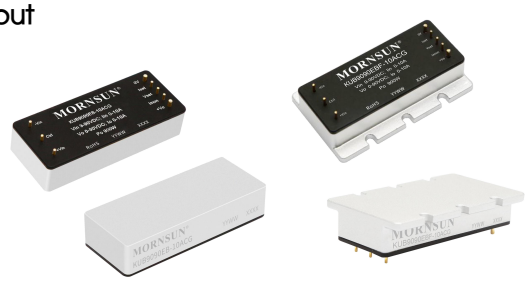
DC/DC Converter

KUB9090EB(F)-10AxG

MORNSUN®

Ultra-wide input, non-isolated, buck-boost single output



Patent Protection RoHS

FEATURES

- Ultra-wide input voltage range: 9 - 90VDC
- Output voltage range: 0 - 90VDC
- High efficiency up to 98.5%
- Built-in output anti-backflow Oring-fet
- Input under-voltage, over-voltage protection, output over-voltage, over-current & short-circuit protection, over-temperature protection
- Operating ambient temperature range: -40℃ to +100℃（case temperature）
- Industry standard 1/8 Brick package and pin-out
- No load current as low as 100mA

KUB9090EB(F)-10AxG is high efficiency switching regulators. It features ultra-wide input range of 9-90VDC, adjustable output voltage range of 0-90VDC,, 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.
--	KUB9090EB(F)-10ACG	9-90	90	10	0-90	10
	KUB9090EB(F)-10ASG	9-90	90	10	0-90	10

Note:
① The input voltage cannot exceed this value, otherwise it may cause permanent and unrecoverable damage;
② Vin > Vo, the maximum output current should not exceed 10A; Vin ≤ Vo, the maximum input current should not exceed 10A;
③ For model with suffix "S", output terminals 5 and 7 are designated as Sense- and Sense+; for model with suffix "C", output terminals 5 and 7 are designated as Iset and Imon; suffix "F" indicates a heat sink package.

Typical input-output Efficiency

Input	Output			Efficiency (%) Typ.
Voltage(VDC)	Voltage(VDC)	Current(A)	Power(W)	
12	72	1.67	120	93.0
	72	0.84	60	92.5
	48	2.5	120	94.0
	48	1.25	60	94.0
	12	10	120	94.0
	12	5	60	96.0
48	72	6.67	480	97.5
	72	3.33	240	98.0
	48	10	480	97.5
	48	5	240	97.5
	12	10	120	93.0
	12	5	60	93.0
72	72	10	720	98.0
	72	5	360	98.0
	48	10	480	97.5
	48	5	240	97.5
	12	10	120	91.0
	12	5	60	91.5

90	90	10	900	98.5
	90	5	450	98.5
Note:100% Io per operating condition: refer to power derating curve (Figure 1)				

Input Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Input Current (no-load)	Vin=12/48/72V, Vout=12V, Io=0A	--	100	--	mA
	Vin=12/48/72V, Vout=48V, Io=0A	--	200	--	
	Vin=12/48/72V, Vout=72V, Io=0A	--	350	--	
Reflected Ripple Current	Vin=48V, Vout=12V, Io=10A	--	150	--	mA
impulse voltage	1sec. max.	--	--	100	VDC
Start-up Voltage		9	--	10	
Under-voltage Protection		8	--	9	
Over-voltage Protection	self-recovery	--	95	--	
Input Filter		Pi filter			
Hot Plug		Unavailable			
Input Reverse Polarity Protection		Unavailable			
Input Current Limit		--	12	--	A
Ctrl	Module on	Ctrl pin pulled GND or pulled low (0-1VDC)			
	Module off	Ctrl pin open or pulled TTL to high(1.6-5.5VDC)			
	Input current when off	--	1	--	mA

