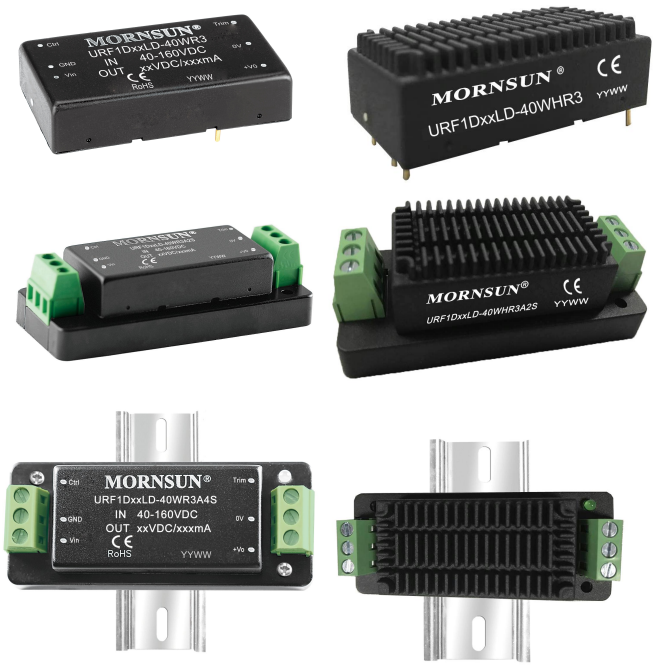
40W isolated DC-DC converter
Ultra-wide input and regulated single output




CE Patent Protection RoHS

3 years Warranty

## FEATURES

- Ultra-wide 4:1 input voltage range
- Reinforced isolation, I/O isolation test voltage 3.0KVDC/1.5KVAC
- Operating ambient temperature range: -40℃ ~ +85℃
- Input under-voltage protection, output short-circuit, over-current, over-voltage protection, over-temperature protection
- EN62368, EN50155 approved
- Input reverse polarity protection available with chassis (A2S) or 35mm Din-Rail mounting (A4S) version
- Industry standard pin-out

*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℃ to +85℃. 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.*

## Selection Guide

| Certification | Part No. ① | Input Voltage (VDC) | | Output | | Full Load Efficiency④ (%) Min./Typ. | Max. Capacitive Load(μF) |
|---|---|---|---|---|---|---|---|
| | | Nominal② (Range) | Max.③ | Voltage (VDC) | Current(mA) Max./Min. | | |
| CE | 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:
①Use "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;
②Minimum 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;
③Exceeding the maximum input voltage may cause permanent damage;
④Efficiency 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 | -- | |
| Surge Voltage (1sec. max.) | | | -0.7 | -- | 180 | VDC |
| Start-up Voltage | 100% load | | -- | -- | 40 | |

| | | | | | |
|---|---|---|---|---|---|
| Input Under-Voltage Protection | | 28 | 32 | -- | VDC |
| 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 | %/℃ |
| Ripple & Noise * | 20MHz bandwidth, nominal input voltage, full load | | -- | 150 | 200 | mV p-p |
| Trim | | | 90 | - | 110 | %Vo |
| Over-voltage Protection | Input voltage range | | 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 | ℃ |
| 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 | ℃ |
| Switching Frequency* | PWM mode | -- | 220 | -- | KHz |
| Vibration | | IEC61373 - Category 1, Grade B | | | |
| MTBF | MIL-HDBK-217F@25℃ | 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 | 26.0g/48.0g/68.0g (Typ.) |
| | With heat sink | Horizontal package/A2S chassis mounting/A4S Din-rail mounting | 34.0g/56.0g/76.0g (Typ.) |
| Cooling Method | | Free air convection | |

