

Typical Features

- ◆ Wide input voltage range (4:1), output power 12W
- ◆ Efficiency up to 89% (Typ.)
- ◆ Standby power consumption 0.15W (Typ.)
- ◆ Continuous short circuit protection, self-recovery
- ◆ Output over voltage & over current protections
- ◆ Isolation voltage 1500VDC
- ◆ Operating temperature from -40°C to +85°C
- ◆ Good EMI performance
- ◆ Standard pin-out alignment



Application Field

PFD12-XXSXXA3(C)2 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 12W output. This series of products can be widely used in the fields of Industrial control, Instrument, Communication, Electricity power, Internet of things, etc. Additional circuit diagram for EMC is recommended for the application with high EMC requirement.

Typical Product List

Certificate	Part No.	Input Voltage Range		Output Voltage/Current (Vo/Io)		Input Current (mA) Typ. @Nominal Volt.		Max. Capacitive Load (uF)	Efficiency (%) @Full load Nominal volt.	
		Nominal (VDC)	Range (VDC)	Vo (VDC)	Io (mA)	Full load	No load		Min	Typ
UL/CE	PFD12-18S3V3A3(C)2	24	9-36	3.3	2400/0	407	2	5000	79	81
UL/CE	PFD12-18S05A3(C)2	24	9-36	5	2000/0	502	2	3000	81	83
UL/CE	PFD12-18S06A3(C)2	24	9-36	6	2000/0	588	2	3000	83	85
UL/CE	PFD12-18S09A3(C)2	24	9-36	9	1333/0	581	2	1500	84	86
UL/CE	PFD12-18S12A3(C)2	24	9-36	12	1000/0	575	2	1000	85	87
UL/CE	PFD12-18S15A3(C)2	24	9-36	15	800/0	568	2	1000	86	88
UL/CE	PFD12-18S17A3(C)2	24	9-36	17	706/0	568	2	1000	86	88
UL/CE	PFD12-18S20A3(C)2	24	9-36	20	600/0	581	2	680	84	86
UL/CE	PFD12-18S24A3(C)2	24	9-36	24	500/0	568	2	470	86	88
-	PFD12-18S48A3(C)2	24	9-36	48	250/0	575	2	100	85	87
CE	PFD12-36S3V3A3(C)2	48	18-75	3.3	2400/0	211	2	5000	76	78
CE	PFD12-36S05A3(C)2	48	18-75	5	2000/0	251	2	3000	81	83
CE	PFD12-36S5V1A3(C)2	48	18-75	5.1	2353/0	301	2	3000	81	83
CE	PFD12-36S5V5A3(C)2	48	18-75	5.5	2181/0	297	2	3000	82	84
CE	PFD12-36S09A3(C)2	48	18-75	9	1333/0	291	2	1500	84	86
CE	PFD12-36S12A3(C)2	48	18-75	12	1000/0	287	2	1000	85	87
CE	PFD12-36S15A3(C)2	48	18-75	15	800/0	281	2	1000	87	89

CE	PFD12-36S24A3(C)2	48	18-75	24	500/0	284	2	1000	86	88
CE	PFD12-36S48A3(C)2	48	18-75	48	250/0	287	2	100	85	87

Note 1: 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 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: Please contact Aipu sales for other output voltages requirement of this series but not listed in this table.

Note 5: PFD12-36S5V1A3(C)2 output power should be derated to 10W at the input voltage from 18V to 24V.

Note 6: See below table for the certification details of the part numbers including suffixes.

Part No. (with suffix)	Certificate	Output voltage
PFD12-18SXXA3(C)2	UL & CE	3V3、05、06、09、12、15、17、20、24
PFD12-18SXXA3(C)2(-T)(-H)(-TS)(-TH)(-TSH)	NO	48
PFD12-36SXXA3(C)2	CE	3V3、05、5V1、5V5、09、12、15、24、48
PFD12-36SXXA3(C)2(-T)(-H)(-TS)(-TH)(-TSH)	NO	3V3、05、5V1、5V5、09、12、15、24、48

