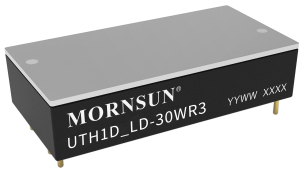
DC/DC Converter

UTH1D_LD-30WR3 Series

MORNSUN®

30W, isolated DC-DC converter
Ultra-wide input and regulated single output



Patent Protection RoHS

FEATURES

- Ultra-wide 4:1 input voltage range: 40 -160VDC
- High efficiency up to 92%
- Reinforced insulation, I/O isolation test voltage 3K VAC
- Operating ambient temperature range -40℃ to +105℃
- Input under-voltage protection, output over–voltage, over-current, short-circuit protection, over-temperature protection
- Industry standard package and pin-out
- Meets EN50155 and AREMA standards
- Meets IEC62368, UL62368, EN62368, EN45545 standards

The UTH1D_LD-30WR3 series is a high-performance product specifically designed for a variety of railway applications. The output power can reach at 30W. It features wide input voltage of 40-160VDC, which is compatible with nominal input type of 72V, 96V and 110V. Meets EN50155 standard for voltage fluctuations. The reinforced high insulation 3000VAC/2800VAC ensures that the system can still be used safely in 5000m high altitude applications. The allowable operating temperature is up to 105℃. It integrates multiple protection functions to ensure the safety and high reliability of the system, with functions of remote control and compensation, output voltage adjustment, etc., which perfectly matches the requirements of line loss and special voltage in the application. It is widely used in vehicle-mounted switches, train control systems, traction control systems and associated equipment.

Certification	Part No	Ctrl Logic	Input Voltage (VDC)		Output		Full Load Efficiency(%) Min./Typ.	Max. Capacitance Load(μF)	Min. Capacitance Load(μF)
			Typ. (Range)	Max.	Voltage (VDC)	Current (mA) (Max./Min.)			
--	UTH1D05LD-30WR3	P	110 (40-160)	160	5	6000/0	86/88	6800	330
	UTH1D12LD-30WR3				12	2500/0	89/91	3300	220
	UTH1D15LD-30WR3				15	2000/0	89/91	3300	220
	UTH1D24LD-30WR3				24	1250/0	89.5/91.5	2000	150
	UTH1D28LD-30WR3				28	1071/0	90/92	2000	150
	UTH1D48LD-30WR3				48	625/0	89/91	330	82
	UTH1D54LD-30WR3				54	556/0	89/91	330	82

Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Input Current (full load)	48V input	5V Output	--	744	775	mA
		12V, 15V, 24V, 28V, 48V, 54V Output	--	718	740	
	72V input	5V Output	--	490	517	
		12V, 15V, 24V, 28V, 48V, 54V Output	--	473	490	
	96V input	5V Output	--	363	383	
		12V, 15V, 24V, 28V, 48V, 54V Output	--	351	370	
	110V input	5V Output	--	313	330	
		12V, 15V, 24V, 28V, 48V, 54V Output	--	303	319	
	156V input	5V Output	--	224	236	
		12V, 15V, 24V, 28V, 48V, 54V Output	--	221	233	
Reflected Ripple Current			--	150	--	
Surge Voltage (1sec. max.)			-0.7	--	200	VDC
Start-up Voltage			--	--	40	
Start-up Time			--	10	100	ms
No-load Input Power	Ctrl pin open or pulled high, DC-DC ON (40-160VDC)		--	1.2	2.0	W
Static Input Power	Ctrl pin pulled low (0-1.2VDC)to GND, DC-DC OFF (40-160VDC)		--	0.8	1.6	
Ctrl①	Module on		Ctrl pin open or pulled high (3.5-12VDC)			

	Module off	Ctrl pin pulled low (0-1.2VDC)to GND,			
Input Under-voltage Protection		30	34	--	VDC

Note:
①The Ctrl pin voltage is referenced to input GND.