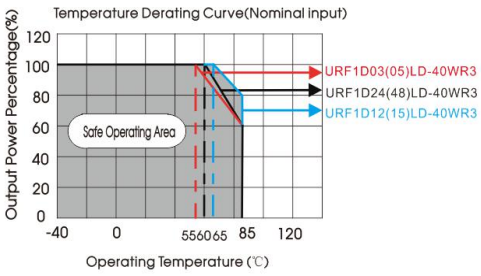
## Electromagnetic compatibility (EMC) (EN62368)

| | | | | |
|---|---|---|---|---|
| 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 ±6KV/Air ±8KV | perf. Criteria A |
| | RS | IEC/EN61000-4-3 | 20V/m | perf. Criteria A |
| | EFT | IEC/EN61000-4-4 | 100kHz ±4KV (see Fig.4-②/4-④ for recommended circuit) | perf. Criteria A |
| | Surge | IEC/EN61000-4-5 | line to line ±2KV (2Ω 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<br>EN55016-2-1 | 150kHz-500kHz 99dBuV (see Fig. 4-①/4-③ for recommended circuit)<br>500kHz-30MHz 93dBuV | |
| | RE | EN50121-3-2<br>EN55016-2-1 | 30MHz-230MHz 40dBuV/m at 10m (see Fig. 4-①/4-③ for recommended circuit)<br>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 .4-②/4-④ for recommended circuit) | perf. Criteria A |
| | Surge | EN50121-3-2 | line to line ±1KV（42Ω，0.5μF） (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



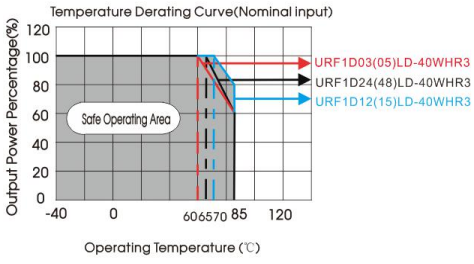




Fig. 1

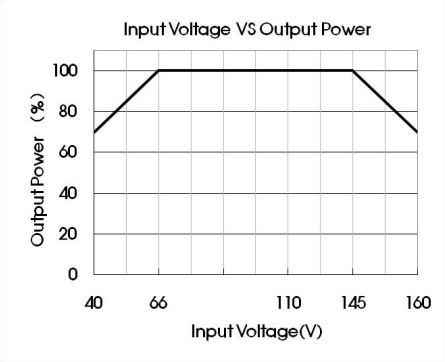
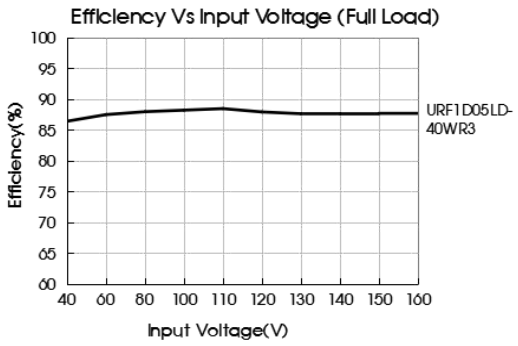
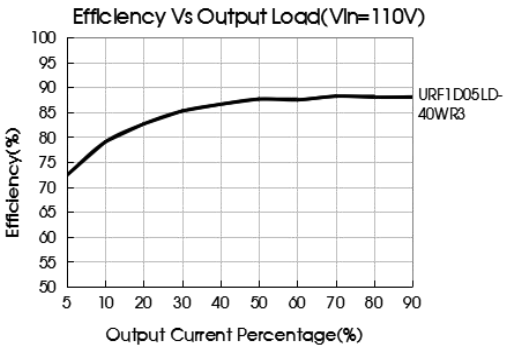
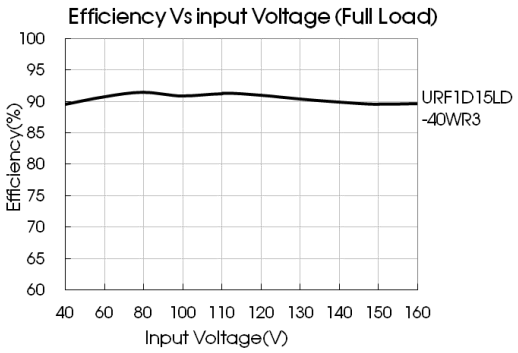


