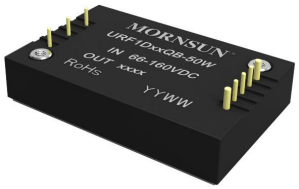
50W isolated DC-DC converter
Wide input and regulated single output



Patent Protection RoHS

FEATURES

- Wide input voltage range 66-160VDC
- High efficiency up to 90%
- Low no-load power consumption
- I/O isolation test voltage 3k VDC
- Operating ambient temperature range -40℃ ~ +100℃
- Input under-voltage protection, output over-voltage, over-current, short-circuit, over-temperature protection
- Industry standard 1/4 brick
- EN50155 approved

URF1D_QB-50W series is a high-performance product specifically designed for a variety of railway applications. The DC-DC converters feature 50W output power with no requirement for minimum load, wide input voltage from 66-160VDC, and allowing operating out-case temperature as high as 100℃. The products also provide input under-voltage protection, output over-voltage, short-circuit and over-temperature protection. Additional functions include remote On/Off control, remote sense compensation and output voltage trim adjustment. This series meet railway standard EN50155 and they are widely used in railway systems and associated equipment.

Selection Guide

Part No.①	Input Voltage (VDC)		Output		Full Load Efficiency (%) Min./Typ.	Max. Capacitive Load(μF)
	Nominal (Range)	Max.②	Voltage (VDC)	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:
①Use "H" suffix for heat sink mounting;
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	--	
Surge Voltage (1sec. max.)			-0.7	--	180	VDC
Start-up Voltage			--	--	66	
Under-voltage Protection			--	58	--	
Start-up Time			--	25	--	ms
Input Filter			Pi filter			
Hot Plug			Unavailable			
Ctrl*	Module on		Ctrl pin open or pulled high (3.5-12VDC)			
	Module off		Ctrl pin pulled low to GND (0-1.2VDC)			
	Input current when off		--	2	--	mA

Note: *The Ctrl pin voltage is referenced to input -Vin.

Output Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
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	
Linear Regulation	Input voltage variation from low to high at full load	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	%/℃
Ripple & Noise *	20MHz bandwidth	URF1D03QB-50W(H)	--	100	350	mVp-p
		Others	--	100	300	
Trim			-5	--	10	%
Output Voltage Remote Compensation(sense)			--	--	5	
Over-voltage Protection	Input voltage range		110	--	140	%Vo
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 .

General Specifications

Item		Operating Conditions	Min.	Typ.	Max.	Unit
Isolation	Input-output	Electric Strength test for 1 minute with a leakage current of 1mA max.	3000	--	--	VDC
	Input-case		1500	--	--	
	Output-case		1500	--	--	
Insulation Resistance		Conditions of Ta=25℃, input-output insulation at 500VDC, humidity =75%RH	--	1000	--	MΩ
Isolation Capacitance		Input-output capacitance at 100KHz/0.1V	--	2200	--	pF
Switching Frequency		PFM mode	--	220	--	KHz
MTBF		MIL-HDBK-217F@25℃	500	--	--	K hours

Environmental Specifications

Item		Operating Conditions	Min.	Max.	Unit
Out-case Temperature Range		According to the operating temperature range	-40	+100	℃
Over-temperature Protection		Out-case Temperature	--	+115	
Thermal Resistance (Rth(B-A))	URF1D_QB-50W	Natural convection (20LFM)	8	--	℃/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	℃

Pin Soldering Resistance Temperature	Soldering spot is 1.5mm away from case for 10 seconds	--	+300	
Cooling Test		EN60068-2-1		
Dry Heat		EN60068-2-2		
Damp heat		EN60068-2-30		
Shock and Vibration Test		IEC/EN61373 - Category 1, Grade B		