Input Specifications

Item	Test Conditions	Min	Typ.	Max	Unit
Standby power consumption	Full input voltage range	/	0.15	/	W
Maximum input current	Full input voltage range	/	/	1.6	A
Start-up voltage	Nominal 24V input series	/	7	9	VDC
	Nominal 48V input series	/	15	18	
Under-voltage protection	Nominal 24V input series	5.5	6.5	/	VDC
	Nominal 48V input series	12	13	/	
Input inrush voltage (1sec.max)	Nominal 24V input series	-0.7	/	50	VDC
	Nominal 48V input series	-0.7	/	100	
Reflected ripple current	Nominal 24V input series	/	40	/	mA
	Nominal 48V input series	/	30	/	
Input filter	/	Pi type filter			
Hog-plug	/	NA			
ON/OFF Control (Ctrl*)	Turn ON the converter	No connection or connected to high level (3.3-12VDC)			
	Turn OFF the converter	Connected to -Vin or low voltage level (0-1.2VDC)			
	Current value for switching off	/	2	/	mA

*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	/	±1	±3	%
Voltage regulation	Rated load, full input voltage range	/	±0.2	±0.5	%
Load regulation	Nominal input voltage, 5% - 100% load	/	±0.5	±1	%

Ripple & Noise	5% - 100% load, 20MHz bandwidth	/	50	100	mVp-p
Dynamic response time	25% load step, full input voltage range	/	300	500	uS
Dynamic response deviation	25% load step, nominal input voltage	/	±3	±5	%
Temperature drift coefficient	Full load	/	/	±0.03	%/°C
Turn-on delay time	Nominal input voltage	/	10	/	mS
Over voltage protection	Full input voltage range	110	160	200	%Vo
Output overshoot		/	/	10	%Vo
Output voltage Trim		90	/	110	%Vo
Over current protection		110	180	250	%Io
Short circuit protection		Continuous, self-recovery			

Note: Ripple & noise ≤5%Vo at 0% - 5% load, it is tested by the Parallel-line 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	/	+85	°C
Storage temperature			-55	/	+125	
Case temperature Max	Within the operating derating range		/	/	+105	
Pin soldering temperature	1.5mm from the case, timing 10S		/	/	+300	
Relative humidity	No condensation		5	/	95	%RH
Isolation voltage	I/P-O/P	Dielectric test 1min, leakage current <1mA	1500	/	/	VDC
	I/P&O/P-Case		1000	/	/	VDC
Insulation resistance	I/P-O/P	@500VDC	1000	/	/	MΩ
Isolation capacitance	I/P-O/P	100KHz/0.1V	/	1000	/	pF
MTBF	MIL-HDBK-217F@25°C		1000	/	/	K hours
Cooling method	Natural air					
Vibration	10-150Hz, 5G, 0.75mm, along X, Y and Z					
Case material	Aluminum					
Weights/Dimensions	Part No.	Weight (Typ.)	Dimensions L x W x H			
	PFD12-XXSXXA3(C)2	15g	25.4X 25.4X11.0 mm	1.00X1.00 X0.433 inch		
	PFD12-XXSXXA3(C)2-H	18g	25.4X 25.4X16.0 mm	1.00X1.00 X0.630 inch		
	PFD12-XXSXXA3(C)2 -T	36g	76.0X31.5X21.3 mm	2.99X1.24X0.838 inch		
	PFD12-XXSXXA3(C)2 -TH	39g	76.0X31.5X26.0 mm	2.99X1.24X1.023 inch		
	PFD12-XXSXXA3(C)2 -TS	56g	76.0X31.5X26.0 mm	2.99X1.24X1.023 inch		
	PFD12-XXSXXA3(C)2 -TSH	59g	76.0X31.5X30.8 mm	2.99X1.24X1.212 inch		

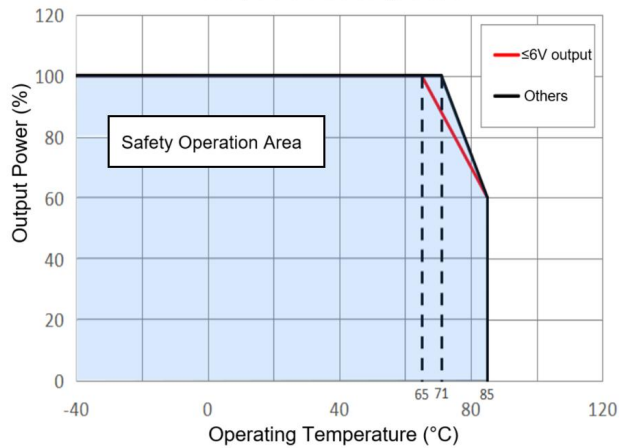
EMC Performance

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)

