Typical Features

- ◆ Wide input voltage range (4:1), output power 60W
- ◆ Efficiency up to 93% (Typ.)
- ◆ Standby power consumption 0.7W (Typ.)
- ◆ Continuous short circuit protection, self-recovery
- ◆ Over voltage, short circuit & over current protections
- ◆ Isolation voltage 1500VDC
- ◆ Operating temperature from -40°C to +105°C
- ◆ Good EMI performance
- ◆ With CE certificate
- ◆ Standard pin-out alignment

CE
EN62368-1

Application Field

FD60-XXSXXB3R2 Series --- DC-DC modular converters with 4:1 wide input voltage range, fast start-up, isolated & regulated single output 60W, DIP/Chassis/DIN-rail flexible mounting options, isolation voltage 1500VDC, with input under voltage protection, output over current, short circuit, over voltage protections. This series of products can be widely used in fields of Industrial control, Electric power, Communications, Industrial robots and Railway electronic devices, etc. The 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		Input Current (mA) Typ. @Nominal Volt.		Max. Capacitive Load	Efficiency (%) @Full load, Nominal Volt.	
		Nominal (VDC)	Range (VDC)	Vo (VDC)	Io (mA)	Full load	No Load	(uF)	Min	Typ.
CE	FD60-18S05B3R2	24	9-36	5	12000	2718	30	10000	90	92
CE	FD60-18S12B3R2			12	5000	2688	30	6000	91	93
CE	FD60-18S15B3R2			15	4000	2688	30	4000	91	93
CE	FD60-18S24B3R2			24	2500	2688	30	2000	91	93
CE	FD60-36S05B3R2	48	18-75	5	12000	1359	15	10000	90	92
CE	FD60-36S12B3R2			12	5000	1344	15	6000	91	93
CE	FD60-36S15B3R2			15	4000	1344	15	4000	91	93
CE	FD60-36S24B3R2			24	2500	1344	15	2000	91	93

Note 1: The part number letter R indicates the parts with both ON/OFF control & output voltage Trim functions.

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).

Note 3: The efficiency is tested at the 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: Please contact Aipu sales for other output voltages requirement in this series but not listed in this table.

Input Specifications

Item	Test Conditions	Min	Typ.	Max	Unit
Standby power consumption	Full input voltage range	/	0.7	/	W
Input current Max	Nominal voltage 24V series	/	/	8.5	A
	Nominal voltage 48V series	/	/	3.6	
Start-up voltage	Nominal voltage 24V series	/	8	9	VDC
	Nominal voltage 48V series	/	16	18	
Under voltage protection	Nominal voltage 24V series	/	7	/	
	Nominal voltage 48V series	/	15	/	
Input inrush voltage (1Sec.max)	Nominal voltage 24V series	-0.7	/	50	
	Nominal voltage 48V series	-0.7	/	100	
Input filter	/	Pi filter			
Hot-plug	/	Unavailable			
ON/OFF Control (Ctrl)	Turn ON the converter	No connection or connected to high level (3V-12VDC)			
	Turn OFF the converter	Connected to -Vin or the low voltage level (0-1.2VDC)			
	Current value for switching off	/	30	/	mA

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

Output Specifications

Items	Test Conditions		Min	Typ.	Max	Unit
Output voltage accuracy	Full input voltage range		/	±1	±2	%
Voltage regulation	Full input voltage range, rated load		/	±0.2	±0.5	%
Load regulation	Nominal input voltage, 5%~100% load		/	±0.5	±1	%
Ripple & Noise	5%-100% load, 20MHz bandwidth	Output ≤15V	/	120	350	mVp-p
		Output 24V	/	150	350	
Dynamic response time	25% rated load step, full input voltage range		/	300	500	uS
Dynamic response deviation	25% rated load step, nominal input voltage	Output 5V	/	±5	±10	%
		Others	/	±3	±5	
Temperature drift coefficient	/		/	/	±0.03	%/°C
Turn-on delay time	Nominal input voltage		/	50	150	mS
Output voltage Trim	Full input voltage range		90	/	110	%Vo
Output start-up overshoot			/	/	10	%Vo
Over voltage protection			110	140	160	%Vo
Over current protection			110	140	200	%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