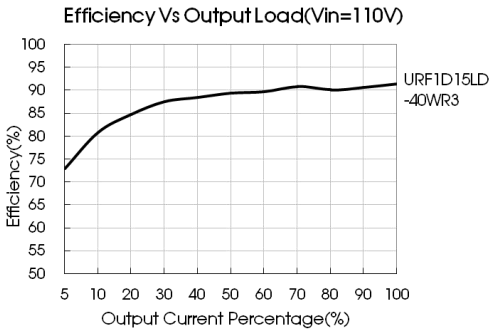

Fig. 2

Note:
Fig.2 is input voltage VS Output power Derating Curve, it is referenced, when customer use product, the converter can operate at input voltage range and 0%-100% load, only ensure case temperature less than 100℃.




## 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 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 max. capacitive load value of the product.

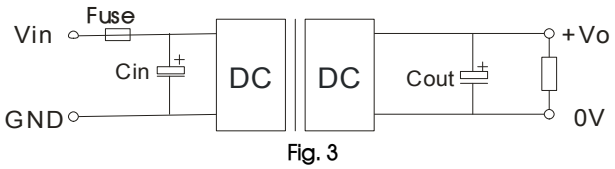



Fig. 3

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

## 2. EMC compliance circuit

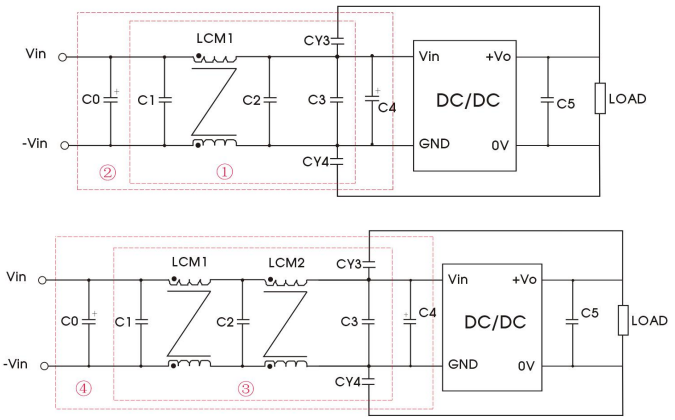
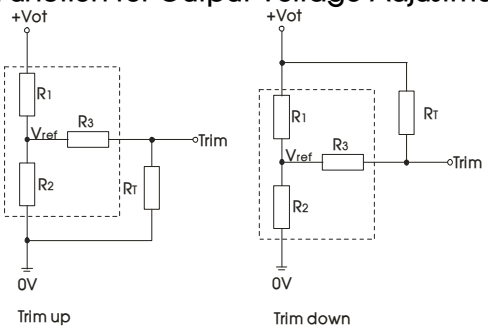



Fig. 4

| Fig.4 List of components: | |
|---|---|
| C0 / C4 | 100μF/200V |
| C1 / C2 | 2.2μF/250V |
| C3 | Refer to the Cin in Fig.3 |
| LCM1 | 15mH (UU common mode inductance) |
| LCM2 | 2.2mH, recommended to use MORNSUN P/N: FL2D-30-222 |
| CY1 / CY2 | 2200pF/400VAC |
| C5 | Refer to the Cout in Fig.3 |

Notes:
1. 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.
2. For 48VDC voltage EMC tests we use Part ④ in Fig. 4 for immunity and part ③ for emissions test.

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




TRIM resistor connection (dashed line shows internal resistor network)

Calculating Trim resistor values:

$$\text{up: } R_T = \frac{aR_2}{R_2-a} - R_3 \qquad a = \frac{V_{ref}}{V_o'-V_{ref}} \cdot R_1$$

$$\text{down: } R_T = \frac{aR_1}{R_1-a} - R_3 \qquad a = \frac{V_o'-V_{ref}}{V_{ref}} \cdot R_2$$