Output Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Voltage Accuracy	Nominal input voltage, 5%-100% load	5V output	--	±1	±3	%
		Other output	--	±1	±2	
Linear Regulation	Input voltage variation from low to high at full load		--	±0.2	±0.5	
Load Regulation	Nominal input voltage, 5%-100% load		--	±0.5	±1	
Transient Recovery Time	25% load step change @25℃		--	300	500	μs
Transient Response Deviation		5V output	--	±4	±8	%
		Other output	--	±3	±5	
Temperature Coefficient	Nominal input voltage, full load		--	--	±0.03	%/℃
Ripple & Noise①	20MHz bandwidth, 5%-100% load	5V, 12V, 15V output	--	100	150	mVp-p
		24V, 28V, 48V, 54V, output	--	100	200	
Trim			90	--	110	%Vo
Over-temperature Protection	Max. Case Temperature		105	--	130	℃
Over-voltage Protection	Input voltage range		110	--	160	%Vo
Over-current Protection			110	--	190	%Io
Short-circuit Protection			Hiccup, continuous, self-recovery			

Note:
①The "Tip and barrel method" is used for ripple and noise test, for details please refer to Fig.2.

General Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Isolation	Electric Strength Test for 1 minute with a leakage current of 5mA max	Input-output(Reinforced insulation)	3000	--	--	VAC
		Input-case	2800	--	--	
		Output-case	2100	--	--	
Insulation Resistance	Input-output resistance at 500VDC		1000	--	--	MΩ
Isolation Capacitance	Input-output capacitance at 100KHz/0.1V		--	1500	--	pF
Operating Temperature			-40	--	105	℃
Storage			-55	--	+125	
Pin Soldering Resistance Temperature	Soldering spot is 1.5mm away from case for 10 seconds		--	--	300	℃
Storage Humidity	Non-condensing		5	--	95	%RH
Switching Frequency	PWM mode		--	170	--	KHz
MTBF	IEC 61709 @25℃		1000	--	--	K hours
Cold Start Test			EN60068-2-1, Test Ad			
Low Temperature Storage Test			EN60068-2-1, Test Ab			
Dry Heat Test			EN60068-2-2, Test B			
Cyclic Humid Heat Test			EN60068-2-30, Test Db			
Shock And Vibration Test			IEC/EN61373 Class B			
Pollution Level			PD 3			
Fire & Smoke Compliance			EN45545-2, HL3			
Salt Mist test			EN60068-2-11, Ka			
Altitude①			≤5000m			

Note:
①If the product is used at an altitude above 2000m, it is necessary to ensure that the surface temperature of the product is lower than 130° C.

Mechanical Specifications

Case Material	Aluminum alloy case; Black plastic bottom, flame-retardant and heat-resistant (UL94 V-0)
Dimension	50.80 x 25.40x 11.80 mm
Weight	41.5g (Typ.)
Cooling Method	Conduction cooling or forced air cooling

Electromagnetic Compatibility (EN50121-3-2)

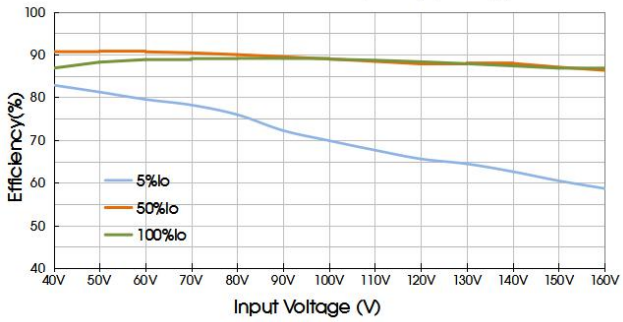
EMI	CE	EN50121-3-2	EN55016-2-1 150kHz-500kHz 99dBuV see Fig.5 500kHz-30MHz 93dBuV see Fig.5	
		EN55032	EN55032-11 150kHz-500kHz 79dBuV see Fig.5 500kHz-30MHz 73dBuV see Fig.5	
	RE	CISPR16-2-3	30MHz-230MHz 40dBuV/m at 10m see Fig.5 230MHz-1GHz 47dBuV/m at 10m see Fig.5 1GHz-6GHz 47dBuV/m at 10m see Fig.5	
EMS	ESD	EN61000-4-2	Contact ±6kV/Air ±8kV	perf. Criteria A
	RS	EN61000-4-3	80 – 800MHz 20V/m 800 – 1000MHz 20V/m 1400 – 2000MHz 10V/m 2000 – 2700MHz 5V/m 5100 – 6000MHz 3V/m	perf. Criteria A
	EFT	EN61000-4-4	±2kV 5/50ns 5kHz see Fig.5	perf. Criteria A
	Surge	EN61000-4-5	line to line ±1kV (42Ω, 0.5μF) line to ground ±2kV (42Ω, 0.5μF) see Fig.5 line to line ±1kV (2Ω, 18μF) line to ground ±2kV (12Ω, 9μF) see Fig.5	perf. Criteria A
	CS	EN61000-4-6	0.15MHz-80MHz 10V r.m.s	perf. Criteria A

