15W & 20W isolated DC-DC converter
Ultra-wide Input and Regulated Single Output

Patent Protection RoHS

FEATURES

- Ultra-wide 4:1 input voltage range
- Reinforced I/O isolation test voltage 3k VAC
- Operating ambient temperature range -40℃ to +85℃
- Input under-voltage protection, output short-circuit, over-current, over–voltage protection
- Low output Ripple & Noise
- CLSPR32/EN55032 CLASS A EMI compliant without external components
- Industry standard pin-out

URF1D_LMD-15W(H)R3G 15W and URF1D_LMD-20W(H)R3G 20W series of isolated DC-DC converter products have an ultra-wide 4:1 input voltage and feature efficiencies of up to 86%. input to output isolation is tested with 3000VAC and the converters safely operate in an ambient temperature of -40℃ to +85℃, input under-voltage protection, output short-circuit, over-current, over-voltage protection, and are offered with various mounting options 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 Efficiency③ (%) Min./Typ.	Capacitive Load (μF)Max.
		Nominal (Range)	Max.②	Voltage (VDC)	Current(mA) Max./Min.		
--	URF1D03LMD-15W(H)R3G	110 (40-160)	170	3.3	4000/0	80/82	5400
	URF1D05LMD-15W(H)R3G			5	3000/0	82/84	5400
	URF1D12LMD-15W(H)R3G			12	1250/0	82/84	1000
	URF1D15LMD-15W(H)R3G			15	1000/0	83/85	820
	URF1D24LMD-15W(H)R3G			24	625/0	83/85	270
	URF1D03LMD-20W(H)R3G			3.3	5000/0	80/82	10000
	URF1D05LMD-20W(H)R3G			5	4000/0	82/84	10000
	URF1D12LMD-20W(H)R3G			12	1667/0	83/85	1600
	URF1D15LMD-20W(H)R3G			15	1333/0	84/86	1000
	URF1D24LMD-20W(H)R3G			24	833/0	84/86	470

Note:
①Use "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;
②Exceeding the maximum input voltage may cause permanent damage;
③Efficiency is measured at nominal input voltage and rated output load.

Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Input Current(full load/no-load)	URF1D_LMD-15WR3G series, Nominal input voltage	3.3V output	--	147/10	150/20	mA
		5V output	--	163/10	167/20	
		Others	--	159/3	166/8	
Input Current(full load/no-load)	URF1D_LMD-20WR3G series, Nominal input voltage	3.3V output	--	183/10	188/20	mA
		5V output	--	217/10	222/20	
		Others	--	214/3	219/8	
Reflected Ripple Current	Nominal input voltage		--	25	--	
Surge Voltage (1sec. max.)			-0.7	--	180	VDC
Start-up Voltage	Full load		--	--	40	
Input Under-voltage Protection			24	33	--	
Start-up Time	Nominal input voltage & constant resistance load		--	10	--	ms
Input Filter			Pi filter			
Hot Plug			Unavailable			

Ctrl *	Module on	Ctrl pin open or pulled high (TTL 3.5-12VDC)			
	Module off	Ctrl pin pulled low to GND (0-1.2VDC)			
	Input current when off	--	2	7	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		--	±0.2	±0.5	
Load Regulation	0%-100% load		--	±0.5	±1	
Transient Recovery Time	25% load step change, nominal input voltage		--	300	500	μs
Transient Response Deviation	25% load step change, nominal input voltage	3.3V/5V output	--	±3	±8	%
		Others	--	±3	±5	
Temperature Coefficient	Full load		--	±0.02	±0.03	%/℃
Ripple & Noise *	20MHz bandwidth, 5%-100% load		--	50	100	mV p-p
Trim	Input voltage range		90	--	110	%Vo
Over-voltage Protection			110	--	160	
Over-current Protection			120	--	260	%Io
Short-circuit Protection			Continuous, self-recovery			
Note: *Under 0% -5% load conditions, ripple & noise does not exceed 5%Vo. The "parallel cable" method is used for Ripple and Noise test, please refer to DC-DC Converter Application Notes 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 5mA max.	3000	--	--	VAC
	Input/output-case Electric Strength Test for 1 minute with a leakage current of 1mA max.	1600	--	--	VDC
Insulation Resistance	Input-output resistance at 500VDC	1000	--	--	MΩ
Isolation Capacitance	Input-output capacitance at 100kHz/0.1V	--	2200	--	pF
Operating Temperature	See Fig. 1	-40	--	+85	℃
Storage Temperature		-55	--	+125	
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	--	300	--	kHz
Shock & Vibration test		IEC61373 - Category 1, Grade B			
MTBF	MIL-HDBK-217F@25℃	1000	--	--	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	50.80 x 25.40 x 11.80mm
	With heat sink	51.40 x 26.20 x 16.50mm
Weight	Without heat sink	26.0g(Typ.)
	With heat sink	34.0g(Typ.)
Cooling Method	Free air convection	

