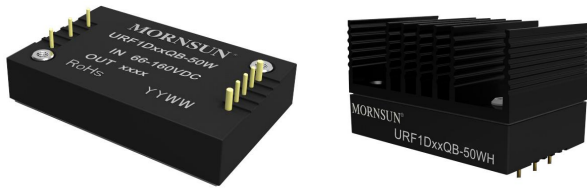


50W, wide input voltage,
isolated & regulated single output DC-DC converter



Patent Protection RoHS



FEATURES

- Wide input voltage range: 66-160VDC
- High efficiency up to 90%
- Low no-load power consumption
- Isolation voltage: 3K VDC
- Operating temperature range: -40°C to +100°C
- Input under-voltage protection, output over-voltage, over-current, short-circuit, over-temperature protection
- International standard: 1/4 brick
- Meets requirements of railway standard EN50155

URF1D_QB -50W Series is a high performance product designed for the field of railway applications. The DC/DC converters feature 50W output power, no min. load requirement, wide input voltage of 66-160VDC, And allow the high base plate temperature(up to 100°C). The products also provide input under-voltage protection, output over-voltage protection, short-circuit protection, over-temperature protection, remote control and compensation, output voltage regulation functions. The series meet railway standard EN50155. And target railway system.

Selection Guide

Part No. ^①	Input Voltage (VDC)		Output		Efficiency (%, Min./Typ.) @ Full Load	Max. Capacitive Load(μF)
	Nominal (Range)	Max. ^②	Output Voltage(VDC)	Output Current (mA)(Max./Min.)		
URF1D03QB-50W	110 (66-160)	170	3.3	15000/0	84/86	10000
URF1D03QB-50WH						
URF1D05QB-50W			5	10000/0	86/88	7500
URF1D05QB-50WH						
URF1D12QB-50W			12	4167/0	86/88	6000
URF1D12QB-50WH						
URF1D15QB-50W			15	3333/0	86/88	4700
URF1D15QB-50WH						
URF1D24QB-50W			24	2083/0	88/90	3000
URF1D24QB-50WH						

Note: ①Series with suffix "H" are heat sink mounting, for example URF1D05QB-50WH is chassis mounting of with heat sink;

②Exceeding the maximum input voltage may cause permanent damage.

Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Input Current (full load / no-load)	Nominal input voltage	URF1D03QB-50W(H)	--	523/5	536/15	mA
		URF1D05QB-50W(H)	--	516/5	528/15	
		URF1D12QB-50W(H)	--	516/5	528/15	
		URF1D15QB-50W(H)	--	516/5	528/15	
		URF1D24QB-50W(H)	--	505/5	516/15	
Reflected Ripple Current	Nominal input voltage		--	50	--	VDC
Surge Voltage (1sec. max.)			-0.7	--	180	
Starting Voltage			--	--	66	
Input Under-voltage Protection			--	58	--	
Starting Time			--	25	--	ms
Input Filter			PI filter			
Hot Plug			Unavailable			
Ctrl*	Module switch on		Ctrl open circuit or connected to TTL high level (3.5-12VDC)			
	Module switch off		Ctrl connected to -Vin or low level (0-1.2VDC)			
	Input current when switched off		--	2	--	mA

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

Output Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Output Voltage Accuracy	Nominal input voltage, 10%-100% load	URF1D03QB-50W(H)	--	--	±3	%
		Others	--	--	±2	
	Nominal input voltage, 0%-10% load	URF1D03QB-50W(H)	--	--	±5	
		Others	--	--	±3	
Line Regulation	Full load, the input voltage is from low to high	URF1D03QB-50W(H)	--	--	±0.5	%
		Others	--	--	±0.3	
Load Regulation	Nominal input voltage, 10%-100% load	URF1D03QB-50W(H)	--	--	±1	%
		Others	--	--	±0.5	
Transient Recovery Time	25% load step change, nominal input voltage		--	300	500	μs
Transient Response Deviation		URF1D03QB-50W(H)	--	±6	±8	%
		Others	--	±3	±5	
Temperature Coefficient	Full load		--	--	±0.03	%/°C
Ripple & Noise *	20MHz bandwidth	URF1D03QB-50W(H)	--	100	350	mVp-p
		Others	--	100	300	
Trim			-5	--	10	%
Output voltage remote compensation(Sense)			--	--	5	
Output Over-voltage Protection	Input voltage range		110	--	140	%Vo
Output Over-current Protection			110	130	180	%Io
Short-circuit Protection		Continuous, self-recovery				
Note: * The measuring method of ripple and noise, please refer to Fig. 1 .						