Electromagnetic Compatibility (AREMA)

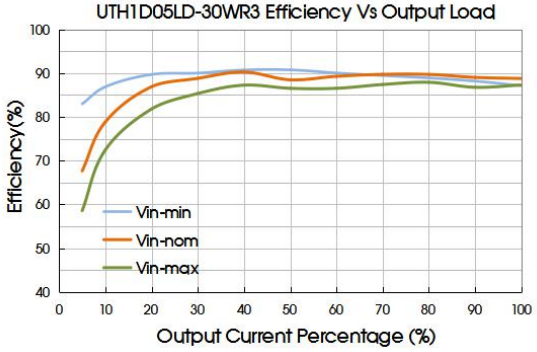
EMI	CE	CISPR16-2-1	150kHz-500kHz 79dBuV see Fig.5	
		CISPR16-1-2	500kHz-30MHz 73dBuV see Fig.5	
	RE	CISPR16-2-3	30MHz-230MHz 40dBuV/m at 10m see Fig.5 230MHz-1GHz 47dBuV/m at 10m see Fig.5	
EMS	ESD	IEC61000-4-2	Contact ±6kV/Air ±8kV	perf. Criteria A
	RS	IEC61000-4-3	80 – 100MHz 10V/m 160 – 165MHz 20V/m 450 – 470MHz 20V/m 800 – 960MHz 20V/m 1400 – 2000MHz 20V/m 2100 – 2500MHz 5V/m	perf. Criteria A
	EFT	IEC61000-4-4	±2kV 5/50ns 5kHz see Fig.5	perf. Criteria A
	Surge	IEC61000-4-5	line to line ±2kV (2Ω, 18μF) line to ground ±2kV(2Ω, 18μF) see Fig.5	perf. Criteria A
	CS	IEC61000-4-6	0.15MHz-80MHz 10V r.m.s	perf. Criteria A
	Magnetic field	IEC61000-4-8	60Hz 100A/m see Fig.5 60Hz 300A/m see Fig.5	perf. Criteria A

Typical Performance Curves

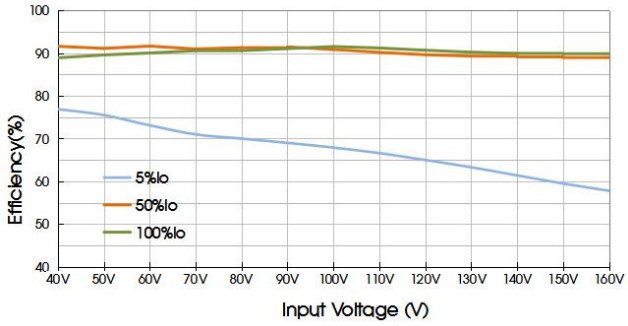
UTH1D05LD-30WR3 Efficiency Vs Input Voltage