Electromagnetic compatibility (EMC) (EN62368)

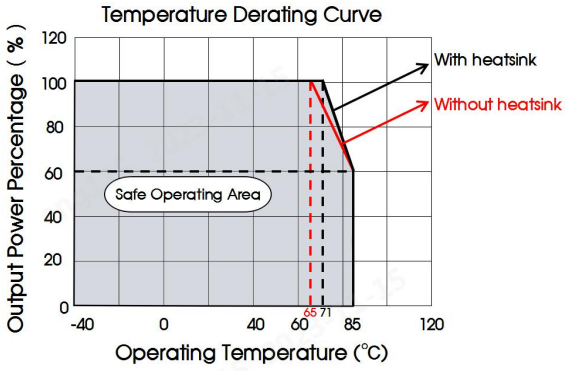
Emissions	CE	CISPR32/EN55032	CLASS A(see Fig.3 for recommended circuit)/ CLASS B(see Fig.5-② for recommended circuit)	
	RE	CISPR32/EN55032	CLASS A(without external components)/ CLASS B (see Fig.5-② for recommended circuit)	
Immunity	ESD	IEC/EN61000-4-2	Contact ±6kV/Air ±8kV	perf. Criteria B
	RS	IEC/EN61000-4-3	10V/m	perf. Criteria A
	EFT	IEC/EN61000-4-4	±4kV (see Fig.4 or Fig.5-① for recommended circuit)	perf. Criteria B
	Surge	IEC/EN61000-4-5	line to line ±2kV (2Ω 18uF see Fig.4 for recommended circuit) line to ground ±4kV (12Ω 9uF see Fig.4 for recommended circuit)	perf. Criteria B
		EN50121-3-2	line to line ±1kV (42Ω 0.5uF see Fig.5-① for recommended circuit) line to ground ±2kV (42Ω 0.5uF see Fig.5-① for recommended circuit)	perf. Criteria B
	CS	IEC/EN61000-4-6	10 Vr.m.s	perf. Criteria A

Electromagnetic Compatibility (EMC) (EN50155)

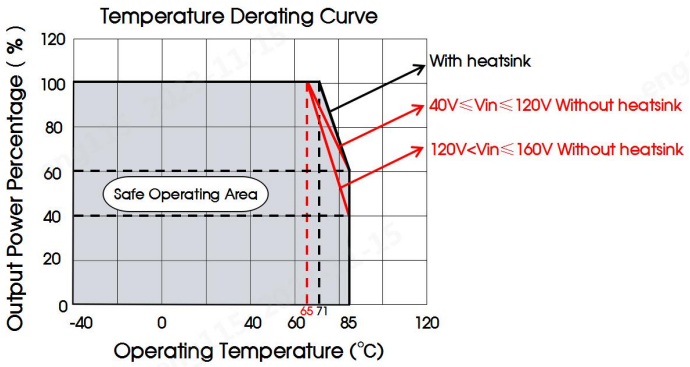
Emissions	CE	EN50121-3-2 EN55016-2-1	150kHz-500kHz 99dBuV 500kHz-30MHz 93dBuV	
	RE	EN50121-3-2 EN55016-2-1	30MHz-230MHz 40dBuV/m at 10m 230MHz-1GHz 47dBuV/m at 10m	
Immunity	ESD	EN50121-3-2	Contact ±6kV/Air ±8kV	perf. Criteria B
	RS	EN50121-3-2	20V/m	perf. Criteria A
	EFT	EN50121-3-2	±2kV 5/50ns 5kHz	perf. Criteria A
	Surge	EN50121-3-2	line to line ±1kV（42Ω，0.5μF） line to ground ±2kV（42Ω，0.5μF）	perf. Criteria B
	CS	EN50121-3-2	0.15MHz-80MHz 10 Vr.m.s	perf. Criteria A

Note: All the tests are measured under the conditions of inputs capacitor 100uF/200V or FC-CX1D filter (the recommended circuit please see Fig.3 or see Fig.4).

