

250W isolated DC-DC converter
Ultra-wide input and regulated single output



Patent Protection RoHS



FEATURES

- Ultra-wide 4:1 input voltage range: 40 -160VDC
- High efficiency up to 90%
- Reinforced insulation, I/O isolation test voltage 3k VAC
- Operating ambient temperature range -40°C to +105°C
- Input under-voltage protection, output over-voltage, over-current, short-circuit protection, over-temperature protection
- Industry standard 1/2-Brick package and pin-out
- Meets EN50155 railway standard

URF1D_HB-250(H)WR3 series is a high-performance product specifically designed for a variety of railway applications. The DC-DC converters feature 250W output power with no requirement for minimum load, wide input voltage from 40-160VDC, and allowing operating temperature as high as 105°C. Additional product features include input under-voltage protection, output over-voltage, short-circuit, over-current and over-temperature protection, remote On/Off control, remote sense compensation, output voltage trim adjustment. The products meet EN50155 railway standards and are widely used in the centralized lighting, air conditioning and related in on-board 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 (A) (Max./Min.)		
URF1D05HB-250W(H)R3	110	40-66	170	5	40000/0	87/88	22000
URF1D12HB-250W(H)R3		66-160			16670/0		
URF1D15HB-250W(H)R3		40-66		12	20840/0	88/90	10000
		66-160					
URF1D24HB-250W(H)R3		40-66		15	13330/0	88/90	6800
		66-160			16670/0		
URF1D48HB-250W(H)R3		40-66		24	8330/0	88/90	4000
		66-160			10420/0		
URF1D54HB-250W(H)R3		40-66		48	4160/0	88/90	680
		66-160			5200/0		
URF1D54HB-250W(H)R3		40-66		54	3700/0	88/90	680
		66-160			4630/0		

Note:
①Use "H" suffix for heat sink mounting. We recommend to choose modules with a heat sink for enhanced heat dissipation and applications with extreme temperature requirements;
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	--	2526/50	2582/70	mA
Reflected Ripple Current		--	100	--	
Surge Voltage (1sec. max.)		-0.7	--	185	VDC
Start-up Voltage		--	--	40	
Input Under-voltage Protection		32	36	--	
Start-up Time		--	40	100	ms
Input Filter		Pi filter			
Ctrl ^①	Module on	Ctrl open circuit or connected to TTL high level (3.5-12VDC)			
	Module off	Ctrl pin connected to -Vin or low level (0-1.2VDC)			
	Input current when off	--	5	10	mA

Hot Plug		Unavailable
Note: ①The Ctrl pin voltage is referenced to input -Vin.		

Output Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Voltage Accuracy		--	±1	±3	
Linear Regulation	Input voltage variation from low to high at full load	--	±0.2	±0.5	%
Load Regulation	Nominal input voltage, 0%-100% load				
Transient Recovery Time	25% load step change @25°C	--	200	500	μs
Transient Response Deviation		--	±3	±5	%
Temperature Coefficient	Full load	--	--	±0.03	%/°C
Ripple & Noise ^①	20MHz bandwidth, 0%-100%load	--	120	200	mVp-p
Trim		90	--	110	%Vo
Sense		--	--	105	
Over-temperature Protection	Max. Case Temperature	--	105	--	°C
Over-voltage Protection	Input voltage range	110	130	160	%Vo
Over-current Protection		110	140	150	%Io
Short-circuit Protection		Continuous, self-recovery			

Note: ①For ripple and noise measuring method, please refer to Fig. 4 .

General Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit	
Isolation	Electric Strength Test for 1 minute with a leakage current of 5mA max	Input-output	3000	--	--	VAC
		Input-case	1500	--	--	
		Output-case	1500	--	--	
Insulation Resistance	Input-output resistance at 500VDC	100	--	--	MΩ	
Isolation Capacitance	Input-output capacitance at 100KHz/0.1V	--	1000	--	pF	
Operating Temperature	See Fig. 1	-40	--	+105	°C	
Storage Temperature		-55	--	+125		
Pin Soldering Resistance Temperature	Soldering spot is 1.5mm away from case for 10 seconds	--	--	300		
Storage Humidity	Non-condensing	5	--	95	%RH	
Switching Frequency	PWM mode	--	260	--	KHz	
MTBF	MIL-HDBK-217F@25°C	250	--	--	K hours	