Physical Specifications

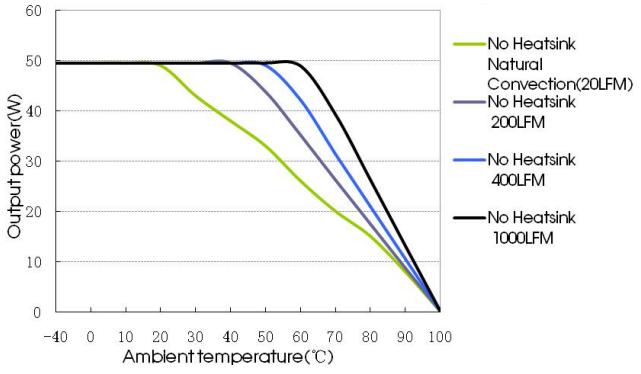
Case Material		Black flame-retardant and heat-resistant plastic (UL94 V-0)
Dimensions	Without Heatsink	60.80 x 39.20 x 12.70mm
	With Heatsink	62.00 x 39.20 x 30.80mm
Weight	Without Heatsink	46.0g (Typ.)
	With Heatsink	76.0g (Typ.)
Cooling Method		Natural convection (20LFM) or Forced convection

Electromagnetic Compatibility (EMC)

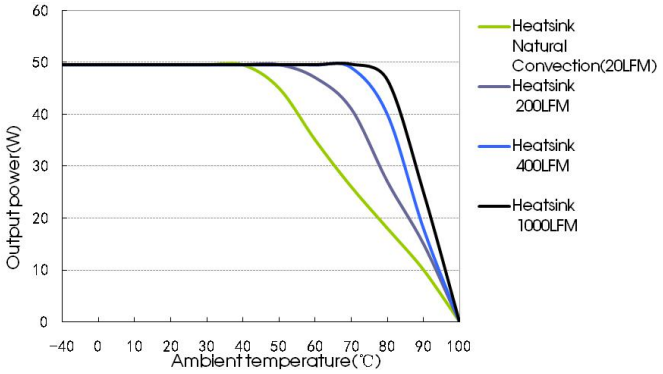
Emissions	CE	CISPR32/EN55032	150KHz-30MHz Class B (see Fig. 2 -1 for recommended circuit)	
	RE	CISPR32/EN55032	30MHz-1GHz Class B (see Fig. 2 -1 for recommended circuit)	
Immunity	ESD	IEC/EN61000-4-2	GB/T17626.2 Contact ±6KV, Air ±8KV	perf.Criteria B
	RS	IEC/EN61000-4-3	GB/T17626.3 10V/m	perf.Criteria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

Typical Characteristic Curves

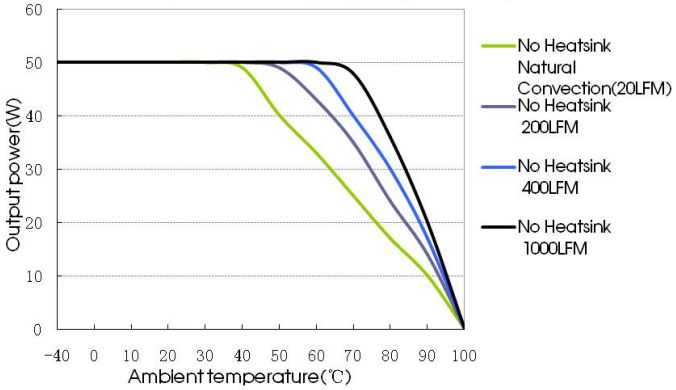
URF1D03QB-50W Temperature Derating Curve (Vin=110V)



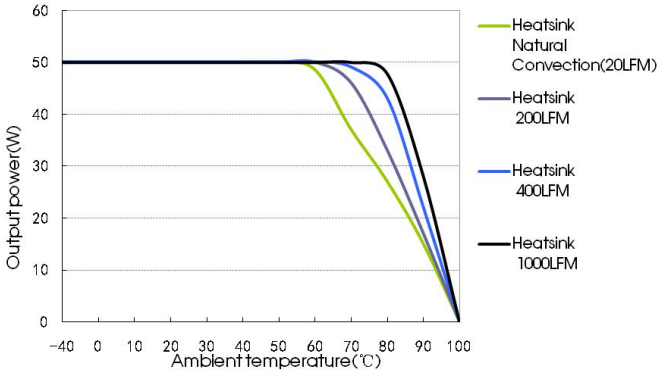
URF1D03QB-50WH Temperature Derating Curve (Vin=110V)



