DC/DC Converter
URF1D_LD-40WR3 Series

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

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 ~ +85°C
- 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°C to +85°C. Input under-voltage protection, output short circuit, over-current, over-voltage, over-temperature protection. It is ideally suited electronic equipment and railway vehicle applications using 72V, 96V and 110V battery voltages.

Selection Guide

<table>
<thead>
<tr>
<th>Certification</th>
<th>Part No.</th>
<th>Input Voltage (VDC) Nominal* (Range)</th>
<th>Output Max.</th>
<th>Full Load Efficiency-% (%) Min./Typ.</th>
<th>Max. Capacitive Load(µF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>URF1D03LD-40WR3</td>
<td>110 (40-160)</td>
<td>3.3</td>
<td>10000/0</td>
<td>85/87</td>
</tr>
<tr>
<td></td>
<td>URF1D05LD-40WR3</td>
<td></td>
<td>5</td>
<td>8000/0</td>
<td>86/88</td>
</tr>
<tr>
<td></td>
<td>URF1D12LD-40WR3</td>
<td></td>
<td>12</td>
<td>3333/0</td>
<td>89/91</td>
</tr>
<tr>
<td></td>
<td>URF1D15LD-40WR3</td>
<td></td>
<td>15</td>
<td>2667/0</td>
<td>89/91</td>
</tr>
<tr>
<td></td>
<td>URF1D24LD-40WR3</td>
<td></td>
<td>24</td>
<td>1667/0</td>
<td>87/89</td>
</tr>
<tr>
<td></td>
<td>URF1D48LD-40WR3</td>
<td></td>
<td>48</td>
<td>833/0</td>
<td>87/89</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Operating Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Current (full load / no-load)</td>
<td>Nominal Input voltage</td>
<td>3.3V output</td>
<td>--</td>
<td>345/5</td>
<td>353/15</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>--</td>
<td>413/3</td>
<td>423/15</td>
<td></td>
</tr>
<tr>
<td>Reflected Ripple Current</td>
<td>Nominal Input voltage</td>
<td>--</td>
<td>25</td>
<td>--</td>
<td>VDC</td>
</tr>
<tr>
<td>Surge Voltage (1sec. max.)</td>
<td></td>
<td>-0.7</td>
<td>--</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Start-up Voltage</td>
<td>100% load</td>
<td>--</td>
<td>--</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>
### Output Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Operating Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Accuracy</td>
<td>0%-100% load</td>
<td>--</td>
<td>±1</td>
<td>±3</td>
<td>%</td>
</tr>
<tr>
<td>Linear Regulation</td>
<td>Input voltage variation from low to high at full load</td>
<td>--</td>
<td>±0.4</td>
<td>±1</td>
<td>%</td>
</tr>
<tr>
<td>Load Regulation</td>
<td>0%-100% load</td>
<td>--</td>
<td>±0.5</td>
<td>±1</td>
<td>%</td>
</tr>
<tr>
<td>Transient Recovery Time</td>
<td>25% load step change, nominal input voltage</td>
<td>--</td>
<td>300</td>
<td>500</td>
<td>µs</td>
</tr>
<tr>
<td>Transient Response Deviation</td>
<td>3.3V/5V output</td>
<td>--</td>
<td>±5</td>
<td>±8</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>--</td>
<td>±3</td>
<td>±5</td>
<td>%</td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td>Nominal input voltage, full load</td>
<td>--</td>
<td>±0.02</td>
<td>±0.03</td>
<td>%/°C</td>
</tr>
<tr>
<td>Ripple &amp; Noise *</td>
<td>20MHz bandwidth, nominal input voltage, full load</td>
<td>--</td>
<td>150</td>
<td>200</td>
<td>mV p-p</td>
</tr>
<tr>
<td>Trim</td>
<td></td>
<td>90</td>
<td></td>
<td>110</td>
<td>%Vo</td>
</tr>
<tr>
<td>Over-voltage Protection</td>
<td>Input voltage range</td>
<td>110</td>
<td></td>
<td>160</td>
<td>%Vo</td>
</tr>
<tr>
<td>Over-current Protection</td>
<td></td>
<td>110</td>
<td></td>
<td>190</td>
<td>%Io</td>
</tr>
<tr>
<td>Short-circuit Protection</td>
<td>Continuous, self-recovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Operating Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation</td>
<td>Input-output Electric Strength Test for 1 minute with a leakage current of 1mA max.</td>
<td>3000</td>
<td>--</td>
<td>--</td>
<td>VDC</td>
</tr>
<tr>
<td></td>
<td>Input-output Electric Strength Test for 1 minute with a leakage current of 5mA max.</td>
<td>1500</td>
<td>--</td>
<td>--</td>
<td>VAC</td>
</tr>
<tr>
<td></td>
<td>Input/output-case Electric Strength Test for 1 minute with a leakage current of 1mA max.</td>
<td>1500</td>
<td>--</td>
<td>--</td>
<td>VDC</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>Input-output resistance at 500VDC</td>
<td>1000</td>
<td>--</td>
<td>--</td>
<td>MΩ</td>
</tr>
<tr>
<td>Isolation Capacitance</td>
<td>Input-output capacitance at 100KHz/0.1V</td>
<td>--</td>
<td>2200</td>
<td>3000</td>
<td>pF</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>See Fig. 1</td>
<td>-40</td>
<td></td>
<td>+85</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td></td>
<td>-55</td>
<td></td>
<td>+125</td>
<td>℃</td>
</tr>
<tr>
<td>Over-temperature Protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Humidity</td>
<td>Non-condensing</td>
<td>5</td>
<td></td>
<td>95</td>
<td>%RH</td>
</tr>
<tr>
<td>Pin Soldering Resistance</td>
<td>Soldering spot is 1.5mm away from case for 10 seconds</td>
<td>--</td>
<td>--</td>
<td>+300</td>
<td>℃</td>
</tr>
<tr>
<td>Temperature</td>
<td>PWM mode</td>
<td>220</td>
<td></td>
<td></td>
<td>KHz</td>
</tr>
<tr>
<td>Vibration</td>
<td>IEC61373 - Category 1, Grade B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTBF</td>
<td>MIL-HDBK-217F@25°C</td>
<td>500</td>
<td></td>
<td></td>
<td>K hours</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Case Material</th>
<th>Aluminum alloy</th>
</tr>
</thead>
</table>

