

150W isolated DC-DC converter
Ultra-wide input and regulated single output



Patent Protection RoHS



FEATURES

- Ultra-wide input voltage range: 43-160VDC
- High efficiency up to 90%
- Low no-load power consumption
- Reinforced insulation, input - output isolation test voltage: 3k VAC, input - case isolation test voltage: 2.1k VAC
- Operating ambient temperature range: -40°C ~ +105°C
- Input under-voltage protection, output short-circuit, over-current, over-voltage, over-temperature protection
- Industry standard 1/2 brick
- Meets EN50155 railway standard

URF1D_HB-150WR3 series is a high-performance product specifically designed for a variety of railway applications. The DC-DC converters feature up to 150W output power with no requirement for minimum load, ultra-wide input voltage from 43-160VDC. 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. they are widely used in railway systems and associated equipment.

Selection Guide

Part No. ^①	Input Voltage (VDC)			Output		Nominal Full Load Efficiency (%) Min./Typ.	Max. Capacitive Load(μF)
	Nominal	Range	Max. ^②	Voltage (VDC)	Current (mA) Max./Min.		
URF1D05HB-150W(H)R3	43-66	110	170	5	19200/0	86/88	26400
					24000/0		33000
	43-66			12	10000/0	87/89	10000
	66-160				12500/0		12500
URF1D15HB-150W(H)R3	43-66	110	170	15	8000/0	87/89	5400
	66-160				10000/0		6800
	43-66			24	4375/0	88/90	3080
	66-160				6250/0		4400
URF1D48HB-150W(H)R3	43-66	110	170	48	2496/0	86/88	800
	66-160				3120/0		1000

Note: ① Use "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;

② Exceeding 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	5VDC output	--	1240/25	1586/45
		12VDC, 15VDC output	--	1533/25	1568/45
		24VDC output	--	1516/25	1550/45
		48VDC output	--	1548/25	1584/45
Reflected Ripple Current	Nominal input voltage	--	100	--	mA
Surge Voltage (1sec. max.)		-0.7	--	180	
Start-up Voltage		--	--	43	VDC
Under-voltage Protection		--	40	--	
Input Filter		Pi filter			
Hot Plug		Unavailable			
Ctrl*	Module on	Ctrl pin open or pulled high (3.5-12VDC)			
	Module off	Ctrl pin -Vin or pulled low (0-1.2VDC)			

Ctrl*	Input current when off	--	2	8	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, 0%-100% load	--	± 1	± 3		%
Linear Regulation	Input voltage variation from low to high at full load	--	± 0.1	± 0.3		
Load Regulation	Nominal input voltage, 0%-100% load	--	± 0.3	± 0.5		
Transient Recovery Time	25% load step change, nominal input voltage	--	200	500		μ s
Transient Response Deviation		5VDC output	--	--	± 10	%
		Others	--	± 3	± 5	
Temperature Coefficient	Full load	--	--	--	± 0.03	$^{\circ}$ C
Ripple & Noise *	20MHz bandwidth, 10%-100%lo load	48VDC output	--	200	300	mVp-p
		Others	--	100	200	
Trim			90	--	110	%Vo
Output Voltage Remote Compensation (sense)			--	--	105	
Over-voltage Protection	Input voltage range	5VDC output	110	--	160	
		Others	110	--	140	
Over-current Protection	Input voltage range		110	140	190	%lo
Short-circuit Protection			Hiccup, continuous, self-recovery			

Note: *Ripple & Noise for 48VDC output at 0%lo-100%lo load ≤ 400 mV, others outputs at 0%lo-100%lo load ≤ 300 mV. 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 5mA max.	3000	--	--	VAC
	Input-case		2100	--	--	
	Output-case	Electric Strength test for 1 minute with a leakage current of 1mA max.	1500	--	--	VDC
Insulation Resistance	Input-output resistance at 500VDC		1000	--	--	M Ω
Isolation Capacitance	Input-output capacitance at 100KHz/0.1V		--	2200	--	pF
Switching Frequency	PFM mode		--	170	--	KHz
MTBF	MIL-HDBK-217F@25 $^{\circ}$ C		500	--	--	K hours

