Descriptions

DC-DC converter



RoHS

Features

- Ultra-wide input voltage range: 9 - 60VDC
- Output voltage range: 0 - 60VDC
- High efficiency up to 98%
- With output Oring-fet inside module
- Protections: input under-voltage, input over-voltage,output over-voltage, short-circuit, output over-current, over-temperature
- Parallel support（4 pcs）
- Operating ambient temperature range: -40℃ to 100℃(case temperature)
- Industry standard half-Brick package and pin-out

Applications

- Robotics
- Communications
- battery management
- DC-DC distributed power supply

Selection Guide

Certification	Part No.	Input			Output	
		Nominal (Range) (VDC)	Max.① (VDC)	Current② (A) Max.	Voltage (Range) (VDC)	Current② (A) Max.
--	DNUHB50-B6060	9-60	60	50	0-60	50

Note:
①The input voltage should not exceed this value, otherwise permanent and unrecoverable damage may be caused.
②When Vin > Vo，the output current does not exceed 50A;when Vin≤Vo，the input current does not exceed 50A.

Typical input-output Efficiency

Input	Output			Efficiency (%)
Voltage(VDC)	Voltage(VDC)	Current(A)	Power(W)	Typ.
60	60	50	3000	97.0
	48	50	2400	98.0
	24	50	1200	96.0
	12	50	600	92.5
48	12	50	600	93.0
	24	50	1200	96.0
	24	40	960	96.5
	24	20	480	97.0
	48	50	2400	97.0
	48	20	960	98.0
28	12	50	600	93.5
	12	40	480	94.5
	12	20	240	96.0
	48	20	960	96.0
12	48	12.5	600	93.0
	48	10	480	93.0
	48	5	240	94.0

Specifications

Product Specifications	Item	Operating Conditions③	Min.	Typ.	Max.	Unit
Input Specifications	Input Current (no-load)	Vin=48V，Vout=12V，Io=0A	--	100	--	mA
		Vin=48V，Vout=24V，Io=0A	--	140	--	
		Vin=48V，Vout=36V，Io=0A	--	160	--	
		Vin=48V，Vout=48V，Io=0A	--	260	--	
		Vin=28V，Vout=12V，Io=0A	--	100	--	
		Vin=28V，Vout=24V，Io=0A	--	90	--	
		Vin=28V，Vout=48V，Io=0A	--	180	--	
	Reflected Ripple Current	Vin=48V，Vout=24V，Io=50A	--	150	--	
	Surge Voltage	1sec. Max.	--	--	80	VDC
	Start-up Voltage		7	--	9	
	Under-voltage Protection		5	--	7	
	Over-voltage Protection	self-recovery	--	65	--	
	Input Filter		PI filter			
	Hot Plug		Unavailable			
	Input Reverse Polarity Protection					
	Input Current Limit	Input Voltage	--	--	55	A
	Ctrl	Module on	Ctrl pin pulled GND or pulled low (0-0.6 VDC)			