Dimensions

<table>
<thead>
<tr>
<th>Without heat sink</th>
<th>Horizontal package</th>
<th>50.80 x 25.40 x 11.80 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A2S chassis mounting</td>
<td>76.00 x 31.50 x 21.20 mm</td>
</tr>
<tr>
<td></td>
<td>A4S Din-rail mounting</td>
<td>76.00 x 31.50 x 25.80 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>With heat sink</th>
<th>Horizontal package</th>
<th>51.40 x 26.20 x 16.50 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A2S chassis mounting</td>
<td>76.00 x 31.50 x 25.30 mm</td>
</tr>
<tr>
<td></td>
<td>A4S Din-rail mounting</td>
<td>76.00 x 31.50 x 29.90 mm</td>
</tr>
</tbody>
</table>

Weight

<table>
<thead>
<tr>
<th>Without heat sink</th>
<th>Horizontal package/A2S chassis mounting/A4S Din-rail mounting</th>
<th>26.0g/48.0g/68.0g (Typ.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Horizontal package/A2S chassis mounting/A4S Din-rail mounting</td>
<td>34.0g/56.0g/76.0g (Typ.)</td>
</tr>
</tbody>
</table>

Cooling Method

Free air convection

Electromagnetic compatibility (EMC) (EN62368)

<table>
<thead>
<tr>
<th>Emissions</th>
<th>CE</th>
<th>CISPR32/EN55032</th>
<th>CLASS B (see Fig. 4-①/4-③ for recommended circuit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD</td>
<td>IEC/EN61000-4-2</td>
<td>Contact ±6kV/Alt ±6kV</td>
<td>perf. Criteria A</td>
</tr>
<tr>
<td>RS</td>
<td>IEC/EN61000-4-3</td>
<td>20V/m</td>
<td>perf. Criteria A</td>
</tr>
<tr>
<td>EFT</td>
<td>IEC/EN61000-4-4</td>
<td>100kHz ±4kV (see Fig. 4-②/4-③ for recommended circuit)</td>
<td>perf. Criteria A</td>
</tr>
<tr>
<td>Surge</td>
<td>IEC/EN61000-4-5</td>
<td>line to line ±2kV (2Ω 18μF see Fig. 4-②/4-③ for recommended circuit)</td>
<td>perf. Criteria A</td>
</tr>
<tr>
<td>CS</td>
<td>IEC/EN61000-4-6</td>
<td>10 Vt.m.s</td>
<td>perf. Criteria A</td>
</tr>
</tbody>
</table>

Electromagnetic Compatibility (EMC) (EN50155)

<table>
<thead>
<tr>
<th>Emissions</th>
<th>CE</th>
<th>EN50121-3-2</th>
<th>150kHz-500kHz 99dBuV (see Fig. 4-①/4-③ for recommended circuit)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RE</td>
<td>EN50121-3-2</td>
<td>30MHz-230MHz 40dBuV/m at 10m (see Fig. 4-①/4-③ for recommended circuit)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EN50121-2-1</td>
<td>230MHz-1GHz 47dBuV/m at 10m</td>
</tr>
<tr>
<td>ESD</td>
<td>EN50121-3-2</td>
<td>Contact ±6kV/Alt ±6kV</td>
<td>perf. Criteria A</td>
</tr>
<tr>
<td>RS</td>
<td>EN50121-3-2</td>
<td>20V/m</td>
<td>perf. Criteria A</td>
</tr>
<tr>
<td>EFT</td>
<td>EN50121-3-2</td>
<td>±2kV 5/50ns 5kHz (see Fig. 4-②/4-③ for recommended circuit)</td>
<td>perf. Criteria A</td>
</tr>
<tr>
<td>Surge</td>
<td>EN50121-3-2</td>
<td>line to line ±1kV (2Ω 0.5 μF) (see Fig. 4-②/4-③ for recommended circuit)</td>
<td>perf. Criteria A</td>
</tr>
<tr>
<td>CS</td>
<td>EN50121-3-2</td>
<td>0.15MHz-80MHz 10 Vt.m.s</td>
<td>perf. Criteria A</td>
</tr>
</tbody>
</table>

