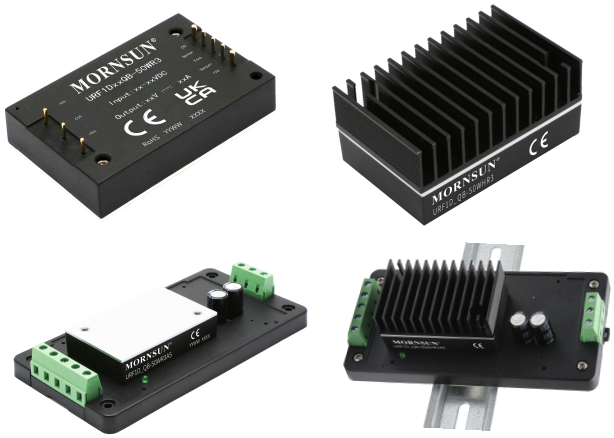
DC/DC Converter

URF1D_QB-50W(H)R3(A5)(A6) Series

MORNSUN®

50W isolated DC-DC converter
Ultra-wide input and regulated single output



Patent Protection RoHS

EN 50155

FEATURES

- Ultra-wide input voltage range: 43-160VDC
- High efficiency up to 89%
- 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℃ to +105℃
- Input under-voltage protection, output short-circuit, over-current, over-voltage, over-temperature protection
- Industry standard 1/4 brick

URF1D_QB-50WR3 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 43-160VDC, and allowing operating temperature as high as 105℃. 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. EN50155 approved and they are widely used in railway systems and associated equipment.

Selection Guide

Certification	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.		
EN	URF1D03QB-50W(H)R3	110 (43-160)	170	3.3	11364/0	84/86	20000
	URF1D05QB-50W(H)R3			5	10000/0	85/87	10000
	URF1D12QB-50W(H)R3			12	4167/0	86/88	3000
	URF1D15QB-50W(H)R3			15	3333/0	86/88	2350
	URF1D24QB-50W(H)R3			24	2083/0	87/89	1500
	URF1D48QB-50W(H)R3			48	1041/0	85/87	240
	URF1D03QB-75W(H)R3A5(A6)③	110 (43-160)	170	3.3	11364/0	82/84	20000
	URF1D05QB-75W(H)R3A5(A6)			5	10000/0	83/85	10000
	URF1D12QB-75W(H)R3A5(A6)			12	4167/0	84/86	3000
	URF1D15QB-75W(H)R3A5(A6)			15	3333/0	84/86	2350
	URF1D24QB-75W(H)R3A5(A6)			24	2083/0	85/87	1500
	URF1D48QB-75W(H)R3A5(A6)			48	1041/0	83/85	240

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.
③Use "A5" suffix for chassis mounting and "A6" suffix for DIN-Rail mounting. The minimum input voltage range and the start-up voltage of the A5/A6 product model are 1VDC higher than the horizontal package;
④Efficiencies for A5 /A6 Model's is decreased by 2% due to the input reverse polarity protection function.

Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Input Current (full load / no-load)	Nominal input voltage	3.3VDC output	--	397/10	406/20	mA
		24VDC output	--	511/10	523/20	
		12VDC, 15VDC output	--	517/10	529/20	
		05VDC, 48VDC output	--	523/10	535/20	

Reflected Ripple Current	Nominal input voltage	--	50	--	
Surge Voltage (1sec. max.)		-0.7	--	180	VDC
Start-up Voltage		--	--	43	
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)			
	Input current when off	--	2	10	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	3.3VDC, 5VDC output	--	--	±0.5	
		Others	--	±0.1	±0.3	
Load Regulation	Nominal input voltage, 10%-100% load	3.3VDC, 5VDC output	--	±0.5	±1.0	
		Others	--	±0.3	±0.5	
Transient Recovery Time	25% load step change		--	200	500	μs
Transient Response Deviation		3.3VDC, 5VDC output	--	±6	±9	%
		Others	--	±3	±5	
Temperature Coefficient	Full load		--	--	±0.03	%/℃
Ripple & Noise *	20MHz bandwidth, 10%Io-100%Io load	48VDC output	--	200	300	mVp-p
		Others	--	100	200	
Trim			90	--	110	%
Output Voltage Remote Compensation(sense)			--	--	105	
Over-temperature Protection	Surface max. temperature		--	105	115	℃
Over-voltage Protection	Input voltage range	3.3VDC, 5VDC output	110	--	160	%Vo
		Others	110	--	140	
Over-current Protection	Input voltage range		110	140	190	%Io
Short-circuit Protection			Hiccup, continuous, self-recovery			