Environmental Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Operating Temperature Range	According to the operating temperature range		-40	--	+105	°C
Over-temperature Protection			--	--	+115	
Storage Humidity	Non-condensing		5	--	95	%RH
Storage Temperature	Soldering spot is 1.5mm away from case for 10 seconds		-55	--	+125	°C
Pin Soldering Resistance Temperature			--	--	+300	
Thermal Resistance	URF1D05HB-150WR3	100LFM	4.3	--	--	°C/W
	URF1D12HB-150WR3					
	URF1D15HB-150WR3					
	URF1D24HB-150WR3	200LFM	2.8	--	--	
	URF1D48HB-150WR3					
	URF1D05HB-150WHR3	Natural convection	3.5	--	--	
		100LFM				
	URF1D12HB-150WHR3	Natural convection	3.4	--	--	
	URF1D15HB-150WHR3					
	URF1D24HB-150WHR3					
	URF1D48HB-150WHR3	100LFM	2.8	--	--	°C/W
Vibration			IEC/EN61373 - Category 1, Grade B			

Mechanical Specifications

Case Material	Black plastic; flame-retardant and heat-resistant (UL94-V0) & Aluminum alloy case		
Dimensions	Without heatsink	61.00 x 57.90 x 13.80mm	
	With heatsink	62.00 x 58.00 x 31.80mm	
Weight	Without heatsink	125.0g(Typ.)	
Cooling Method	Free air convection or forced convection		

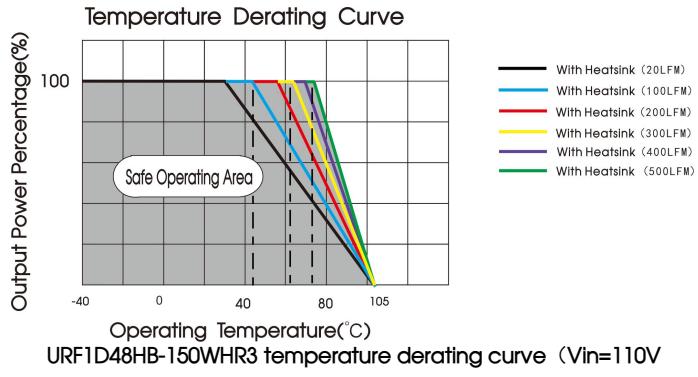
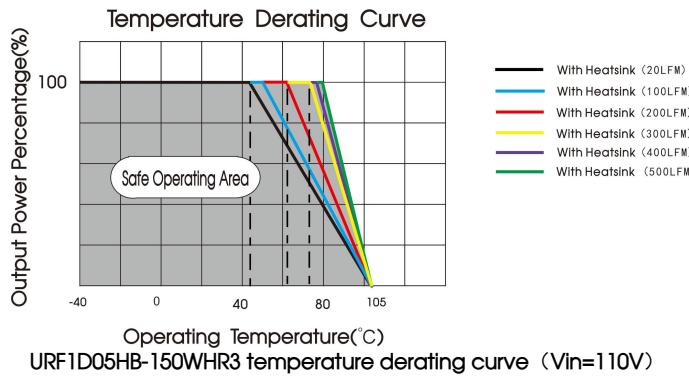
Electromagnetic Compatibility (EMC)

Emissions	CE	CISPR32/EN55032	150KHz-30MHz	Class B (see Fig. 2 for recommended circuit)	
	RE	CISPR32/EN55032	30MHz-1GHz	Class B (see Fig. 2 for recommended circuit)	
Immunity	ESD	IEC/EN61000-4-2	GB/T17626.2	Contact ±6KV, Air ±8KV	perf. Criteria A
	RS	IEC/EN61000-4-3	GB/T17626.3	20V/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 circuit	±2KV (5KHz, 100KHz) (see Fig. 2 for recommended	perf. Criteria A
	Surge	IEC/EN61000-4-5	GB/T17626.5	line to line ±2KV (1.2 μs/50 μs 2 Ω) (see Fig. 2 for recommended circuit)	perf. Criteria A

Electromagnetic Compatibility (EMC) (EN50155)