		Module off	Ctrl pin open or pulled TTL to high (2.5-5.5 VDC)			
		Input current when off	--	2	--	mA
Output Specifications	Output voltage accuracy①	3.3V-60Vo，5%Io-100%Iomax	±100mV ±2%*Vout-2%*Vout*Iout/Iomax			
		3.3V-60Vo，0%Io-5%Iomax	±100mV ±3%*Vout -2%*Vout*Iout/Iomax			
	Load Regulation	Nominal input voltage, 5%Io-100%Iomax	-2%*Vout*Iout/Iomax（typ.）			
	Transient Response Deviation	Vin=28V, Vo=12V, 25% load step change, 0.1A/uS	--	600	--	mV
	Transient Recovery Time	Vin=28V, Vo=12V, 25% load step change, 0.1A/uS	--	400	--	uS
	Temperature Coefficient	Operating temperature -40℃ to +100℃	--	±0.02	--	%/℃
	Ripple & Noise②	20MHz bandwidth,Vin=28V，Vout=12V，Io=50A	--	50	--	mVp-p
		20MHz bandwidth,Vin=28V，Vout=24V，Io=50A	--	450	--	
		20MHz bandwidth, Vin=28V，Vout=48V，Io=23A	--	300	--	
	Over-temperature Protection	Maximum surface temperature of the product	--	105	--	℃
	Output Over-voltage Protection	Input voltage range, output power range, self-recovery	--	65	--	VDC
	Output Current Limit	Input voltage range, output power range	--	55	--	A
	Over current &Short-circuit Protection	Input voltage range	constant current			
	Iset	Input to set maximum output current	See Iset function for output current adjustment			
		Pin Voltage floating	--	3.3	--	V
		Adjustable range of output current	0	--	50	A
	Vset	Input to set output voltage	See Vset function for output voltage adjustment			
		Pin Voltage floating	--	2.5	--	VDC
		Adjustable range of output voltage	0	--	60	
	Sense	See part of Remote Sense Application	See Sense function adjustment			
		Sense compensation voltage range	--	--	105	%Vo
	Ishare	Current detection	IshareThe relationship between voltage and output current Io is shown in Figure 10			
		Current sharing, four modules can be connected in parallel	Current detection and sharing Ishare design and precautions for use 2			
General Specifications	Isolation	Input/Output - Shell, Electric Strength Test for 1 minute with a leakage current of 1mA max.	500	--	--	VDC
	Operating Temperature④		-40	--	+100	℃
	Storage Temperature		-55	--	+125	
	Storage Humidity	Non-condensing	5	--	95	%RH
	Pin Soldering Resistance Temperature	Wave-soldering, max. 10 second	+255	+260	+265	℃
		Soldering spot is 1.5mm away from case for 10 seconds	--	--	+300	
	Pollution Degree		PD 3			

	Vibration	10-150Hz, 5g, 0.75mm, 90 Min. along X, Y and Z				
	Switching Frequency	Full load, nominal input voltage	--	270	--	kHz
	Operating altitude	Altitude: ≤2000m, Atmospheric pressure: 80-110KPa				
	MTBF	MIL-HDBK-217F@25℃	500	--	--	k hours
Mechanical Specifications	Case Material	Aluminum alloy				
	Dimensions	63.14 × 60.6 × 12.70 mm				
	Weight	150 g(Typ.)				
	Cooling Method	Free air convection forced convection				

Note:

①When the output voltage is less than 3.3V, the module operates in non regulated mode.

②The testing method for ripple and noise adopts the reliable measurement method.

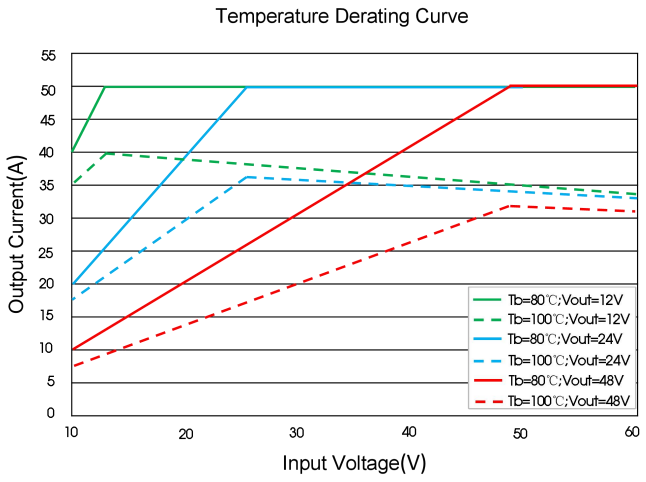
③test condition： Ta = 25℃, the product surface temperature is less than 100℃ .

④Working temperature refers to the surface temperature of the product.

Electromagnetic Compatibility (EMC)

Emissions	CE	CISPR32/EN55032 CLASS A (see Fig. 3 for recommended circuit)	
	RE	CISPR32/EN55032 CLASS A (see Fig. 3 for recommended circuit)	
Immunity	ESD	IEC/EN 61000-4-2 Contact ±6kV	perf. Criteria B
	RS	IEC/EN 61000-4-3 10V/m	perf. Criteria A
	EFT	IEC/EN 61000-4-4 ±2kV (see Fig. 3 for recommended circuit)	perf. Criteria B
	Surge	IEC/EN 61000-4-5 line to line ±2kV (see Fig. 3 for recommended circuit)	perf. Criteria B
	CS	IEC/EN 61000-4-6 10Vr.m.s	perf. Criteria A

Characteristic Curve



Note: Control the relationship between the maximum output power derating curve and the input voltage when the temperature at point A of the metal base is 80 ° C and 100 ° C

