3000W ultra-wide input, non-isolated, buck-boost single output

Patent Protection 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（4PCS）
- Operating ambient temperature range: -40℃ to 100℃(case temperature)
- Industry standard half-Brick package and pin-out

KUB6060HB-50AG is high efficiency switching regulators. It features ultra-wide input range of 9-60VDC, adjustable output voltage range of 0-60VDC, efficiency up to 98%, operating temperature of -40℃ to +100℃, input over-voltage and under-voltage protection, output short-circuit and output over-voltage, over-current, over-temperature protection, remote control, output voltage regulation and remote compensation, current monitor, parallel support and other functions. It is widely used in robotics, communications, battery management, DC-DC distributed power supply and other occasions.

Selection Guide

Certification	Part No.	Input			Output	
		Nominal (Range) (VDC)	Max.① (VDC)	Current ② (A) Max.	Voltage (Range) (VDC)	Current ② (A) Max.
--	KUB6060HB-50AG	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 (%) Typ.
Voltage(VDC)	Voltage(VDC)	Current(A)	Power(W)	
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

Input Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
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	Nominal input voltage	--	150	--	mA
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		Unavailable			
Input Current Limit		--	--	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

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Output voltage accuracy	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			
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 & Noise①	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, lock	--	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	--	VDC
	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	VDC

Sense	See part of Remote Sense Application	See Sense function adjustment			
		--	--	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			

Note:
①The "parallel cable" method is used for ripple and noise test ;
②When the output voltage is 0-3.3V, it can work in Non-fixed voltage mode
③test condition：Ta = 25℃, the product surface temperature is less than 100℃

General Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Isolation	Input/Output - Shell, Electric Strength Test for 1 minute with a leakage current of 1mA max.	500	--	--	VDC
Operating Temperature①	Surface temperature	-40	--	+100	℃
Storage Temperature		-55	--	+125	
Storage Humidity	Non-condensing	5	--	95	%RH
Pin Soldering Resistance	Wave-soldering, max. 10 second	+255	+260	+265	℃
Temperature	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

Note:
①Operating temperature refers to the surface temperature of the product.

Mechanical Specifications

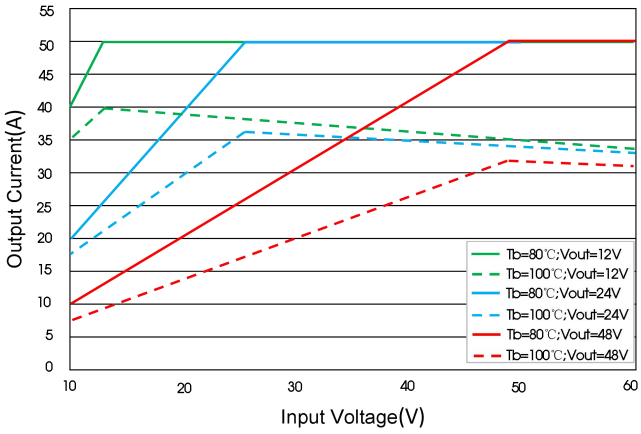
Case Material	Aluminum alloy
Dimensions	63.14 x 60.6 x 12.70 mm
Weight	150 g(Typ.)
Cooling Method	Free air convection forced convection