Note: *Ripple & Noise for 48VDC output at 0%Io-100%Io load ⩽ 400mV, others outputs at 0%Io-100%Io load ⩽ 300mV, 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	--	--	MΩ
Isolation Capacitance	Input-output capacitance at 100KHz/0.1V		--	2200	--	pF
Switching Frequency	PFM mode		--	170	--	kHz
MTBF	MIL-HDBK-217F@25℃		500	--	--	khours

Environmental Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Operating Temperature Range	See temperature derating curves	-40	--	+105	℃
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			

Mechanical Specifications

Case Material	Aluminum alloy case; Black plastic bottom, flame-retardant and heat-resistant (UL94 V-0)	
Dimensions	URF1D_QB-50WR3	60.80 x 39.20 x 12.70 mm
	URF1D_QB-50WHR3	61.50 x 39.20 x 27.70 mm
	URF1D_QB-50WR3A5	135.00 x 70.00 x 22.60 mm
	URF1D_QB-50WR3A6	137.00 x 70.00 x 28.10 mm
	URF1D_QB-50WHR3A5	135.00 x 70.00 x 36.20 mm
	URF1D_QB-50WHR3A6	137.00 x 70.00 x 41.70 mm
Weight	URF1D_QB-50WR3	88.0g (Typ.)
	URF1D_QB-50WHR3	119.0g (Typ.)
	URF1D_QB-50WR3A5	164.0g (Typ.)
	URF1D_QB-50WR3A6	237.0g (Typ.)
	URF1D_QB-50WHR3A5	200.0g (Typ.)
	URF1D_QB-50WHR3A6	268.0g (Typ.)
Cooling Method	Free air convection or forced convection	

Electromagnetic Compatibility (EMC)

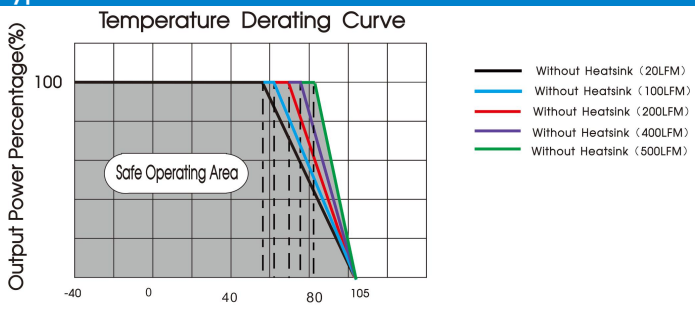
Emissions	CE	CISPR32/EN55032	150KHz-30MHz	Class B (see Fig. 3 for recommended circuit)	
	RE*	CISPR32/EN55032	30MHz-1GHz	Class B (see Fig. 3 for recommended circuit)	
Immunity	ESD	IEC/EN61000-4-2	GB/T17626.2	Contact ±6KV, Air ±8KV	perf.Criteria A
	RS	IEC/EN61000-4-3	GB/T17626.3	20V/m	perf.Criteria A
	CS	IEC/EN61000-4-6	GB/T17626.6	10Vr.m.s	perf.Criteria A
	EFT	IEC/EN61000-4-4	GB/T17626.4	±2KV (5KHz, 100KHz) (see Fig. 3 for recommended circuit)	perf.Criteria A
	Surge	IEC/EN61000-4-5	GB/T17626.5	line to line ±2KV (1.2 μs/50 μs 2Ω) (see Fig. 3 for recommended circuit)	perf.Criteria A

Note: *The standard only suit for URF1D_QB-50WR3 series (without heatsink).

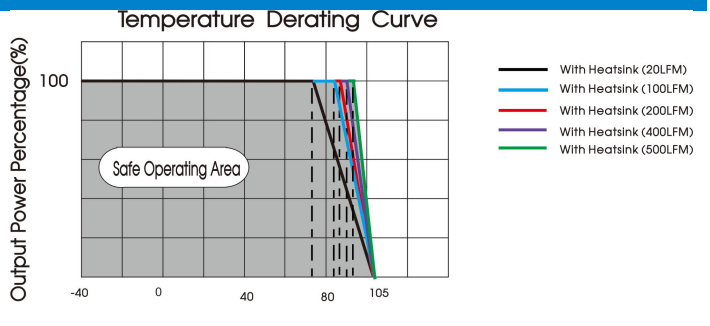
Electromagnetic Compatibility (EMC) (EN50155)