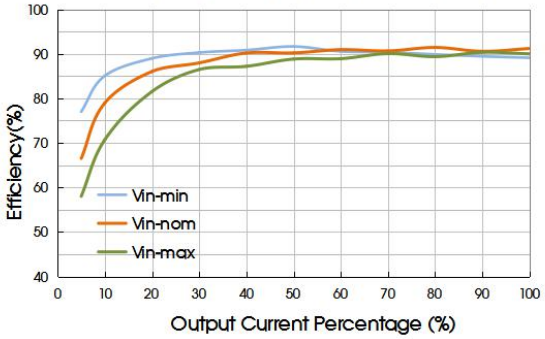
UTH1D05LD-30WR3 Efficiency Vs Output Load



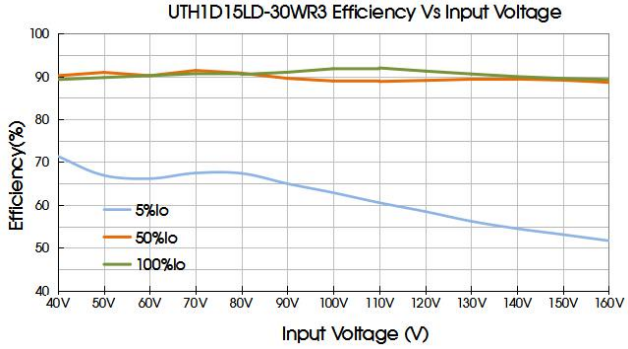
UTH1D12LD-30WR3 Efficiency Vs Input Voltage



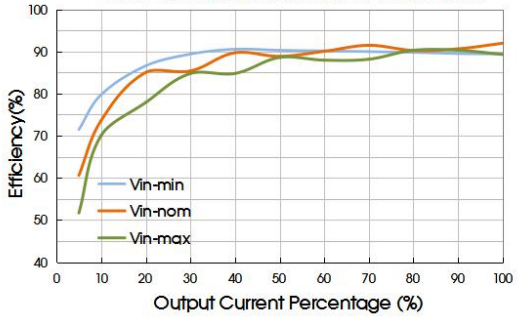
UTH1D12LD-30WR3 Efficiency Vs Output Load



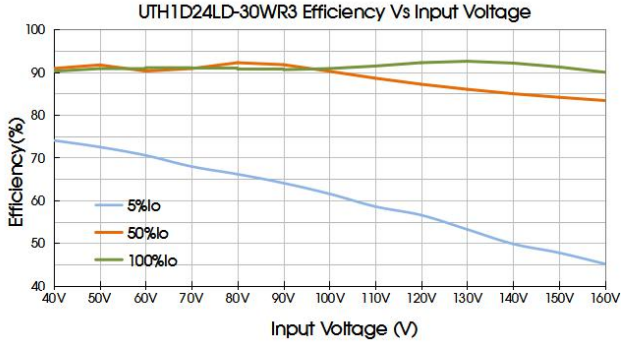
UTH1D15LD-30WR3 Efficiency Vs Input Voltage



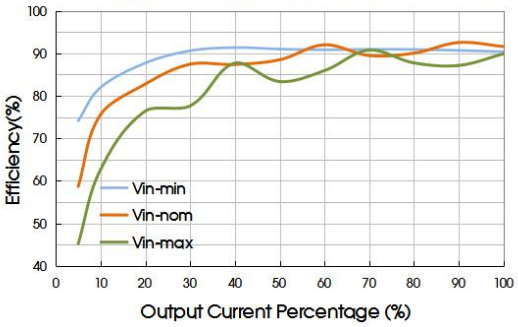
UTH1D15LD-30WR3 Efficiency Vs Output Load

