

40W isolated DC-DC converter  
Ultra-wide input and regulated single output



Patent Protection  
CE Report EN62368-1 UK CA Report BS EN62368-1 RoHS

URF1D\_LD-40WR3 series of isolated 40W DC-DC converter products have an ultra-wide input voltage of 40-160VDC and feature efficiency of up to 91%. Meet reinforced isolation, input to output isolation is tested with 3000VDC/1500VAC and the converters safely operate in an ambient temperature of -40°C to +85°C. Input under-voltage protection, output short circuit, over-current, over-voltage, over-temperature protection. It is ideally suiting electronic equipment and railway vehicle applications using 72V, 96V and 110V battery voltages.

## FEATURES

- Ultra-wide 4:1 input voltage range
- Reinforced isolation, I/O isolation test voltage 3.0KVDC/1.5KVAC
- Operating ambient temperature range: -40°C to +85°C
- Input under-voltage protection, output short-circuit, over-current, over-voltage protection, over-temperature protection
- Input reverse polarity protection available with chassis (A2S) or 35mm Din-Rail mounting (A4S) version
- Industry standard pin-out

## Selection Guide

Certification	Part No. <sup>①</sup>	Input Voltage (VDC)		Output		Full Load Efficiency <sup>④</sup> (%) Min./Typ.	Max. Capacitive Load(μF)
		Nominal <sup>②</sup> (Range)	Max. <sup>③</sup>	Voltage (VDC)	Current(mA) Max./Min.		
EN/BS EN	URF1D03LD-40WR3	110 (40-160)	170	3.3	10000/0	85/87	10000
	URF1D05LD-40WR3			5	8000/0	86/88	10000
	URF1D12LD-40WR3			12	3333/0	89/91	2700
	URF1D15LD-40WR3			15	2667/0	89/91	1680
	URF1D24LD-40WR3			24	1667/0	87/89	680
	URF1D48LD-40WR3			48	833/0	87/89	470

Note:  
① Use "H" suffix for heat sink mounting, "A2S" suffix for chassis mounting and "A4S" suffix for Din-Rail mounting. We recommend to choose modules with a heat sink for enhanced heat dissipation and applications with extreme temperature requirements;  
② Minimum input voltage and start-up voltage are increased by 1V for all models with A2S (wiring) and A4S (rail) suffixes because of the input reverse polarity function;  
③ Exceeding the maximum input voltage may cause permanent damage;  
④ Efficiency is measured at nominal input voltage and rated output load; efficiencies for A2S and A4S Model's is decreased by 2% due to the input reverse polarity protection.

## Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Input Current (full load / no-load)	Nominal input voltage	3.3V output	--	345/5	353/15	mA
		Others	--	413/3	423/15	
Reflected Ripple Current	Nominal input voltage		--	25	--	VDC
Surge Voltage (1sec. max.)			-0.7	--	180	
Start-up Voltage	100% load		--	--	40	
Input Under-Voltage Protection			28	32	--	
Start-up Time	Nominal input voltage & constant resistance load		--	20	--	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	10	mA

Note: \*The Ctrl pin voltage is referenced to input GND.

## Output Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Voltage Accuracy	0% -100% load		--	±1	±3	%
Linear Regulation	Input voltage variation from low to high at full load		--	±0.4	±1	
Load Regulation	0% -100% load		--	±0.5	±1	
Transient Recovery Time	25% load step change, nominal input voltage		--	300	500	μs
Transient Response Deviation		3.3V/5V output	--	±5	±8	%
		Others	--	±3	±5	
Temperature Coefficient	Nominal input voltage, full load		--	±0.02	±0.03	%/°C
Ripple & Noise *	20MHz bandwidth, nominal input voltage, full load		--	150	200	mV p-p
Trim	Input voltage range		90	-	110	%Vo
Over-voltage Protection			110	--	160	
Over-current Protection			110	--	190	%Io
Short-circuit Protection			Continuous, self-recovery			
Note: *Ripple & Noise at < 5% load is 5%Vo max. The "parallel cable" method is used for Ripple and Noise test, please refer to DC-DC Converter Application Note for specific information.						