Note: * The measuring method of ripple and noise, please refer to Fig. 1 .

General Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Insulation Voltage	Input-output	3000	--	--	VDC
	Input-case	1500	--	--	
	Output-case	1500	--	--	
Insulation Resistance	conditions of Ta=25°C, Input-output, insulation voltage 500VDC/1 minute, humidity =75%RH	--	1000	--	MΩ
Isolation Capacitance	Input-output, 100KHz/0.1V	--	2200	--	pF
Switching Frequency	PFM mode	--	220	--	KHz
MTBF	MIL-HDBK-217F@25°C	500	--	--	K hours

Environmental Specifications

Item	Operating Conditions	Min.	Max.	Unit
Base-Plate Temperature Range	Within the operating temperature curve	-40	+100	°C
Over-temperature Protection	Base- Plate Temperature	--	+115	
Thermal Resistance (Rth(B-A))	URF1D_QB-50W	Natural convection (20LFM)	8	°C/W
		200LFM convection	6.0	
		400LFM convection	5.0	
		1000LFM convection	4.0	
	URF1D_QB-50WH	Natural convection (20LFM)	5.1	
		200LFM convection	2.8	
		400LFM convection	2.2	
		1000LFM convection	1.8	
Storage Humidity	Non-condensing	5	95	%RH
Storage Temperature		-55	+125	°C
Pin Welding Resistance Temperature	Welding spot is 1.5mm away from the casing, 10 seconds	--	+300	

Cooling Test		EN60068-2-1
Dry Heat		EN60068-2-2
Damp heat		EN60068-2-30
Shock and Vibration Test		IEC/EN 61373 car body 1 B mold

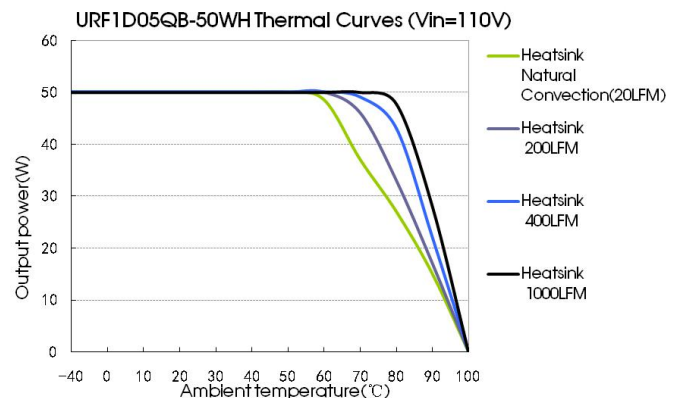
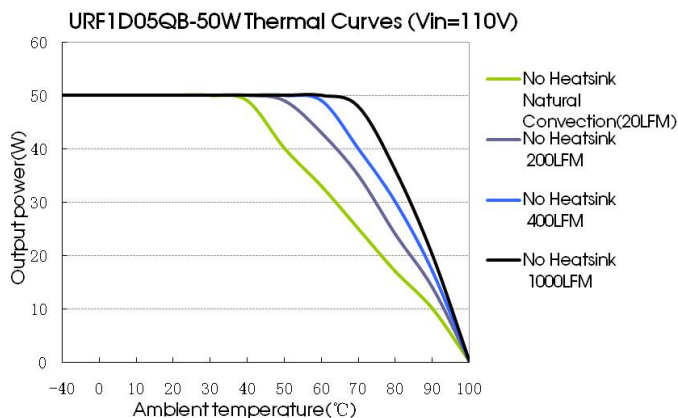
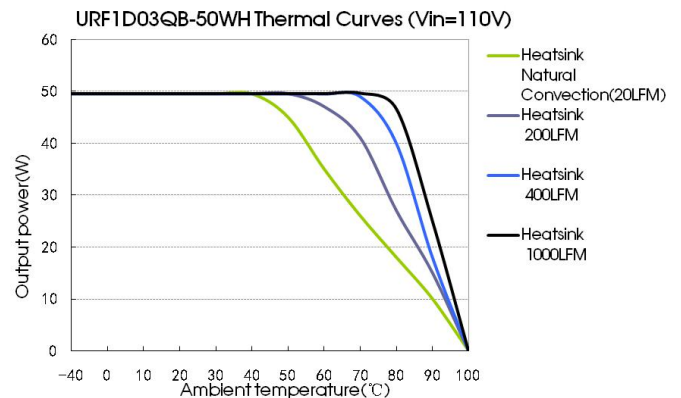
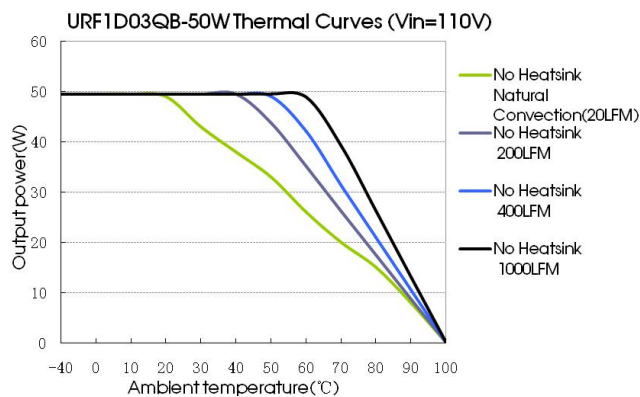
Physical Specifications

