## Typical Features

- Wide input voltage range (4:1), output power 12W
- Efficiency up to 88% (Typ.)
- Standby power consumption 0.7W (Typ.)
- Input under voltage protection, output over voltage & over current protections
- Continuous short circuit protection, Self-recovery
- Isolation voltage 5000VDC
- Operating temperature from -40°C to +105°C
- Encapsulated CR & CL distances 5.1mm
- Good EMC performance
- Standard pin-out alignment


## Application Field

**PFD12-XXSXXB2(C)5 series ----** DIP mounting standard 2"X1" package DC-DC modular converters with wide input voltage range 4:1, low standby power consumption，isolated & regulated single output 12W. This series of products can be widely used in the fields of Industrial control, Instrument, Communication, Electricity power and IoT, etc. Additional circuit diagram for EMC is recommended for the application with high EMC requirement.

## Typical Product List

| Certificate | Part No. | Input Voltage | | Output Voltage/Current (Vo/Io) | | Input Current @Nominal volt. (mA) Typ. | | Max Capacitive load | Efficiency @Full load, Nominal volt. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Nominal (VDC) | Range (VDC) | Vo (VDC) | Io (mA) | Full load | No load | (uF) | Min (%) | Typ (%) |
| - | *PFD12-18S3V3B2(C)5 | 24 | 9-36 | 3.3 | 2400/0 | 388 | 30 | 8000 | 83 | 85 |
| - | PFD12-18S05B2(C)5 | | | 5 | 2400/0 | 561 | 20 | 5000 | 85 | 87 |
| - | *PFD12-18S09B2(C)5 | | | 9 | 1333/0 | 581 | 30 | 2000 | 84 | 86 |
| - | PFD12-18S12B2(C)5 | | | 12 | 1000/0 | 568 | 2 | 1000 | 86 | 88 |
| - | PFD12-18S15B2(C)5 | | | 15 | 800/0 | 568 | 10 | 800 | 86 | 88 |
| - | PFD12-18S24B2(C)5 | | | 24 | 500/0 | 575 | 2 | 500 | 85 | 87 |
| - | *PFD12-36S3V3B2(C)5 | 48 | 18-75 | 3.3 | 2400/0 | 194 | 30 | 8000 | 83 | 85 |
| - | PFD12-36S05B2(C)5 | | | 5 | 2400/0 | 291 | 20 | 5000 | 85 | 87 |
| - | *PFD12-36S09B2(C)5 | | | 9 | 1333/0 | 291 | 30 | 2000 | 84 | 86 |
| - | PFD12-36S12B2(C)5 | | | 12 | 1000/0 | 284 | 2 | 1000 | 86 | 88 |
| - | *PFD12-36S15B2(C)5 | | | 15 | 800/0 | 284 | 2 | 800 | 86 | 88 |
| - | *PFD12-36S24B2(C)5 | | | 24 | 500/0 | 287 | 2 | 500 | 85 | 87 |

Note 1: The * marked parts have been developed in process.

Note 2: The part number letter R indicates the part with both ON/OFF Control & Trim functions, C indicates the part with Control function, T indicates with Trim function, N indicates with None of Control or Trim.

Note 3: The typical value of efficiency is tested at nominal input voltage and rated load.

Note 4: 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 5: The chip could operate at jitter frequency situation with no load or light load to decrease the no-load power consumption, so no load is not available. ≥10% load or a high-frequency low resistance E-cap(≥330uF) load is recommended, to avoid the output ripple increasing.

Note 6: Please contact Aipu sales for other output voltages requirements of this series but not listed in this table.