Mechanical Specifications

Case Material	Aluminum alloy case; Black plastic bottom, flame-retardant and heat-resistant (UL94 V-0)				
Dimension	URF1D_HB-250WR3	61.00 x 57.90 x 13.80mm			
	URF1D_HB-250WHR3	62.00 x 58.00 x 31.80mm			
Weight	URF1D_HB-250WR3	135g (Typ.)			
	URF1D_HB-250WHR3	185g (Typ.)			
Cooling Method	Free air convection (20LFM) or forced air convection				

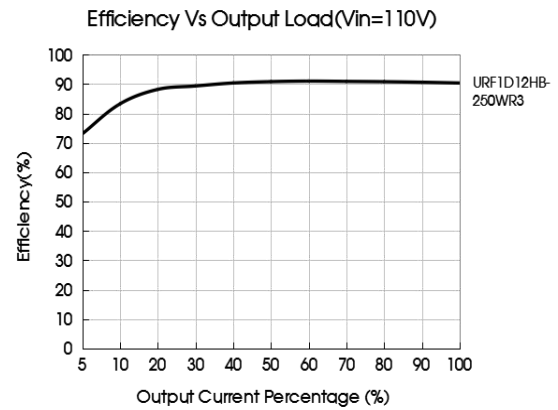
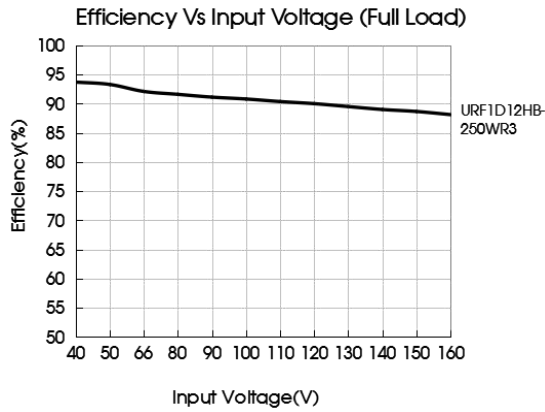
Electromagnetic Compatibility (EMC)

Emissions	CE	CISPR32/EN55032	CLASS A (see Fig. 6 for recommended circuit)		
	RE	CISPR32/EN55032	CLASS A (see Fig. 6 for recommended circuit)		
Immunity	ESD	IEC/EN61000-4-2	Contact ±6KV Air ±8KV		perf.Criteria A
	RS	IEC/EN61000-4-3	20V/m		perf.Criteria A
	CS	IEC/EN61000-4-6	10 Vr.m.s		perf.Criteria A
	EFT	IEC/EN61000-4-4	±2KV(see Fig. 6 for recommended circuit)		perf.Criteria A
	Surge	IEC/EN61000-4-5	differential mode ±1KV, 1.2/50us, source impedance 2Ω (see Fig. 6 for recommended circuit)		perf.Criteria A

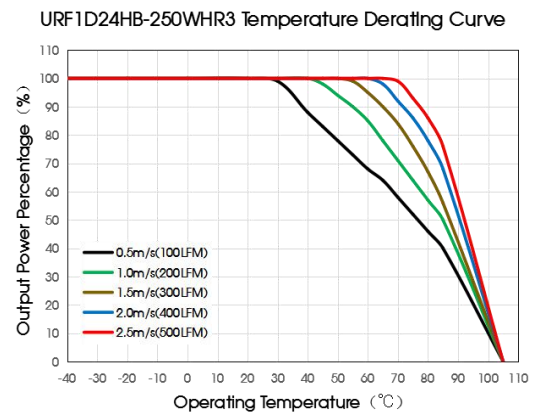
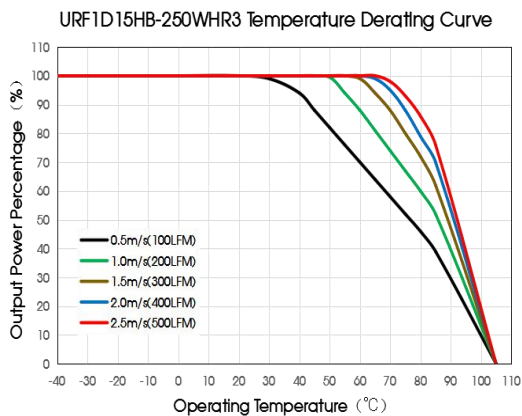
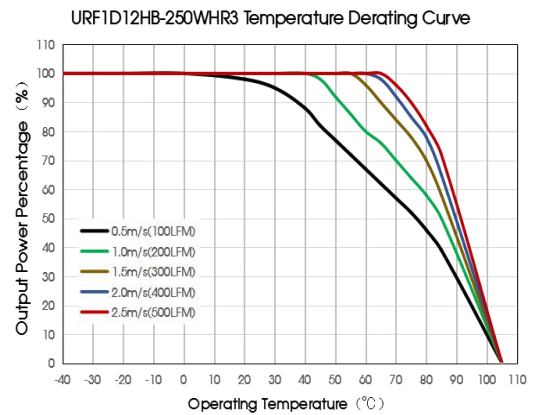
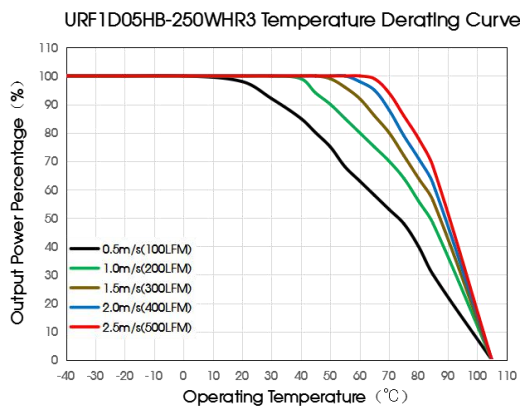
Electromagnetic Compatibility (EMC) (EN50155)