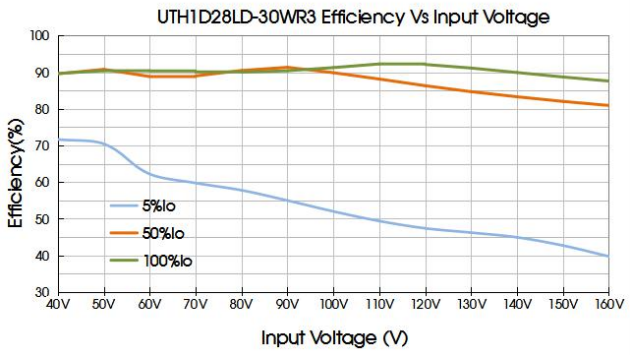


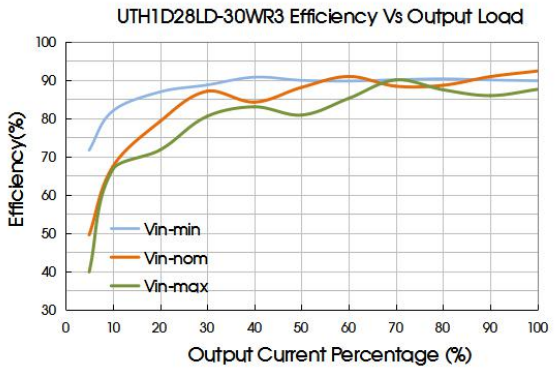
UTH1D24LD-30WR3 Efficiency Vs Input Voltage

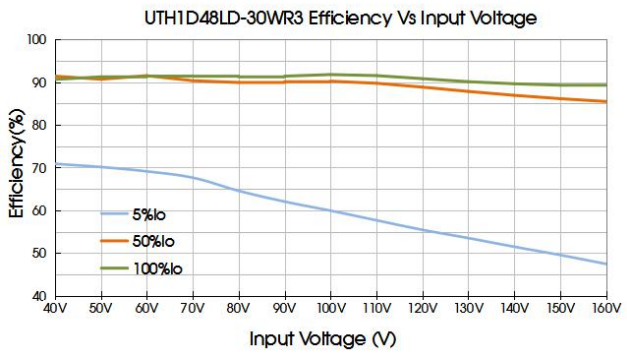


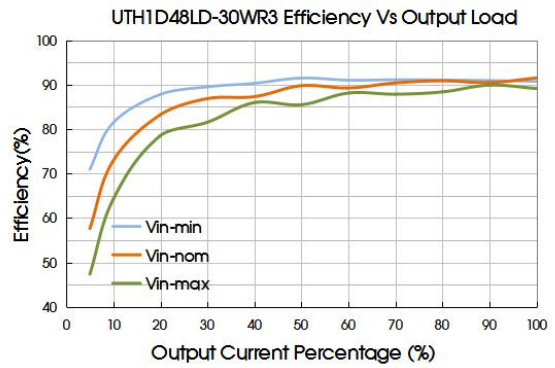
UTH1D24LD-30WR3 Efficiency Vs Output Load