图 1

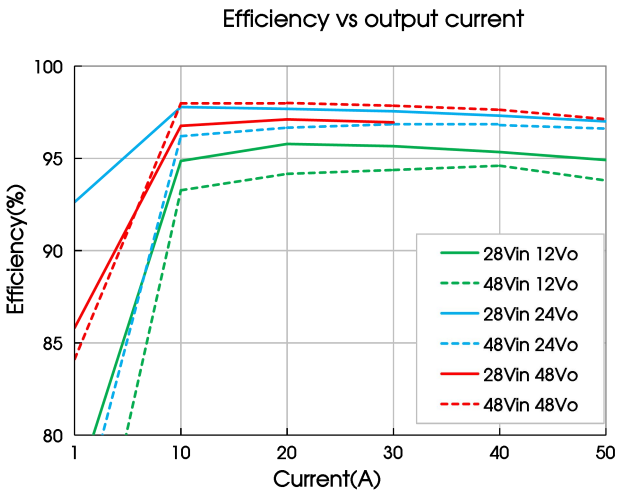
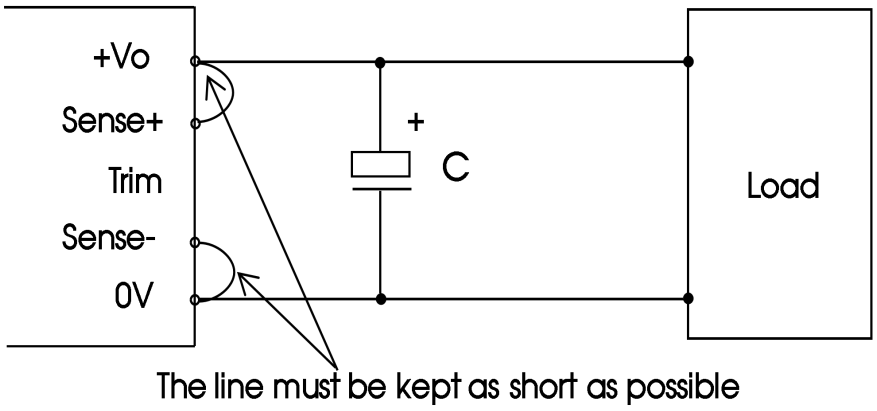


图 2

Remote Sense Application

1. Remote Sense Connection if not used

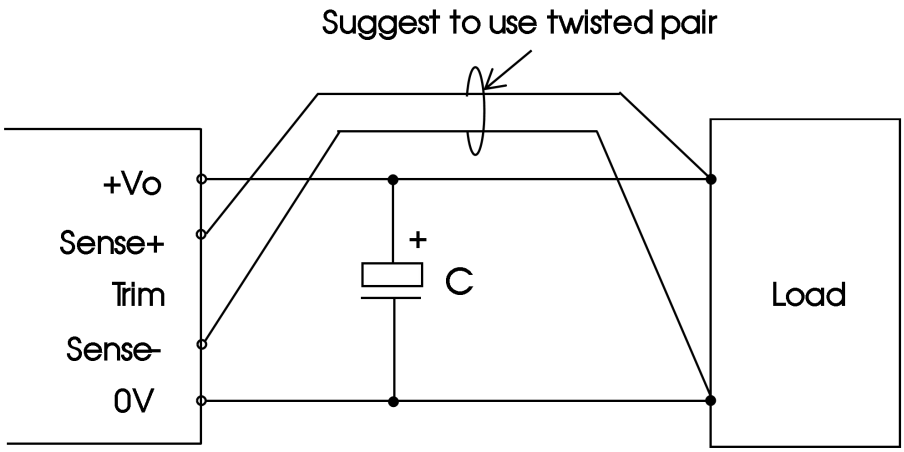


Notes:

① If the sense function is not used for remote regulation the user must connect the +Sense to +Vo and -Sense to 0V at the DC-DC converter pins and will compensate for voltage drop across pins only;

② The connections between sense lines and their respective power lines must be kept as short as possible, otherwise they may be picking up noise, interference and/or causing unstable operation of the power module.