Output Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Output voltage accuracy①	3.3V-90Vo, 5%Io-100%Iomax	±100mV ±2%*Vout ±2%*Vout*Iout/Iomax			
	3.3V-90Vo, 0%Io-5%Iomax	±100mV ±3%*Vout ±2%*Vout*Iout/Iomax			
Load Regulation	Nominal input voltage, 5%Io-100%Iomax	±2%*Vout*Iout/Imax (Typ)			
Transient Response Deviation	Vin=48V, Vout=12V, 25% load step change, 0.1A/uS	--	800	--	mV
Transient Recovery Time	Vin=48V, Vout=12V, 25% load step change, 0.1A/uS	--	500	--	uS
Temperature Coefficient	Operating temperature -40℃ to +100℃	--	±0.02	--	%/℃
Ripple & Noise②	20MHz bandwidth,Vin=48V, Vout=12V, Io=10A	--	120	--	mVp-p
	20MHz bandwidth,Vin=72V, Vout=48V, Io=10A	--	200	--	
	20MHz bandwidth, Vin=12V, Vout=72V, Io=1.67A	--	100	--	
Over-temperature Protection	Maximum surface temperature of the product	--	105	--	℃
Output Over-voltage Protection	Input voltage range, output power range, self-recovery	--	91	--	VDC
Output Current Limit	Input voltage range, output power range	--	12	--	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)	--	2.5	--	VDC
	Adjustable range of output current	0	--	10	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	--	90	VDC
Sense	See part of Remote Sense Application	See Sense function adjustment			
		--	--	105	%Vo

Note:
①When the output voltage is 0-3.3V, it can work in Non-fixed voltage mode;
②The "parallel cable" method is used for ripple and noise test ;
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.	1500	--	--	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	--	280	--	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.
②The pin soldering temperature tolerance is not the actual temperature set by the soldering iron but the temperature required for proper solder joints. The actual temperature set by the customer should be determined comprehensively based on factors such as PCB thickness, copper coverage, soldering iron power, and soldering iron tip selection

Mechanical Specifications

Case Material	Aluminum alloy	
Dimensions	KUB9090EB-10ACG、 KUB9090EB-10ASG	60.80*25.00*12.70mm
	KUB9090EBF-10ACG、 KUB9090EBF-10ASG	60.80*36.83*12.70mm
Weight	KUB9090EB-10ACG、 KUB9090EB-10ASG	53 g(Typ.)
	KUB9090EBF-10ACG、 KUB9090EBF-10ASG	58 g(Typ.)
Cooling Method	Free air convection forced convection	

Electromagnetic Compatibility (EMC)

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

Typical Characteristic Curves

Power derating curve

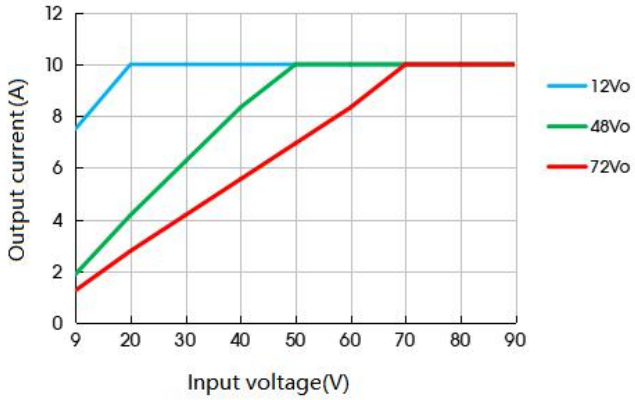
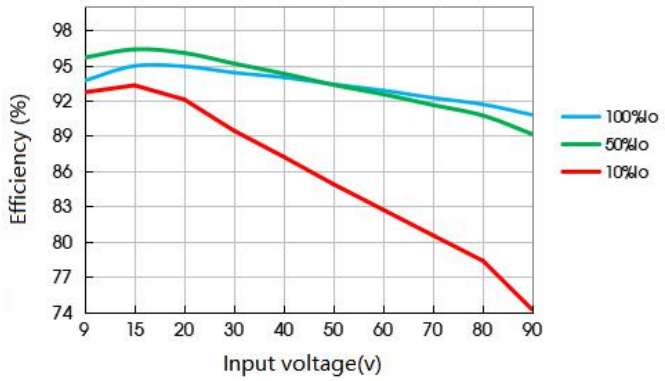
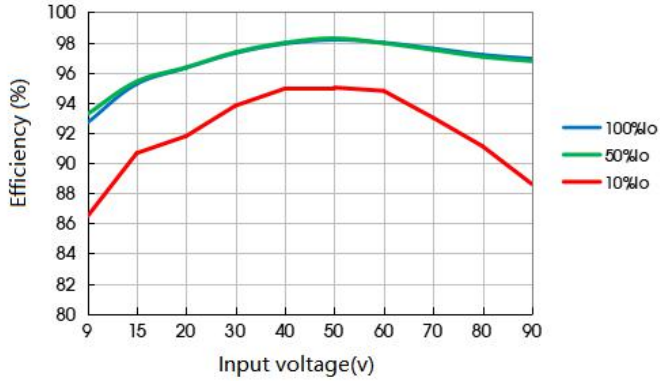
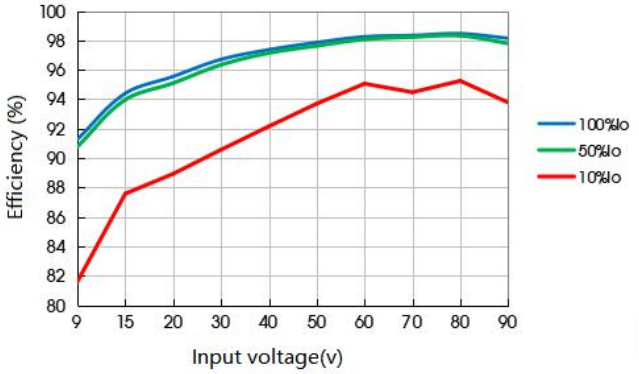
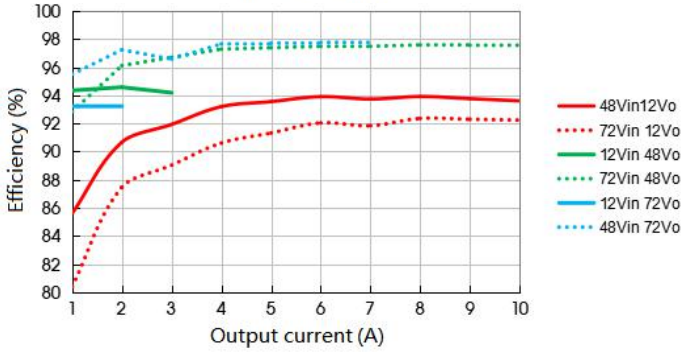