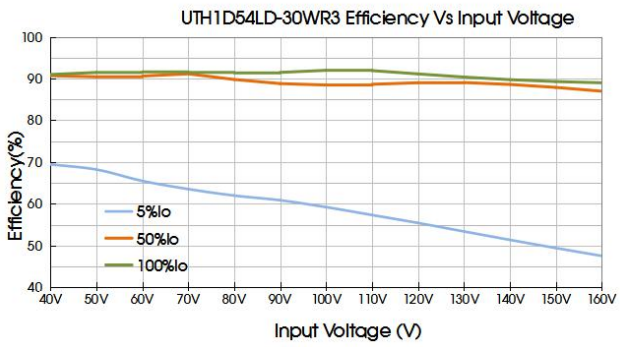


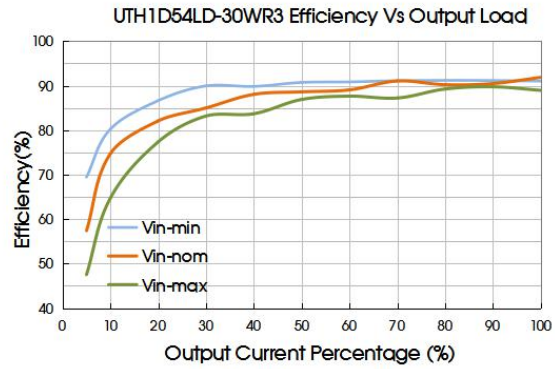


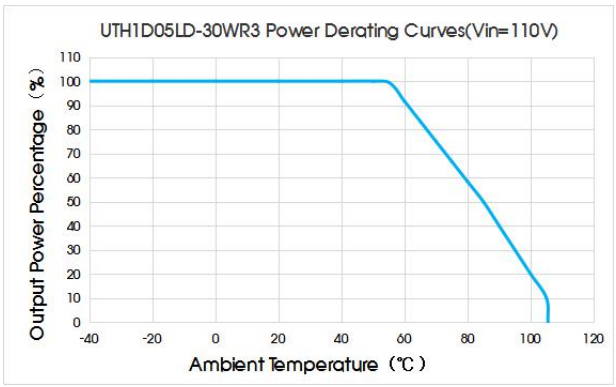












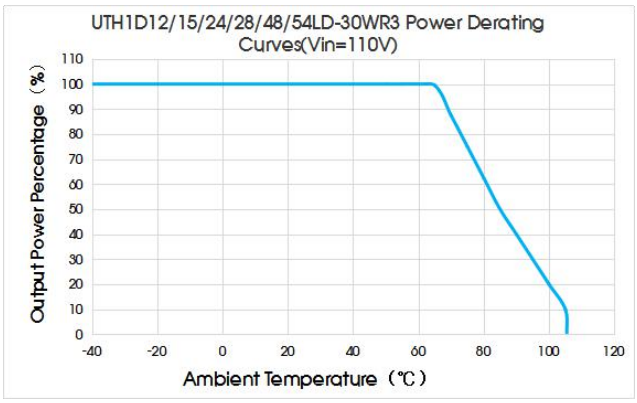


Fig.1

Design Reference

1. Ripple & noise

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

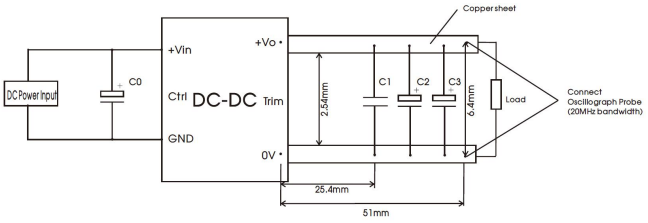


Fig.2

Output voltage \ Capacitors value	C0(μF)	C1(μF)	C2(μF)	C3(μF)
5VDC	100μF /250V	1μF/16V	10μF/16V	330uF/16V
12VDC		1μF/25V	10μF/25V	220uF/25V
15VDC				
24VDC		1μF/50V	10μF/50V	150uF/50V
28VDC				
48VDC		1μF/100V	10uF/100V	82uF/100V
54VDC				

2. Typical application

(1) 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.

(2) Output ripple can be further reduced by appropriately increasing the output capacitor values Cin, 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. capacitance load value of the product.

(3) The recommended circuit for Ctrl function please refer to Fig.3.

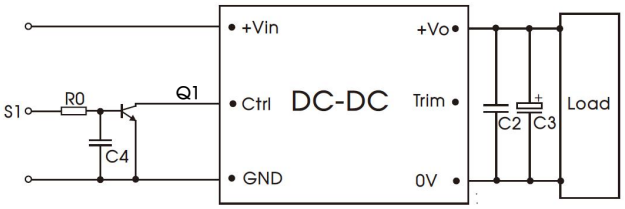


Fig.3

Components	Value	Recommended Component
R0	10K	--
C4	0.1μF	Voltage≥25V
Q1	Ic≥10mA	Voltage≥30V

3. Trim function for output voltage adjustment (open if unused)

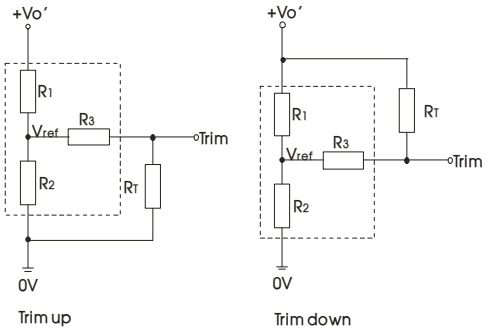


Fig.4

Calculation formula of Trim resistance:

$$\text{Trim up}: R_T = \frac{a * R_2}{R_2 - a} - R3 \qquad a = \frac{V_{ref} * R_1}{V_o - V_{ref}}$$

$$\text{Trim down}: R_T = \frac{b * R_1}{R_1 - b} - R_3 \qquad b = \frac{(V_0 - V_{ref}) * R_2}{V_{ref}}$$