2. Remote Sense Connection used for Compensation



Notes:

①When using remote compensation, the output voltage range should not exceed 0-60VDC:

②Using remote sense with long wires may cause unstable output, please contact technical support if long wires must be used;

③PCB-tracks or cables/wires for Remote Sense must be kept as short as possible. Twisted pair or shielded wires are suggested for remote compensation and must be kept as short as possible;

④We recommend using adequate cross section for PCB-track layout and/or cables to connect the power supply module to the load in order to keep the voltage drop below 0.3V and to make sure the power supply's output voltage remains within the specified range;

⑤Note that large wire impedance may cause oscillation of the output voltage and/or increased ripple. Consult technical support or factory for further advice of sense operation.

Design and precautions for regulating output voltage Vset

The impedance between control pin Vset and 0V can adjust the output voltage within the range of 0-60Vdc. Two methods can be used to adjust the output voltage: external adjustment resistor or external power supply. When pin Vset is suspended, its voltage is 2.5V, and the output voltage is 0V. The relationship curve between Vset voltage and output voltage Vo is as follows:

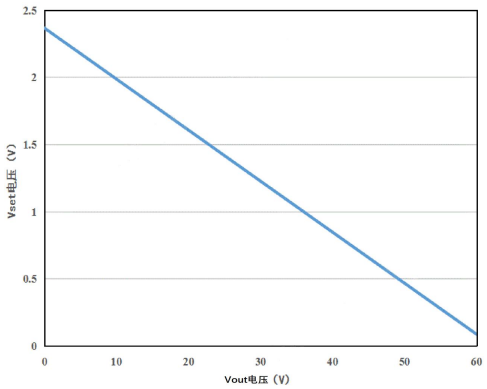


Fig.3 Voltage Vs output voltage

Usage mode 1: external power driver, wiring mode see Fig. 4 on the right

Vset Voltage calculation formula:

$$V_{vset}=2.366-0.038V_o$$

Note: Vo is the desired output voltage,units:V,

Vvset is the voltage of the external power supply,units:V.

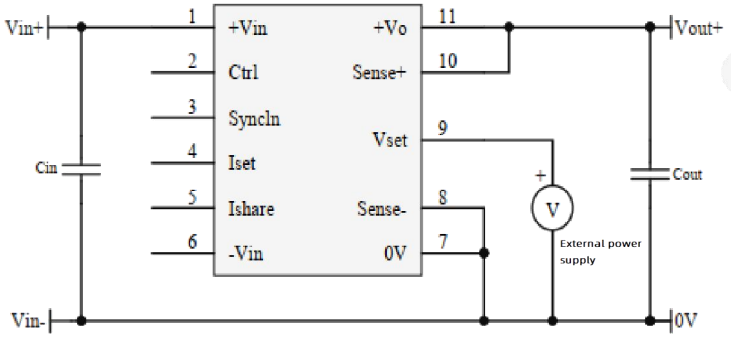


Fig. 4 Vset external power driver wiring diagram

Use mode 2: external adjusting resistor R(Vset), the wiring mode is shown in Fig.5 on the right.

Vset resistance calculation formula:

$$R_{vset}=\frac{aR_2}{R_2-a}$$

$$a=\frac{2.366-0.038V_o}{0.934+0.038V_o}R_1$$

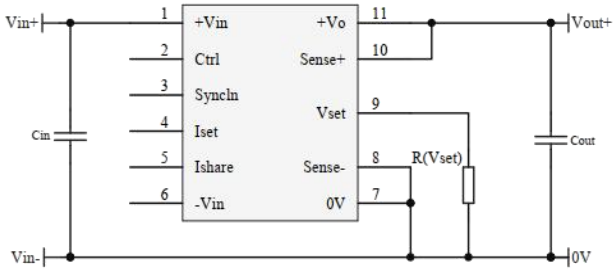


Fig.5 Vset External Adjusting resistance R(Vset) wiring diagram

Note: Rvset is an external adjusting resistor;units:kΩ

a indicates a user-defined parameter and has no actual meaning.

Vo is the desired output voltage,units:V;

Figure 6 on the right shows the internal Vset circuit of the module, where R1=15kΩ and R2=47kΩ.