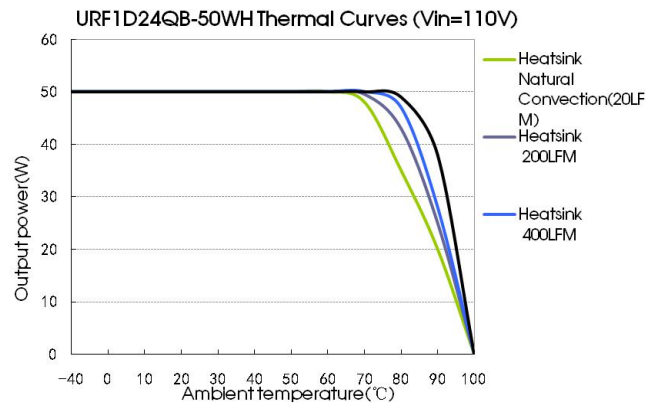
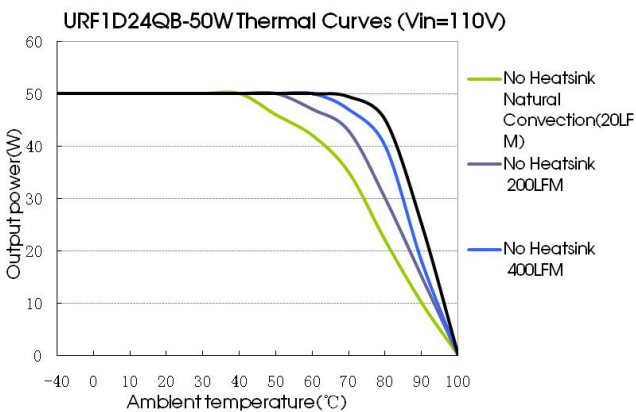
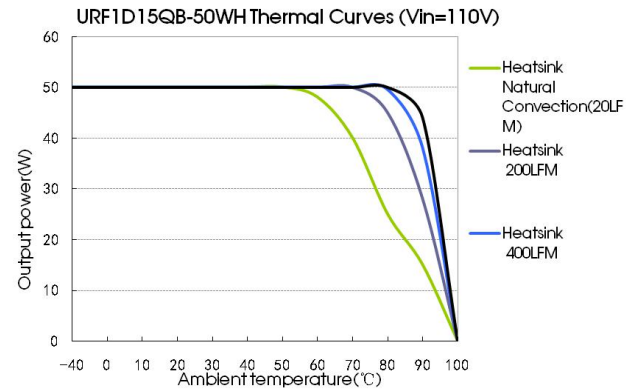
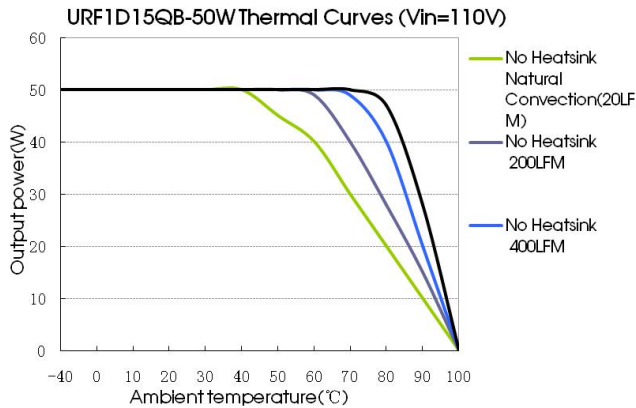
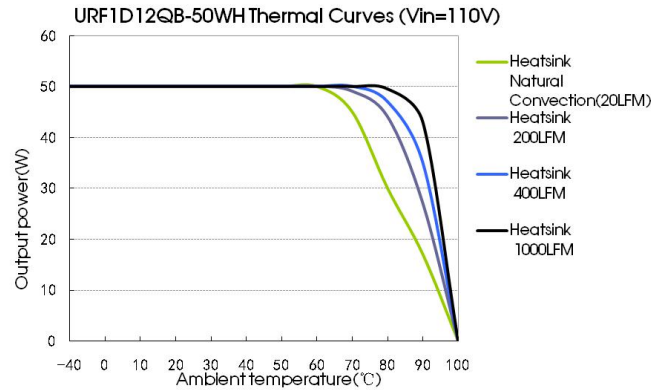
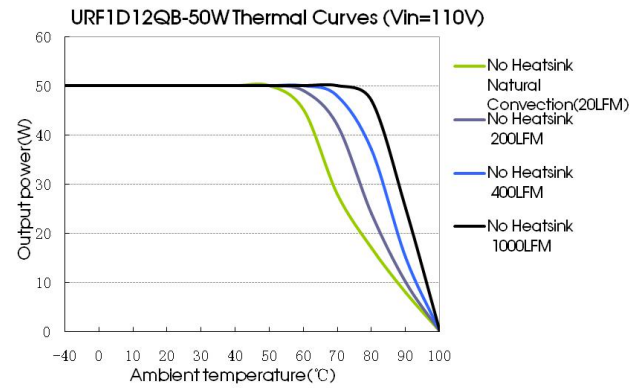
Casing Material		Black flame-retardant and heat-resistant plastic (UL94 V-0)
Dimension	Without Heatsink	60.80*39.20*12.70mm
	With Heatsink	62.00*39.20*30.80mm
Weight	Without Heatsink	46g (Typ.)
	With Heatsink	76g (Typ.)
Cooling Method		Natural convection (20LFM) or Forced convection

