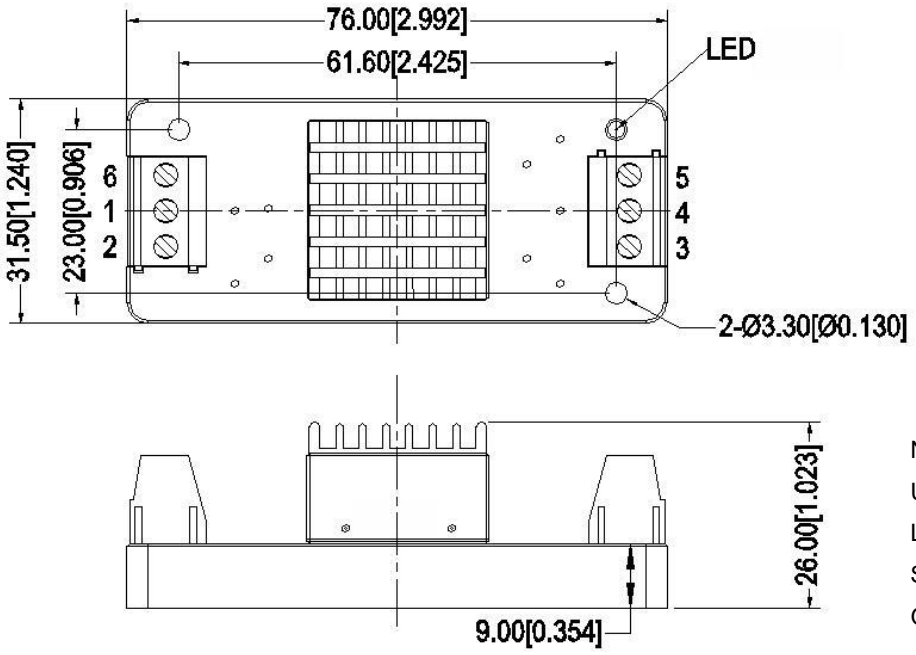
## A3-T Package Dimensions




Note:
Unit: mm [inch]
Lead wires gauge: 24-12AWG
Screwing torque: 0.4N.m Max
General tolerance: ±1.00[±0.039]

| Terminal No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| PFD12-XXDXXA3C2 | -Vin | +Vin | +Vout | COM | -Vout | Ctrl |

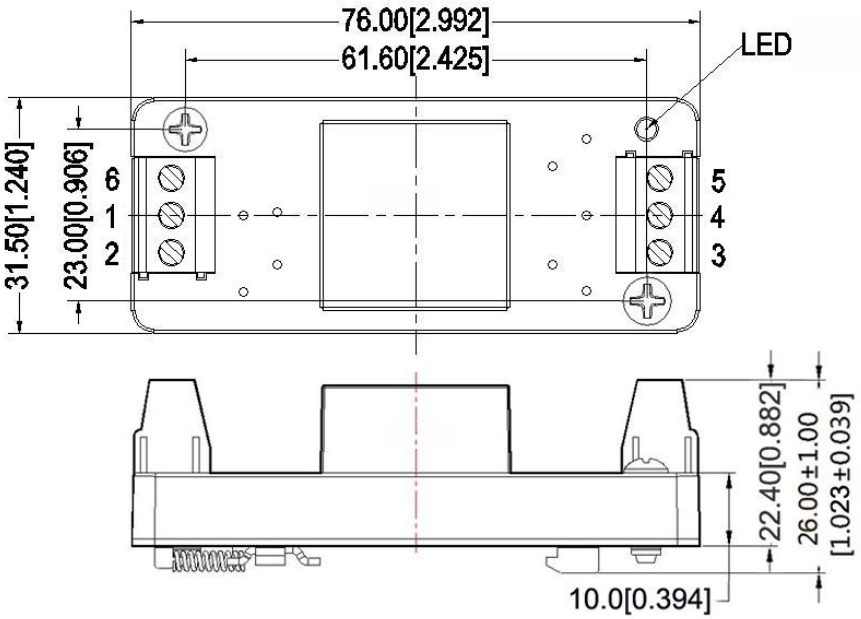
## A3-TH Package Dimensions (with heat sink)