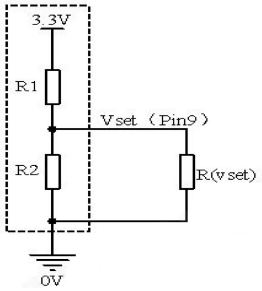


Fig.6 Vset connection diagram inside the module (dashed box)

Vo(V)	3.3	5	12	15	20	24	36	48	55
Rvset (kΩ)	97.61	75.99	36.71	28.94	20.39	15.78	7.547	3.145	1.41

Design and precautions for regulating output voltage Vset

The module contains an output overcurrent protection circuit. The impedance between the control pin Iset and SENSE-can adjust the output current within the range of 0-50A. The output current can be adjusted by adjusting resistance or external power drive. When the Iset foot is suspended, the voltage is 3.3V, and the overcurrent point is 110% x 50A by default.

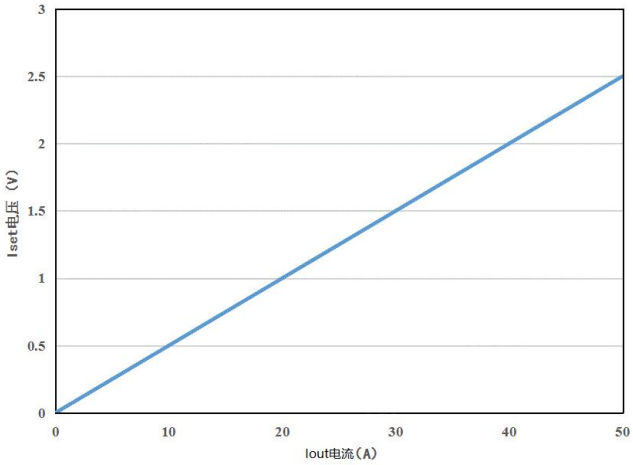


Fig.7 Iset voltage Vs output current

Usage mode 1: external power drive, wiring mode see Fig.8 on the right.

Iset Voltage calculation formula:

$$V_{Iset}=0.05Iset$$

Note:Iset is the expected output current，units:A;

VIset is the external power supply，units:V。

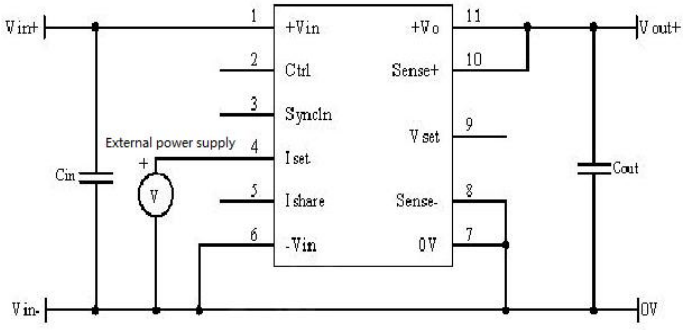


Fig.8 Iset external power driver wiring diagram

Use mode 2: external adjusting resistor R(Vset), wiring mode is shown in Figure 9 on the right.

Iset resistance calculation formula:

$$R_{Iset}=\frac{25Iset}{165-2.5Iset}$$

Note:RIset is the external resistance，units:kΩ;

Iset is the expected output current，units:A。

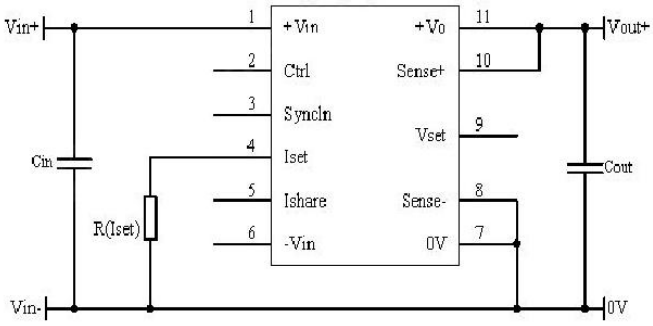


Fig.9 Iset External Adjusting resistance R(Iset) wiring diagram

Current detection and sharing Ishare design and precautions

Usage mode 1: Current detection

Ishare Voltage calculation formula:

$$V_{Ishare} = 0.05 * I_o + 0.2$$

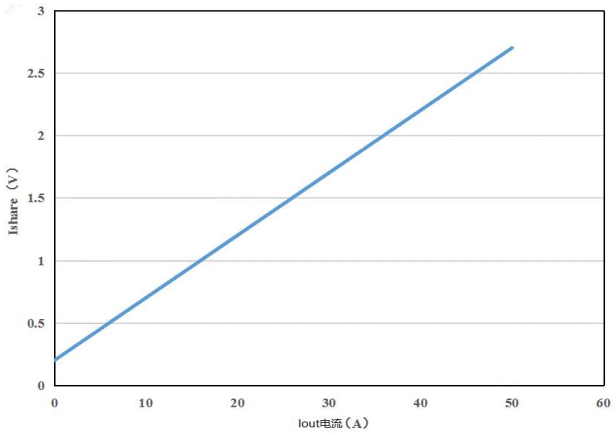


Fig.10 Ishare Vs output current

Note:Io is the actual output current，unit:A；VIshare is the Ishare pin voltage，unit:V，Ishare level in a 0V as a reference

Usage mode 2: Current share

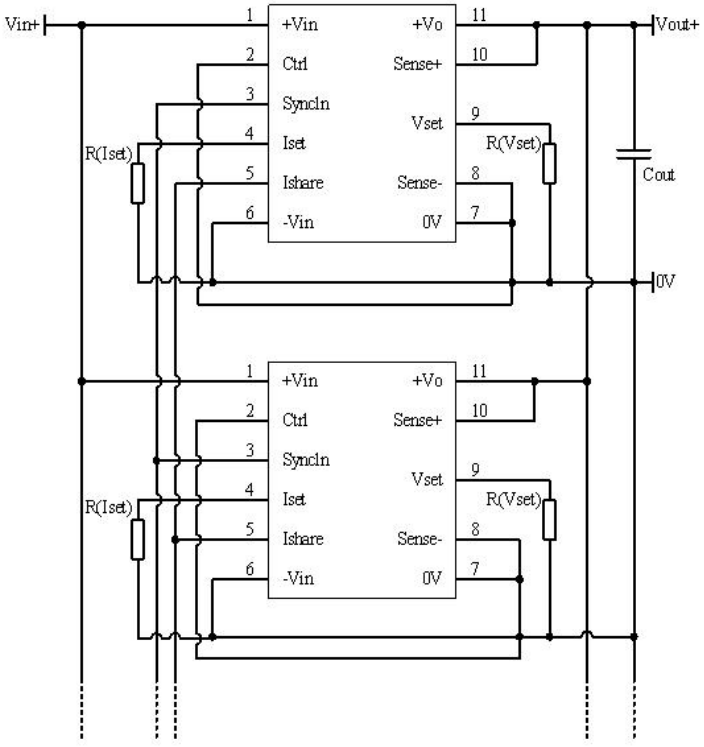


Figure 11 Parallel current sharing wiring diagram

Precautions for parallel use

1.Use Vset pin to set the single module at the same output voltage;

2.Use iset pin to set the single module at the same output current limit;

3 Connect the +Vin,-Vin,Syncln, Ishare, +Vo, OV of each module respectively inTogether;

4. Connect the cables as shown on the left to support a maximum of 4 modules in parallel, and the current of a single module does not exceed 50A when parallel.

Design Reference

1. Application circuit

① During product testing and application, please follow the recommended test circuit (Figure 12); At least one electrolytic capacitor Cin (≥470μF) is guaranteed to be connected externally to suppress the possible input surge voltage;

② If the input terminal of the product is connected in parallel with a circuit with large transient energy (such as a parallel motor drive circuit), the input voltage of the product may be pulled down. At this time, pay attention to the fluctuation of the input voltage of the product, and it is recommended to appropriately increase the capacitance of the electrolytic capacitor Cin at the input terminal to ensure the stability of the input terminal voltage and avoid the situation where the input voltage is lower than the under-voltage protection point and cause the product to restart repeatedly;

③If the output end of the product is inductive load (such as relay and motor), it is recommended to increase the output capacitance Cout capacitance within the capacitive load specification and add TVS tubes to filter out voltage spikes;

④If the input and output ripple needs to be further reduced, Cin and Cout capacity of external capacitors can be appropriately increased or external capacitors with small series equivalent impedance can be selected. Cout capacity of external capacitors cannot be greater than the maximum capacitive load of products.

⑤When using Ctrl, it can be directly short circuited with - Vin (Pin6) to enable output control.