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

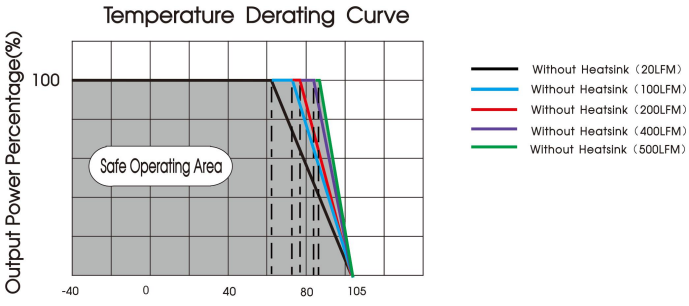
Typical Characteristic Curves



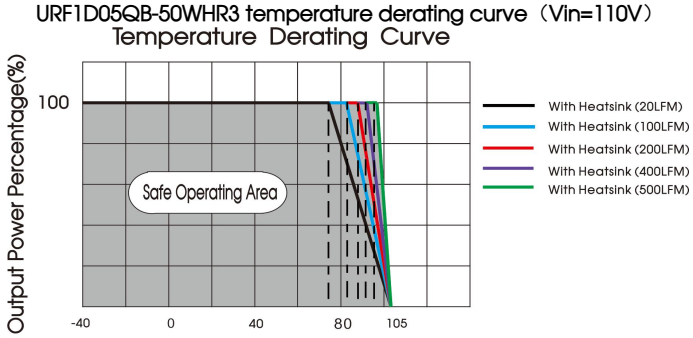
URF1D05QB-50WR3 temperature derating curve（Vin=110V）



URF1D05QB-50WHR3 temperature derating curve（Vin=110V）



URF1D12QB-50WR3 temperature derating curve（Vin=110V）



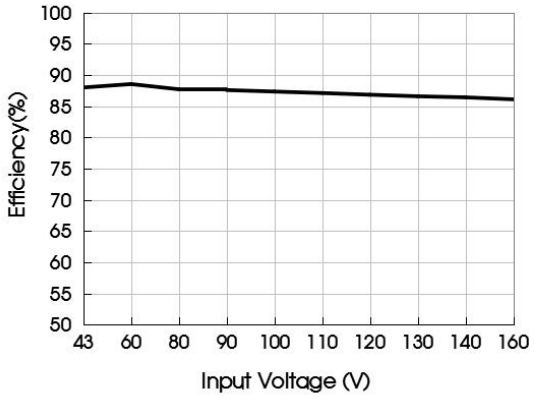
URF1D12QB-50WHR3 temperature derating curve（Vin=110V）

Note：

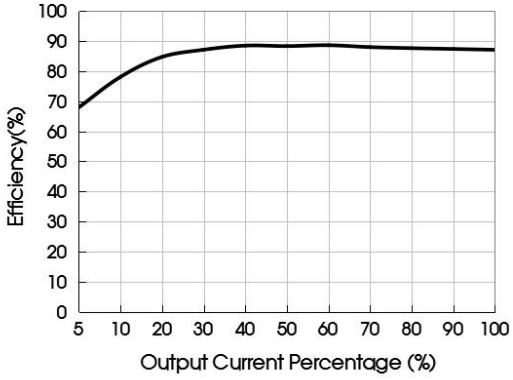
1、Temperature derating curves and efficiency curves are typical test values.

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.