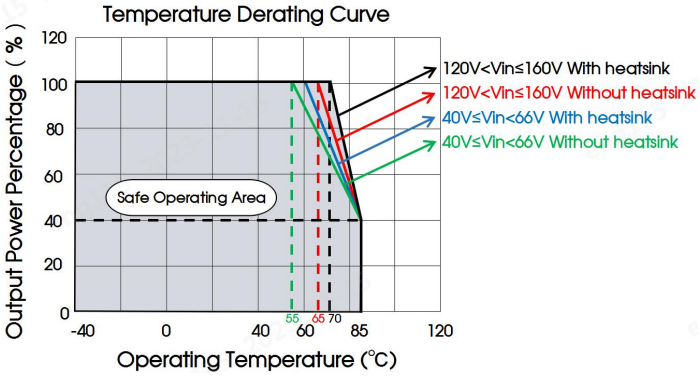
Typical Characteristic Curves

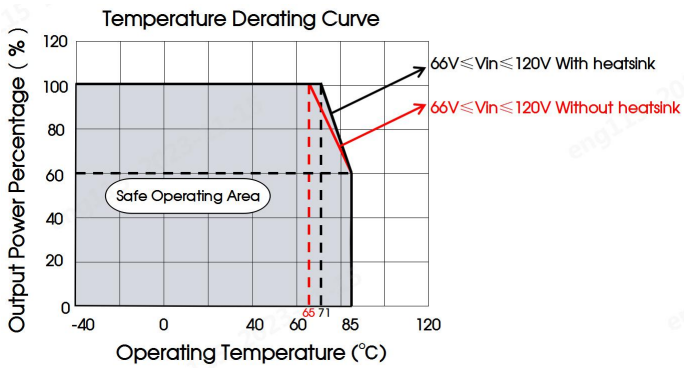


Operating Temperature, Except URF1D03/05LMD-20W(H)R3G



URF1D03LMD-20W(H)R3G Operating Temperature

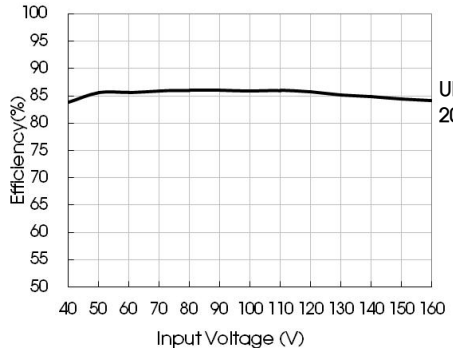




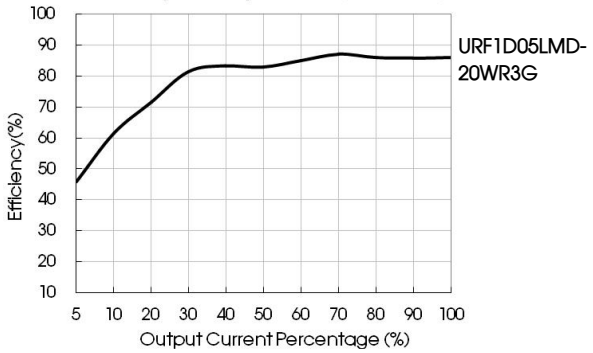
URF1D05LMD-20W(H)R3G Operating Temperature

Fig. 1

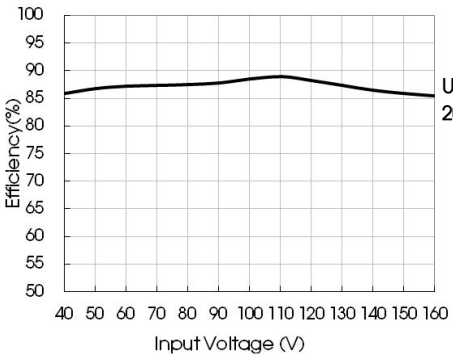
Efficiency Vs Input Voltage (Full Load)