EMC Specifications

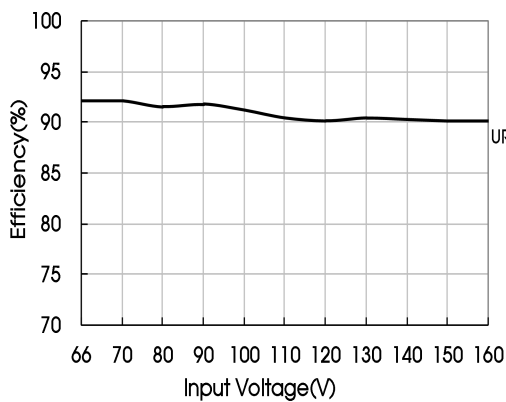
EMI	CE	CISPR32/EN55032	150KHz-30MHz Class B (see Fig. 2-1for recommended circuit)	
	RE	CISPR32/EN55032	30MHz-1GHz Class B (see Fig. 2-1for recommended circuit)	
EMS	ESD	IEC/EN61000-4-2	GB/T17626.2 Contact $\pm 6\text{KV}$, Air $\pm 8\text{KV}$	perf.Criteria B
	RS	IEC/EN61000-4-3	GB/T17626.3 10V/m	perf.Criteria A
	CS	IEC/EN61000-4-6	GB/T17626.6 10Vr.m.s	perf.Criteria A
	EFT	IEC/EN61000-4-4	GB/T17626.4 $\pm 2\text{KV}$ (5KHz, 100KHz)(see Fig. 2-1for recommended circuit)	perf.Criteria B
	Surge	IEC/EN61000-4-5	GB/T17626.5 line to line $\pm 2\text{KV}$ (1.2 μs /50 μs 2 Ω),(see Fig.2-1for recommended circuit)	perf.Criteria B

Product Characteristic Curves

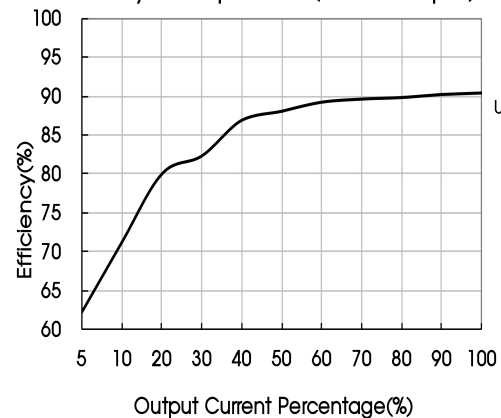




Efficiency Vs input Voltage (Full Load)



Efficiency Vs Output Load (Nominal input)

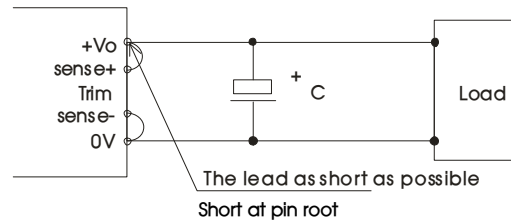


Note:

1. The temperature derating curve and the efficiency curve are typical test values
2. Temperature derating curve in accordance with our laboratory test conditions for testing, the actual use of environmental conditions if the customer is not consistent, to ensure that the product aluminum shell temperature does not exceed 100 °C, can be used within any rated load range.

Sense of application and precautions

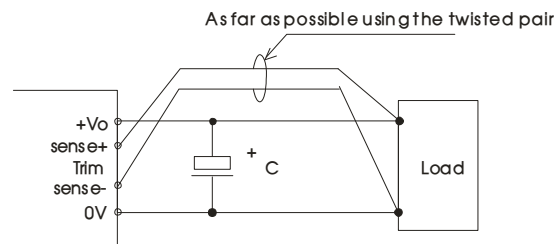
1. When not using remote sense



Notes:

- 1) When not using remote sense, make sure +Vo and Sense + are shorted, and that 0V and Sense- are shorted as well;
- 2) Keep the tracks between +Vo and Sense +, 0V and Sense- as short as possible, and close to the terminal. Avoid a looping track. If noise interferes the loop, the operation of the power module will become unstable.

2. When Remote Sense is used



Notes:

1. Using remote sense with long wires may cause output voltage to become unstable. Consult us if long sensing wiring is necessary.
2. Sense tracks or wires should be as short as possible. If using wires, it should not use twisted-pair or shielded wires.
3. Please use wide PCB tracks or a thick wires between the power supply module and the load, the line voltage drop should be kept less than 0.3V. Make sure the power supply module's output voltage remains within the specified range.
4. The impedance of wires may cause the output voltage oscillation or a greater ripple, please take adequate assessments before using.

Design Reference

1. Ripple & Noise

All the URF1D_QB-50W(H) series have been tested according to the following recommended test circuit before delivery (see Fig. 1).