Items	Test Conditions	Min	Typ.	Max	Unit
Switching frequency	Operating mode（PWM）	/	370	/	KHz
Operating temperature	Refer to the Temperature Derating Graph	-40	/	+105	℃

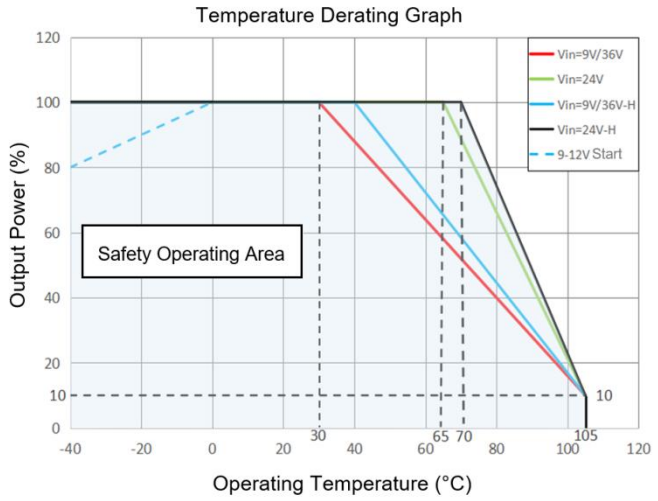
Storage temperature	/	-55	/	+125	℃
Case temperature Max	Within the temperature derating range	/	/	+105	℃
Pin soldering temperature	1.5mm from the case, soldering time 10S	/	/	300	
Relative humidity	No condensation	5	/	95	%RH
Isolation voltage	I/P-O/P, test 1 Min, leakage current <1mA	1500	/	/	VDC
	I/P&O/P-CASE, test 1 Min, leakage current <1mA	1000	/	/	VDC
Isolation capacitance	I/P-O/P, 100KHz/0.1V	/	2200	/	pF
Insulation resistance	I/P-O/P, @500VDC	100	/	/	mΩ
MTBF	MIL-HDBK-217F@25℃	1000	/	/	KHrs
Vibration	10-150Hz, 5G, 0.75mm, along X, Y and Z				
Cooling method	Nature air				
Case material	Aluminum				

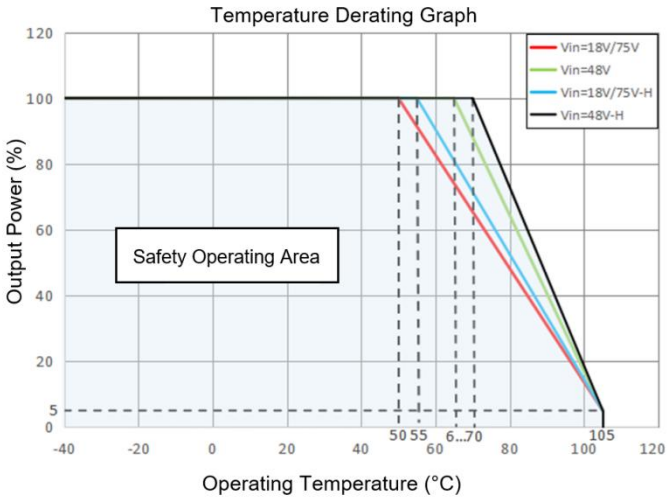
Weights & Dimensions	Part No.	Weight (Typ.)	Dimensions L x W x H	
	FD60-XXSXXB3R2	41g	50.8 X 25.4 X 11.8 mm	2.00 X 1.00 X 0.464 inch
	FD60-XXSXXB3R2-H	53g	50.8 X 25.4 X 21.8 mm	2.00 X 1.00 X 0.858 inch
	FD60-XXSXXB3R2-T	62g	76.0 X 31.5 X 21.3 mm	2.99 X 1.24 X 0.838 inch
	FD60-XXSXXB3R2-TH	74g	76.0 X 31.5 X 31.0 mm	2.99 X 1.24 X 1.220 inch
	FD60-XXSXXB3R2-TS	82g	76.0 X 31.5 X 26.0 mm	2.99 X 1.24 X 1.023 inch
	FD60-XXSXXB3R2-TSH	94g	76.0 X 31.5 X 35.5 mm	2.99 X 1.24 X 1.397 inch