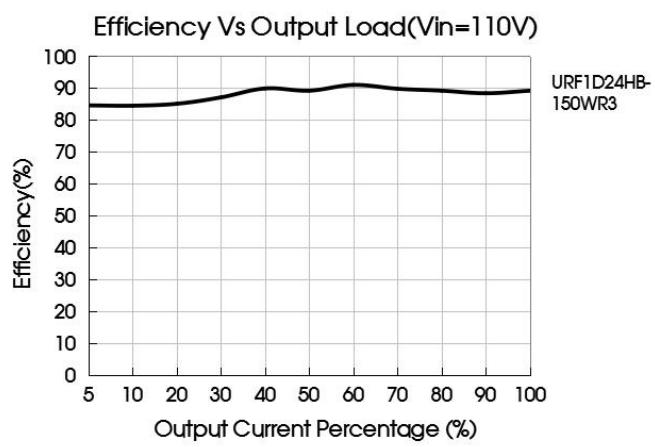
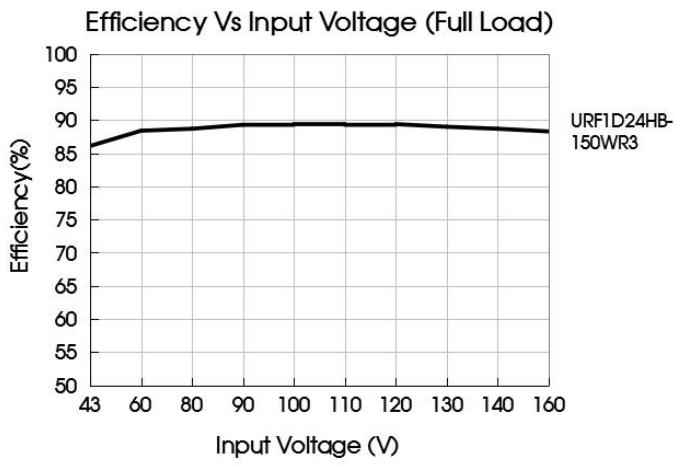
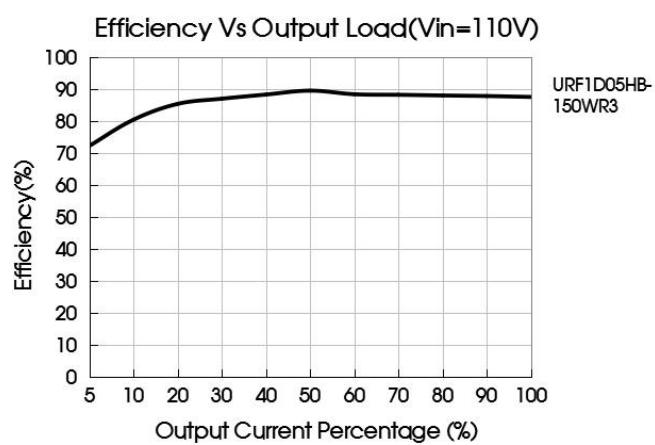
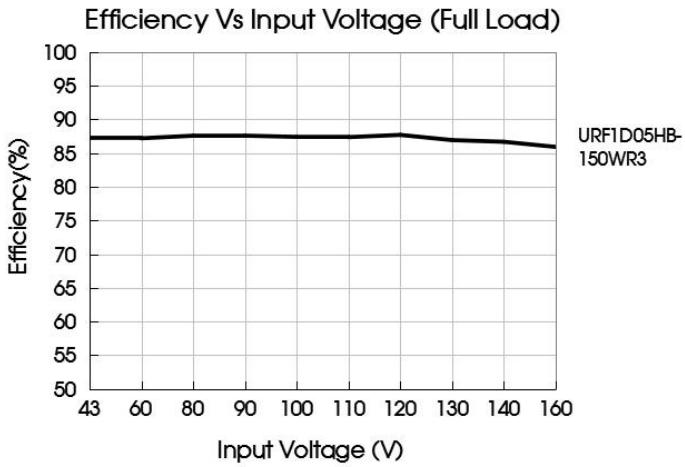
Emissions	CE	EN50121-3-2	150kHz-500kHz	99dBuV (see Fig. 2 for recommended circuit)	
		EN55016-2-1	500kHz-30MHz	93dBuV (see Fig. 2 for recommended circuit)	
Immunity	RE	EN50121-3-2	30MHz-230MHz	40dBuV/m at 10m (see Fig. 2 for recommended circuit)	
		EN55016-2-1	230MHz-1GHz	47dBuV/m at 10m (see Fig. 2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

Typical Characteristic Curves



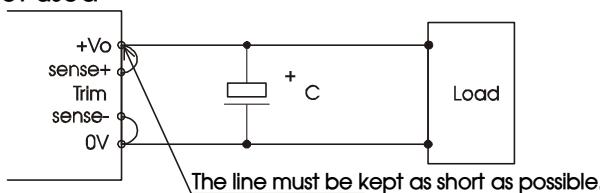
Notes:

1. Temperature derating curves and efficiency curves are typical test values.



Remote Sense Application

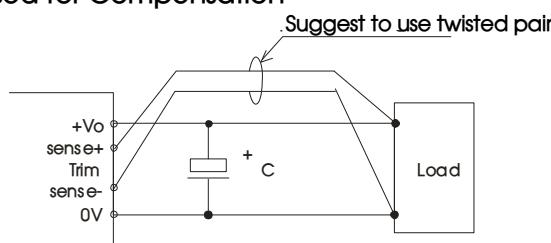
1. Remote Sense Connection if not used



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



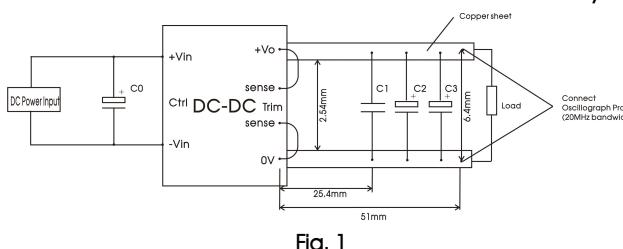
Notes:

- (1) 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 wires 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. 1.



Output voltage	Capacitors value	C0(μF)	C1(μF)	C2(μF)	C3(μF)
5VDC	100μF/200V	1μF/16V	10μF/16V	330μF/16V	
12VDC		1μF/25V	10μF/25V	330μF/25V	
15VDC		1μF/25V	10μF/25V	330μF/25V	
24VDC		1μF/50V	10μF/50V	330μF/50V	
48VDC		1μF/100V	10μF/100V	330μF/100V	

2. Typical application

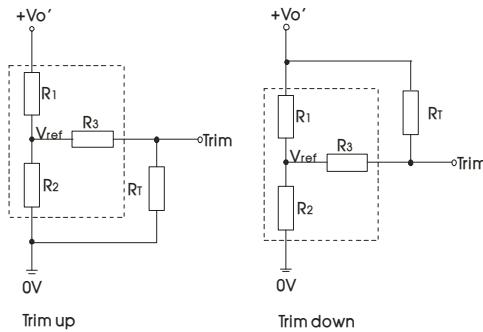
We recommended using Mornsun's EMC circuit, otherwise please ensure that at least a 100μF electrolytic capacitors is connected at the input in order to ensure adequate voltage surge suppression and protection.

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.



Output Voltage	capacitor value	Cin(μF)	Cout(μF)
5VDC	100μF/200V	330μF/16V	
12VDC		330μF/25V	
15VDC		330μF/25V	
24VDC		330μF/50V	
48VDC		330μF/100V	

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



TRIM resistor connection (dashed line shows internal resistor network)

Trim resistor calculation:

$$\text{up: } R_t = \frac{\alpha R_2}{R_2 - \alpha} - R_3 \quad \alpha = \frac{V_{ref}}{V_{o'} - V_{ref}} \cdot R_1$$

$$\text{down: } R_t = \frac{\alpha R_1}{R_1 - \alpha} - R_3 \quad \alpha = \frac{V_{o'} - V_{ref}}{V_{ref}} \cdot R_2$$

Table1

V_o resistance	5(VDC)	12(VDC)	15(VDC)	24(VDC)	48(VDC)
$R_1(K\Omega)$	2.87	11	14.49	24.87	58.69
$R_2(K\Omega)$	2.87	2.87	2.87	2.87	3.21
$R_3(K\Omega)$	4	11	16	21	7.89
$V_{ref}(V)$	2.5	2.5	2.5	2.5	2.5

Note:

Value for R_1 , R_2 , R_3 , 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.