Note:
Unit: mm [inch]
Lead wires gauge: 24-12AWG
Screwing torque: 0.4N.m Max
General tolerance: ±1.00[±0.039]

| Terminal No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| PFD12-XXDXXA3C2 | -Vin | +Vin | +Vout | COM | -Vout | Ctrl |

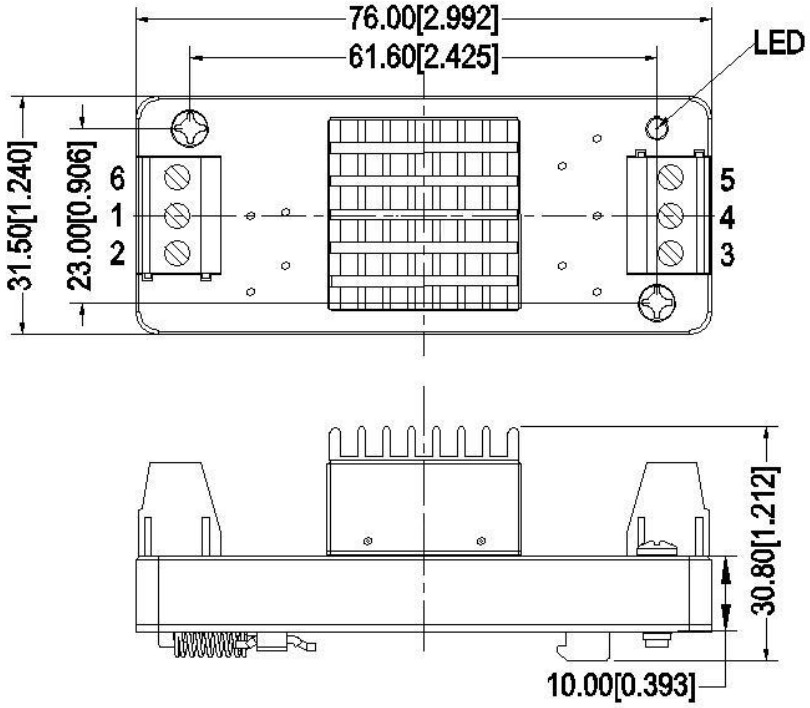
## A3-TS Package Dimensions




Note:
Unit: mm [inch]
Lead wires gauge: 24-12AWG
Screwing torque: 0.4N.m Max
General tolerance: ±1.00[±0.039]

| Terminal No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| PFD12-XXDXXA3C2 | -Vin | +Vin | +Vout | COM | -Vout | Ctrl |

## A3-TSH Package Dimensions (with heat sink)




Note:
Unit: mm [inch]
Lead wires gauge: 24-12AWG
Screwing torque: 0.4N.m Max
General tolerance: ±1.00[±0.039]

| Terminal No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| PFD12-XXDXXA3C2 | -Vin | +Vin | +Vout | COM | -Vout | Ctrl |

| Other Models Pin-out Function Description | | | | | | |
|---|---|---|---|---|---|---|
| Pin/Terminal No. | 1 | 2 | 3 | 4 | 5 | 6 |
| PFD12-XXDXXA3N2 | -Vin | +Vin | +Vout | COM | -Vout | No Pin |

**Application Notice**

1.The products should be used according to the specifications in this datasheet, otherwise it could be permanently damaged.

2. The product performance in this datasheet cannot be guaranteed if it works at a lower load than the minimum load defined.

3. The product performance in this datasheet cannot be guaranteed if it works at over-load condition.

4. Unless otherwise specified, all values or indicators in this datasheet are tested at Ta=25℃, humidity<75%RH, nominal input voltage and rated load (pure resistance load).

5. All values or indicators in this datasheet had been tested based on Aipupower test specifications.

6.The specifications are specially for the parts listed in this datasheet, any other non-standard model performances could be out of the specifications. Please contact our technician for specific requirements.

7. Aipupower can provide customization service.

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