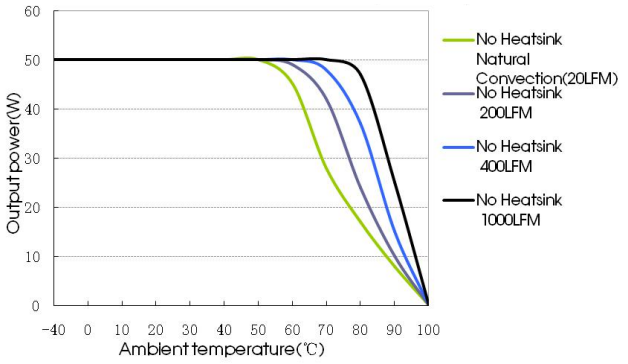
URF1D05QB-50W Temperature Derating Curve (Vin=110V)



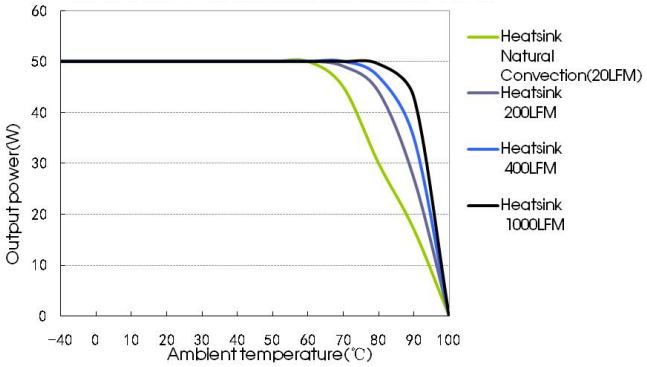
URF1D05QB-50WH Temperature Derating Curve (Vin=110V)



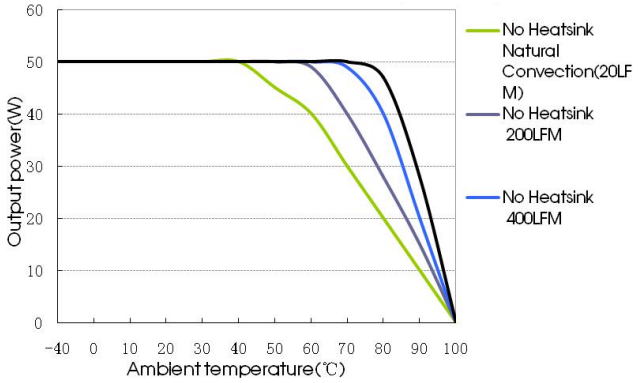
URF1D12QB-50W Temperature Derating Curve (Vin=110V)



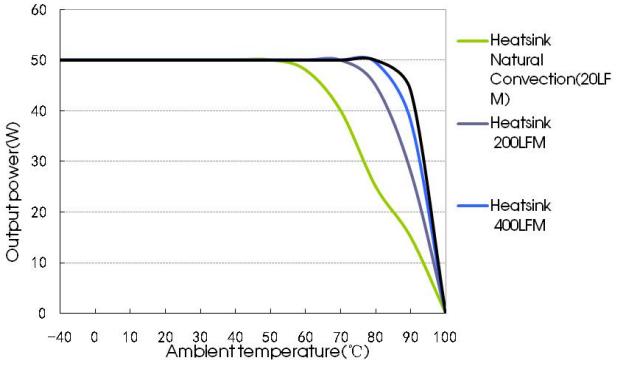
URF1D12QB-50WH Temperature Derating Curve (Vin=110V)



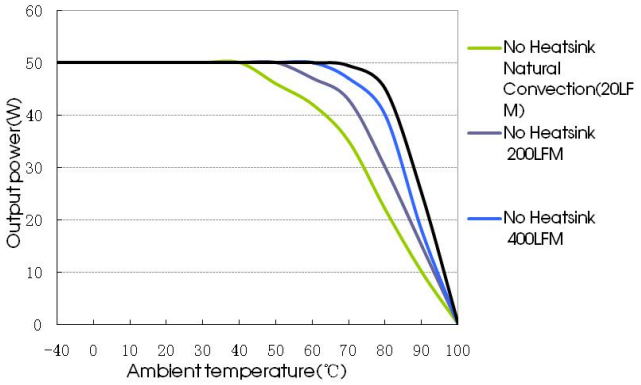
URF1D15QB-50W Temperature Derating Curve (Vin=110V)