## Input Specifications

| Items | Test Conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|
| Standby power consumption | Full input voltage range | / | 0.7 | / | W |
| Input current Max | Full input voltage range | / | / | 1.6 | A |
| Start-up voltage | 24V nominal input series | / | 8 | 9 | VDC |
| | 48V nominal input series | / | 15 | 18 | VDC |
| Input under voltage protection | 24V nominal input series | / | 7 | / | VDC |
| | 48V nominal input series | / | 14 | / | VDC |
| Input inrush voltage (1sec.max) | 24V nominal input series | -0.7 | / | 50 | VDC |
| | 48V nominal input series | -0.7 | / | 100 | VDC |
| Input filter | / | Pi type filter | | | |
| Hot-plug | / | NA | | | |
| ON/OFF control (*Ctrl) | Turn ON the converter | No connection or connected to high level (2.5V-12VDC) | | | |
| | Turn OFF the converter | Connected to -Vin or the low voltage level (0-1.2VDC) | | | |
| | Input current for switching off | / | 5 | / | mA |

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

## Output Specifications

| Items | Test Conditions | | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Output voltage accuracy | Full input voltage range | | / | ±1 | ±2 | % |
| Line regulation | Full input voltage range, rated load | | / | ±0.2 | ±0.5 | % |
| Load regulation | Nominal input voltage, 10%-100% load | | / | ±0.5 | ±1 | % |
| Ripple & noise | 10%-100% load, 20MHz bandwidth | | / | 50 | 100 | mVp-p |
| Dynamic response time | 25% rated load step, full input voltage range | | / | 300 | 500 | uS |
| Dynamic response deviation | 25% rated load step, nominal input voltage | 3.3V&5V output | / | ±3 | ±8 | % |
| | | Others | / | ±3 | ±5 | % |
| Temperature drift coefficient | Full load | | / | / | ±0.03 | %/°C |
| Turn on delay time | Nominal input voltage | | / | 30 | / | mS |
| Output voltage Trim | Full input voltage range | | 90 | / | 110 | %Vo |
| Output overshoot | | | / | / | 10 | %Vo |
| Over voltage protection | | | 110 | 140 | 200 | %Vo |
| Over current protection | | | 110 | 140 | 220 | %Io |
| Short Circuit Protection | | | Continuous, self-recovery | | | |

Note: Ripple & Noise ≤5%Vo at 0% - 10% load, it is tested by the Parallel-line method (refer to the following test instruction).

## General Specifications

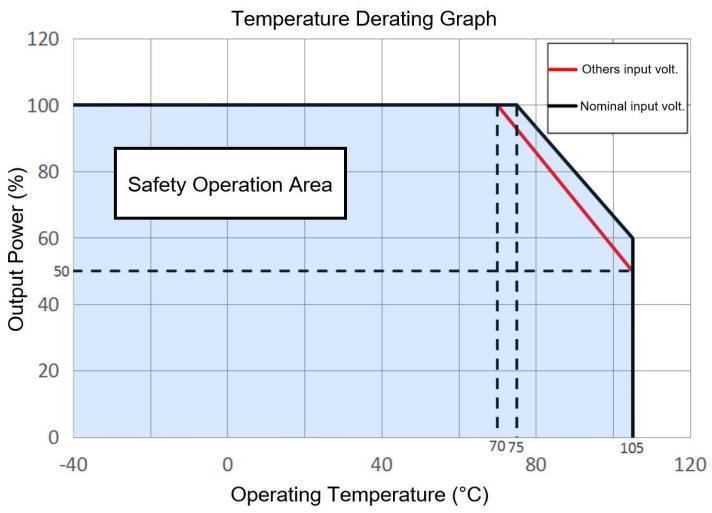
| Items | Test Conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|
| Switching frequency | Operating Mode (PWM) | / | 250 | / | KHz |
| Operating temperature | Refer to the Temperature Derating Graph | -40 | / | +105 | ℃ |
| Storage temperature | | -55 | / | +125 | |
| Case temperature | Within the operating derating range | / | / | +105 | |
| Pin soldering temperature | 1.5mm from the case, soldering time 10S | / | / | 280 | |
| Relative humidity | No condensing | 5 | / | 95 | %RH |
| Isolation voltage | I/P – O/P, test 1min, leakage current <1mA | 5000 | / | / | VDC |
| Isolation capacitance | I/P – O/P, 100KHz/0.1V | / | 1000 | / | pF |
| Insulation resistance | I/P – O/P, @ 500VDC | 100 | / | / | MΩ |
| MTBF | MIL-HDBK-217F@25℃ | 1000 | / | / | K hours |
| Cooling method | Nature air | | | | |
| Vibration | 10-1000Hz, 10G, 1mm, along X, Y and Z, 2h | | | | |
| Case material | Plastic in black, flame class UL94-V0 | | | | |

| Weight/Dimensions | Part No. | Weight (Typ) | Dimensions L x W x H | |
|---|---|---|---|---|
| | PFD12-XXSXXB2(C)5 | 26g | 50.8 X 25.4 X 15.6 mm | 2.000 X 1.000 X 0.614 inch |