## 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-output Electric Strength Test for 1 minute with a leakage current of 5mA max.	1500	--	--	VAC
	Input/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	3000	pF
Operating Temperature	See Fig. 1	-40	--	+85	°C
Storage Temperature		-55	--	+125	
Over-temperature Protection		--	100	130	
Storage Humidity	Non-condensing	5	--	95	%RH
Pin Soldering Resistance Temperature	Soldering spot is 1.5mm away from case for 10 seconds	--	--	+300	°C
	Wave soldering, 10 seconds	255	260	265	
Switching Frequency*	PWM mode	--	220	--	KHz
Vibration		IEC61373 - Category 1, Grade B			
MTBF	MIL-HDBK-217F@25°C	500	--	--	K hours

Note: \* Switching frequency is measured at full load. The module reduces the switching frequency for light load (below 50%) efficiency improvement.

## Mechanical Specifications

Case Material	Aluminum alloy				
Dimensions	Without heat sink	Horizontal package	50.80 x 25.40 x 11.80 mm		
		A2S chassis mounting	76.00 x 31.50 x 21.20 mm		
		A4S Din-rail mounting	76.00 x 31.50 x 25.80 mm		
	With heat sink	Horizontal package	51.40 x 26.20 x 16.50 mm		
		A2S chassis mounting	76.00 x 31.50 x 25.30 mm		
		A4S Din-rail mounting	76.00 x 31.50 x 29.90 mm		

Weight	Without heat sink	Horizontal package/A2S chassis mounting/A4S Din-rail mounting	32.3g/56.3g/76.3g (Typ.)
	With heat sink	Horizontal package/A2S chassis mounting/A4S Din-rail mounting	41.0g/65.0g/85.0g (Typ.)
Cooling Method		Free air convection	

### Electromagnetic compatibility (EMC) (EN62368)

Emissions	CE	CISPR32/EN55032	CLASS B(see Fig. 4-①/4-③ for recommended circuit)	
	RE	CISPR32/EN55032	CLASS B (see Fig. 4-①/4-③ for recommended circuit)	
Immunity	ESD	IEC/EN61000-4-2	Contact $\pm 6\text{KV}$ /Air $\pm 8\text{KV}$	perf. Criteria A
	RS	IEC/EN61000-4-3	20V/m	perf. Criteria A
	EFT	IEC/EN61000-4-4	100kHz $\pm 4\text{KV}$ (see Fig.4-②/4-④ for recommended circuit)	perf. Criteria A
	Surge	IEC/EN61000-4-5	line to line $\pm 2\text{KV}$ ( $2\Omega$ 18uF see Fig.4-②/4-④ for recommended circuit)	perf. Criteria A
	CS	IEC/EN61000-4-6	10 Vr.m.s	perf. Criteria A

### Electromagnetic Compatibility (EMC) (EN50155)

Emissions	CE	EN50121-3-2	150kHz-500kHz 99dBuV (see Fig. 4-①/4-③ for recommended circuit)	
	RE	EN55016-2-1	500kHz-30MHz 93dBuV	
Immunity	ESD	EN50121-3-2	Contact $\pm 6\text{KV}$ /Air $\pm 8\text{KV}$	perf. Criteria A
	RS	EN50121-3-2	20V/m	perf. Criteria A
	EFT	EN50121-3-2	$\pm 2\text{kV}$ 5/50ns 5kHz (see Fig.4-②/4-④ for recommended circuit)	perf. Criteria A
	Surge	EN50121-3-2	line to line $\pm 1\text{KV}$ ( $42\Omega$ , $0.5\mu\text{F}$ ) (see Fig.4-②/4-④ for recommended circuit)	perf. Criteria A
	CS	EN50121-3-2	0.15MHz-80MHz 10 Vr.m.s	perf. Criteria A