Figure 1









Temperature derating curve

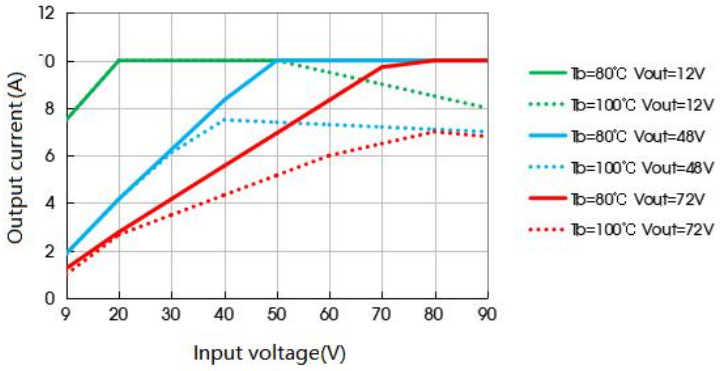
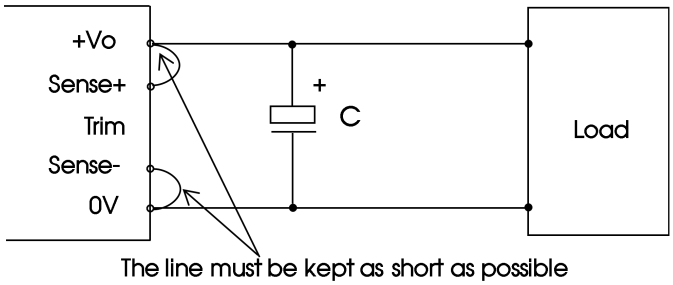


Figure 2

Remote Sense Application

1. Remote Sense Connection if not used

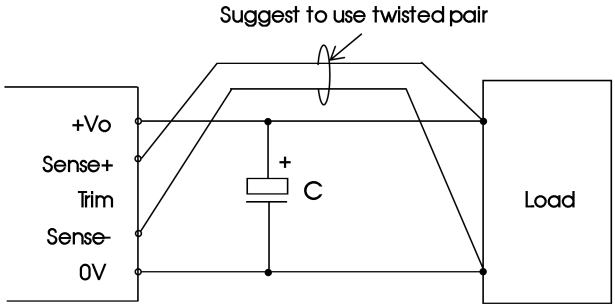


Notes：

(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:

(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.