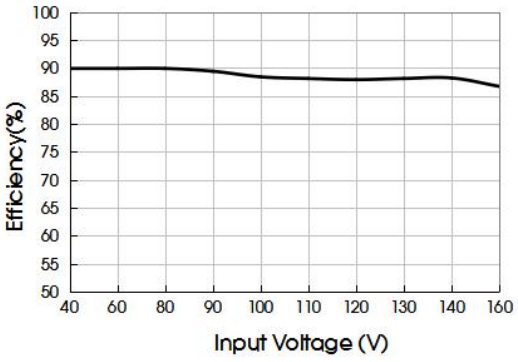
URF1D05QB-50WR3



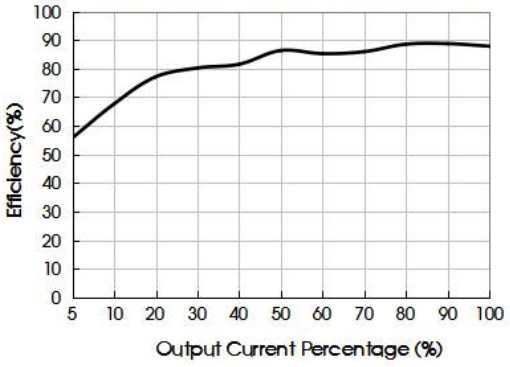
URF1D05QB-50WR3



URF1D24QB-50WR3

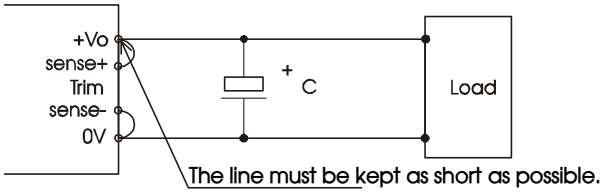


URF1D24QB-50WR3



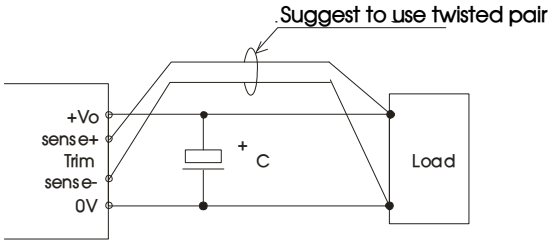
Remote Sense Application

1. Remote Sense Connection if not used



Note:
(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



Note:
(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. 1.

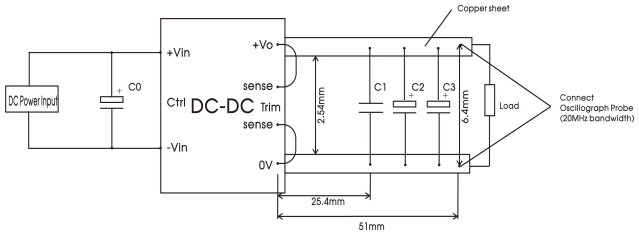


Fig.1

Capacitors value / Output voltage	C0(μF)	C1(μF)	C2(μF)	C3(μF)
3.3VDC	100	1	10	1000
5VDC				680
12VDC				220
15VDC				
24VDC				
48VDC				

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.

Capacitors value / Output voltage	Cout(μF)	Cin(μF)
3.3VDC	1000	100
5VDC	680	
12VDC	220	
15VDC		
24VDC		
48VDC		

3. EMC compliance recommended circuit

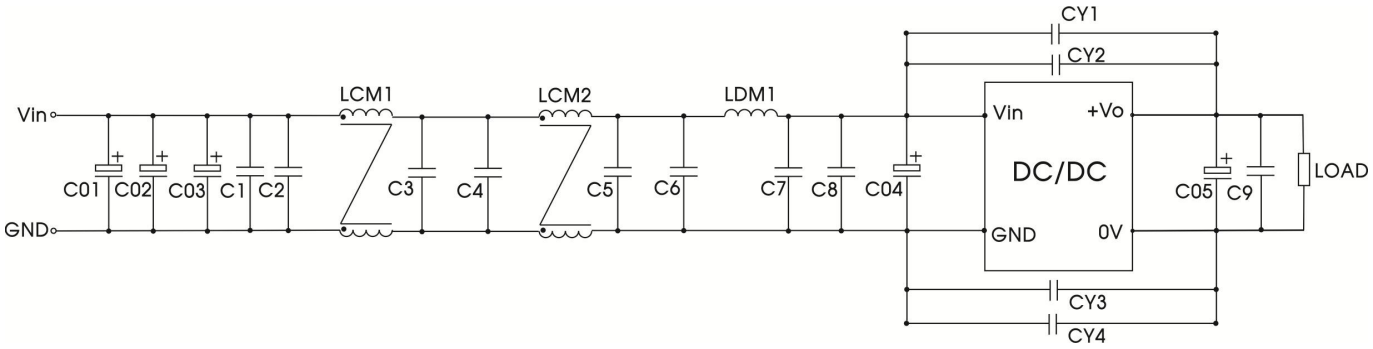


Fig.2

C01, C02, C03, C04	220uF/200V (electrolytic capacitor)
C05	220uF/63V (electrolytic capacitor)
LDM1	1.5uH (Shielded inductor)
C1, C2, C3, C4, C5, C6, C7, C8, C9	2.2uF/250V
CY1, CY2, CY3, CY4	2200 pF /400VAC (Y safety capacitor)
LCM1	Mornsun' FL2D-30-472
LCM2	Mornsun' FL2D-30-102