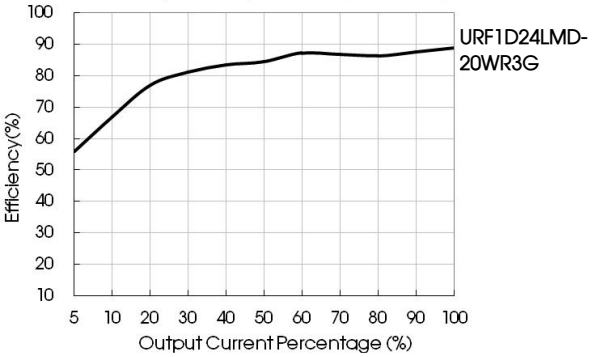
Efficiency Vs Output Load(Vin=110V)



Efficiency Vs Input Voltage (Full Load)



Efficiency Vs Output Load(Vin=110V)



Design Reference

1. Typical application

All the DC-DC converters of this series are tested before delivery using the recommended circuit shown in Fig. 2.

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. 2

Vout(VDC)	Fuse	Cin	Cout
3.3/5	2A, slow blow	100μF/250V	470μF/16V
12/15			220μF/25V
24			100μF/50V

2. EMC compliance circuit

Fig. 3

Notes: Fig. 3 Cin please use the 250V withstand voltage of the capacitor.

Fig. 3 List of components:

Cin	100μF/250V
Cout	Refer to the Cout in Fig.2

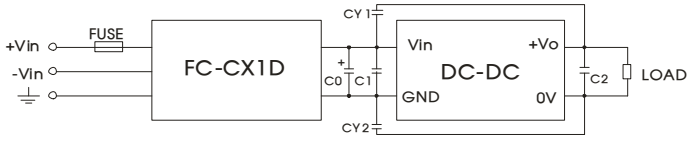


Fig. 4

Fig. 4 List of components:

FUSE	Choose according to actual input current
FC-CX1D	FC-CX1D：Mornsun EMC filter, Input voltage range: 40V-160V
C0	100μF/200V
C1	Refer to the Cin in Fig.2
C2	Refer to the Cout in Fig.2
CY1, CY2	1000pF/400VAC

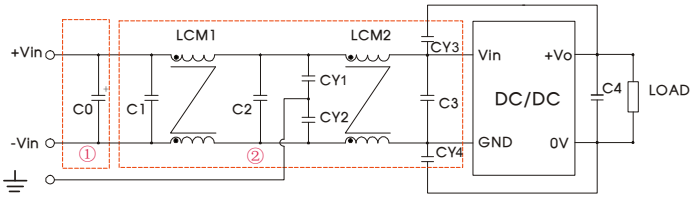


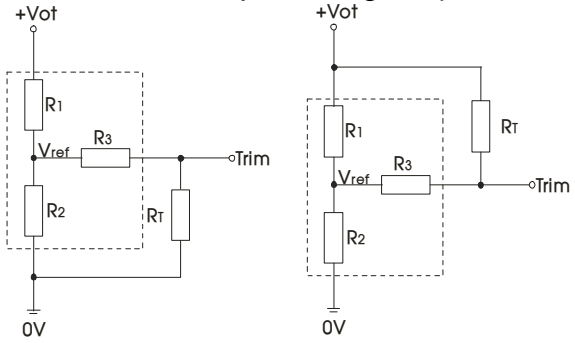
Fig. 5

Notes: Part ① in the Fig. 5 is used for EMS test and part ② for EMI test

Fig. 5 List of components:

Model	URF1D_LMD-15WR3G	URF1D_LMD-20WR3G
C0	100μF/200V	
C1, C2	0.22μF/250V	
C3	Refer to the Cin in Fig.2	
LCM1	15mH (UU common mode inductance)	2.2mH(FL2D-10-222)
LCM2	15mH (UU common mode inductance)	0.53mH (material: TN150P-RH12.7*12.7*7.9)
CY1, CY2, CY3, CY4	1000pF/400VAC	
C4	Refer to the Cout in Fig.2	
Notes: FL2D-10-222: Mornsun common mode filter.		