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

Design Reference

1.Application circuit

(1) When testing and applying the product, please follow the recommended testing circuit in Figure 3; Ensure at least one external electrolytic capacitor Cin (≥ 1000 μ F) is connected to suppress potential surge voltages at the input terminal;

(2) If a circuit with high transient energy is connected in parallel at the input end of the product (such as a parallel motor drive circuit), it may cause the input voltage of the product to be pulled low. At this time, attention should be paid to the fluctuation of the input voltage of the product. It is recommended to increase the capacitance of the electrolytic capacitor Cin at the input end appropriately to ensure the stability of the input voltage and avoid the situation where the input voltage is lower than the undervoltage protection point and the product is repeatedly started;

(3) If the output terminal of the product is an inductive load (such as a relay or motor), it is recommended to increase the output capacitance Cout and add TVS tubes to filter out voltage spikes;

(4) To further reduce input and output ripple, the external capacitors Cin and Cout can be appropriately increased or external capacitors with lower series equivalent impedance can be selected.

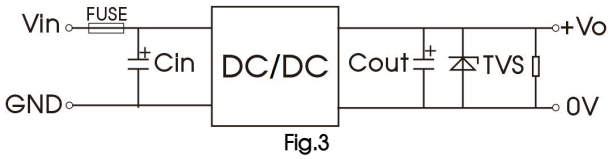


Fig.3

Fuse (optional)	Cin*	Cout	TVS tube (optional)
30A，Slow circuit breaker	1000μF/100V	100μF/100V	Select based on output voltage

Note: During the use of external capacitors, attention should be paid to the ambient temperature of the product. In low temperature conditions, the capacitance value of the electrolytic capacitor should be increased to at least twice the original parameter.

2. EMC compliance circuit

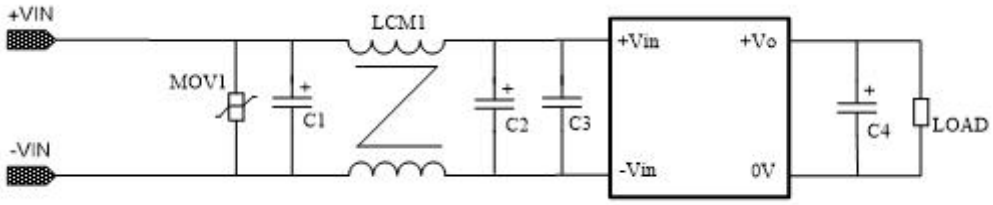


Fig.4Recommended compliance circuit

MOV1	101K（SFV10D101K）
C1、C2	1000uF/100V
C5	560uF/100V
C4	100uF/100V
C3	4.7uF/100V
LCM1	90uH（FL2D-A0-900）

3. The product does not support the use of parallel output to increase power

4. Recommended solution for thermal testing

During the application process, the thermal design of the product can be evaluated by combining the temperature derating curve of the product Alternatively, the stable working range of the product can be determined by the temperature at point A in the following test chart. When the temperature at point A is below 100 ℃, it is the stable working range of the product

Vset Function for Output Voltage Adjustment

The impedance between the control pin Vset and 0V can adjust the output voltage within the range of 0-90VDC. The output voltage can be adjusted by either adjusting the resistor or driving it with an external power source。

1、When the Vset pin is connected to an external power source for adjustment:

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

Vset Voltage calculation formula:

$$Vvset(Vset) = \left[2.366 - 2.316\frac{Vset}{V\,\max}\right] (V)$$

Notes:

1.Vset is the expected output voltage, with an adjustable range of 0-90V

2.Vmax is 90V

3.External power supply range: 0V-2.5V

4.The Vset pin cannot be suspended.

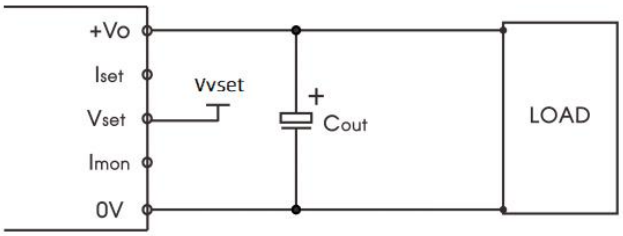


Fig. 5 Vset external power driver wiring diagram

2、When the Vset pin is connected to an external resistor for adjustment:

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

Vset resistance calculation formula:

$$Rvset(Vset) = \left[\left(\frac{11830 \times V\,\max}{Vset + 0.058 \times V\,\max}\right) - 10912\right] (\Omega)$$

Notes:

1. Vo is the desired output voltage, with an adjustable range of 0-90V

2. R (Vset) is measured in KΩ

3. Vmax is 90V

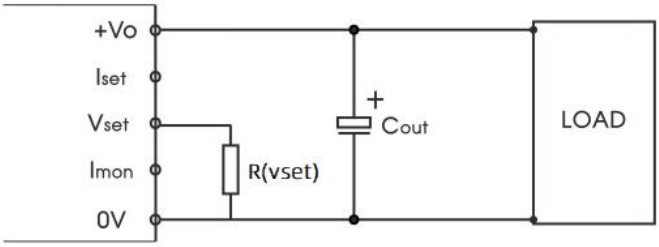


Fig.6 Vset External Adjusting resistance R(Vset) wiring diagram

Vo/V	3.3	12	24	36	48	60	72	90
Rvset/KΩ	114.05	50.98	25.53	14.98	9.09	5.41	2.88	0.27

Iset Function for Output Current Adjustment

The module contains an output overcurrent protection circuit inside. The impedance between the control pin Iset and 0V can limit the output current to be adjusted within the range of 0-10A. The output current can be adjusted by either adjusting the resistor or driving it with an external power supply. When the Iset pin is suspended, its voltage is 2.5V, and at this time, the default overcurrent point is 110%*10A.

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

Iset Voltage calculation formula:

$$Viset(Iset) = \left(0.0953 + 2.085 * Iset / \mathrm{Im}\,ax\right) (V)$$

Notes:

1.The output current regulation range of Iset is 0-10A

2.Imax is 10A

3.External voltage range: 0V-2.5V, Viset voltage is relative to the output pin 0V

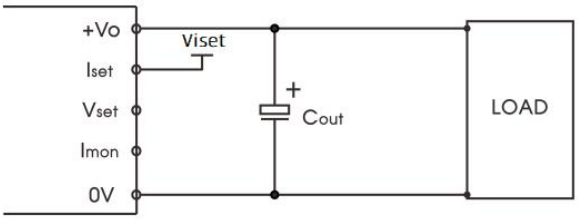


Fig.7 Iset external power driver wiring diagram

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

Iset resistance calculation formula:

$$RIset(Iset)=\left[\left(\frac{0.0469\,\mathrm{Im}ax+Iset}{1.153\,\mathrm{Im}ax-Iset}\right)*10200-10\right]\ (\Omega)$$

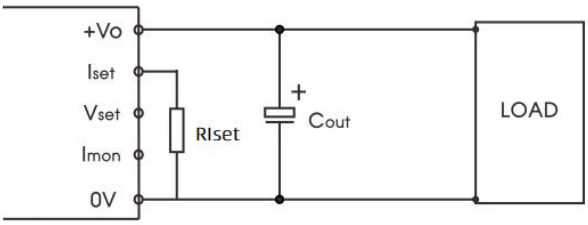


Fig.8 Iset External Adjusting resistance R(Iset) wiring diagram

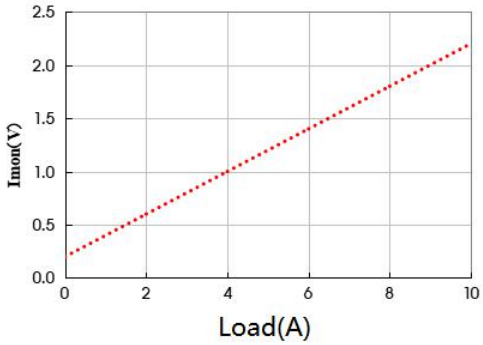
Notes:

1.The output current regulation range of Iset is 0-10A

2. Imax is 10A

Io/A	1	2	4	6	8	10
R_{Iset}/KΩ	1.41	2.63	6.04	11.92	24.46	69.78

Output current detection Imon curve and precautions



The calculation formula for the output current detection Imon pin voltage and output current is as follows:

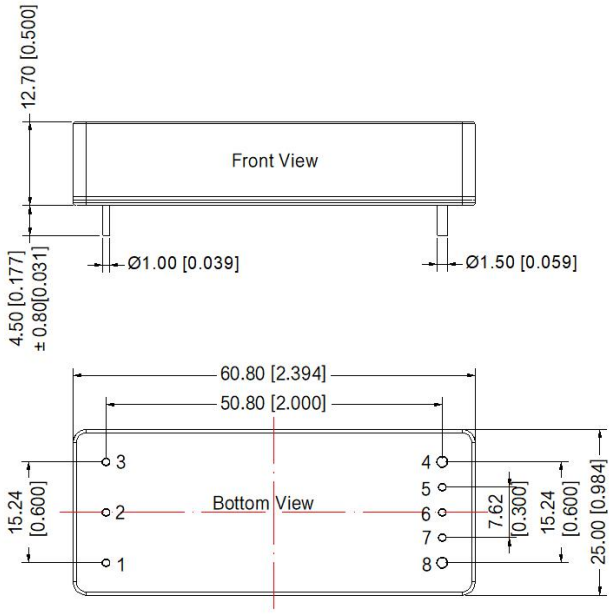
$$V_{Imon}=0.20*Io+0.20$$

Notes:

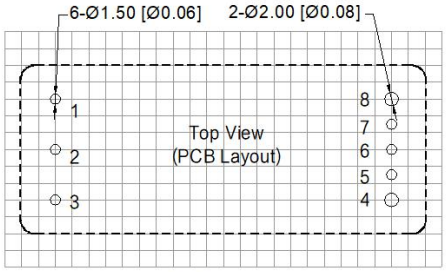
① Vlmon is the voltage at the Imon pin, which is relative to the output pin 0V and measured in volts;

② Io is the output current, measured in A.

KUB9090EB-10ACG Dimensions and Recommended Layout



THIRD ANGLE PROJECTION

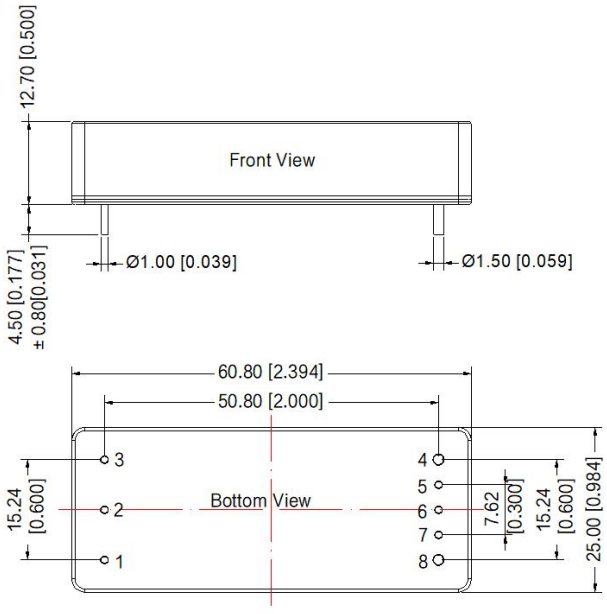


Note: Grid 2.54*2.54mm

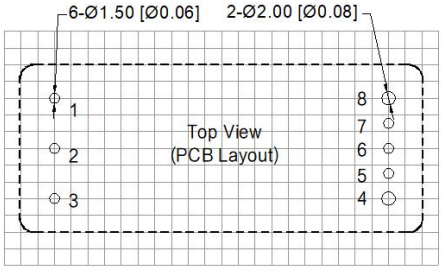
Pin-Out			
Pin	Mark	Pin	Mark
1	+Vin	5	Iset
2	Ctrl	6	Vset
3	-Vin	7	Imon
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1,2,3,5,6,7 diameter: 1.00[0.039]
Pin4,8 diameter: 1.50[0.059]
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]