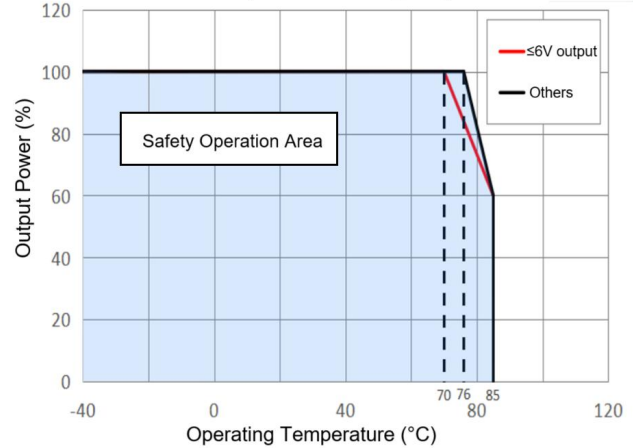
EMS	RS	IEC/EN61000-4-3	10V/m Perf. Criteria B (with the Recommended EMC circuit)
	CS	IEC/EN61000-4-6	3Vr.m.s Perf. Criteria B (with the Recommended EMC circuit)
	ESD	IEC/EN61000-4-2	Contact $\pm 4\text{KV}$ Perf. Criteria B
	Surge	IEC/EN61000-4-5	$\pm 2\text{KV}$ Perf. Criteria B (with the Recommended EMC circuit)
	EFT	IEC/EN61000-4-4	$\pm 2\text{KV}$ Perf. Criteria B (with the Recommended EMC circuit)