### Typical Characteristic Curves

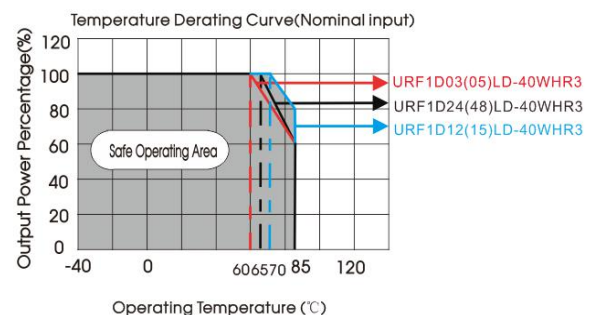
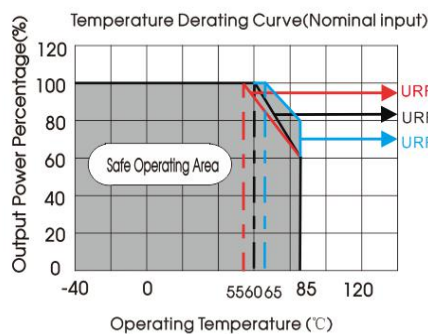


Fig. 1

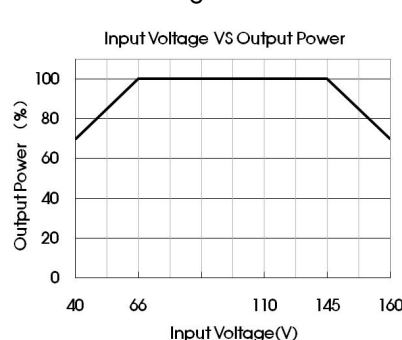
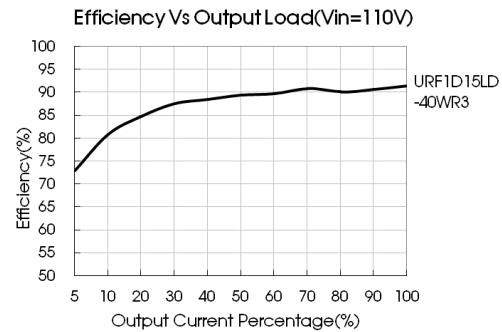
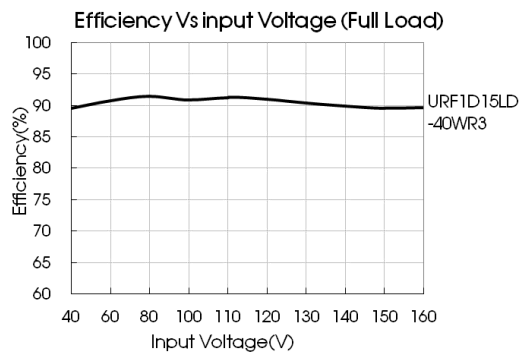
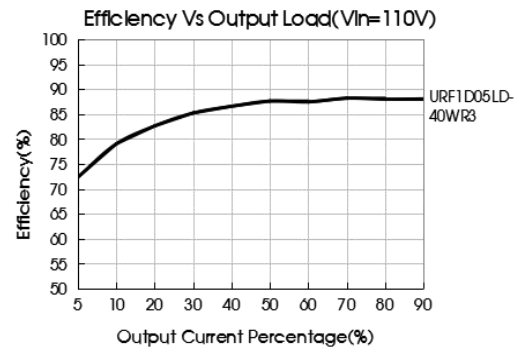
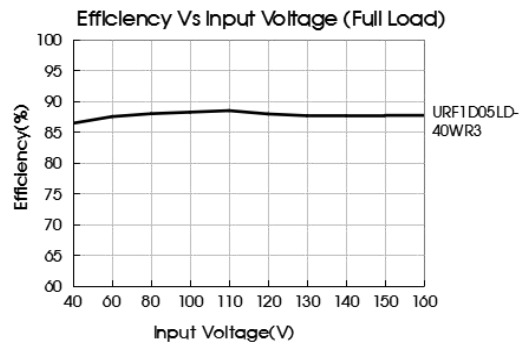


Fig. 2

Note:  
Fig.2 Input voltage VS output power derating curve for reference only, when operating, as long as the case temperature does not exceed  $100^{\circ}\text{C}$ , the product can be used under any conditions within the input voltage and output load range.