RT = Trim Resistor value;
a = self-defined parameter;
Vo' = desired output voltage

| 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

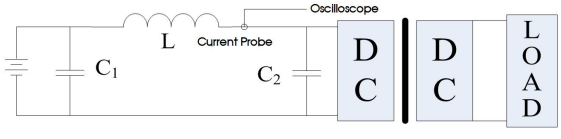


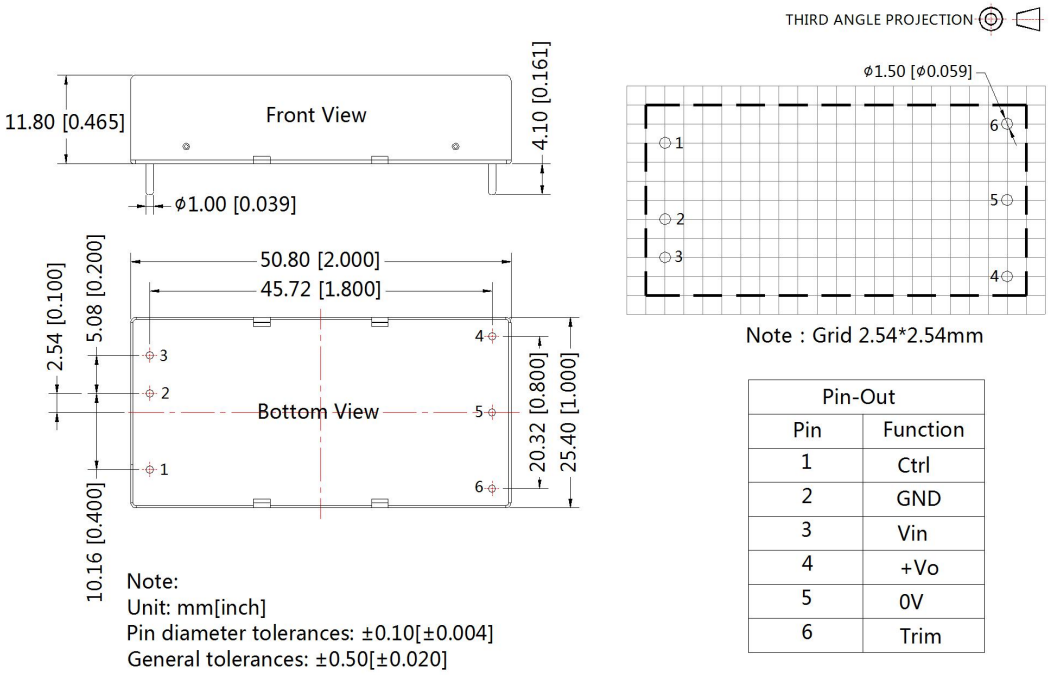

Fig.5

| 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

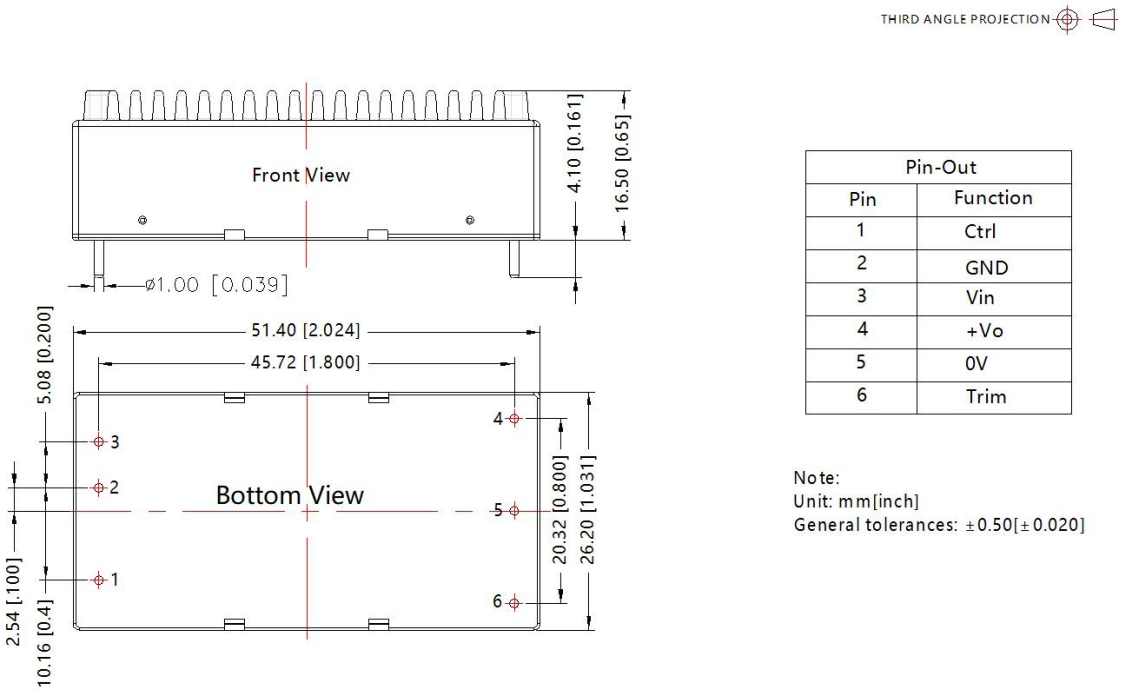
## Horizontal Package (without heat sink) Dimensions and Recommended Layout