Temperature Derating Graphs

PFD12-XXSXXA3C2(without heatsink)
Temperature Derating Graph

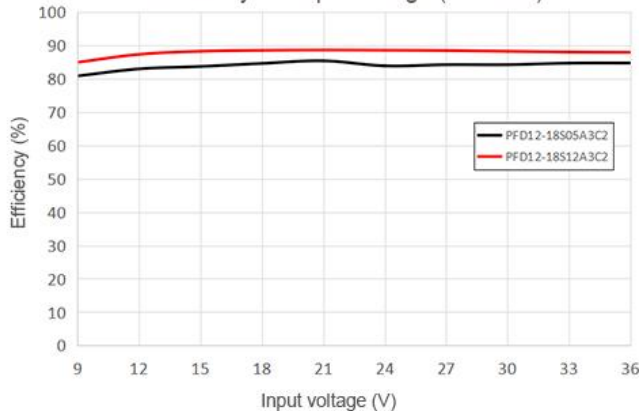


PFD12-XXSXXA3C2-H(with heatsink)
Temperature Derating Graph

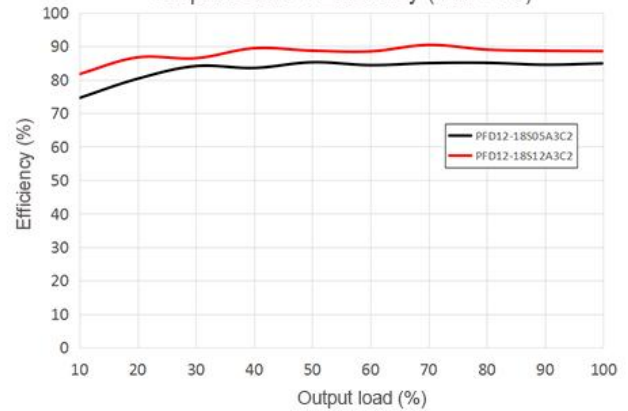


Efficiency Graphs

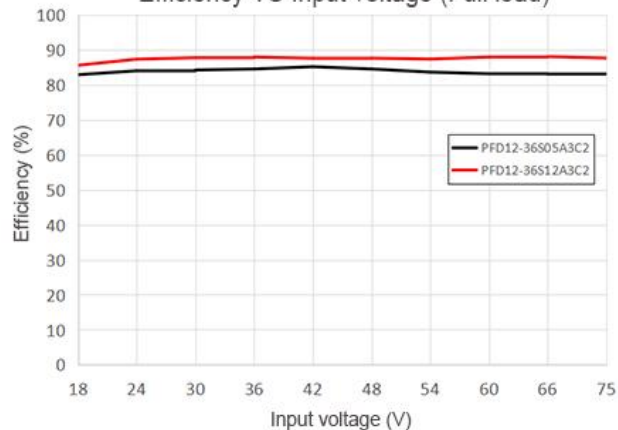
Efficiency VS Input voltage (Full load)



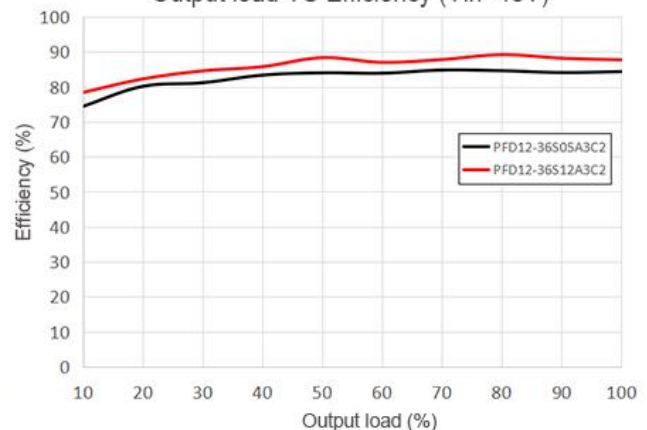
Output load VS Efficiency (Vin=24V)



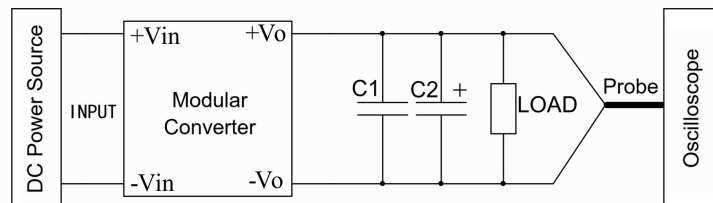
Efficiency VS Input voltage (Full load)



Output load VS Efficiency (Vin=48V)



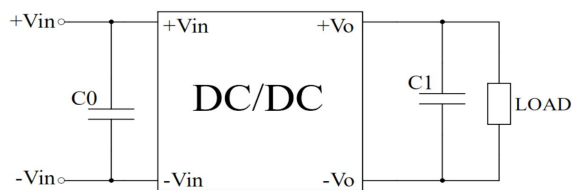
Ripple & Noise Test Instruction (Parallel-line Method, 20MHz Bandwidth)



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 impedance 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 $\geq 5\%$ load or a high frequency low impedance electrolytic capacitor ($\geq 100\mu\text{F}$) load at the output to avoid the output ripple increasing.

Recommended Circuits for Application

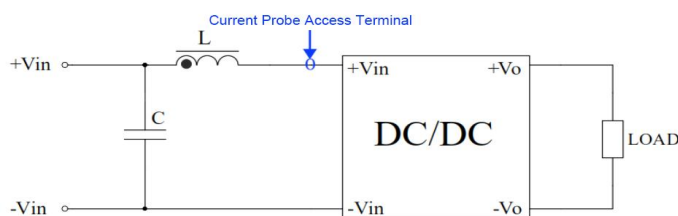
1. DC/DC test circuit diagram



Components	Parameter
C0	100uF/100V
C1	47uF/50V

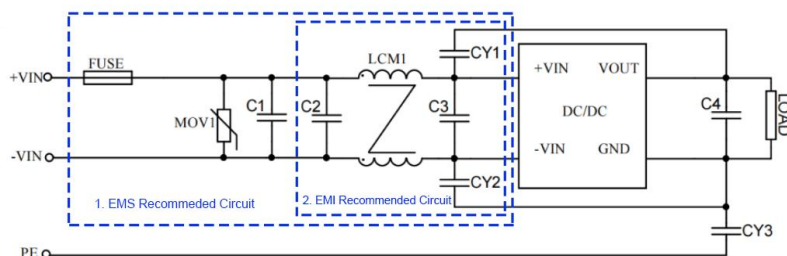
2. Input reflected ripple current test circuit diagram

A low ESR capacitor is recommended for C which withstanding voltage should be more than the maximum input voltage.