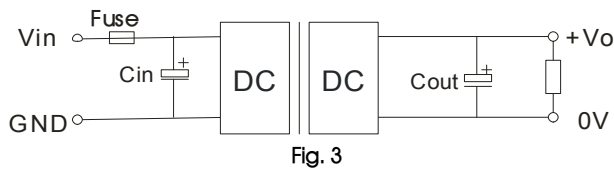


## Design Reference

### 1. Typical application

All DC-DC converters of this series are tested before delivery using the recommended circuit shown in Fig. 3.

Input and/or output ripple can be further reduced by appropriately increasing the input & output capacitor values  $C_{in}$  and  $C_{out}$  and/or by selecting capacitors with a low ESR (equivalent series resistance). Also make sure that the capacitance is not exceeding the max. capacitive load value of the product.



Vout(VDC)	Fuse	Cin	Cout
3.3, 5	2A, slow blow	100μF	470μF
12, 15			220μF
24, 48			100μF

## 2. EMC compliance circuit

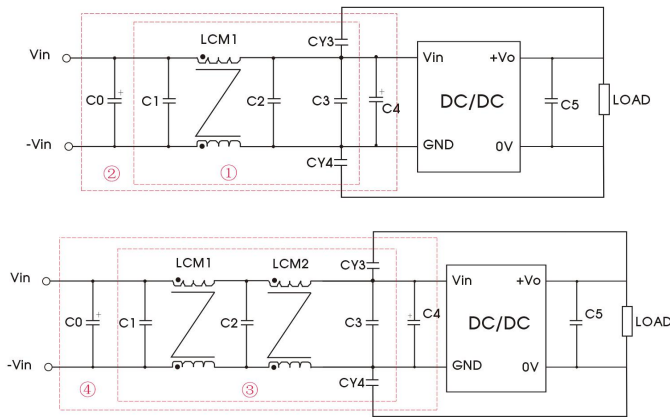


Fig. 4

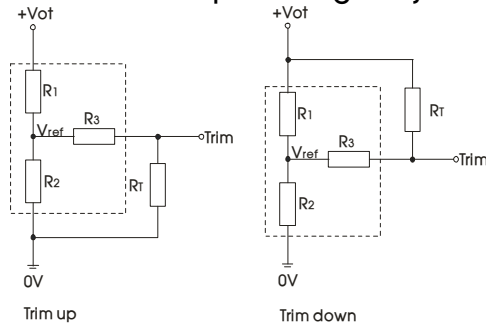
### Notes:

- For 3.3VDC, 5VDC, 12VDC, 15VDC, 24VDC output EMC tests we use Part ② in Fig. 4 for immunity and part ① for emissions test.
- For 48VDC voltage EMC tests we use Part ④ in Fig. 4 for immunity and part ③ for emissions test.

Fig.4 List of components:

C0, C4	100μF/200V
C1, C2	2.2μF/250V
C3	Refer to the Cin in Fig.3
LCM1	10mH, recommended to use MORNSUN P/N: FL2D-30-103(C)
LCM2	2.2mH, recommended to use MORNSUN P/N: FL2D-30-222
CY3, CY4	2200pF/400VAC
C5	Refer to the Cout in Fig.3

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



Calculating Trim resistor values:

$$\text{up: } R_T = \frac{aR_2}{R_2 - a} - R_3$$

$$a = \frac{V_{ref}}{V_o' - V_{ref}} \cdot R_1$$

$$\text{down: } R_T = \frac{aR_1}{R_1 - a} - R_3$$

$$a = \frac{V_o' - V_{ref}}{V_{ref}} \cdot R_2$$

$R_T$  = Trim Resistor value;  
 $a$  = self-defined parameter;  
 $V_o'$  = desired output voltage

TRIM resistor connection (dashed line shows internal resistor network)