EMC Performance

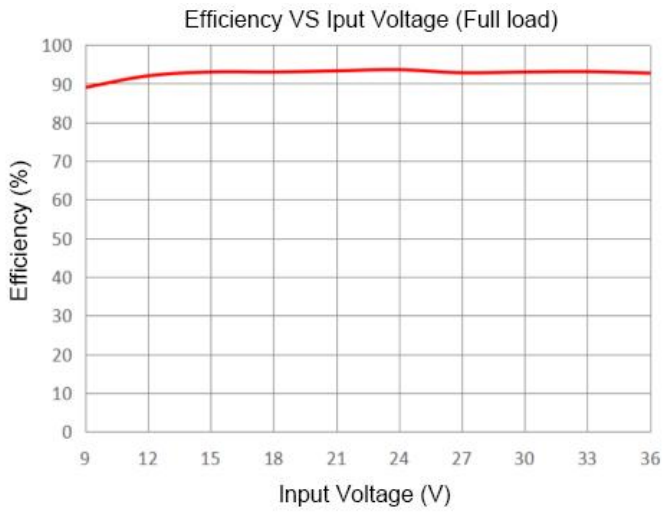
Items		Test Standards	Performance/Class
EMI	CE	CISPR32/EN55032	CLASS B (with the Recommended EMC Circuit)
	RE	CISPR32/EN55032	CLASS B (with the Recommended EMC Circuit)
EMS	RS	IEC/EN61000-4-3	10V/m Perf. Criteria A (with the Recommended EMC Circuit)
	CS	IEC/EN61000-4-6	3Vr.m.s Perf. Criteria A (with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