Components	Parameter
C	220uF
L	4.7uH

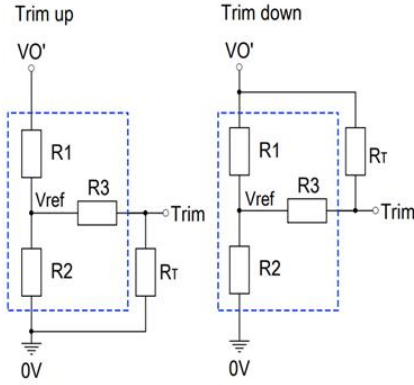
3. Recommended EMC circuit diagram



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

Components	24V input series	48V input series
FUSE	TBD by the customer	
MOV1	14D560K	14D101K
LCM1	5mH	5mH
C1, C2, C3	330uF/50V	330uF/100V
C4	47uF/50V	47uF/50V
CY1, CY2	2.2nF/2000V	

4. Output voltage Trim and Calculation of Trim Resistance



Trim Resistance calculating fomula

$$\begin{aligned} \text{up: } R_T &= \frac{\alpha R_2}{R_2 - \alpha} - R_3 & \alpha &= \frac{V_{ref}}{V_{0'} - V_{ref}} \cdot R_1 \\ \text{down: } R_T &= \frac{\alpha R_1}{R_1 - \alpha} - R_3 & \alpha &= \frac{V_{0'} - V_{ref}}{V_{ref}} \cdot R_2 \end{aligned}$$

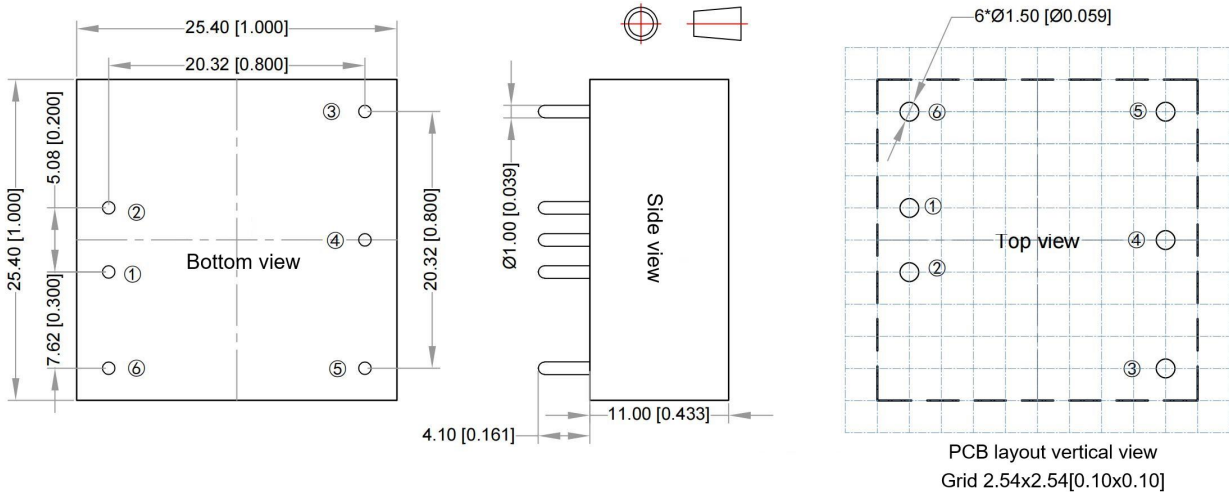
R_T is the Trim resistance
 α is a self-defined parameter
 $V_{0'}$ is the required Up-voltage or Down-voltage

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

Output Voltage	Internal circuit parameters for Trim			
V_o (VDC)	R_1 (K Ω)	R_2 (K Ω)	R_3 (K Ω)	V_{ref} (V)
3.3	4.22	2.55	18	1.25
5	5.1	5.1	20	2.5
9	9.31	3.58	24	2.5
12	18	4.75	33	2.5
15	18	3.6	30	2.5
24	30	3.48	30	2.5
48	45.3	2.47	18	2.5

Note: The Trim function works only for the output voltages in this table.