Note:
Unit: mm[inch]
Pin diameter tolerances: ±0.10[±0.004]
General tolerances: ±0.50[±0.020]

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

## Horizontal Package (with heat sink) Dimensions

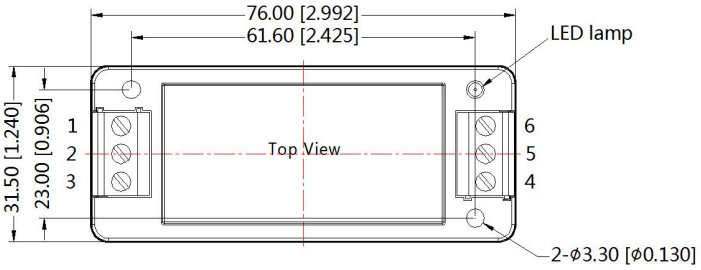



| Pin-Out | |
|---|---|
| Pin | Function |
| 1 | Ctrl |
| 2 | GND |
| 3 | Vin |
| 4 | +Vo |
| 5 | 0V |
| 6 | Trim |

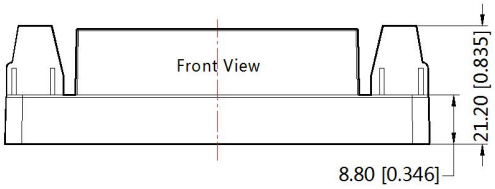
Note:
Unit: mm[inch]
General tolerances: ±0.50[±0.020]

## URF1D_LD-40WR3A2S (without heatsink) Dimensions

THIRD ANGLE PROJECTION



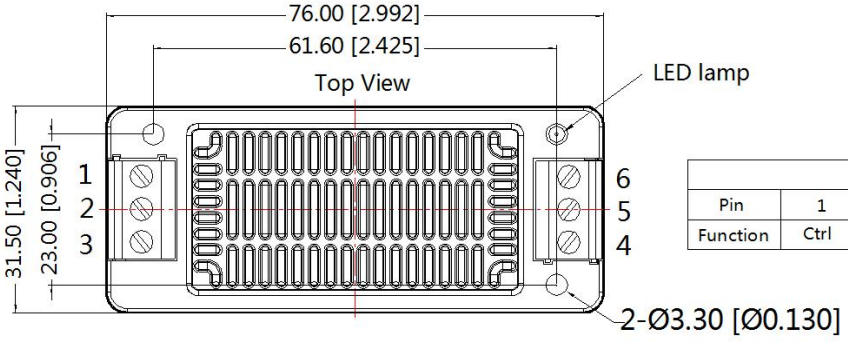

| Pin-Out | | | | | | |
|---|---|---|---|---|---|---|
| Pin | 1 | 2 | 3 | 4 | 5 | 6 |
| Function | Ctrl | GND | Vin | +Vo | 0V | Trim |