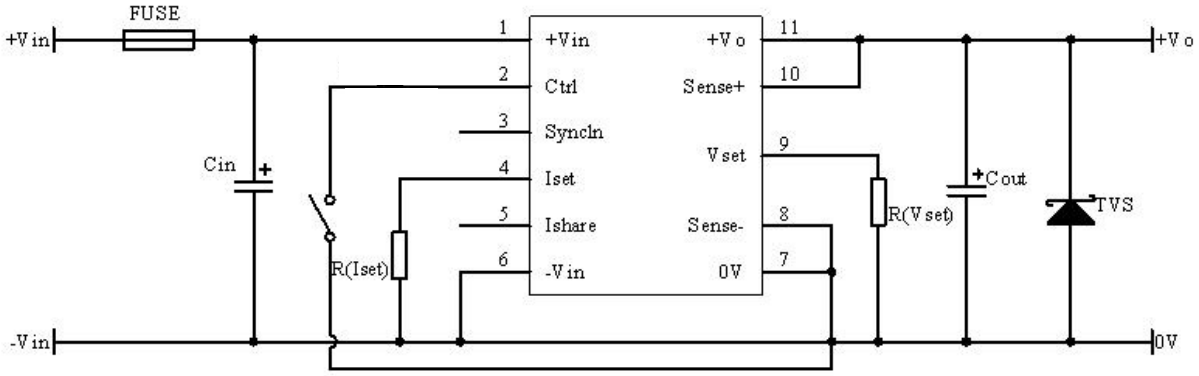


Fig.12 Recommended Test Circuit

Fuse（optional）	Cin*	Diode（optional）	Cout	TVS（optional）
80A	560μF/100V（Electrolytic capacitance）+ 2.2uF/100V*5（Ceramic capacitor）	Diode	330μF/100V*2（Solid-state capacitance）+ 2.2uF/100V*5（Ceramic capacitor）	Select based on output

Note: *During the use of external capacitor, attention should be paid to the external environment temperature of the product. Under low temperature, the electrolytic capacitor capacity value should be increased to 1.5 times of the original parameter at least.