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

Typical Characteristic Curves

Temperature Derating 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

Fig.1

Efficiency vs output current

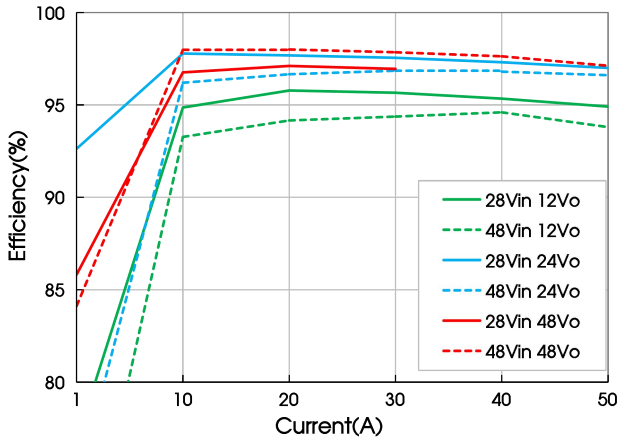
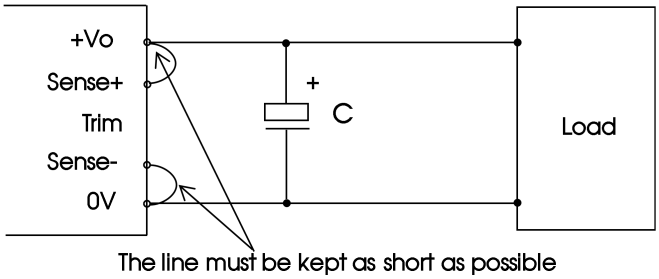


Fig.2

Remote Sense Application

1. Remote Sense Connection if not used



The line must be kept as short as possible

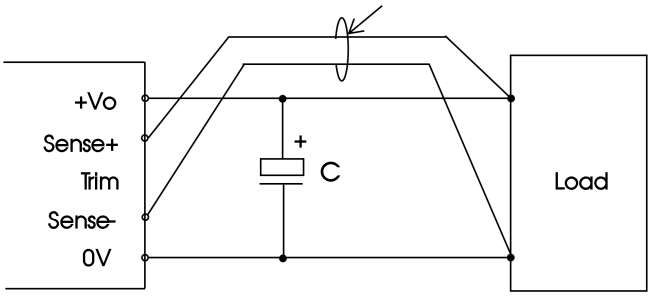
Notes:

(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

Suggest to use twisted pair



Notes:

(1) Do not exceed the output voltage range when using remote compensation;

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

(3) PCB-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;

(4) We 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;

(5) Note 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 Reference

1. Application circuit

(1) During product testing and application, please follow the recommended test circuit (Figure 3); At least one electrolytic capacitor Cin (≥560μF) 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;

(3) If 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;

(4) If 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.

(5) When ctrl is used, it can be directly connected to 0V Pin to achieve output enable control, if remote control is used and the control signal is non-TTL level signal or multiple modules use the same control signall, a diode needs to be connected in series at each module, and the independent line from the 0V pin is used as the reference point of ctrl.