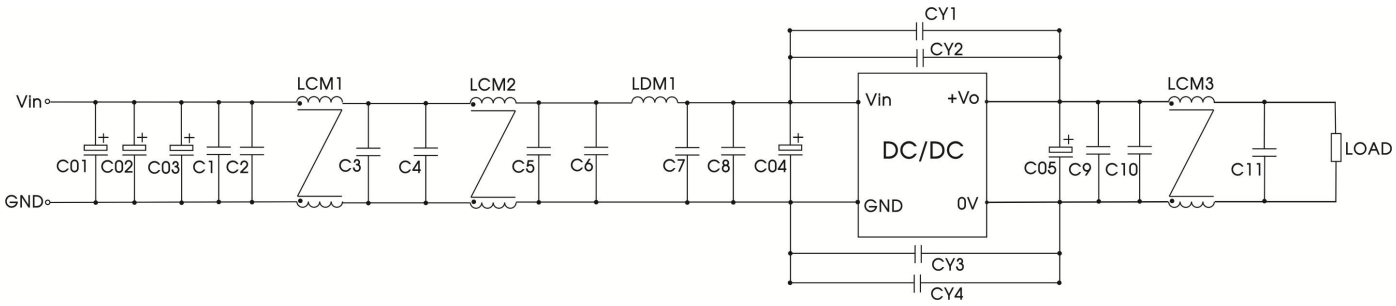
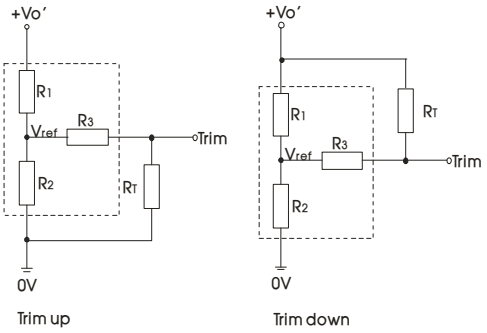


Fig.3

C01, C02, C03, C04	220uF/200V (electrolytic capacitor)
C05	220uF/63V (electrolytic capacitor)
LDM1	1.5uH (Shielded inductor)
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11	2.2uF/250V
CY1, CY2, CY3, CY4	2200 pF /400VAC (Y safety capacitor)
LCM1	Mornsun' FL2D-30-472
LCM2	Mornsun' FL2D-30-102
LCM3	Mornsun' FL2D-70-360C (7A max.)
	Mornsun' FL2D-A3-360C (13A max.)
	Mornsun' FL2D-B5-360C (25A max.)

4. 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

Vo / resistance	3.3(VDC)	5(VDC)	12(VDC)	15(VDC)	24(VDC)	48(VDC)
R1(KΩ)	4.74	8.74	11	14.49	24.87	58.7
R2(KΩ)	2.87	2.87	2.87	2.87	2.87	3.21
R3(KΩ)	9.66	11	11	16	21	11
Vref(V)	1.25	1.25	2.5	2.5	2.5	2.5

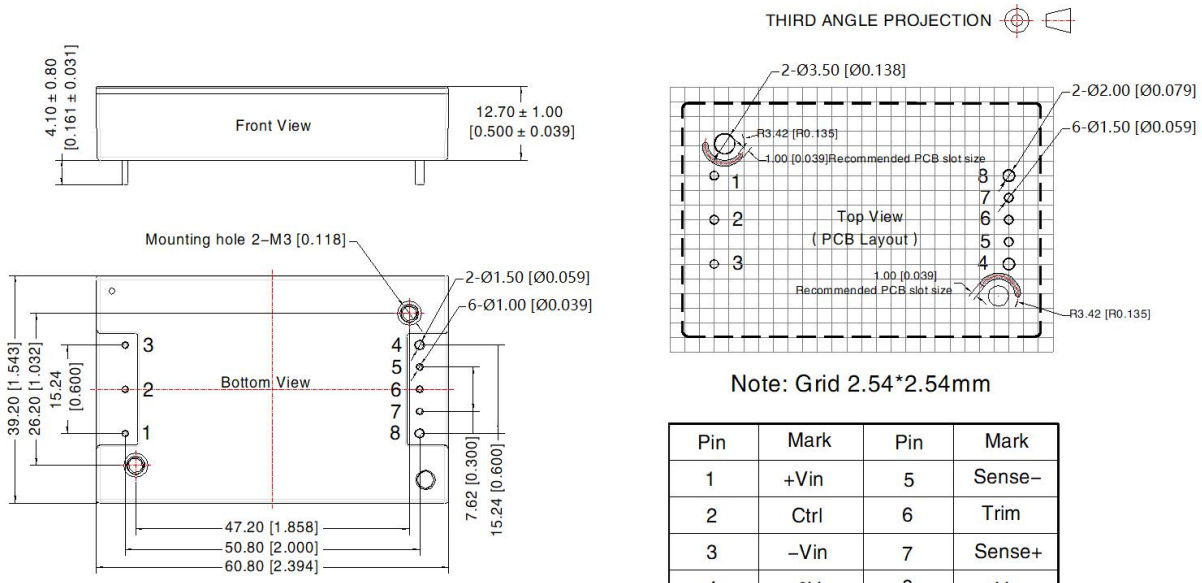
Note:

For R1, R2, R3 and Vref values refer to table 1. RT = Trim Resistor value; a = self-defined parameter Vo'= desired output voltage

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

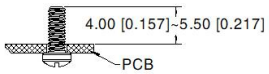
URF1D_QB-50WR3 Dimensions (without heatsink)



Note: Grid 2.54*2.54mm

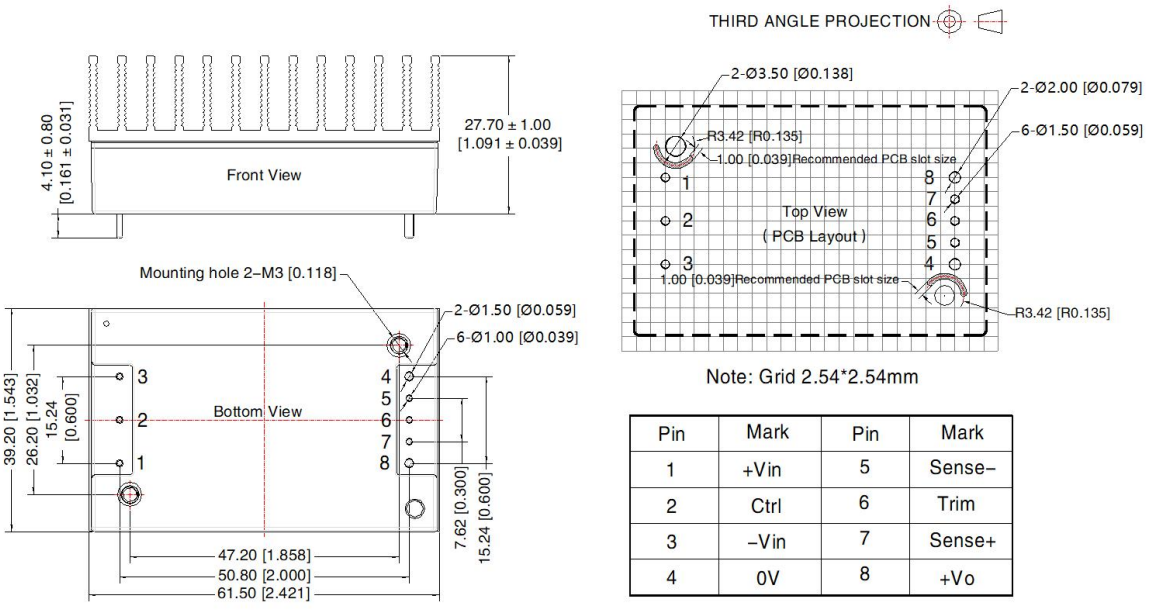
Pin	Mark	Pin	Mark
1	+Vin	5	Sense−
2	Ctrl	6	Trim
3	−Vin	7	Sense+
4	0V	8	+Vo

Recommended screw length



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

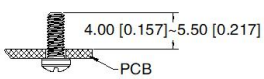
URF1D_QB-50WHR3 Dimensions (with heatsink)