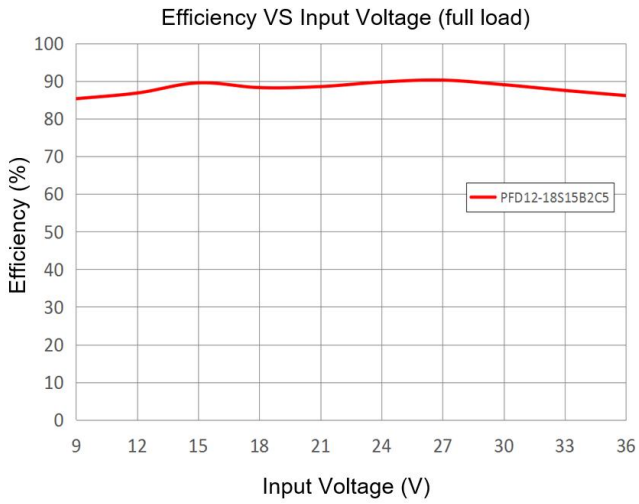
## EMC Performance

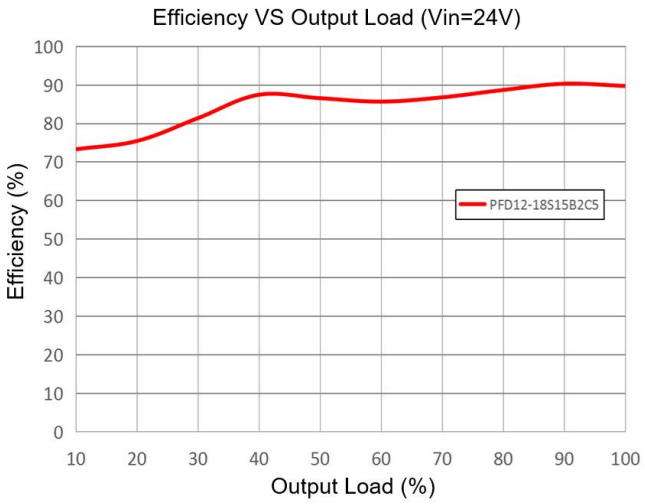
| Item | | | Test Standard | Performance/Class |
|---|---|---|---|---|
| EMC | EMI | CE | CISPR32/EN55032 | CLASS B (with the Recommended EMC Circuit) |
| | | RE | CISPR32/EN55032 | CLASS B (with the Recommended EMC Circuit) |
| | EMS | RS | IEC/EN61000-4-3 | 10V/m Perf. Criteria B (with the Recommended EMC Circuit) |
| | | CS | IEC/EN61000-4-6 | 3V r.m.s Perf. Criteria B (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) |

## Temperature Derating Graph



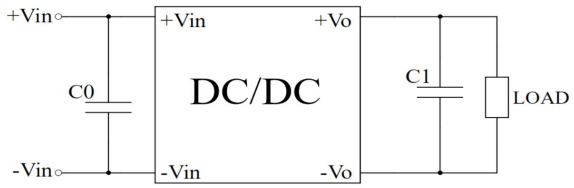
## Efficiency Graphs



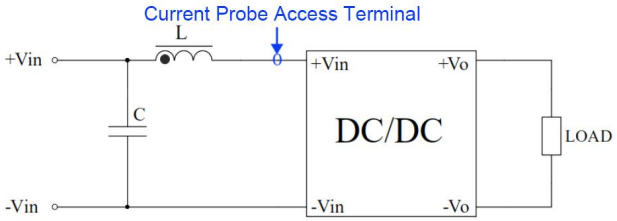

## Recommended Circuits for Application

1, All this series of converters will be tested according to this circuit diagram below before shipping. To increase the capacitance of C1 can decrease the output ripple, but the output capacitance must be less than the Max capacitance load defined.