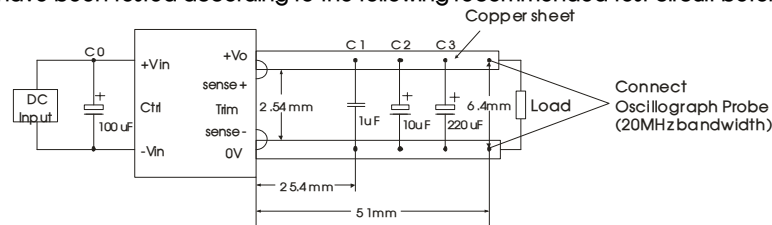


Fig. 1

2. Typical application

If not using Mornsun's recommended circuit, please ensure an 100 μ F electrolytic capacitors in parallel with the input, which used to suppress the surge voltage come from the input terminal.

If it is required to further reduce input&output ripple, properly increase the input & output of additional capacitors Cin and Cout or select capacitors of low equivalent impedance, provided that the capacitance is no larger than the max. capacitive load of the product.



Capacitive Parameter	Cout(μ F)	Cin(μ F)
Output Voltage		
3.3 VDC	220	100
5VDC		
12VDC		
15VDC		
24VDC		

3. EMC solution-module recommended circuit

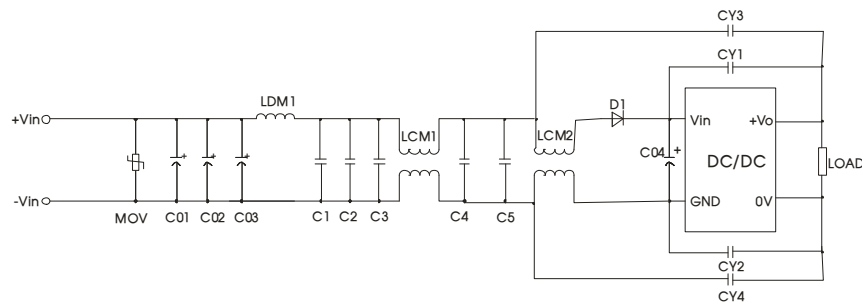


Fig. 2-1

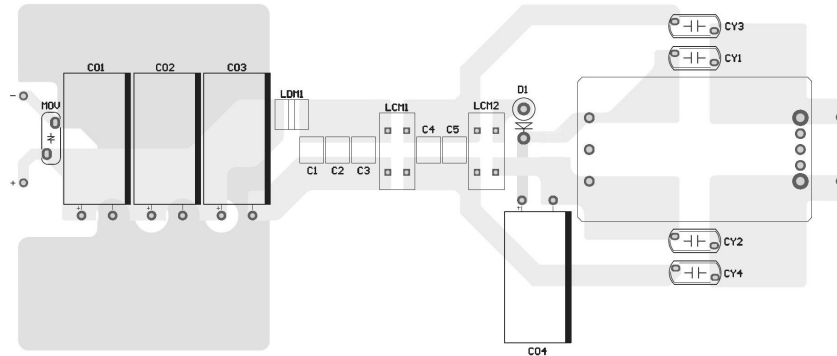


Fig. 2-2

MOV	S20K130(Varistor)
C01、C02、C03、C04	100uF/400V(electrolytic capacitor)
LDM1	10uH(Shielded inductor)
C1、C2、C3、C4、C5	2.2uF/250V
D1	SF306
CY1、CY2、CY3、CY4	2200 pF /400VAC (Y safety capacitor)
LCM1	FL2D-30-222
LCM2	FL2D-30-472

4. Thermal design

The maximum operating temperature of base-plate TB is 100 °C, as long as the user's thermal system keeps TB <100 °C, the converter can deliver its full rated power. A power derating curve can be calculated for any heatsink that is attached to the base-plate of the converter. It is often airflow rate. This information is usually available from the heatsink vendor. The following formula can be used to determine the maximum necessary to determine the thermal resistance, Rth(B-A), of the chosen heatsink between the base-plate and the ambient air for a given power the converter can dissipate for a given thermal condition if its base-plate is to be no higher than 100 °C.