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



Trim up Trim down

TRIM resistor connection (dashed line shows internal resistor network)

Calculating Trim resistor values:

$$\text{up: } R_T = \frac{aR_2}{R_2 - a} - R_3 \qquad a = \frac{Vref}{Vo' - Vref} \cdot R_1$$

$$\text{down: } R_T = \frac{aR_1}{R_1 - a} - R_3 \qquad a = \frac{Vo' - Vref}{Vref} \cdot R_2$$

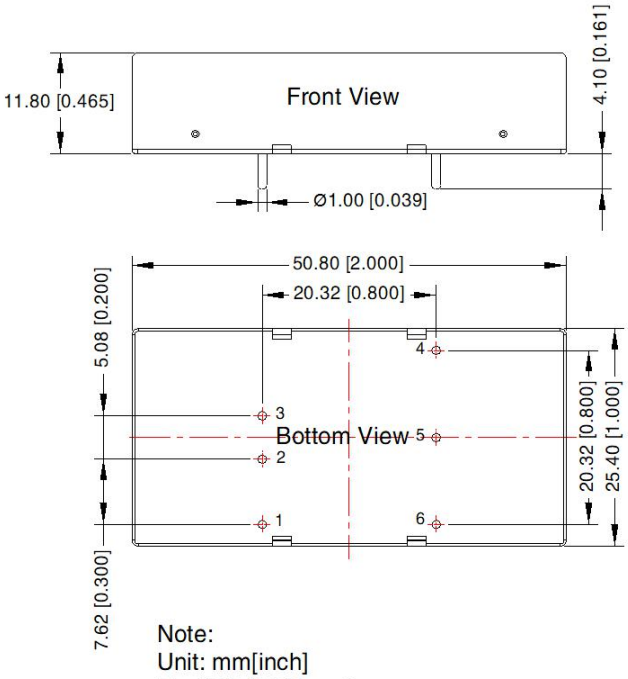
Note:
Trim Suspended when not in use;
R_T = Trim Resistor value;
a = self-defined parameter;
Vo' = desired output voltage.

Vout(V)	R1(kΩ)	R2(kΩ)	R3(kΩ)	Vref(V)
3.3	4.772	2.87	10	1.25
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

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

5. For additional information please refer to DC-DC converter application notes on www.mornsun-power.com

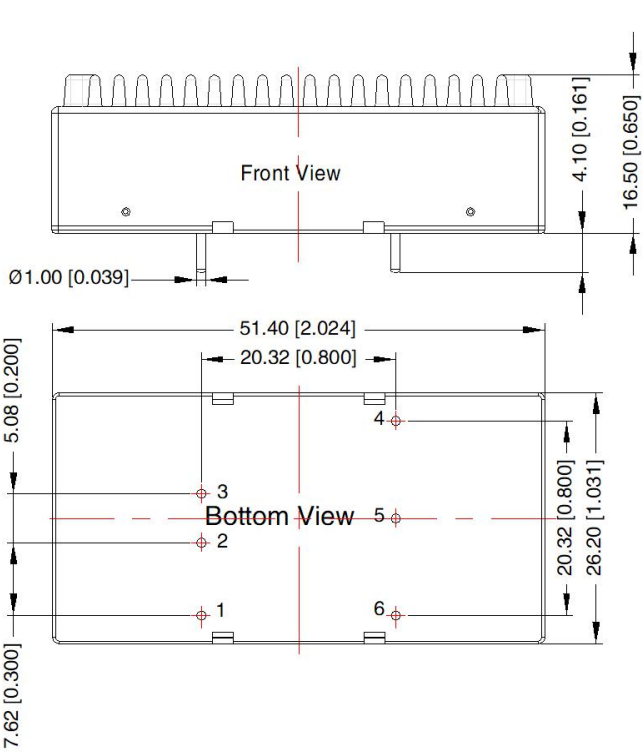
URF1D_LMD-15WR3G & URF1D_LMD-20WR3G Dimensions and Recommended Layout



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

Note:
Unit: mm[inch]
Pin1/2/3/4/5/6: Ø1mm
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]

URF1D_LMD-15WHR3G & URF1D_LMD-20WHR3G Dimensions and Recommended Layout



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

Note:
Unit: mm[inch]
Pin1/2/3/4/5/6: Ø1mm
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]

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);
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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