Emissions	CE	EN50121-3-2 150kHz-500kHz 99dBuV (see Fig. 6 for recommended circuit) EN55016-2-1 500kHz-30MHz 93dBuV	
	RE	EN50121-3-2 30MHz-230MHz 40dBuV/m at 10m (see Fig. 6 for recommended circuit) EN55016-2-1 230MHz-1GHz 47dBuV/m at 10m	
Immunity	ESD	EN50121-3-2 Contact ±6KV/Air ±8KV	perf. Criteria A
	RS	EN50121-3-2 20V/m	perf. Criteria A
	EFT	EN50121-3-2 ±2kV 5/50ns 5kHz (see Fig. 6 for recommended circuit)	perf. Criteria A
	Surge	EN50121-3-2 line to line ±1KV (42Ω, 0.5μF) (see Fig. 6 for recommended circuit)	perf. Criteria A
	CS	EN50121-3-2 0.15MHz-80MHz 10 V.r.m.s	perf. Criteria A

Efficiency Curves



Typical Performance Curves



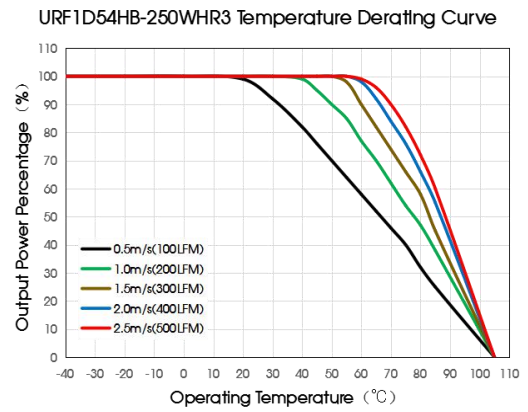
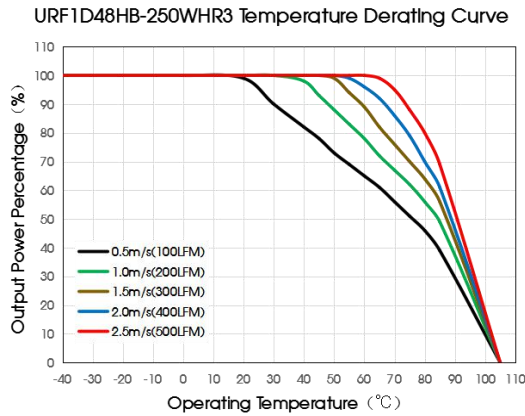


Fig.1

Remote Sense Application

1. Remote Sense Connection if not used

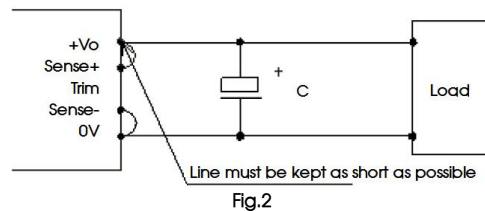


Fig.2

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

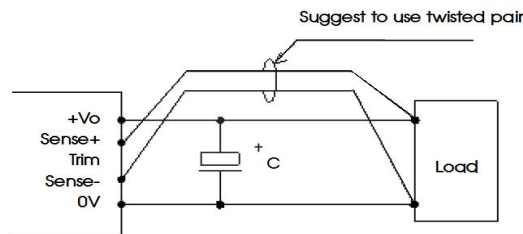


Fig.3

Notes:

- (1) Using remote sense with long wires may cause unstable output, please contact technical support if long wires must be used.
- (2) PCB-tracks or cables/wires for Remote Sense must be kept as short as possible. Twisted pair or shielded wairs are suggested for remote compensation and must be kept as short as possible.
- (3) 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.
- (4) 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. Ripple & noise

All the DC-DC converters of this series are tested before delivery using the recommended circuit shown in Fig. 4.

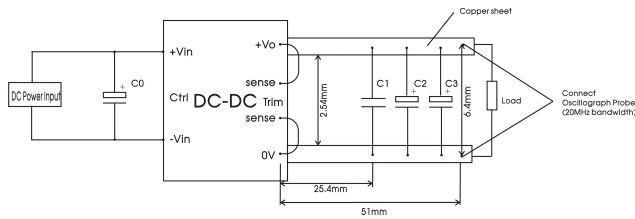


Fig.4

Capacitors value Output voltage	C0	C1	C2	C3
5VDC	100µF aluminum Electrolytic capacitor (Voltage ≥ 200V)	105K/50V ceramic capacitor	10µF/35V tantalum capacitor	220µF/35V electrolytic capacitor
12VDC				
15VDC				
24VDC				
48VDC				
54VDC	105K/100V ceramic capacitor	—	220µF/100V electrolytic capacitor	

2. Typical application

We recommended using Mornsun's EMC circuit, 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.5

Capacitor Value Output Voltage	Cout(µF)	Cin(µF)
5V/12V/15V/24V/48V/54V	220	100

3. EMC solution-recommended circuit

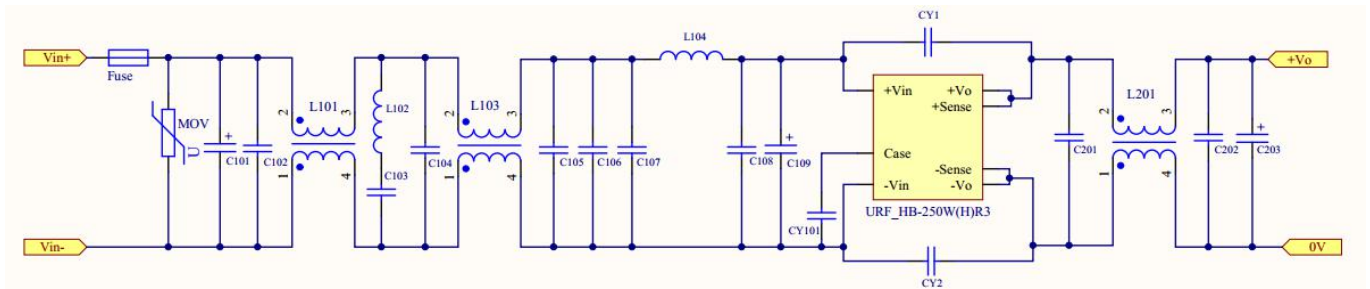
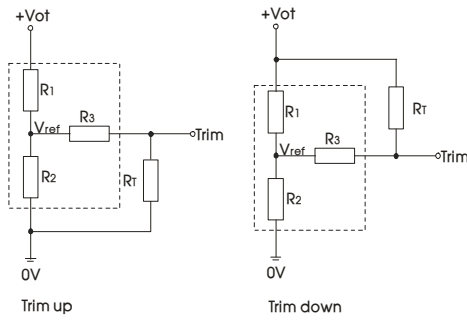


Fig. 6

Components	5V	12V/15V/24V/48V/54V
	Recommended Component value	Recommended Component value
FUSE	Choose according to actual input current	Choose according to actual input current
MOV	S20K130 (Varistor)	S20K130 (Varistor)
C101	150µF/400V electrolytic capacitor	150µF/400V electrolytic capacitor
C109	100µF/200V electrolytic capacitor	100µF/200V electrolytic capacitor
C203	220µF/35V electrolytic capacitor	220µF/63V electrolytic capacitor
C102, C103, C104, C105, C106, C107, C108, C201, C202	2.2µF/ 250V ceramic capacitor	2.2µF/ 250V ceramic capacitor
L101	220uH common mode choke	9.5mH common mode choke
L102	0.47uH Shielded inductor	0.47uH Shielded inductor
L103	9.5mH common mode choke	220uH common mode choke
L104	2.2uH Shielded inductor	2.2uH Shielded inductor
L201	TDG TN40H 3.3uH φ 2.0mm* 3/3T common mode choke	TDG TN100B 89uH φ 1.0mm* 10/10T common mode choke
CY1	2.2nF/400VAC Y1 safety capacitor	2.2nF/400VAC Y1 safety capacitor
CY2	1nF/400VAC Y1 safety capacitor	2.2nF/400VAC Y1 safety capacitor
CY101	1nF/400VAC Y1 safety capacitor	1nF/400VAC Y1 safety capacitor