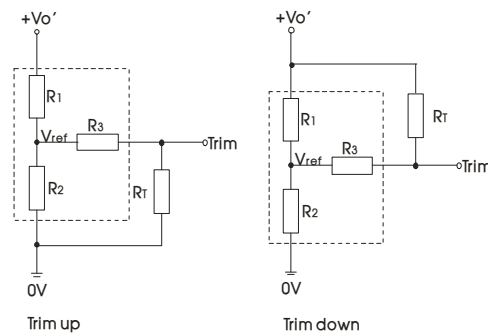
$$P_{diss}^{max} = \frac{100 - T_A}{R_{th(B-A)}} \quad (T_A \text{ is ambient temperature, } R_{th(B-A)} \text{ is thermal resistance of base-plate, } P_{diss}^{max} \text{ is max dissipation power})$$

The maximum load operating power of power supply module at a certain ambient temperature can be calculated by the power dissipation, Formula is as follows:

$$P_{Omax} = \frac{P_{diss}^{max}}{\left(\frac{1}{\eta} - 1\right)} \quad (\eta \text{ is converter efficiency})$$

Therefore, customers can according to the actual application to choose the right heatsink.

5.Application of Trim and calculation of Trim resistance



Applied circuits of Trim (Part in broken line is the interior of models)

Calculation formula of Trim resistance:

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

table 1

Vo Parameter	3.3(VDC)	5(VDC)	12(VDC)	15(VDC)	24(VDC)
R1(KΩ)	4.77	2.94	11	14.49	24.87
R2(KΩ)	2.87	2.87	2.87	2.87	2.87
R3(KΩ)	10	10	15	15	20
Vref(V)	1.24	2.5	2.5	2.5	2.5

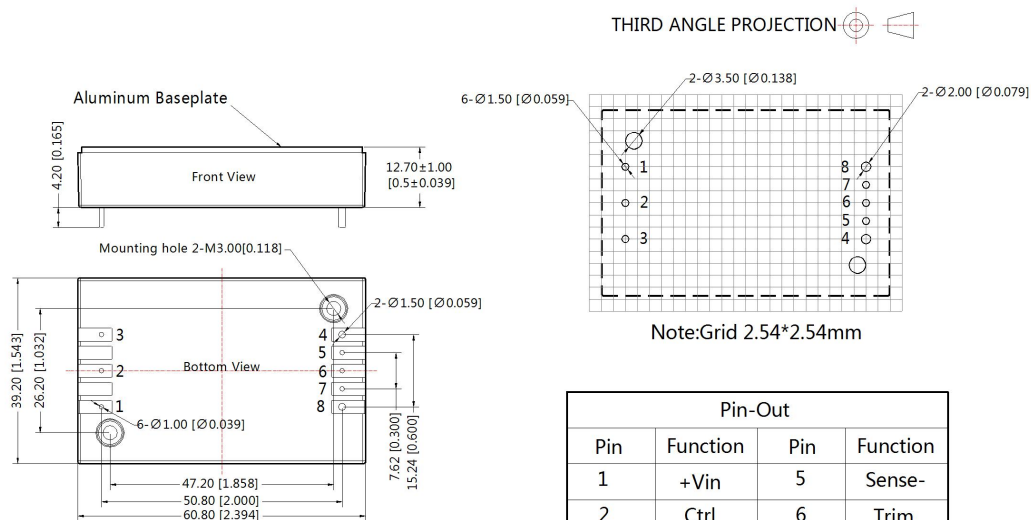
Note:

Value for R1, R2, R3, and V_{ref} refer to the above table 1. R_T: Resistance of Trim. α: User-defined parameter, no actual meanings. V_{o'}: The trim up/down voltage.