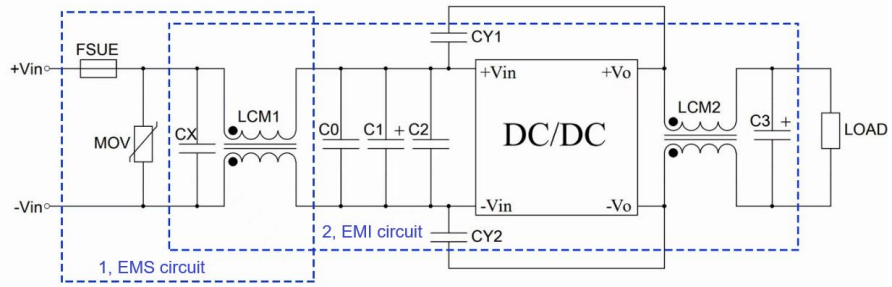

| Component | Parameter |
|---|---|
| C0 | 47-100uF/100V |
| C1 | 100uF/50V |

2, Input reflected ripple current test circuit diagram




| Component | Parameter |
|---|---|
| C | 220uF/100V |
| L | 4.7uH/15A |

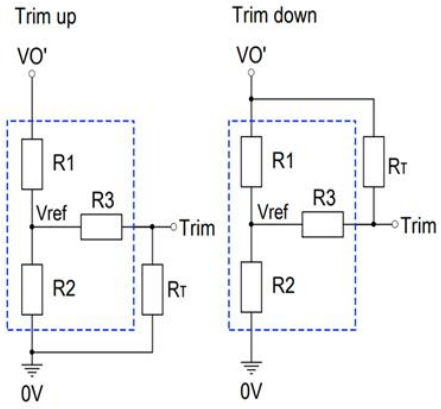
3, Recommended EMC circuit diagram




| Component | Vin=24V | Vin=48V |
|---|---|---|
| FUSE | TBD by the customer | |
| MOV | 14D560K | 14D101K |
| CX | 0.47uF | 0.47uF |
| LCM1 | 10mH | 10mH |
| C0, C2 | 1uF/100V | 1uF/100V |
| C1 | 220uF/100V | 220uF/100V |
| LCM2 | 30uH | 30uH |
| C3 | 47uF/ 50V | 47uF/ 50V |
| CY1, CY2 | 1nF/2000V | 1nF/2000V |

Note: Part 1 circuit is for EMS, part 2 for EMI filtering, both can be adjusted according to the actual situation.

4, Output voltage Trim and Calculation of Trim Resistance




Note: Trim up & down circuits, the components in the dotted area are inside of the converter.

**Rrim Resistance calculating fomula**

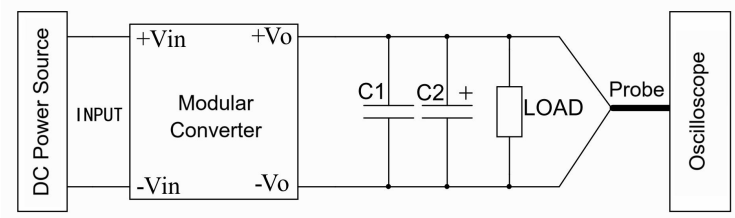
$$up:\ R_T=\frac{aR_2}{R_2-a}-R_3 \qquad a=\frac{Vref}{Vo'-Vref}\cdot R_1$$

$$down:\ R_T=\frac{aR_1}{R_1-a}-R_3 \qquad a=\frac{Vo'-Vref}{Vref}\cdot R_2$$

$R_T$ is the Trim resistance
a is a self-defined parameter
Vo' is the required Up-voltage or Down-voltage