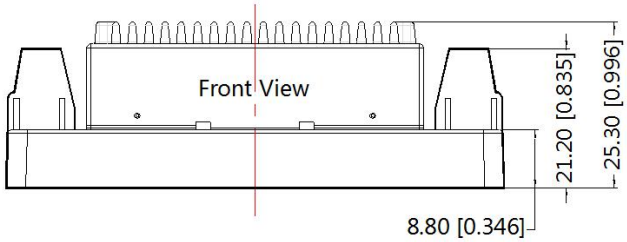

Note:
Unit: mm[inch]
Wire range: 24-12 AWG
Tightening torque: Max 0.4 N·m
General tolerances: ±0.50[±0.020]

## URF1D_LD-40WHR3A2S (with heatsink) Dimensions

THIRD ANGLE PROJECTION



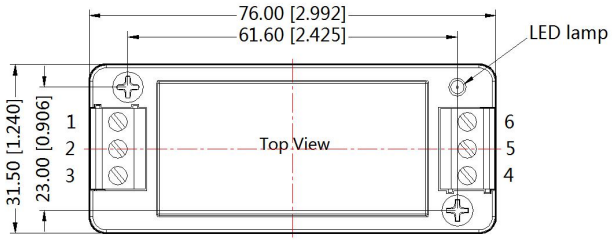

| Pin-Out | | | | | | |
|---|---|---|---|---|---|---|
| Pin | 1 | 2 | 3 | 4 | 5 | 6 |
| Function | Ctrl | GND | Vin | +Vo | 0V | Trim |



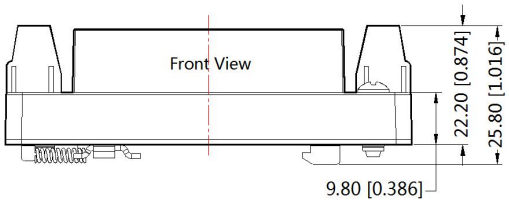

Note:
Unit: mm[inch]
Wire range: 24-12 AWG
Tightening torque: Max 0.4 N·m
General tolerances: ±1.00[±0.039]

## URF1D_LD-40WR3A4S (without heatsink) Dimensions

THIRD ANGLE PROJECTION



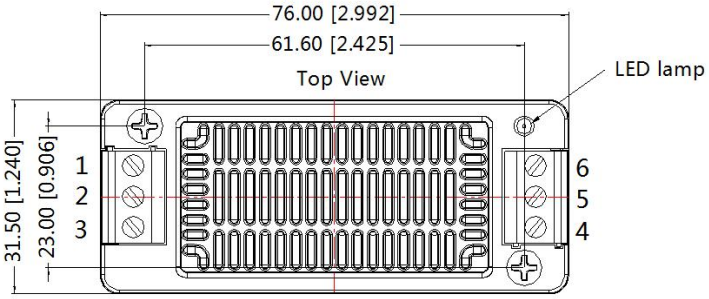

| Pin-Out | | | | | | |
|---|---|---|---|---|---|---|
| Pin | 1 | 2 | 3 | 4 | 5 | 6 |
| Function | Ctrl | GND | Vin | +Vo | 0V | Trim |



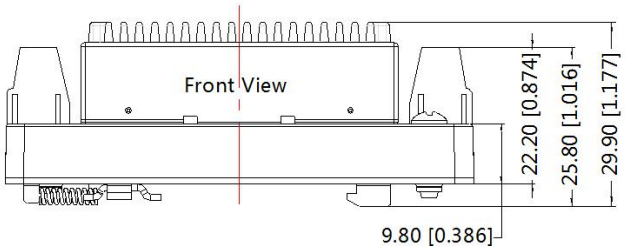

Note:
Unit: mm[inch]
Mounting rail: TS35
Wire range: 24-12 AWG
Tightening torque: Max 0.4 N·m
General tolerances: ±1.00[±0.039]

## 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: ±1.00[±0.039]

Note:

1. For additional information on Product Packaging please refer to 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 Ta=25℃, 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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