Note: Grid 2.54*2.54mm

Pin	Mark	Pin	Mark
1	+Vin	5	Sense−
2	Ctrl	6	Trim
3	−Vin	7	Sense+
4	0V	8	+Vo

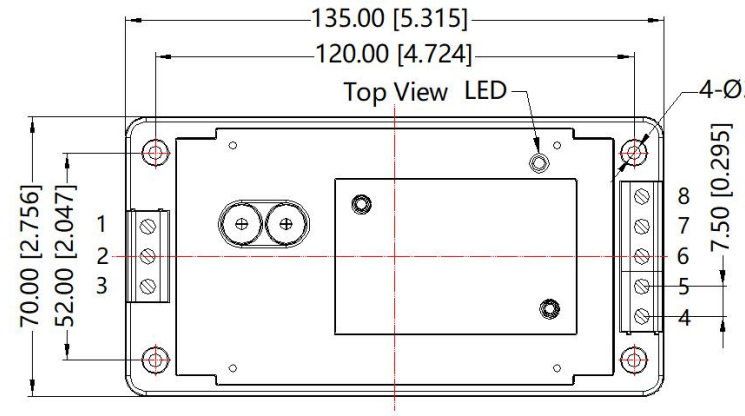
Recommended screw length

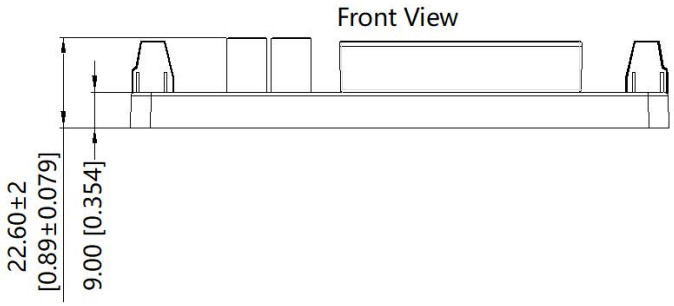


Note:
Unit: mm[inch]
Pin1, 2, 3, 5, 6, 7's diameter: 1.00[0.039]
Pin4, 8's diameter: 1.50[0.059]
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]
Mounting hole screwing torque: Max 0.4 N ▪ m

URF1D_QB-50WR3A5 Dimensions and Recommended Layout

THIRD ANGLE PROJECTION



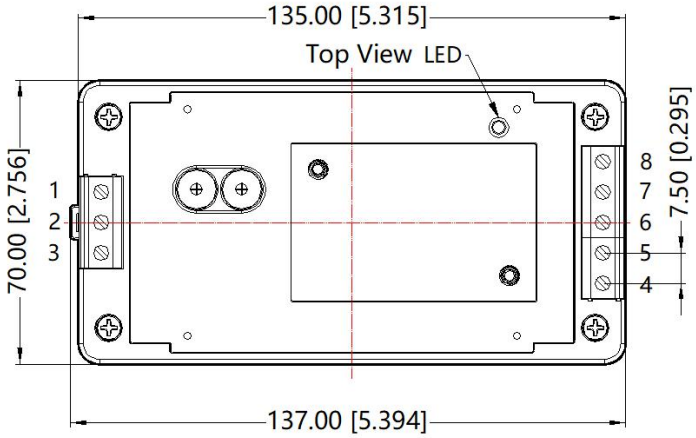


Pin	Mark
1	+Vin
2	Ctrl
3	-Vin
4	0V
5	Sense-
6	Trim
7	Sense+
8	+Vo

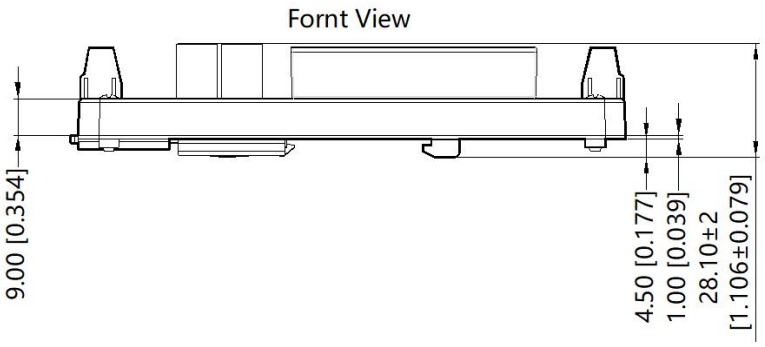
Note:
Unit: mm[inch]
Wire range: 16~12 AWG
Tightening torque: Max 0.4 N・m
General tolerances: ±1.00[±0.040]

URF1D_QB-50WR3A6 Dimensions and Recommended Layout

THIRD ANGLE PROJECTION



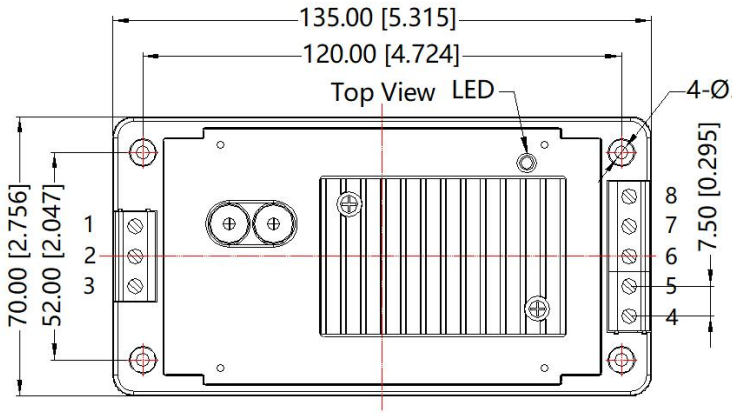
Pin	Mark
1	+Vin
2	Ctrl
3	-Vin
4	0V
5	Sense-
6	Trim
7	Sense+
8	+Vo