6.It is not allowed to connect modules output in parallel to enlarge the power

7.For more information please find the application notes on www.mornsun-power.com

Dimensions and Recommended Layout (without heatsink)

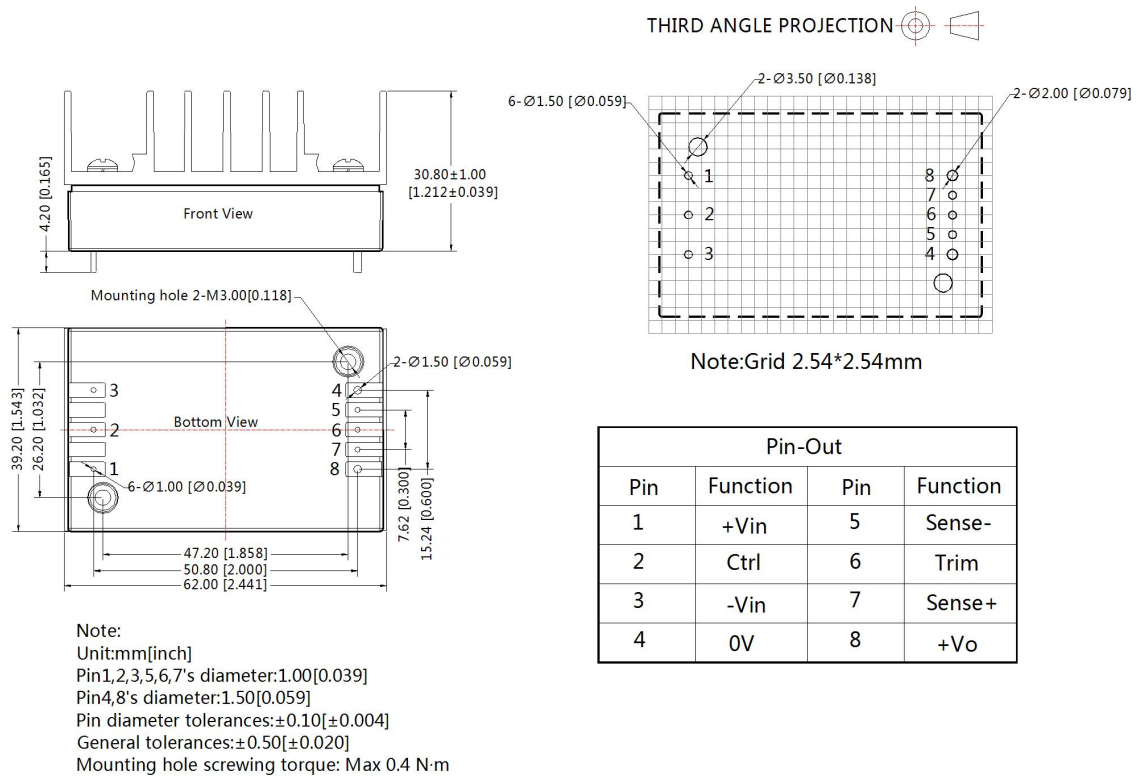


Note:Grid 2.54*2.54mm

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

Note:
Unit:mm[inch]
Pin1,2,3,5,6,7's diameter:1.00[0.039]
Pin4,8's diameter:1.50[0.059]
Pin diameter tolerances:±0.10[±0.004]
General tolerances:±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N·m

Dimensions and Recommended Layout(with heatsink)



Note:

1. Packing Information please refer to 'Product Packing Information'. Packing bag number: 58010113(without heatsink), 58220017(with heatsink);
2. Recommend to use module with more than 5% load, if not, the ripple of the product may exceeds the specification, but does not affect the reliability of the product;
3. The maximum capacitive load offered were tested at input voltage range and full load;
4. If the customer tests EMC, suggest to take our recommended circuit. If the customer needs to meet the performance aspects of the surge, and don't take our recommended circuit, please make sure the surge residual voltage is less than 180V, to ensure the reliability of the product;
5. Recommends that customers plus silicone film or thermal grease between the module and the heatsink,in order to ensure good heat dissipation;
6. Unless otherwise specified, parameters in this datasheet were measured under the conditions of Ta=25°C, humidity<75%RH with nominal input voltage and rated output load;
7. All index testing methods in this datasheet are based on Company's corporate standards;
8. We provide product customization service and match filter module, please directly contact our technicians for specific information;
9. Specifications of this product are subject to changes without prior notice.

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