Vout(V)	R1(KΩ)	R2(KΩ)	R3(KΩ)	Vref(V)
3.3	4.801	2.87	10	1.24
5	2.883	2.87	10	2.5
12	11.000	2.87	15	2.5
15	14.384	2.87	15	2.5
24	24.872	2.87	17.8	2.5
48	55.28	3.0	20	2.5

## 4. Reflected Ripple Current testing circuit

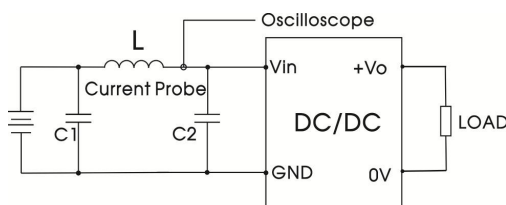


Fig.5

Fig.5 Parameter description:

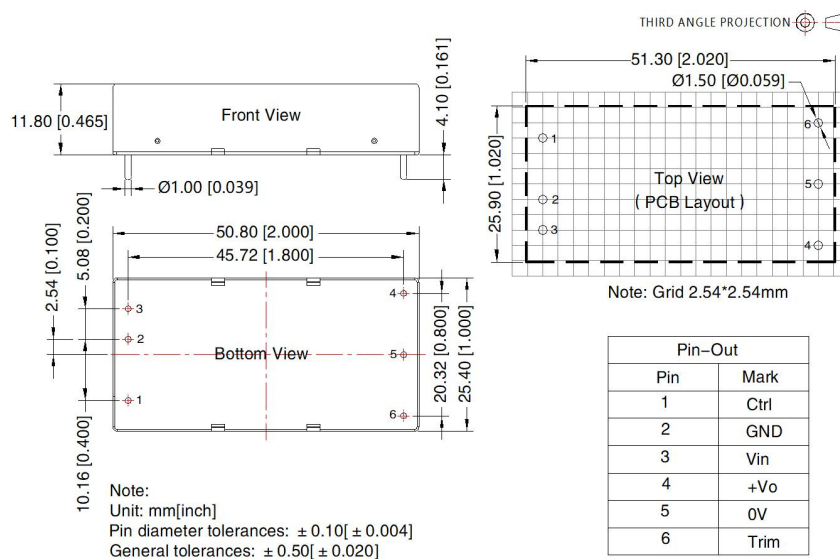
C1	220uF, ESR<1.0Ω at 100KHz
L	4.7uH
C2	4.7uF/250V

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

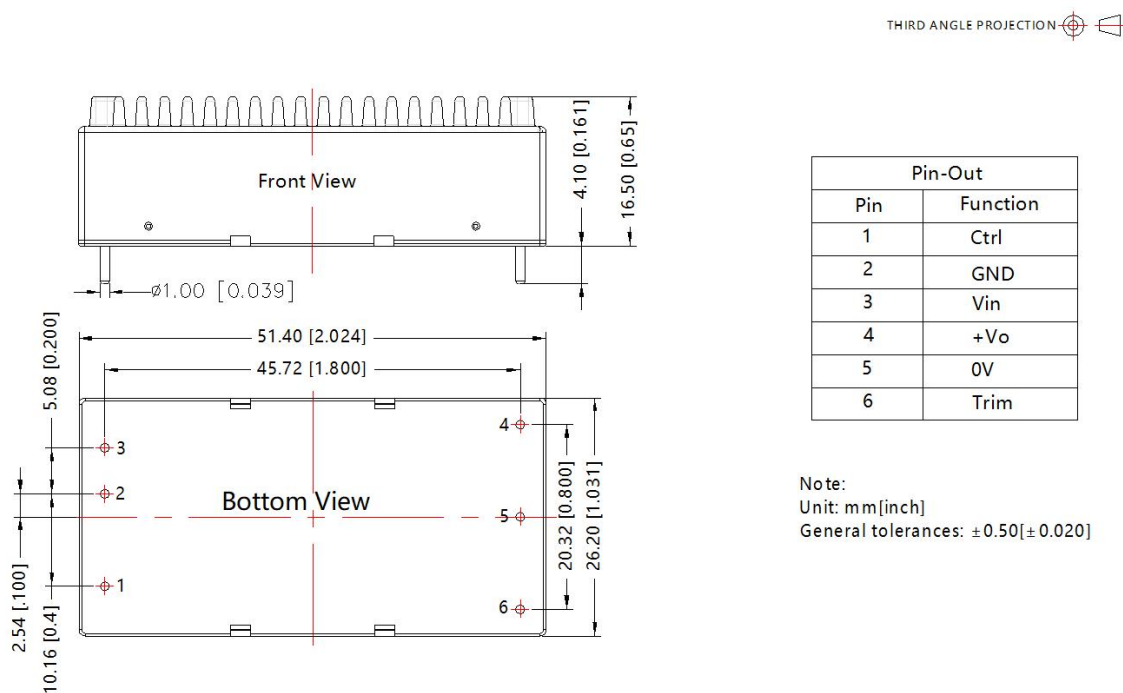
## 6. For additional information please refer to DC-DC converter application notes on [www.mornsun-power.com](http://www.mornsun-power.com)