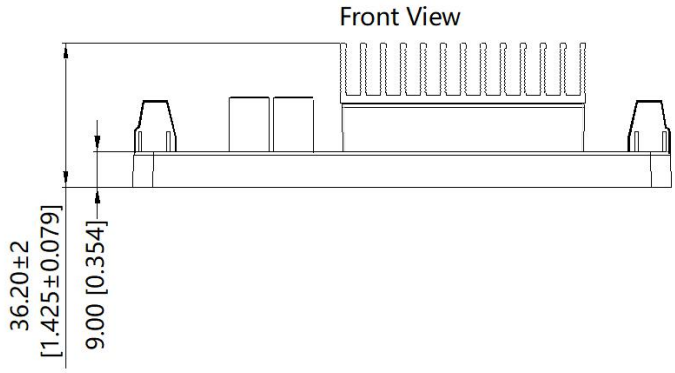
Note:
Unit: mm[inch]
Wire range: 16~12 AWG
Tightening torque: Max 0.4 N・m
Installed on DIN RAIL TS35
General tolerances: ±1.00[±0.040]

URF1D_QB-50WHR3A5 Dimensions and Recommended Layout

THIRD ANGLE PROJECTION



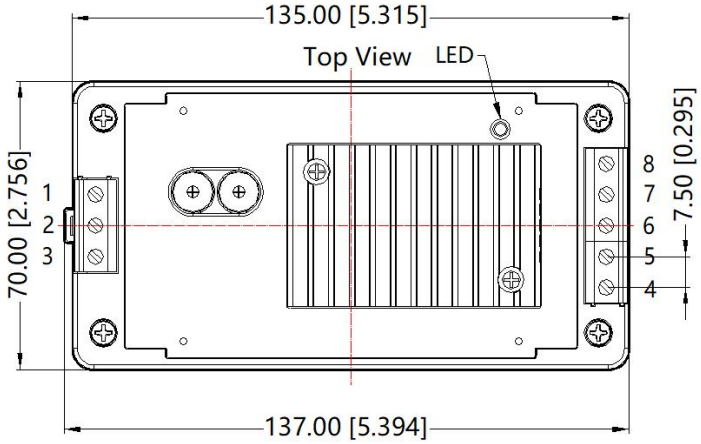
Pin	Mark
1	+Vin
2	Ctrl
3	-Vin
4	0V
5	Sense-
6	Trim
7	Sense+
8	+Vo

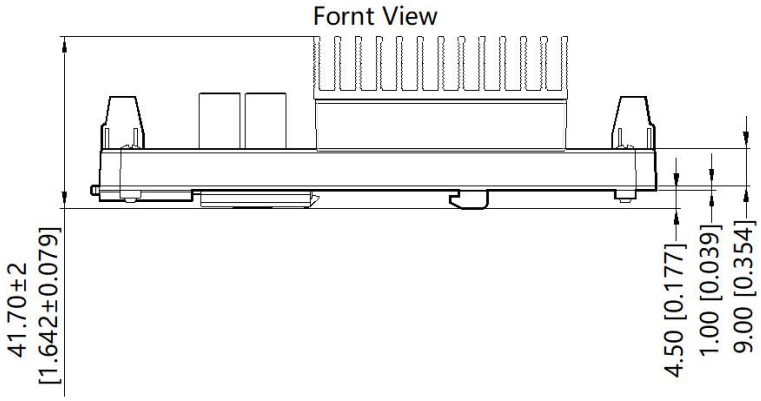


Note:
Unit: mm[inch]
Wire range: 16~12 AWG
Tightening torque: Max 0.4 N・m
General tolerances: ± 1.00[± 0.040]

URF1D_QB-50WHR3A6 Dimensions and Recommended Layout

THIRD ANGLE PROJECTION





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

Note:
Unit: mm[inch]
Wire range: 16~12 AWG
Tightening torque: Max 0.4 N・m
Installed on DIN RAIL TS35
General tolerances: ± 1.00[± 0.040]

Note:
1. For additional information on Product Packaging please refer to www.mornsun-power.com. The Packaging bag number of Horizontal packaging: 58010113(without heatsink), 58220017(with heatsink), 58220031(A5/A6 package);
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, data in this datasheet should be tested under the conditions of Ta=25℃, humidity<75%RH with nominal input voltage and rated load;
7. All index testing methods in this datasheet are based on company corporate standards;
8. We provide product customization service and match filter module, please directly contact our technicians for specific information;
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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