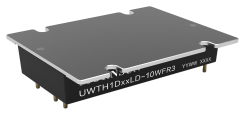
10W isolated DC-DC converter
Ultra-wide input and regulated single output



CB Report Patent Protection RoHS

CSA62368 EN62368 BS EN50155 EN45545 EN62368 IEC62368-1

FEATURES

- Ultra-wide 12:1 input voltage range: 14 -160VDC
- High efficiency up to 84%
- 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
- Industry standard package and pin-out
- Meets EN50155 and AREMA standards
- Meets IEC62368, UL62368, CSA62368, EN62368 standards
- Meets EN45545 standards

The UWTH1D_LD-10W(F/H)R3 series is a high-performance product specifically designed for a variety of railway applications. The output power can reach at 10W. It features wide input voltage of 14-160VDC, which is compatible with nominal input type of 24V, 36V, 48V, 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.

Selection Guide

Certification	Part No.	Ctrl Logic①	Input Voltage (VDC)		Output		Full Load Efficiency(%)③ Min./Typ.	Max. Capacitance Load(μF)
			Typ (Range)	Max.②	Voltage (VDC)	Current (mA) (Max./Min.)		
CSA/EN/BS EN/IEC	UWTH1D03LD-10W(F/H)R3	P	110 (14-160)	160	3.3	3030/0	78/80	1000
	UWTH1D05LD-10W(F/H)R3				5	2000/0	78/80	1000
	UWTH1D12LD-10W(F/H)R3				12	833/0	82/84	470
	UWTH1D15LD-10W(F/H)R3				15	667/0	82/84	330
	UWTH1D24LD-10W(F/H)R3				24	417/0	82/84	220
	UWTH1D28LD-10W(F/H)R3				28	357/0	82/84	220
	UWTH1D48LD-10W(F/H)R3				48	208/0	82/84	150
	UWTH1D54LD-10W(F/H)R3				54	185/0	82/84	150

Note:
①"P" means positive logic, "N" means negative logic;
②Exceeding the maximum input voltage may cause permanent damage;
③This efficiency value is the full load efficiency measured at the nominal 48V input voltage at room temperature;
④When the product with input at 14V~16.8V / 160V-200V, the working time is 0.1s and 1s respectively;
⑤When starting with a capacitive load, Trim is only applicable to the input voltage range 16.8V-160V;

Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Input Current (full load)	24V input	3.3V, 5V, 12V, 15V Output	--	550	625	mA
		24V, 28V, 48V, 54V Output	--	510	525	
	36V input	3.3V, 5V, 12V, 15V Output	--	356	390	
		24V, 28V, 48V, 54V Output	--	340	350	
	48V input	3.3V, 5V, 12V, 15V Output	--	265	280	
		24V, 28V, 48V, 54V Output	--	250	260	
	72V input	3.3V, 5V, 12V, 15V Output	--	175	195	
		24V, 28V, 48V, 54V Output	--	170	180	
	96V input	3.3V, 5V, 12V, 15V Output	--	135	150	
		24V, 28V, 48V, 54V Output	--	130	135	
	110V input	3.3V, 5V, 12V, 15V Output	--	115	135	
		24V, 28V, 48V, 54V Output	--	110	115	
Reflected Ripple Current	Nominal input voltage		--	150	190	
Surge Voltage (1sec. max.)			-0.7	--	200	VDC
Start-up Voltage			--	--	14	
Start-up Time			--	50	100	ms
No-load input power	Ctrl pin open or pulled high, DC-DC ON (14-160VDC)		--	1.2	2.2	W
Idle input power	Ctrl pin pulled low to GND, DC-DC OFF (14-160VDC)		--	0.7	1.6	
Ctrl①	Module on		Ctrl pin open or pulled high (3.5-12VDC)			
	Module off		Ctrl pin pulled low to -Vin (0-1.2VDC)			
Input Under-voltage rotection			10	12	--	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	3.3V, 5V output	--	±1	±3	%
		Other output				
Linear Regulation	Input voltage variation from low to high at full load		--	±0.5	±1	
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		3.3V, 5V output	--	±5	±10	%
		Other output	--	±3	±5	
Temperature Coefficient	Nominal input voltage, full load		--	--	±0.03	%/℃
Ripple & Noise①	20MHz bandwidth, 5%-100%load	3.3V, 5V, 12V, 15V output	--	100	150	mVp-p
		Other output	--	150	200	
Trim			90	--	110	%Vo
Over-voltage Protection	Input voltage range		110	--	--	%Vo
Over-current Protection			110	--	260	%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.1.