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



Calculation formula of Trim resistance:

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

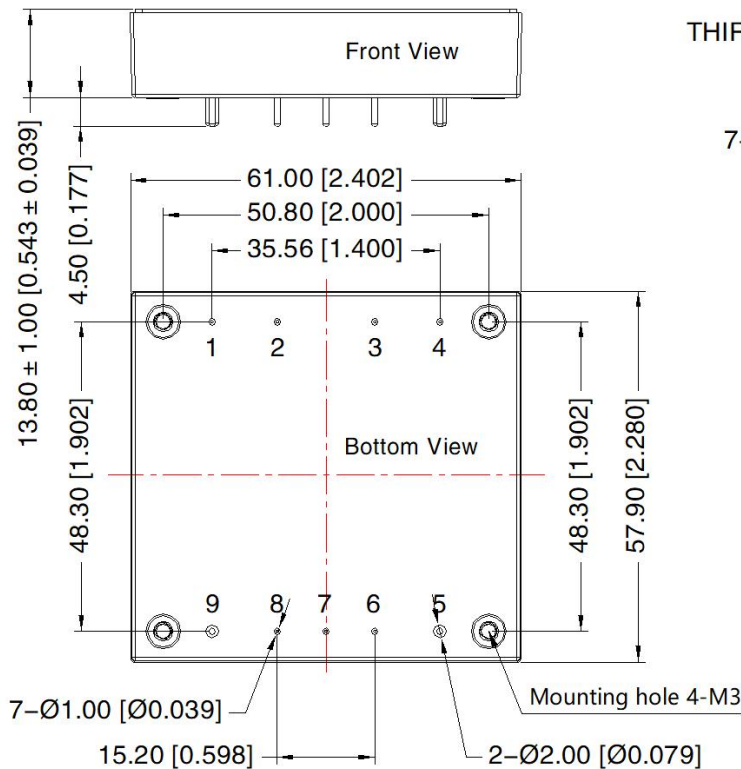
Note: Value for R1, R2, R3, and V_{ref} refer to the above table 1.
R_T: Resistance of Trim.
α: User-defined parameter, no actual meanings.
V_{O'}: The trim up/down voltage.

TRIM resistor connection (dashed line shows internal resistor network)

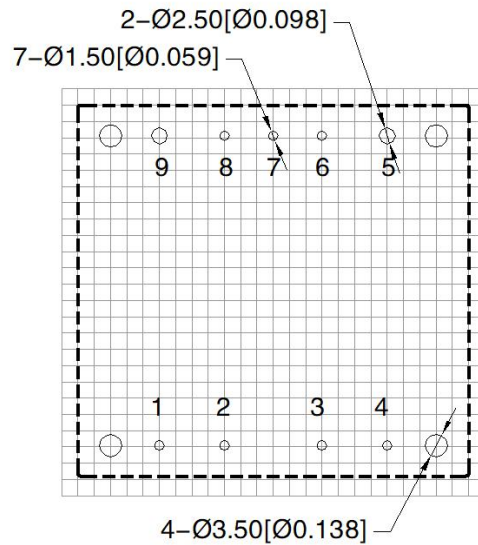
Vo Res	5(VDC)	12(VDC)	15(VDC)	24(VDC)	48(VDC)	54(VDC)
R1(KΩ)	2.92	11	14.49	24.87	58.69	60.44
R2(KΩ)	2.87	2.87	2.87	2.87	3.21	2.91
R3(KΩ)	12	17.8	20	20	20	17.8
Vref(V)	2.495	2.495	2.495	2.495	2.495	2.495

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

URF1D_HB-250WR3 Dimensions and Recommended Layout



THIRD ANGLE PROJECTION



Note: Grid 2.54*2.54mm

Note:

Unit:mm[inch]