## Horizontal Package (without heat sink) Dimensions and Recommended Layout

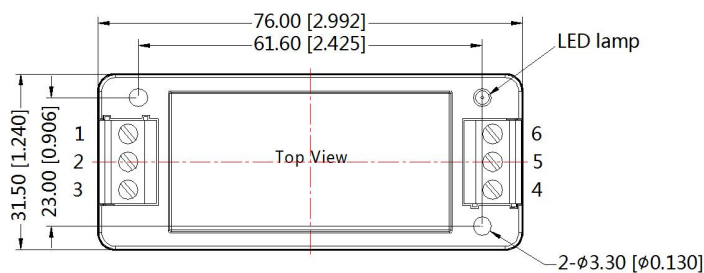


## Horizontal Package (with heat sink) Dimensions



URF1D\_LD-40WR3A2S (without heatsink) Dimensions

THIRD ANGLE PROJECTION

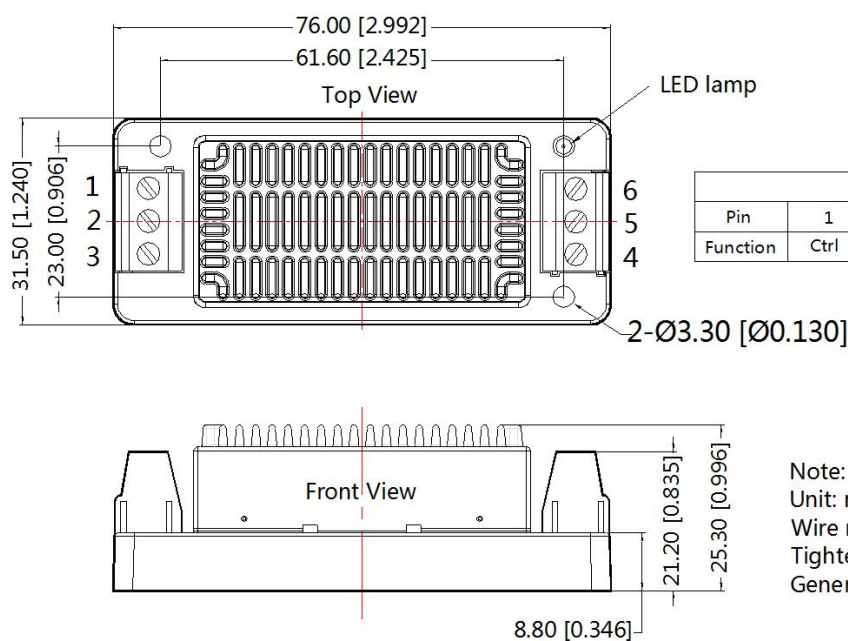


Pin-Out						
Pin	1	2	3	4	5	6
Function	Ctrl	GND	Vin	+Vo	0V	Trim

Note:  
Unit: mm[inch]  
Wire range: 24-12 AWG  
Tightening torque: Max 0.4 N·m  
General tolerances:  $\pm 0.50[\pm 0.020]$