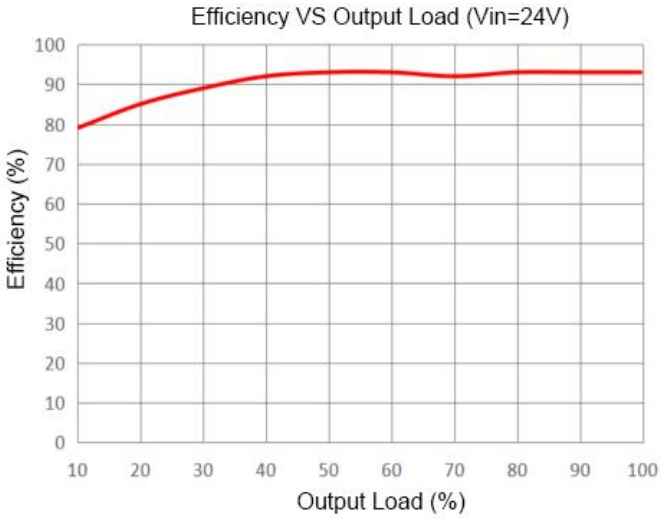
Temperature Derating Graphs

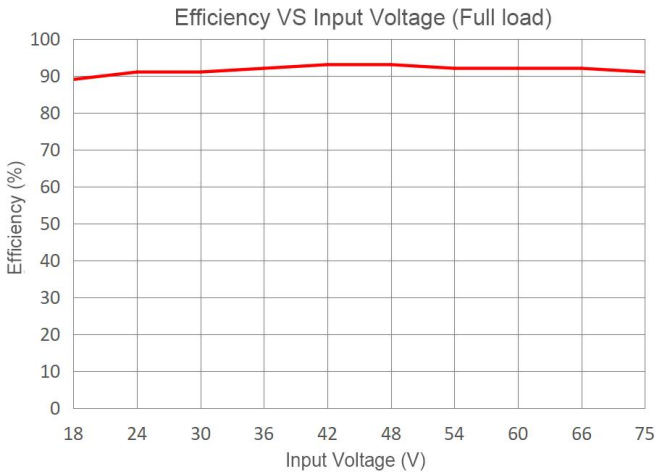


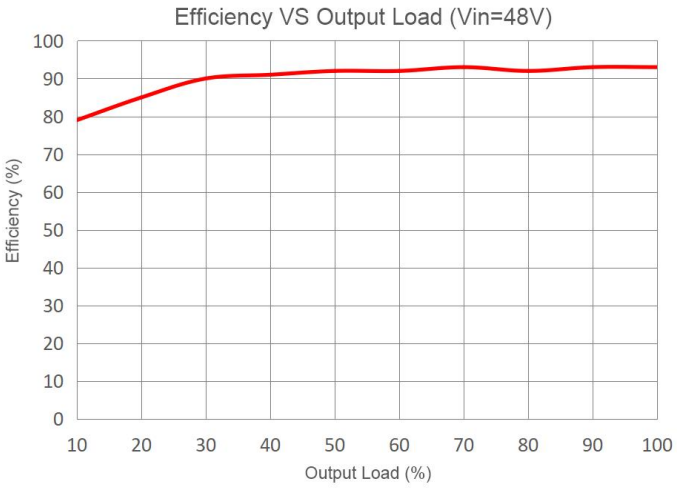


Efficiency Graphs

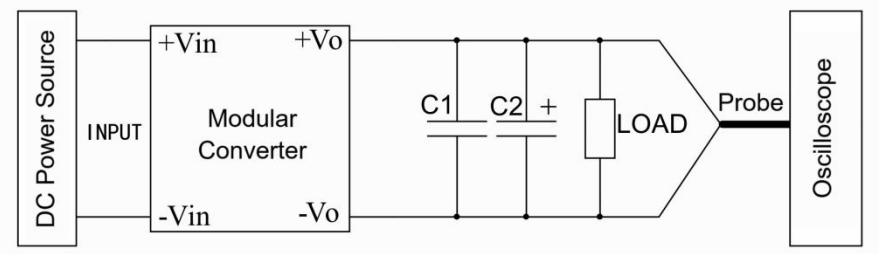








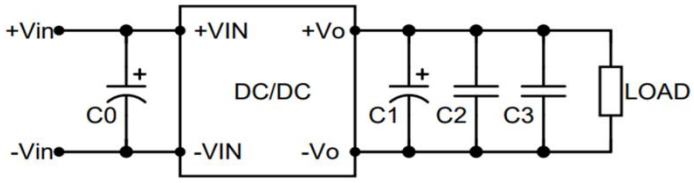
Ripple & Noise Test Instruction (Parallel-line method, 20MHz Bandwidth)



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 input power on.
3. It is recommended to connect a ≥5% load or a high-frequency low impedance electrolytic capacitor (≥470uF) load at the output to avoid the output ripple increasing.