KUB9090EB-10ASG Dimensions and Recommended Layout



THIRD ANGLE PROJECTION

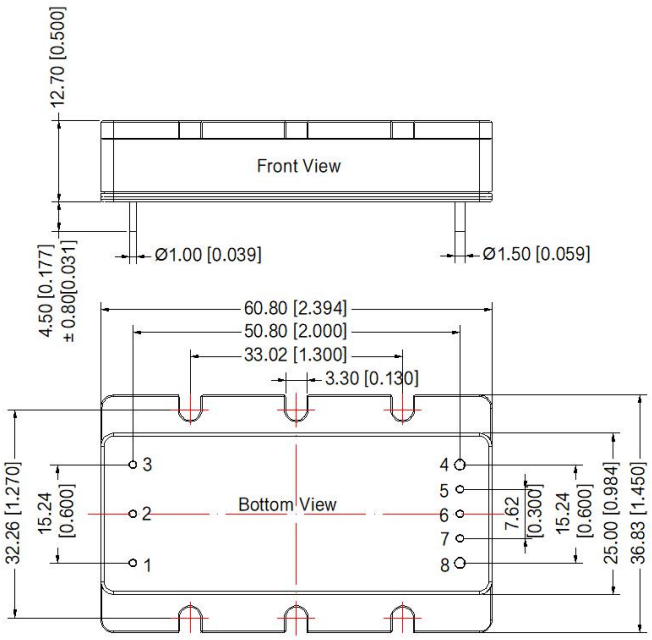


Note: Grid 2.54*2.54mm

Pin-Out			
Pin	Mark	Pin	Mark
1	+Vin	5	Sense-
2	Ctrl	6	Vset
3	-Vin	7	Sense+
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1,2,3,5,6,7 diameter: 1.00[0.039]
Pin4,8 diameter: 1.50[0.059]
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]

KUB9090EBF-10ACG Dimensions and Recommended Layout



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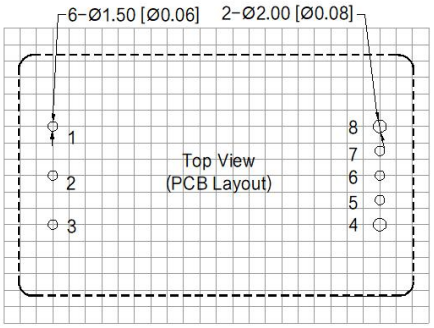
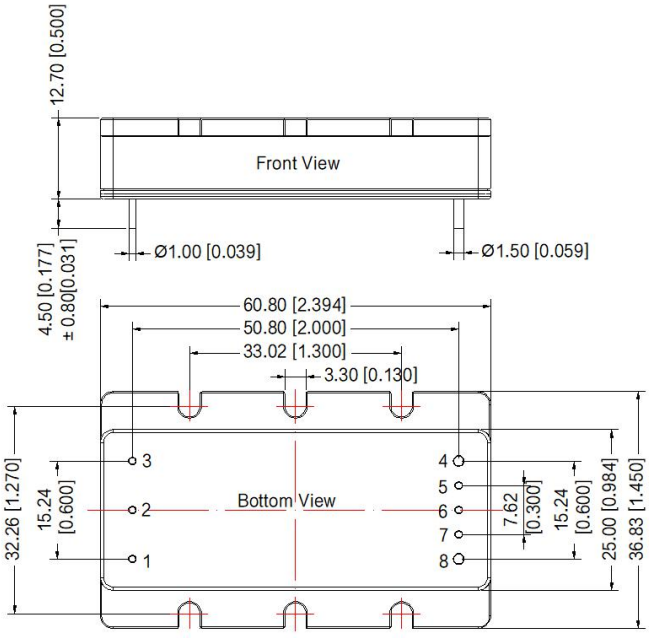


Note: Grid 2.54*2.54mm

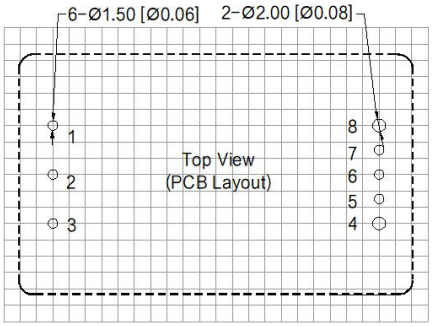
Pin-Out			
Pin	Mark	Pin	Mark
1	+Vin	5	Iset
2	Ctrl	6	Vset
3	-Vin	7	Imon
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1,2,3,5,6,7 diameter: 1.00[0.039]
Pin4,8 diameter: 1.50[0.059]
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]

KUB9090EBF-10ASG Dimensions and Recommended Layout



THIRD ANGLE PROJECTION



Note: Grid 2.54*2.54mm

Pin-Out			
Pin	Mark	Pin	Mark
1	+Vin	5	Sense-
2	Ctrl	6	Vset
3	-Vin	7	Sense+
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1,2,3,5,6,7 diameter: 1.00[0.039]
Pin4,8 diameter: 1.50[0.059]
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]

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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