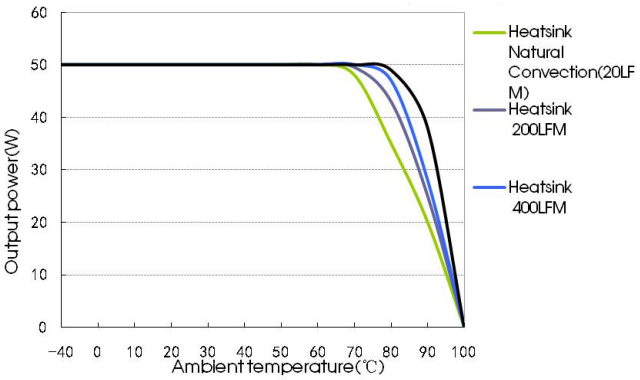
URF1D15QB-50WH Temperature Derating Curve (Vin=110V)



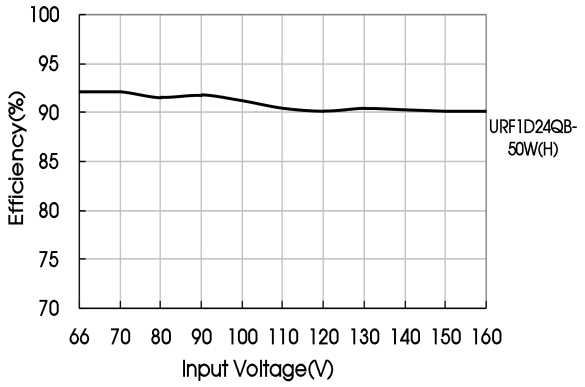
URF1D24QB-50W Temperature Derating Curve (Vin=110V)



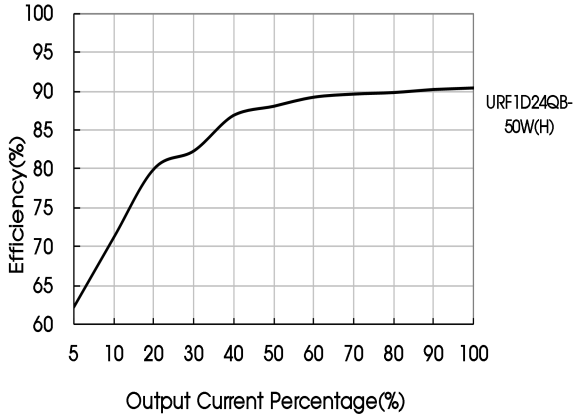
URF1D24QB-50WH Temperature Derating Curve (Vin=110V)



Efficiency Vs input Voltage (Full Load)



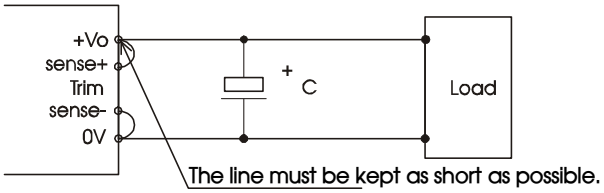
Efficiency Vs Output Load(Nominal input)



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 ℃, can be used within any rated load range.

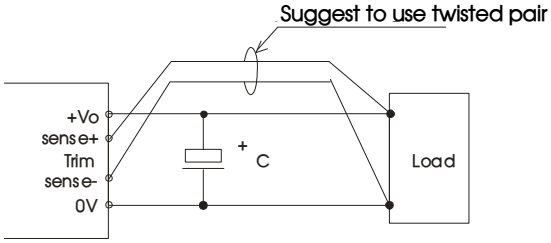
Remote Sense Application

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) PCB-tracks or cables/wires for Remote Sense must be kept as short as possible.
(2) In cables and discrete wiring applications, twisted pair or other techniques should be implemented.
(3) Using remote sense with long wires long wires may cause unstable operation. 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.
(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.

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. 1-1).