Mechanical Dimensions (without heat sink)

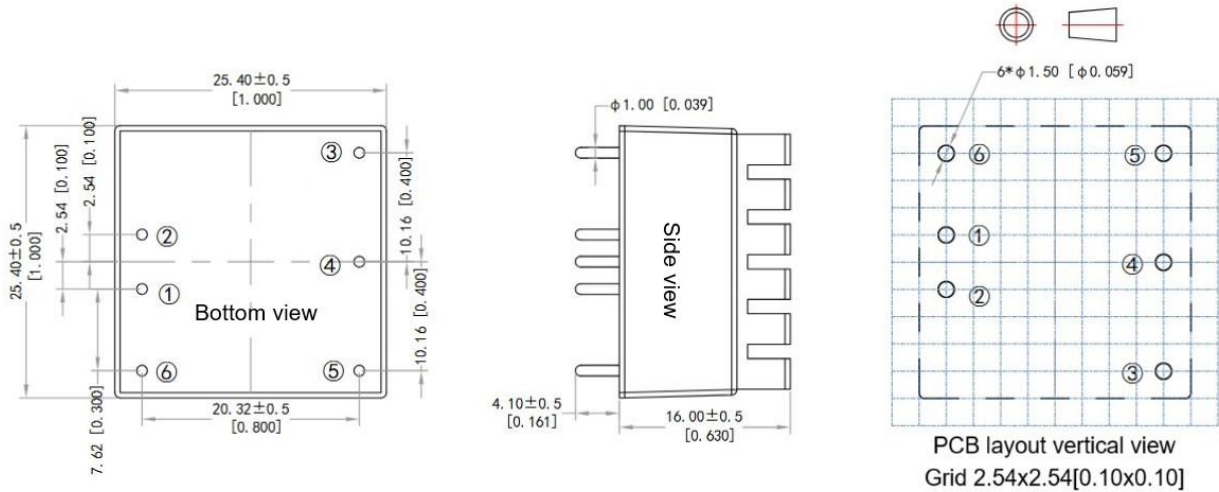


Unit: mm[inch]
General tolerance: $\pm 0.50 [\pm 0.020]$
Pin diameter tolerance: $\pm 0.10 [\pm 0.004]$

Pin-out Function Description

Pin No.	1	2	3	4	5	6
PFD12-XXSXXA3R2	-Vin	+Vin	+Vo	Trim	GND	Ctrl

-H Package Dimensions (with heat sink)

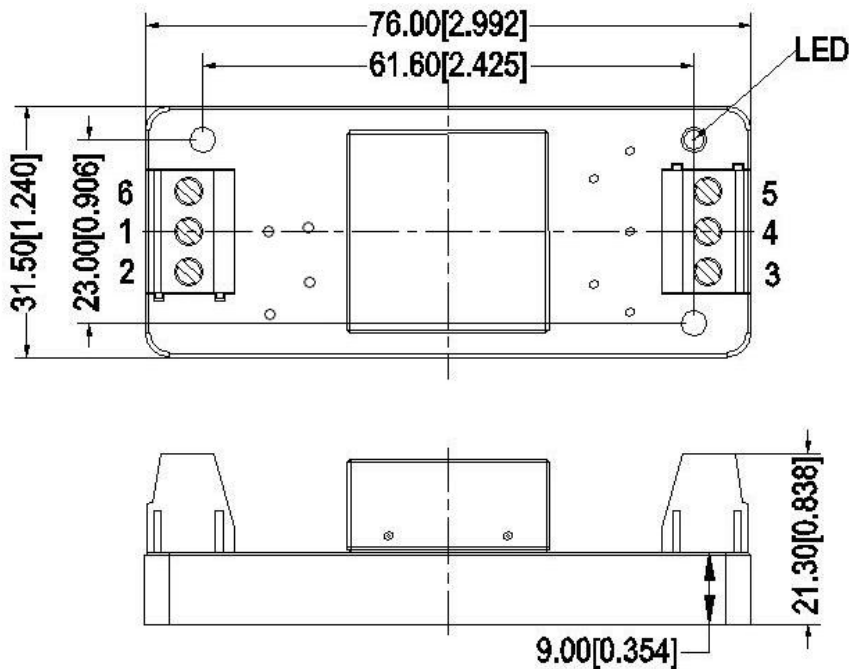


Unit: mm(inch)
 General tolerance: ±0.50(±0.020)
 Pin diameter tolerance: ±0.10(±0.004)