Pin1,2,3,4,6,7,8's diameter:1.00[0.039]

Pin5,9's diameter:2.00[0.079]

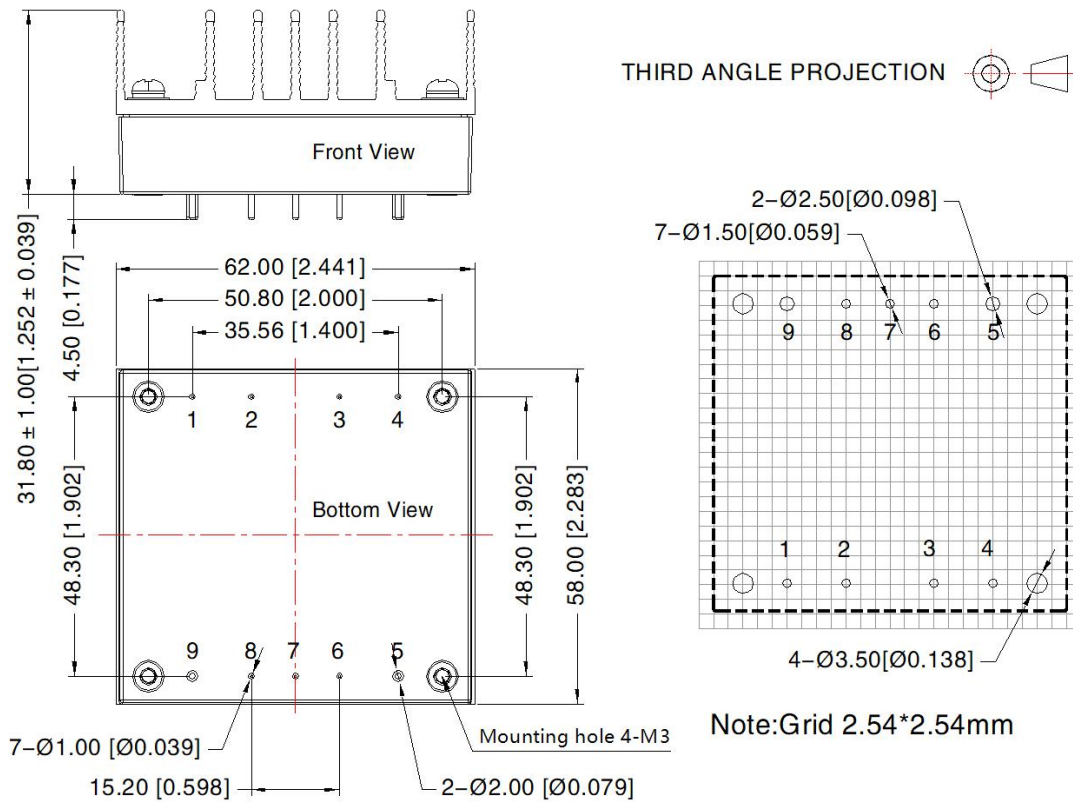
Pin diameter tolerances: ± 0.10[± 0.004]

General tolerances: ± 0.50[± 0.020]

Mounting hole screwing torque:Max 0.4 N·m

Pin-Out			
Pin	Function	Pin	Function
1	+Vin	6	Sense-
2	Ctrl	7	Trim
3	Case	8	Sense+
4	-Vin	9	+Vo
5	0V		

URF1D_HB-250WHR3 Dimensions and Recommended Layout



Note:
Unit:mm[inch]
Pin1,2,3,4,6,7,8's diameter:1.00[0.039]
Pin5,9's diameter:2.00[0.079]
Pin diameter tolerances: ± 0.10[± 0.004]
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Mounting hole screwing torque:Max 0.4 N·m

Pin-Out			
Pin	Function	Pin	Function
1	+Vin	6	Sense-
2	Ctrl	7	Trim
3	Case	8	Sense+
4	-Vin	9	+Vo
5	0V		

- Note:
- For additional information on Product Packaging please refer to www.mornsun-power.com. Packaging bag number: 58200069 (without heatsink), 58200061 (with heatsink);
 - The maximum capacitive load offered were tested at input voltage range and full load;
 - Unless otherwise specified, data in this datasheet should be tested under the conditions of Ta=25°C, humidity<75%RH with nominal input voltage and rated load;
 - All index testing methods in this datasheet are based on our company corporate standards;
 - We can provide product customization service and match filter module;
 - Products are related to laws and regulations: see "Features" and "EMC";
 - 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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