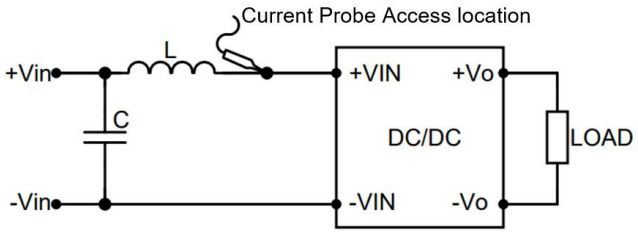
Recommended Circuits for Application

1. **DC/DC test circuit diagram**



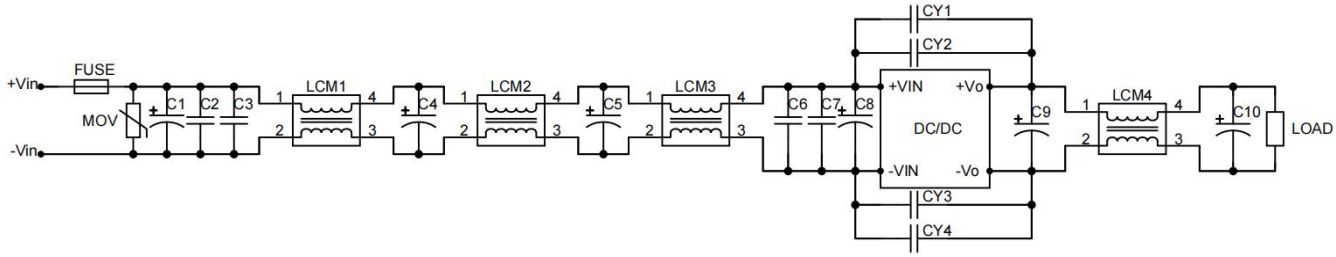
Vout (VDC)	C0	C1	C2	C3
5	100uF 100V	330uF/50V	1uF/16V	10uF/16V
12			1uF/25V	10uF/25V
15		100uF/50V	1uF/25V	10uF/25V
24			1uF/50V	10uF/50V

2. **Input reflected ripple current test circuit diagram**



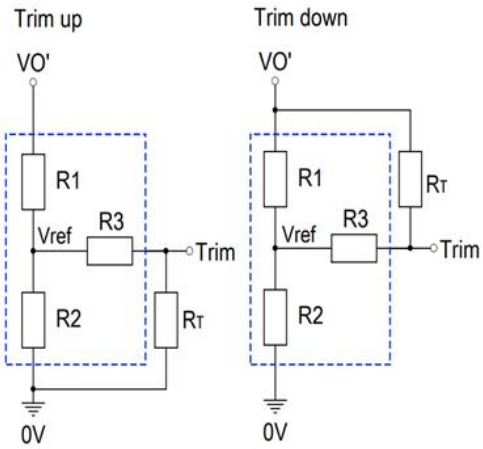
Components	Parameters
C	220uF/100V
L	4.7uH/15A

3. **Recommended EMC circuit diagram**



Component No.	Nominal 24V input series	Nominal 48V input series
FUSE	TBD by the customer	
MOV	14D470K	14D101K
LCM1	2.2mH	
LCM2	1.0mH	
LCM3, LCM4	270uH	
C1, C4, C5, C8	330uF/100V	
C2, C3	4.7uF/100V	
C6, C7	10uF/100V	
C9, C10	100uF/100V	
CY1, CY3	2.2nF/2KV	
CY2, CY4	10nF/2KV	

4. Output voltage Trim and calculation of Trim resistance



Rrim Resistance calculating fomula

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

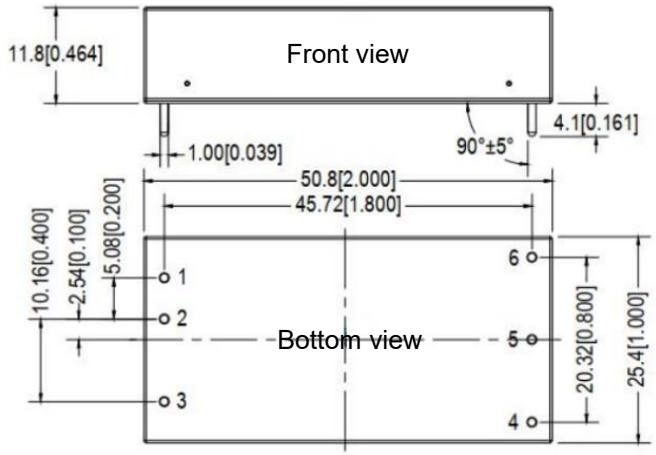
$$down:\ R_T=\frac{aR_1}{R_1-a}-R_3 \qquad a=\frac{Vo'-Vref}{Vref}\cdot R_2$$