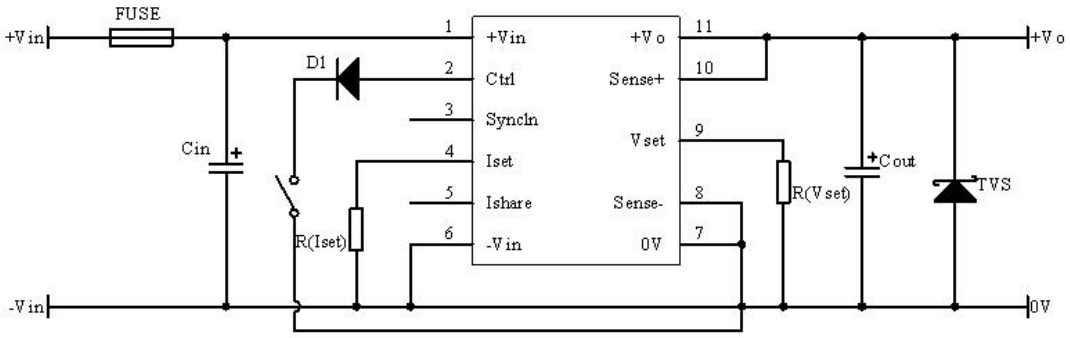


Fig.3

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

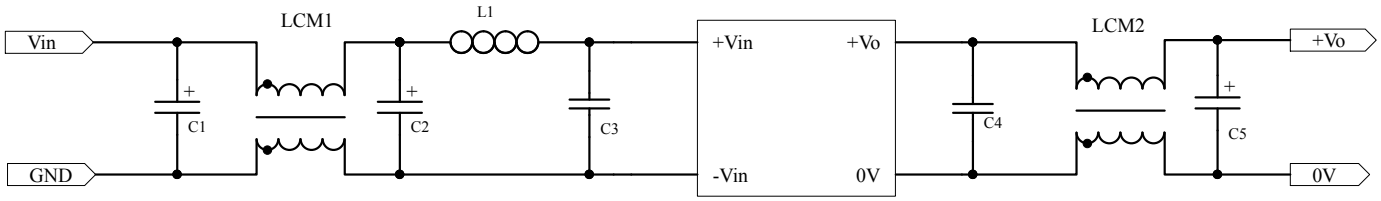


Fig.3 Recommended compliance circuit

C1	LCM1	C2	L1	C3	C4	LCM2	C5
100uF/200V	FL2D-F5-040	330uF/100V	480nH	475/100V*16	475/100V*4	FL2D-F5-040	330uF/100V

3. Vset Function for Output Voltage Adjustment

The output voltage can be programmed to any voltage between OVdc and 60Vdc by connecting one resistor, R(Vset),between the Vset pin (9) and Vout- pin (7); See Figure15. For a desired output voltage, the value of the resistor should be:

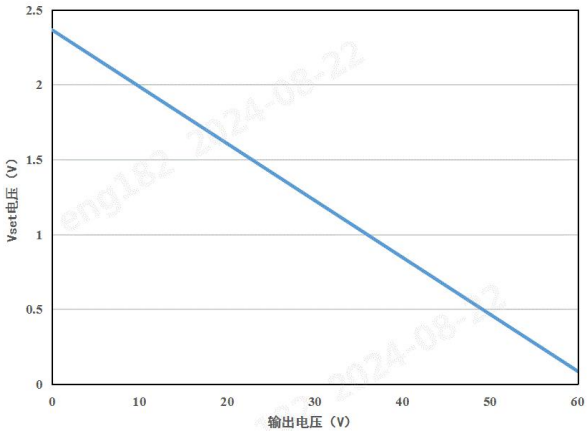


Fig.4 Voltage Vs output voltage

Usage mode 1: external power driver, wiring mode see Fig. 5 on the right

Vset Voltage calculation formula：

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

Note: Vo is the desired output voltage,units:A,
Vvset is the voltage of the external power supply,units:V.

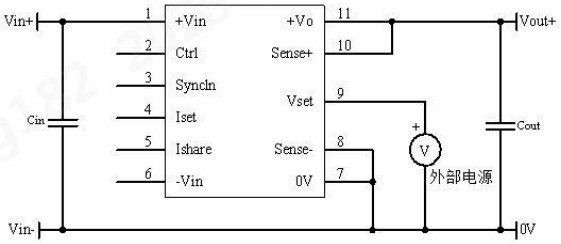


Fig. 5 Vset external power driver wiring diagram

Use mode 2: external adjusting resistor R(Vset), the wiring mode is shown in Fig.6 on the right.

Vset resistance calculation formula:

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

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

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.

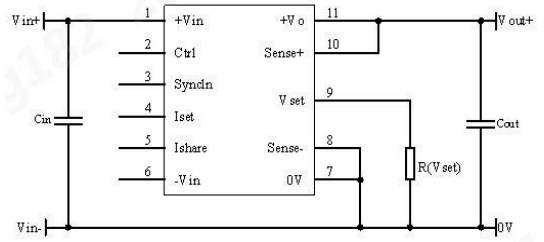


Fig.6 Vset External Adjusting resistance R(Vset) wiring diagram

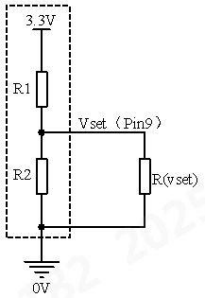


Fig.7 Vset connection diagram inside the module (dashed box)

Vo(V)	3.3	5	10	15	20	24	36	48	55
R_{vset} (kΩ)	97.61	75.99	43.8	28.94	20.39	15.78	7.547	3.145	1.41

4. Iset Function for Output Current Adjustment

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.