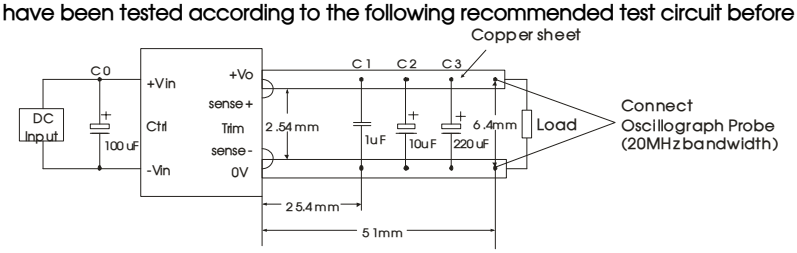


Fig. 1-1

2. Typical application

We recommened using the recommended circuit shown in Fig. 1-2 during product application, otherwise please ensure that at least a 100μF electrolytic capacitors is connected at the input in order to ensure adequate voltage surge suppression and protection.
Input and/or output ripple can be further reduced by appropriately increasing the input & output capacitor values Cin and Cout and/or by selecting capacitors with a low ESR (equivalent series resistance). Also make sure that the capacitance is not exceeding the specified max. capacitive load value of the product.

Fig. 1-2

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

3. EMC compliance circuit

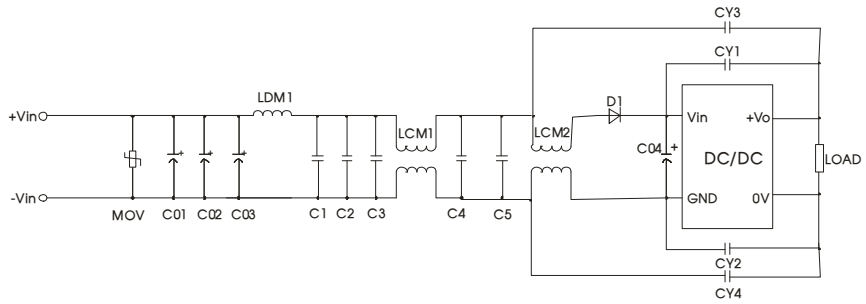


Fig. 2-1

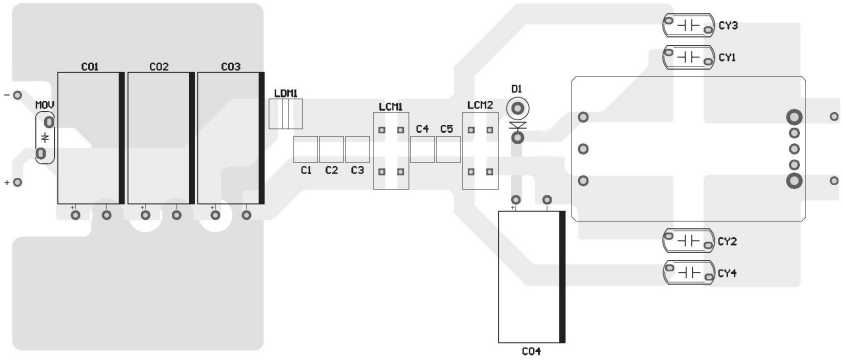


Fig. 2-2

MOV	S20K130(Varistor)
C01、C02、C03、C04	100uF/400V(electrolytic caoacitor)
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 ℃, as long as the user's thermal system keeps TB <100 ℃, the converter car 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 onen airflow rate. This information is usually available from the heatsink vendor. The following formula can the be used to determine the maximly necessary to determine the thermal resistance, Rth(B-A), of the chosen heatsink between the base-plate and the ambient air for c givum power the converter can dissipate for a given thermal condition if its base-plate is to be no higher than 100 ºC.

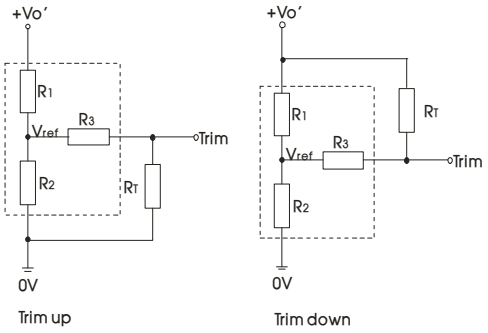
$$P_{diss}^{max} = \frac{100 - T_A}{Rth_{B-A}}$$ (T_A is ambient temperature, $Rth(B-A)$ is thermal resistance of base-plate, P_{diss}^{max} is max dissipation power)