4. EMC compliance circuit

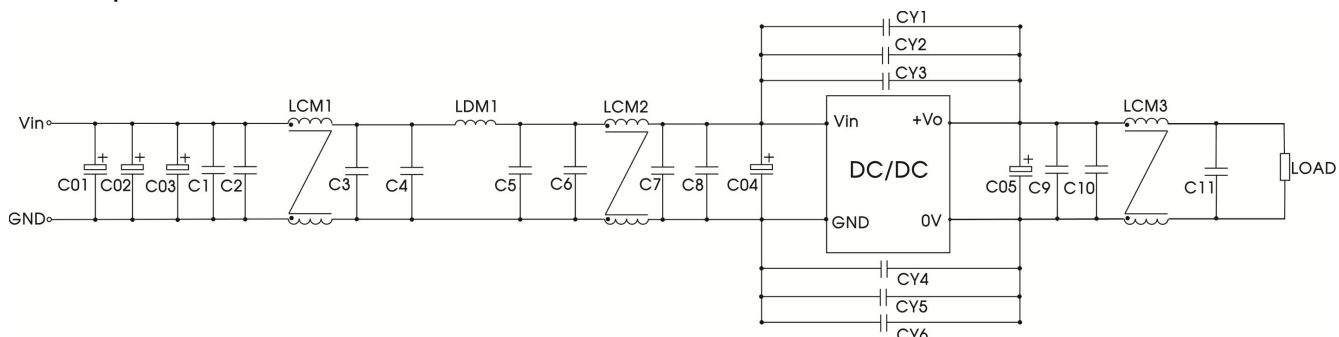


Fig.2

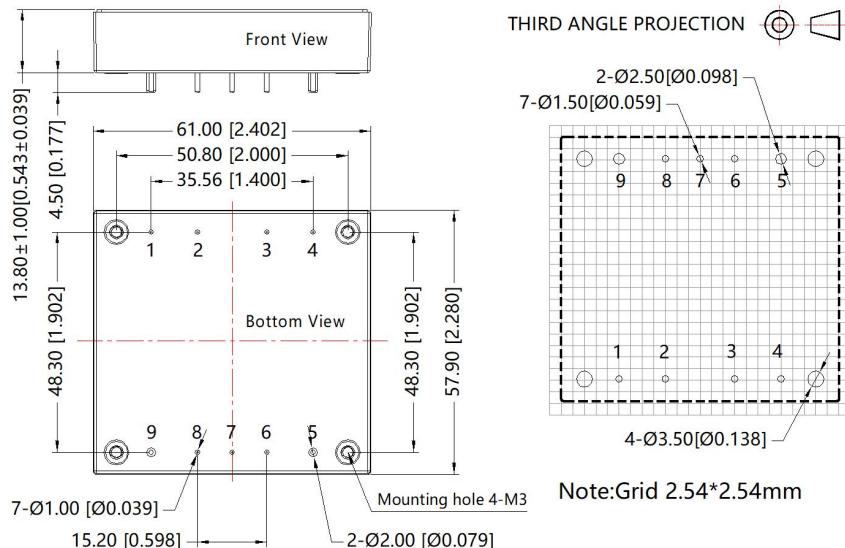
Components	Value	Reference
C01, C02, C03, C04	220uF/200V	RUBYCON
C05	220uF/63V	RUBYCON
LDM1	1.5uH	Shielded inductor
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11	2.2uF/250V	2220 MLCC
CY1, CY2, CY3, CY4, CY5, CY6	2200 pF /400VAC	Y safety capacitor
LCM1	FL2D-30-102	FL2D-30-102
LCM2	22uH±10%	TN40H-T18*10*10
LCM3	360uH±10%	TL13-T18*10*10

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

6. For additional information please refer to DC-DC converter application notes on

www.mornsun-power.com

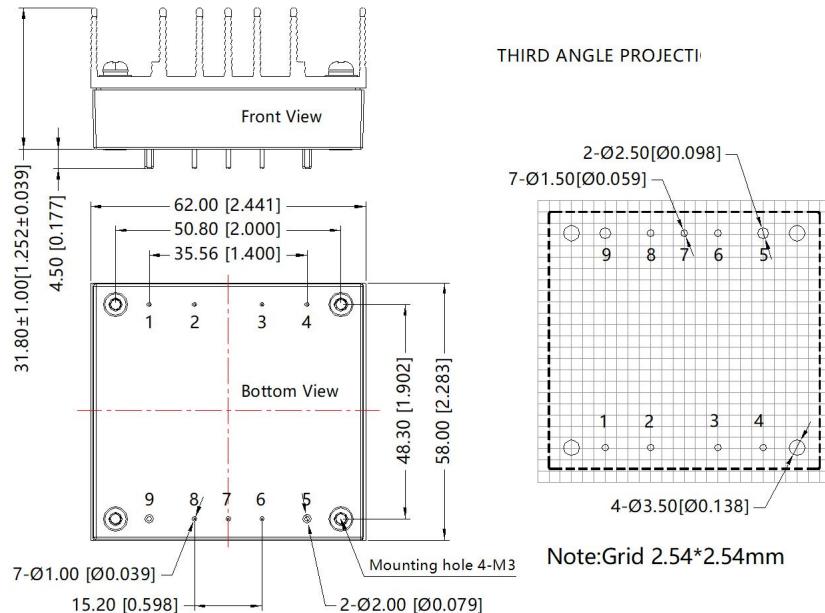
URF1D_HB-150WR3 Dimensions (without heatsink)



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-150WHR3 Dimensions (with heatsink)



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]
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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:

1. For additional information on Product Packaging please refer to www.mornsun-power.com. The Packaging bag number of Horizontal packaging: 58200069(without heatsink), 58200061(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. 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 $T_a=25^{\circ}\text{C}$, 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. Products are related to laws and regulations: see "Features" and "EMC";
10. 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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