Pin-out Function Description

Pin No.	1	2	3	4	5	6
PFD12-XXSXXA3R2	-Vin	+Vin	+Vo	Trim	GND	Ctrl

-T Package Dimensions (without heat sink)

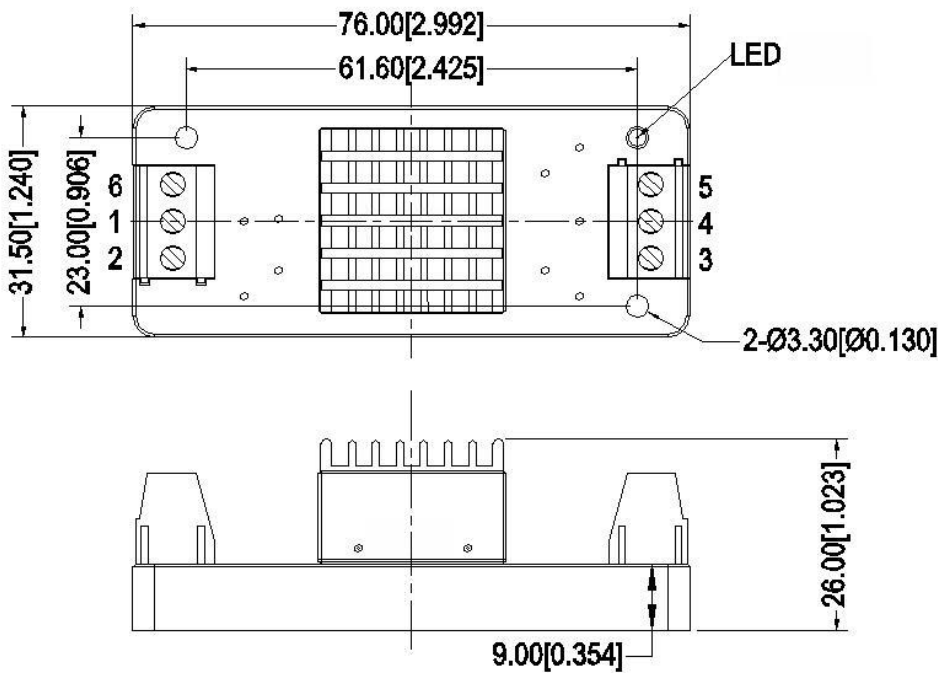


Note:
 Unit: mm [inch]
 Lead wires gauge: 24-12AWG
 Screwing torque: 0.4N.m Max
 General tolerance: ±1.00[±0.039]

Terminal Function Description

Terminal No.	1	2	3	4	5	6
PFD12-XXSXXA3R2	-Vin	+Vin	+Vo	Trim	GND	Ctrl

-TH Package Dimensions (with heat sink)