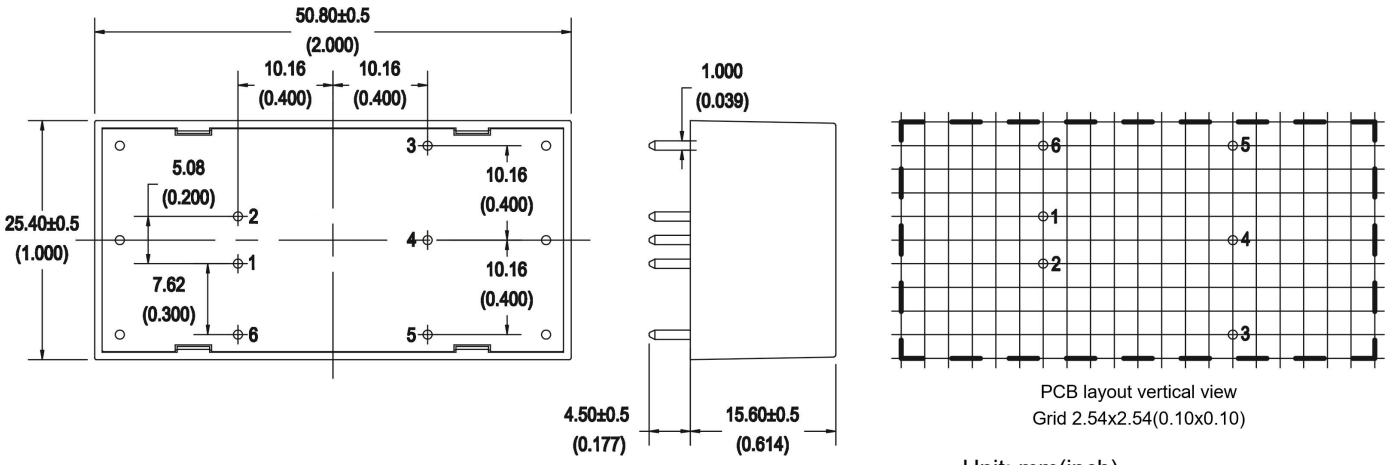
| Output voltage | Trim internal circuit parameters | | | |
|---|---|---|---|---|
| Vo (VDC) | R1(KΩ) | R2(KΩ) | R3(KΩ) | Vref(V) |
| 3.3 | 24 | 14.53 | 68 | 1.25 |
| 5 | 18 | 18 | 68 | 2.5 |
| 9 | 25.5 | 9.79 | 30 | 2.5 |
| 12 | 18 | 4.7 | 30 | 2.5 |
| 15 | 25.5 | 5.1 | 30 | 2.5 |
| 24 | 25.5 | 2.95 | 18 | 2.5 |

## Ripple & Noise Test Instruction (Parallel-line Method, 20MHz Bandwidth)




1. The Ripple & Noise test needs the cables in parallel, an oscilloscope that should be set at the Sample Mode, bandwidth 20MHz. 100M bandwidth probe with cap and ground removed. One polypropylene capacitor C1(0.1uF) and one high-frequency low-resistance electrolytic capacitor C2(10uF) are connected in parallel with the probe.
2. Refer to the test diagram, the converter output connects to the electronic load by the jig with cables which size should be defined according to the output current value. The test can start at the converter output terminals after the input power on.
3. It is recommended to use a ≥10% load or a high-frequency low resistance electrolytic capacitor (≥470uF) load at the output to avoid the output ripple increasing.

## Mechanical Dimensions




Unit: mm(inch)
Pin diameter tolerance: ±0.10(±0.004)
General tolerance: ±0.25(±0.010)

**Pin-out Function Description**

| Pin No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| PFD12-XXSXXB2C5 | -Vin | +Vin | +Vo | No Pin | GND | Ctrl |
| PFD12-XXSXXB2R5 | -Vin | +Vin | +Vo | Trim | GND | Ctrl |
| PFD12-XXSXXB2T5 | -Vin | +Vin | +Vo | Trim | GND | No Pin |
| PFD12-XXSXXB2N5 | -Vin | +Vin | +Vo | No Pin | GND | No Pin |

**Application Notice**

1.The product should be used according to the specifications, otherwise it could be permanently damaged.

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

3. The product performance cannot be guaranteed if it works under over-load condition.

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

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

6.The specifications are specially for the parts listed on 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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