Note:
Table 1 Values of R1, R2, R3, Vref;
R_T(kΩ): Resistance of Trim;
a,: self-defined parameter, accurate to two decimal places;
Vo: Output voltage change;

Table 1

Res \ Vo	5(VDC)	12(VDC)	15(VDC)	24(VDC)	28(VDC)	48(VDC)	54(VDC)
R1(KΩ)	8.7	28.6	37.6	64.6	76.7	137	155
R2(KΩ)	2.87	7.5	7.5	7.5	7.5	7.5	7.5
R3(KΩ)	11.2	30	30	30	30	30	30
Vref(V)	1.25	2.5	2.5	2.5	2.5	2.5	2.5

Practical Example trim up +10% for 12V output:

$$a=\frac{2.5*28.6}{13.2-2.5}=6.68$$

$$R_T=\frac{6.68*7.5}{7.5-6.68}-30=31.1K\Omega$$

R_T according to≈31kΩ

Practical Example trim down -10% for 12V output:

$$b=\frac{(10.8-2.5)*7.5}{2.5}=24.9$$

$$R_T=\frac{24.9*28.6}{28.6-24.9}-30=162.47K\Omega$$

R_T according to≈162kΩ

4. EMC compliance circuit

EMC recommended circuit and parameters when the shell is not connected to PE:

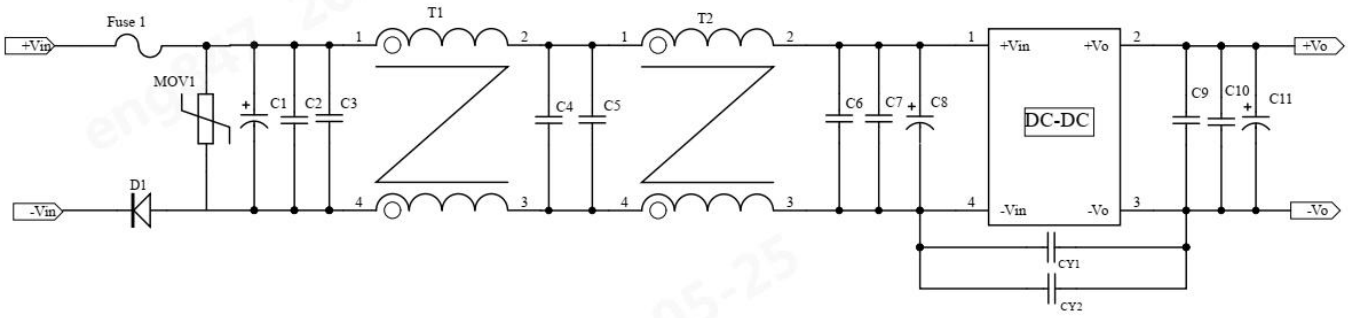


Fig.5

Component	Value		Recommended Component
	Surge standard line to line ±2kV (2Ω, 0.5μF) line to ground ±2kV	Surge standard line to line ±1kV (2Ω, 0.5μF) line to ground ±2kV(12Ω, 0.5μF)	
Fuse 1	3.15A	3.15A	Fuse, 3.15A, Slow-blow type
C1	220uF	100uF	Aluminum electrolytic capacitor, voltage≥250V
C8	100uF	100uF	Aluminum electrolytic capacitor, voltage≥250V
C11	220uF	220uF	Aluminum electrolytic capacitor, voltage≥100V
C2、C4、C6、C9	0.1uF	0.1uF	Ceramic capacitance, voltage ≥250V
C3、C5、C7、C10	1nF	1nF	Ceramic capacitance, voltage ≥250V
CY1、CY2	2200 pF /400VAC	2200 pF /400VAC	Y1 Safety capacitance
D1	3A/400V	3A/400V	Schottky diode: SF306
MOV1	10D271K	10D271K	varistor
T1	10mH	10mH	CM inductor, 10A/5mH/100mΩ
T2	6.5mH	6.5mH	CM inductor, 10A/6.5mH/20mΩ