2. EMC compliance circuit

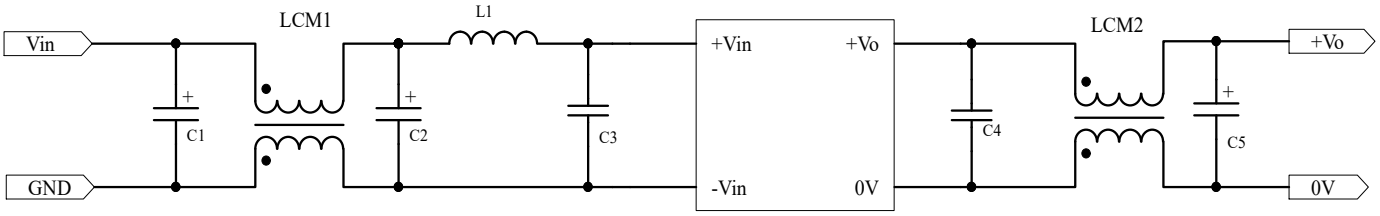


Fig.13 Recommended compliance circuit

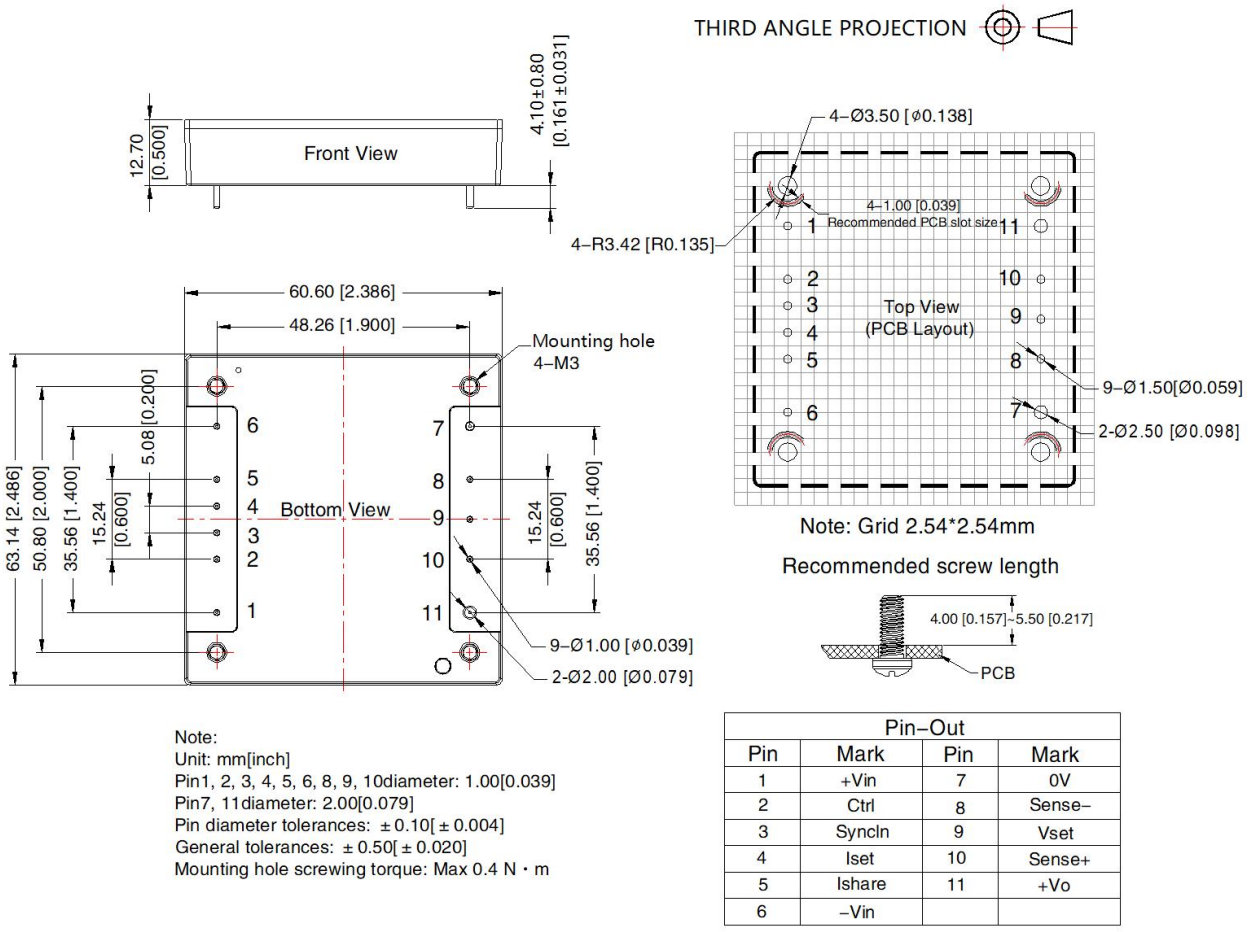
C1	LCM1	C2	L1	C3	C4	LCM2	C5
100uF/200V (Electrolytic capacitor)	EFL2D-65-040	330uF/100V (Electrolytic capacitor)	480nH	475/100V*16 (Ceramic capacitor)	475/100V*4 (Ceramic capacitor)	EFL2D-65-040	330uF/100V (Solid state capacitor)

3. Recommended solution for thermal test

In the process of application, product thermal design can be evaluated by combining product temperature derating curve; Or determine the stable working range of the product by the temperature at point A of the metal shell in the following test diagram. When the temperature at point A is lower than 100℃, it is the stable working range of the product. Or under the condition of natural air cooling, when the maximum temperature of the center point of the four positions on the side of the control module shell is lower than 90℃, it is the stable working range of the product.



Dimensions and Recommended Layout



Note:
Unit: mm[inch]
Pin1, 2, 3, 4, 5, 6, 8, 9, 10diameter: 1.00[0.039]
Pin7, 11diameter: 2.00[0.079]
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]
Mounting hole screwing torque: Max 0.4 N・m

Pin–Out			
Pin	Mark	Pin	Mark
1	+Vin	7	0V
2	Ctrl	8	Sense–
3	Syncln	9	Vset
4	Iset	10	Sense+
5	Ishare	11	+Vo
6	–Vin		

Notes:

1. The maximum capacitive load offered were tested at nominal input voltage and full load;
2. Unless otherwise specified, parameters in this datasheet were measured under the conditions of Ta=25℃, humidity<75%RH with nominal input voltage and rated output load;
3. All index testing methods in this datasheet are based on our company corporate standards;
4. Products are related to laws and regulations: see "Features" and "EMC";
5. Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units.