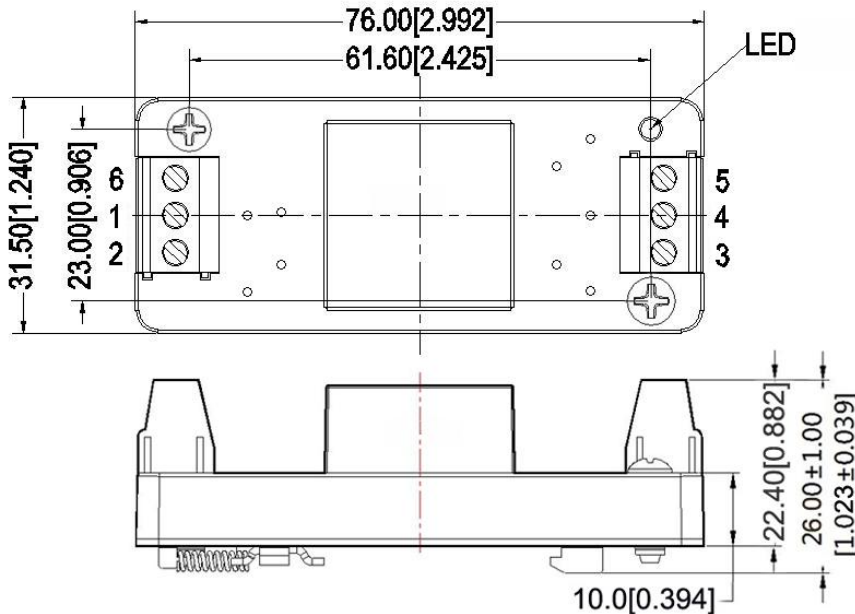


Note:
Unit: mm [inch]
Lead wires gauge: 24-12AWG
Screwing torque: 0.4N.m Max
General tolerance: $\pm 1.00[\pm 0.039]$

Terminal Function Description

Terminal No.	1	2	3	4	5	6
PFD12-XXSXXA3R2	-Vin	+Vin	+Vo	Trim	GND	Ctrl

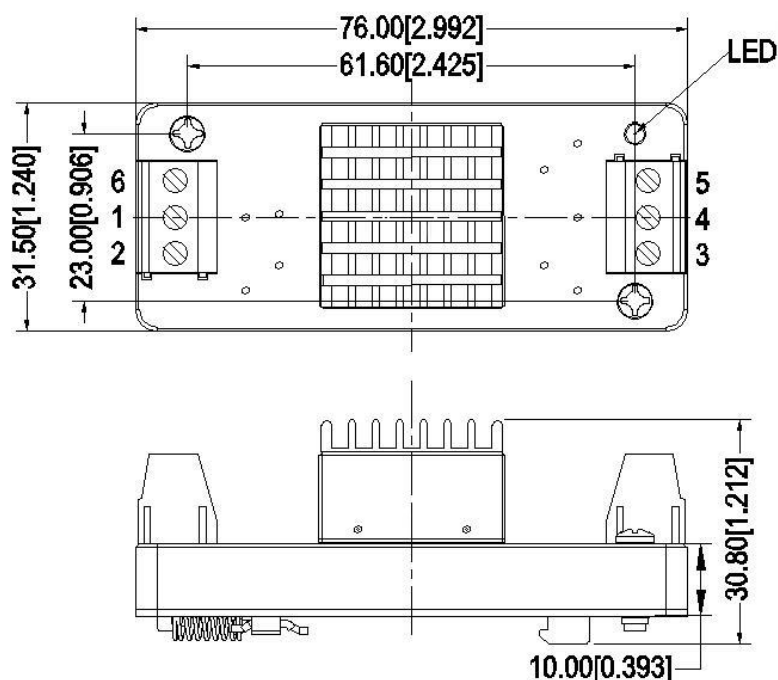
-TS Package Dimensions (without heat sink)



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

Terminal Function Description

Terminal No.	1	2	3	4	5	6
PFD12-XXSXXA3R2	-Vin	+Vin	+Vo	Trim	GND	Ctrl

-TSH Package Dimensions (with heat sink)

Note:

Unit: mm [inch]

Lead wires gauge: 24-12AWG

Screwing torque: 0.4N.m Max

General tolerance: $\pm 1.00 [\pm 0.039]$ **Terminal Function Description**

Terminal No.	1	2	3	4	5	6
PFD12-XXSXXA3R2	-Vin	+Vin	+Vo	Trim	GND	Ctrl

Other Models Terminal Function Description

Pin/Terminal No.	1	2	3	4	5	6
PFD12-XXSXXA3N2	-Vin	+Vin	+Vo	No Pin	GND	No Pin
PFD12-XXSXXA3C2	-Vin	+Vin	+Vo	No Pin	GND	Ctrl
PFD12-XXSXXA3T2	-Vin	+Vin	+Vo	Trim	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 $T_a=25^{\circ}\text{C}$, 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. The product should operate under the condition of nature air, please contact us if it could be used at a closed space.
8. Aipupower can provide customization service.

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