Typical Characteristic Curves

Fig. 1
DC/DC Converter
URF1D_LD-40WR3 Series

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°C.

**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.

<table>
<thead>
<tr>
<th>Vout(VDC)</th>
<th>Fuse</th>
<th>Cin</th>
<th>Cout</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3/5</td>
<td>3.3/5, slow</td>
<td>680µF</td>
<td>100µF</td>
</tr>
<tr>
<td>12/15</td>
<td>12/15, slow</td>
<td>100µF</td>
<td>220µF</td>
</tr>
<tr>
<td>24/48</td>
<td>24/48, slow</td>
<td>100µF</td>
<td>100µF</td>
</tr>
</tbody>
</table>
2. EMC compliance circuit

![EMC circuit diagram]

**Fig. 4**

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 function diagram]

Calculating Trim resistor values:

\[
\text{up: } R_T = \frac{a R_2}{R_2-a} - R_3
\]

\[
\text{down: } R_T = \frac{a R_1}{R_1-a} - R_3
\]

RT = Trim Resistor value;
α = Trim Resistor value;
Vo’ = self-defined parameter;
Vo = desired output voltage

<table>
<thead>
<tr>
<th>Vout (V)</th>
<th>R1 (KΩ)</th>
<th>R2 (KΩ)</th>
<th>R3 (KΩ)</th>
<th>Vref (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>4.801</td>
<td>2.87</td>
<td>10</td>
<td>1.24</td>
</tr>
<tr>
<td>5</td>
<td>2.883</td>
<td>2.87</td>
<td>10</td>
<td>2.5</td>
</tr>
<tr>
<td>12</td>
<td>11.000</td>
<td>2.87</td>
<td>15</td>
<td>2.5</td>
</tr>
<tr>
<td>15</td>
<td>14.384</td>
<td>2.87</td>
<td>15</td>
<td>2.5</td>
</tr>
<tr>
<td>24</td>
<td>24.872</td>
<td>2.87</td>
<td>17.8</td>
<td>2.5</td>
</tr>
<tr>
<td>48</td>
<td>55.28</td>
<td>3.0</td>
<td>20</td>
<td>2.5</td>
</tr>
</tbody>
</table>

4. Reflected Ripple Current testing circuit

![Reflected ripple current circuit]

**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

Pin-Out

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ctrl</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>Vin</td>
</tr>
<tr>
<td>4</td>
<td>+Vo</td>
</tr>
<tr>
<td>5</td>
<td>0V</td>
</tr>
<tr>
<td>6</td>
<td>Trim</td>
</tr>
</tbody>
</table>

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

Horizontal Package (with heat sink) Dimensions

Pin-Out

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ctrl</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>Vin</td>
</tr>
<tr>
<td>4</td>
<td>+Vo</td>
</tr>
<tr>
<td>5</td>
<td>0V</td>
</tr>
<tr>
<td>6</td>
<td>Trim</td>
</tr>
</tbody>
</table>

Note:
Unit: mm[inch]
General tolerances: ±0.50[±0.020]
**URF1D_LD-40WR3A2S (without heatsink) Dimensions**

![Dimensions Diagram](image1)

**Pin-Out**

<table>
<thead>
<tr>
<th>Pin</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Ctrl</td>
<td>GND</td>
<td>Vin</td>
<td>+Vo</td>
<td>0V</td>
<td>Trim</td>
</tr>
</tbody>
</table>

**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**

![Dimensions Diagram](image2)

**Pin-Out**

<table>
<thead>
<tr>
<th>Pin</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Ctrl</td>
<td>GND</td>
<td>Vin</td>
<td>+Vo</td>
<td>0V</td>
<td>Trim</td>
</tr>
</tbody>
</table>

**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

Pin-Out

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ctrl</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>Vin</td>
</tr>
<tr>
<td>4</td>
<td>+Vo</td>
</tr>
<tr>
<td>5</td>
<td>0V</td>
</tr>
<tr>
<td>6</td>
<td>Trim</td>
</tr>
</tbody>
</table>

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

Pin-Out

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ctrl</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>Vin</td>
</tr>
<tr>
<td>4</td>
<td>+Vo</td>
</tr>
<tr>
<td>5</td>
<td>0V</td>
</tr>
<tr>
<td>6</td>
<td>Trim</td>
</tr>
</tbody>
</table>

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]
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