5. Recommended capacitance for holding time

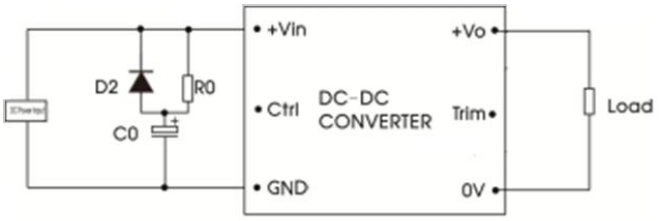


Fig.6

Recommended formula for calculating capacitance:

$$C_0 = \frac{2P_0\Delta t}{\left(V_{input} - V_{shutdown}\right)^2 \bullet \eta} \times 10^3$$

Remark
PO(W)：Output power;
η：Efficiency;

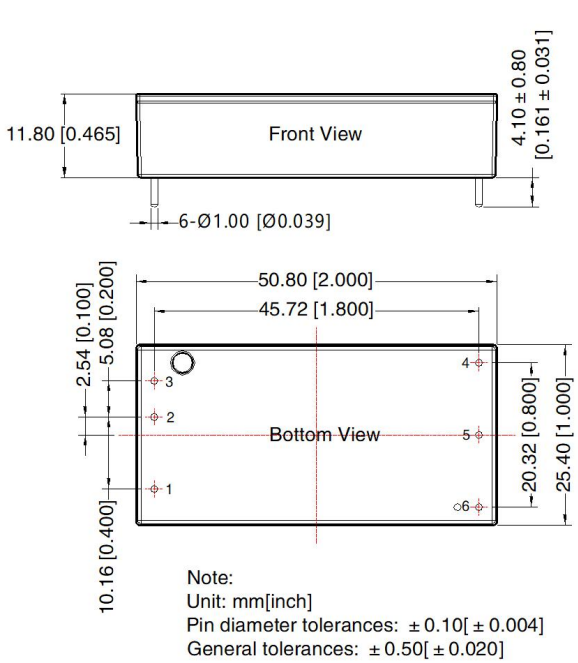
t(ms)： Power-down retention time

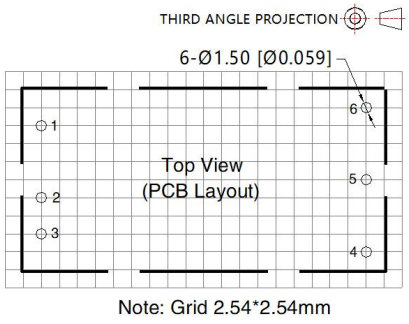
10ms, 30ms power off holding time reference table:

Vin (V)		48	72	96	110	134	156
Po (W)		30	30	30	30	30	30
Turn-off voltage (V)		40	40	40	40	40	40
D2		10A/250V					
R0		200Ω/10W					
C0 (uF)	△t: 10ms	10000	660	220	150	82	56
C0 (uF)	△t: 30ms	30000	2000	660	560	240	150
V_{C0}		200V	200V	200V	200V	200V	200V

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

UTH1D_LD-30WR3 Dimensions and Recommended Layout





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

Note:

1. For additional information on Product Packaging please refer to www.mornsun-power.com. Packaging bag number: 58200035;
2. The maximum capacitive load offered were tested at nominal input voltage 40V-60V and full load;
3. Unless otherwise specified, data in this data sheet should be tested under the conditions of Ta=25℃, humidity<75%RH with nominal input voltage and rated load;
4. All index testing methods in this data sheet are based on our company corporate standards;
5. We can provide product customization service and match filter module;
6. Products are related to laws and regulations: see "Features" and "EMC";
7. 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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