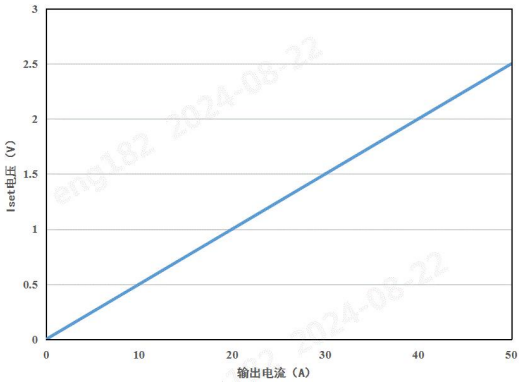


Fig.8 Iset voltage Vs output current

Usage mode 1: external power drive, wiring mode see Fig.9 on the right.

Iset Voltage calculation formula:

$$V_{Iset}=0.05Iset$$

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

Vset is the external power supply，units:V。

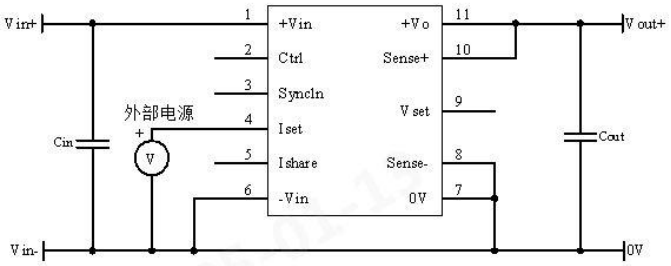


Fig.9 Iset external power driver wiring diagram

Use mode 2: external adjusting resistor R(Vset), wiring mode is shown in Figure 10 on the right.

Iset resistance calculation formula:

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

Note:R_{Iset} is the external resistance，units:kΩ；

Iset is the expected output current，units:A。

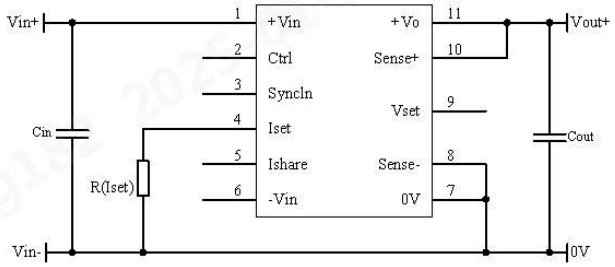


Fig.10 Iset External Adjusting resistance R(Iset) wiring diagram

5. Current detection and sharing Ishare design and precautions

Usage mode 1: Current detection

Ishare Voltage calculation formula:

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

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

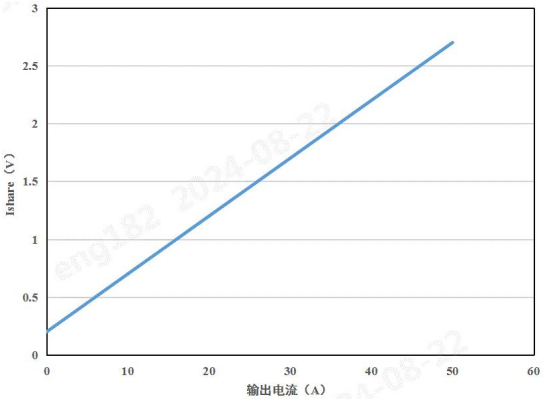


Fig.11 Ishare Vs output current

Usage mode 2: Current share

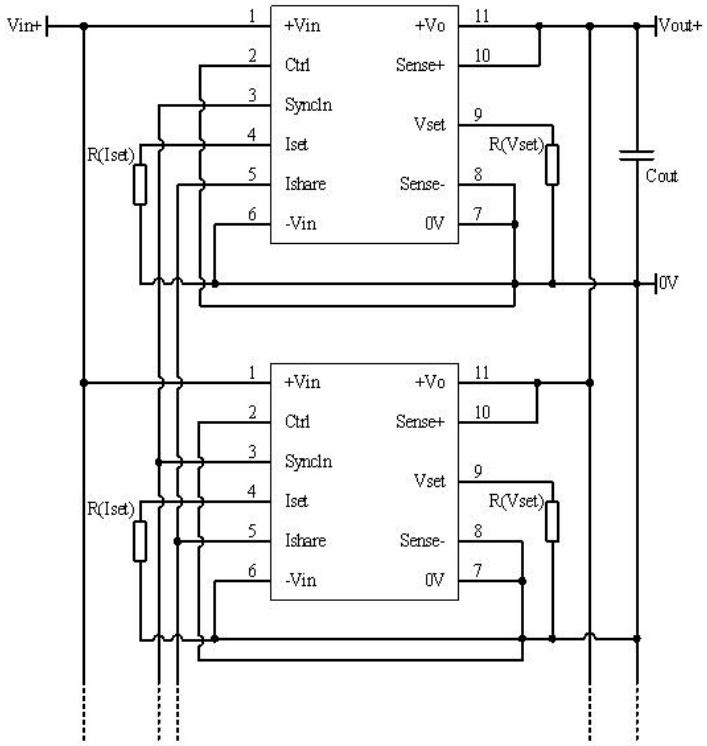


Figure 12 Parallel current sharing wiring diagram

Precautions for parallel use

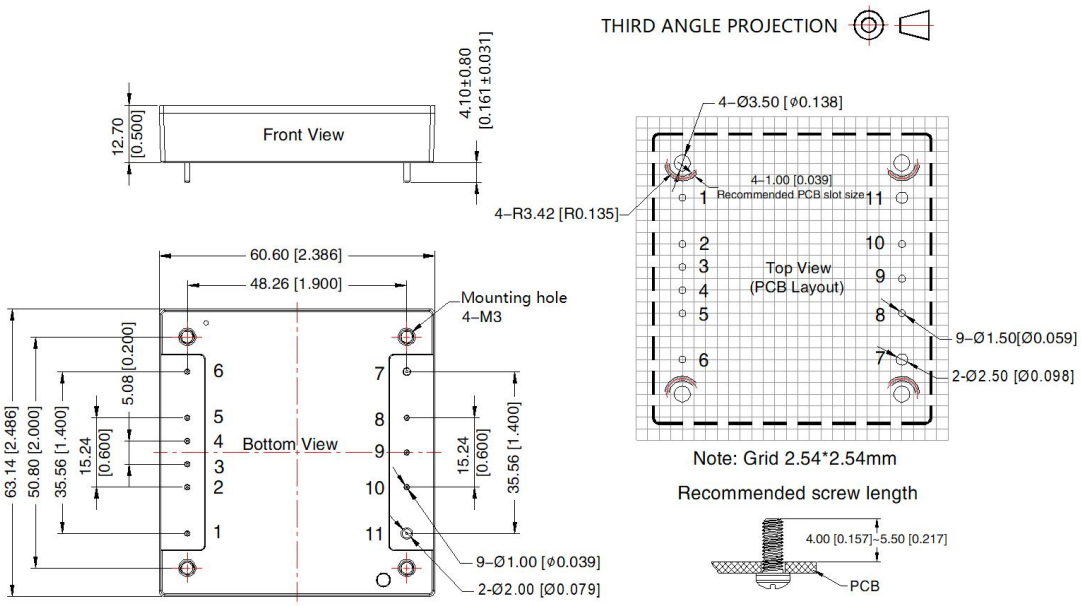
1. Use Vset pin to set the single module at the same output voltage;
2. Use iset pin to set the single module at the same output current limit;
3 Connect the +Vin,-Vin,SyncIn, Ishare, +Vo, OV of each module respectively inTogether;
4. Connect the cables as shown on the left to support a maximum of 4 modules in parallel, and the current of a single module does not exceed 50A when parallel.

6. 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.

7. For additional information please refer to DC-DC converter application notes on www.mornsun-power.com

KUB6060HB-50AG 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. For additional information on Product Packaging please refer to www.mornsun-power.com. Packaging bag number: 58200069;
2. The maximum capacitive load offered were tested at nominal input voltage and full load;
3. 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;
4. All index testing methods in this datasheet are based on our company corporate standards;
5. We can provide product customization service, please contact our technicians directly for specific information;
6. Products are related to laws and regulations: see "Features" and "EMC";
7. Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units.

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