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:

$$Po_{\max} = \frac{P_{diss}^{\max}}{(\frac{1}{\eta} - 1)}$$ (η is converter efficiency)

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

5. Trim Function for Output Voltage Adjustment (open if unused)



TRIM resistor connection (dashed line shows internal resistor network)

Trim resistor calculation:

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

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

table 1

Parameter \ Vo	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

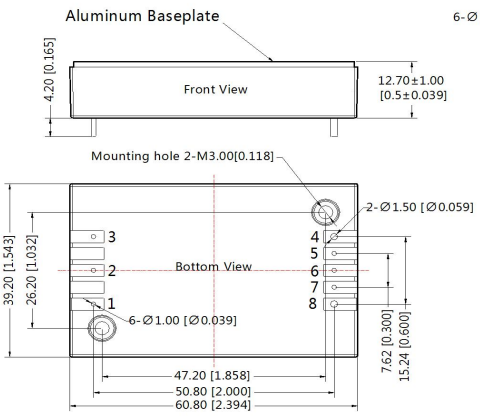
Note:

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

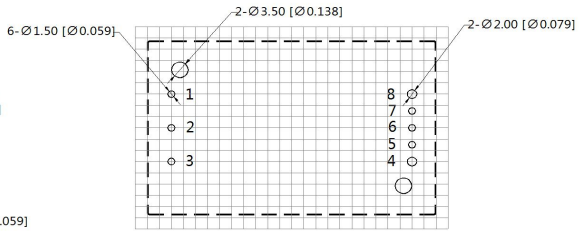
6. The products do not support parallel connection of their output

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

Horizontal Package (without heat sink) Dimensions and Recommended Layout



THIRD ANGLE PROJECTION



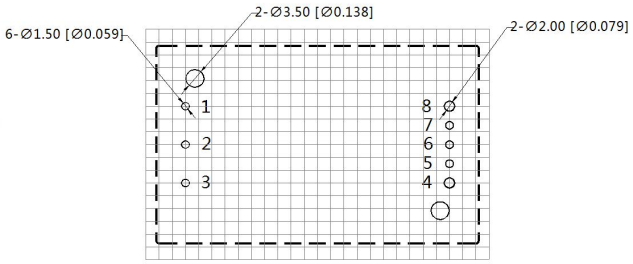
Note:Grid 2.54*2.54mm

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

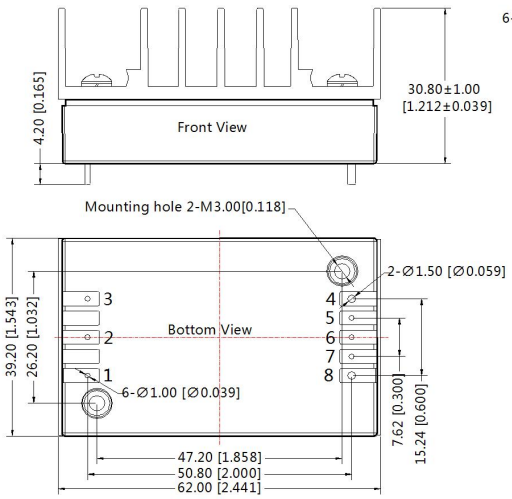
Note:
Unit:mm[inch]
Pin1,2,3,5,6,7's diameter:1.00[0.039]
Pin4,8's diameter:1.50[0.059]
Pin diameter tolerances:±0.10[±0.004]
General tolerances:±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N·m

Horizontal Package (with heat sink) Dimensions

THIRD ANGLE PROJECTION



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

Note:

1. For additional information on Product Packaging please refer to www.mornsun-power.com. The Packaging bag number of Horizontal packaging: 58010113(without heat sink), 58220017(with heat sink)
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. It is suggested to take our recommended circuit for EMC testing. If the customer needs to meet the performance of the surge and without taking recommended solution of ours, please make sure the residual voltage of surge less than 180V;
5. It is suggested that customers use enamel film or thermal grease between the heat sink and the module when using the heat sink to ensure good heat dissipation;
6. 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;
7. All index testing methods in this datasheet are based on company corporate standards;
8. We can provide customized and matched filter modules. For details, please contact our technical staff;
9. Specifications of this product are subject to changes without prior notice.

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