URF1D\_LD-40WHR3A2S (with heatsink) Dimensions

THIRD ANGLE PROJECTION

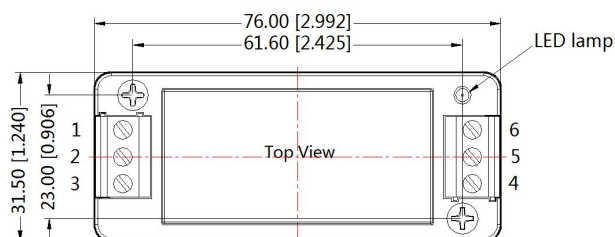


Pin-Out						
Pin	1	2	3	4	5	6
Function	Ctrl	GND	Vin	+Vo	0V	Trim

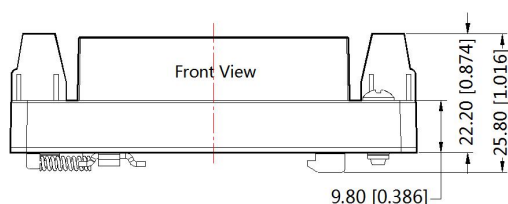
Note:  
Unit: mm[inch]  
Wire range: 24-12 AWG  
Tightening torque: Max 0.4 N·m  
General tolerances:  $\pm 1.00[\pm 0.039]$

URF1D\_LD-40WR3A4S (without heatsink) Dimensions

THIRD ANGLE PROJECTION



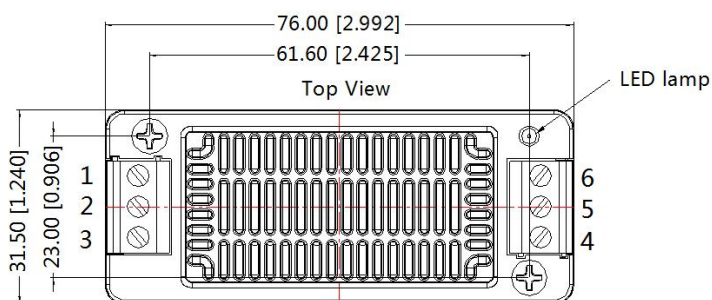
Pin-Out						
Pin	1	2	3	4	5	6
Function	Ctrl	GND	Vin	+Vo	0V	Trim



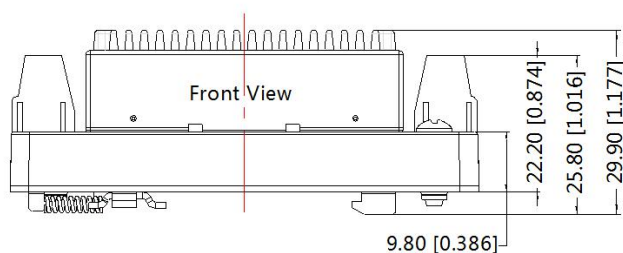
Note:  
Unit: mm[inch]  
Mounting rail: TS35  
Wire range: 24-12 AWG  
Tightening torque: Max 0.4 N·m  
General tolerances:  $\pm 1.00[\pm 0.039]$

URF1D\_LD-40WHR3A4S (with heatsink) Dimensions

THIRD ANGLE PROJECTION



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



Note:  
Unit: mm[inch]  
Mounting rail: TS35  
Wire range: 24-12 AWG  
Tightening torque: Max 0.4 N·m  
General tolerances:  $\pm 1.00[\pm 0.039]$



Note:

1. For additional information on Product Packaging please refer to [www.mornsun-power.com](http://www.mornsun-power.com). The Packaging bag number of Horizontal packaging: 58200035(without heat sink), 58200051(with heat sink), A2S/ A4S packaging number: 58220022;
2. The maximum capacitive load offered were tested at input voltage range and full load;
3. 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;
4. All index testing methods in this datasheet are based on company corporate standards;
5. Other product application information, please see DC-DC (railway power supply) Converter Application Notes for specific operation methods;
6. We can provide product customization service, please contact our technicians directly for specific information;
7. Products are related to laws and regulations: see "Features" and "EMC";
8. 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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