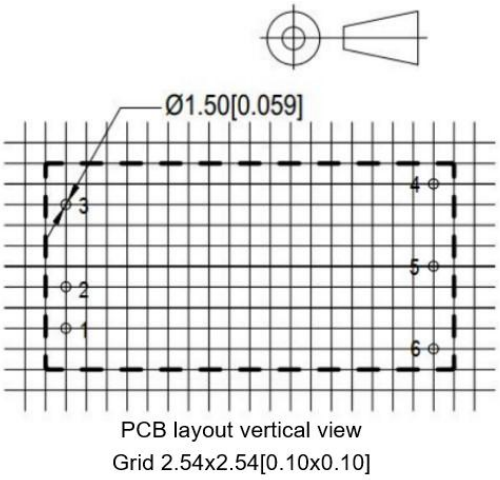
R_T is the Trim resistance
a is a self-defined parameter
Vo' is the required Up-voltage or Down-voltage

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

Output Voltage	Internal circuit components parameters			
Vout (VDC)	R1(KΩ)	R2(KΩ)	R3(KΩ)	Vref(V)
5	2.91	2.87	6.1	2.5
12	11.00	2.87	6.1	2.5
15	14.39	2.87	6.1	2.5
24	24.73	2.87	6.1	2.5

Mechanical Dimensions (without Heat Sink)





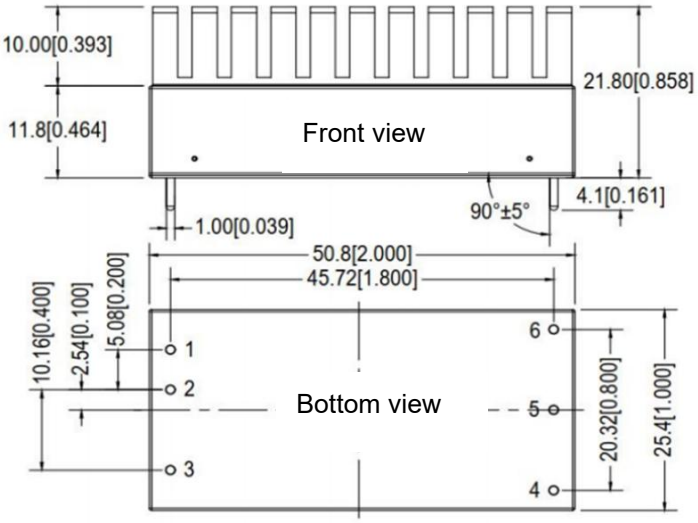
PCB layout vertical view
Grid 2.54x2.54[0.10x0.10]

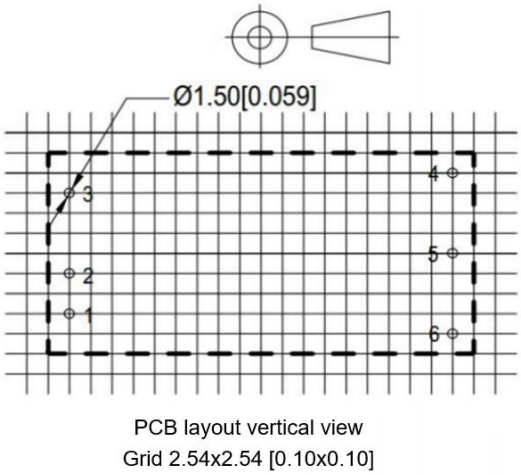
Unit: mm[inch]
Pin diameter tolerance: ±0.10[±0.004]
General tolerance: ±0.50[±0.020]

Pin-out Function Description

Pin No.	1	2	3	4	5	6
FD60-XXSXXB3R2	+Vin	-Vin	Ctrl	Trim	-Vo	+Vo

-H Mechanical Dimensions (with Heat Sink)





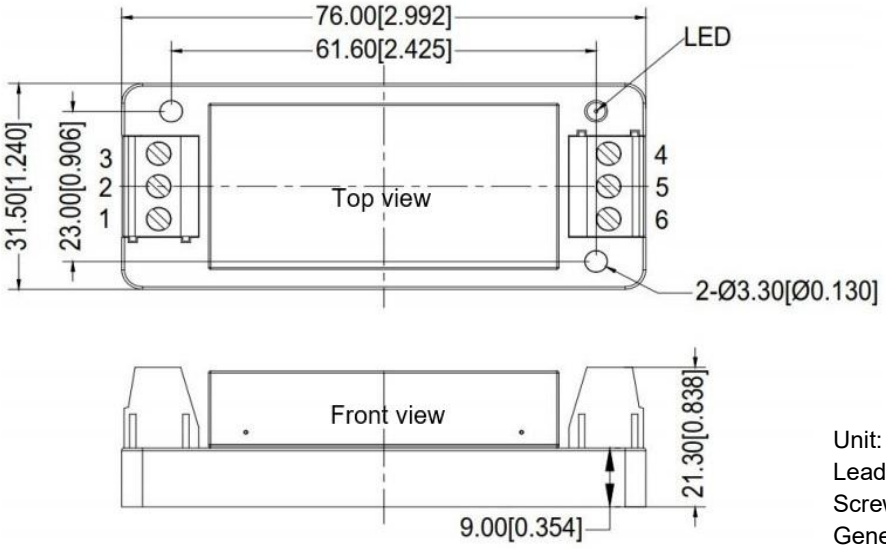
PCB layout vertical view
Grid 2.54x2.54 [0.10x0.10]

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

Pin-out Function Description

Pin No.	1	2	3	4	5	6
FD60-XXSXXB3R2	+Vin	-Vin	Ctrl	Trim	-Vo	+Vo

-T Mechanical Dimensions (without Heat Sink)

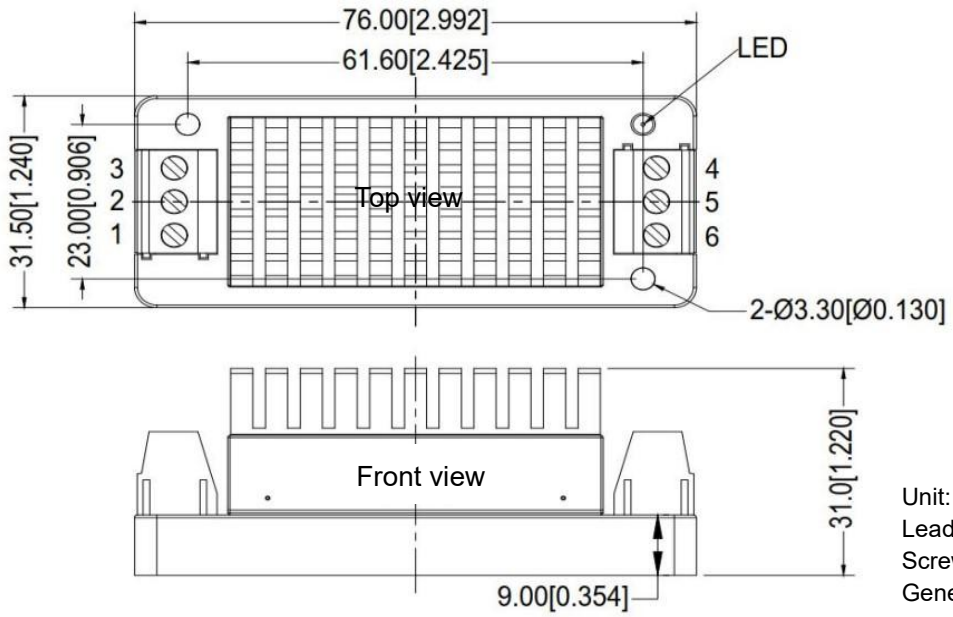


Unit: mm[inch]
Lead wires gauge: 24-12AWG
Screwing torque: 0.4N.m Max
General tolerance: ±1.00[±0.039]

Terminal Function Description

Terminal No.	1	2	3	4	5	6
FD60-XXSXXB3R2	+Vin	-Vin	Ctrl	Trim	-Vo	+Vo

-TH Mechanical Dimensions (with Heat Sink)

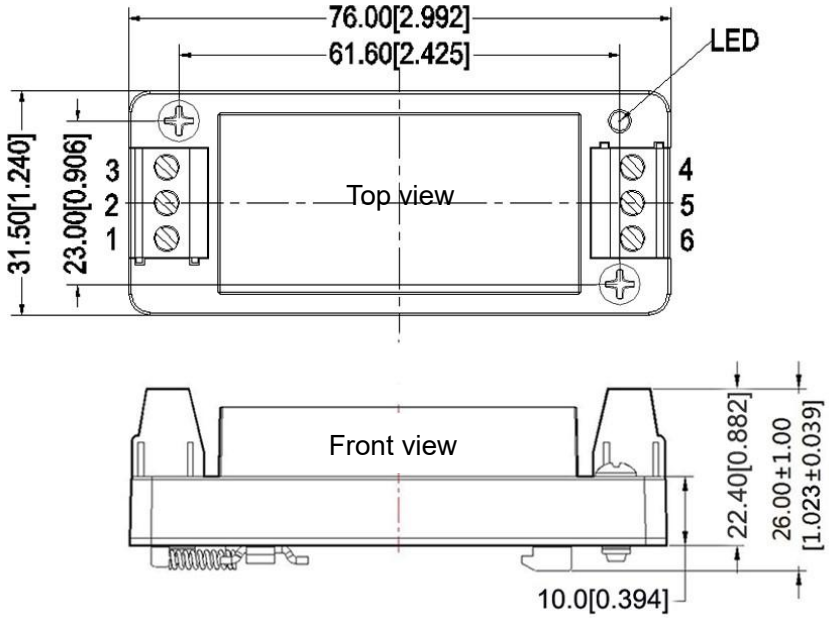


Unit: mm[inch]
Lead wires gauge: 24-12AWG
Screwing torque: 0.4N.m Max
General tolerance: ±1.00[±0.039]

Terminal Function Description

Terminal No.	1	2	3	4	5	6
FD60-XXSXXB3R2	+Vin	-Vin	Ctrl	Trim	-Vo	+Vo

-TS Mechanical Dimensions (without Heat Sink)

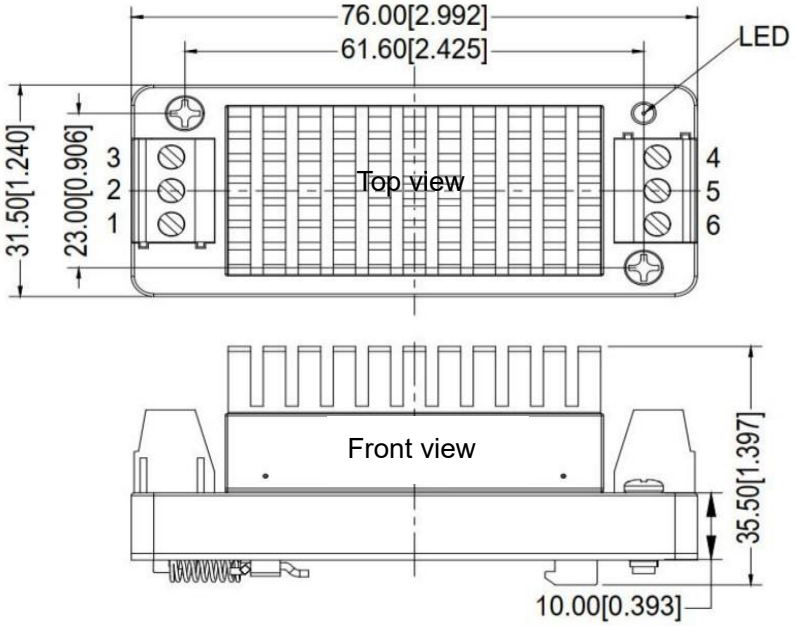


Unit: mm[inch]
Lead wires gauge: 24-12AWG
Screwing torque: 0.4N.m Max
General tolerance: ±1.00[±0.039]

Terminal Function Description

Terminal No.	1	2	3	4	5	6
FD60-XXSXXB3R2	+Vin	-Vin	Ctrl	Trim	-Vo	+Vo

-TSH Mechanical Dimensions (with Heat Sink)



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
FD60-XXSXXB3R2	+Vin	-Vin	Ctrl	Trim	-Vo	+Vo

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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