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	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 Temperature		-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
Cooling Test		EN60068-2-1			
Dry Heat		EN60068-2-2			
Damp Heat		EN60068-2-30			
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		Altitude：≤5000m, Atmospheric pressure: 50～110KPa			

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	Without heat sink	50.80 x 25.40 x 11.80 mm
	With H heat sink	50.80 x 25.40 x 22.80 mm
	With F heat sink	50.80 x 40 x 11.80 mm
Weight	Without heat sink	41.5g (Typ.)
	With H heat sink	55.0g (Typ.)
	With F heat sink	43.0g (Typ.)
Cooling Method	Conduction cooling or forced air cooling Free air convection cooling with addtional heat sink	

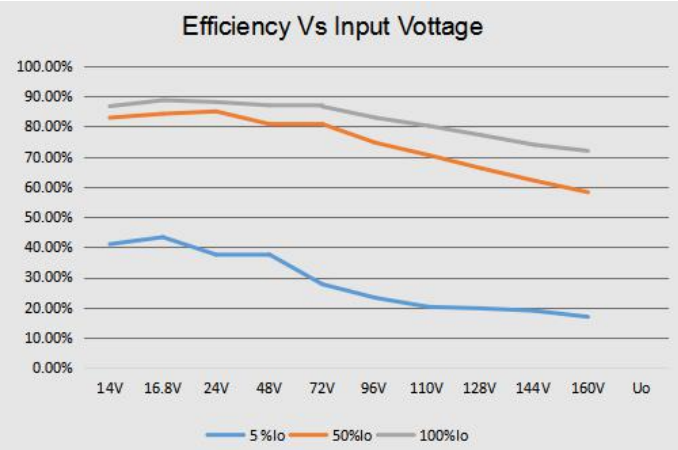
Electromagnetic Compatibility (EMC) (EN50121-3-2)

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

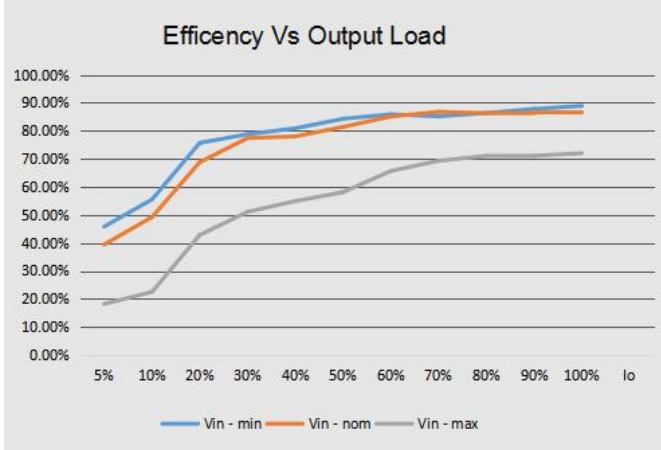
Electromagnetic Compatibility (EMC) (AREMA)

Emissions	CE	CISPR16-2-1	150kHz-500kHz 79dBuV (see Fig. 4 for recommended circuit)	
		CISPR16-1-2	500kHz-30MHz 73dBuV (see Fig. 4 for recommended circuit)	
	RE	CISPR16-2-3	30MHz-230MHz 40dBuV/m at 10m (see Fig. 4 for recommended circuit)	
			230MHz-1GHz 47dBuV/m at 10m (see Fig. 4 for recommended circuit)	
Immunity	ESD	IEC61000-4-2	Contact ±6kV/ Air ±8kV	perf. Criteria A
	RS	IEC61000-4-3	80 – 1000MHz 10V/m (see Fig. 4 for recommended circuit)	perf. Criteria A
			160 – 165MHz 20V/m (see Fig. 4 for recommended circuit)	
			450 – 470MHz 20V/m (see Fig. 4 for recommended circuit)	
			800 – 960MHz 20V/m (see Fig. 4 for recommended circuit)	
			1400 – 2000MHz 20V/m (see Fig. 4 for recommended circuit)	
			2100 – 2500MHz 5V/m (see Fig. 4 for recommended circuit)	
	EFT	IEC61000-4-4	±2kV 5/50ns 5kHz (see Fig. 4 for recommended circuit)	perf. Criteria A
	Surge	IEC61000-4-5	line to line ±2kV (2Ω , 18μF) (see Fig. 4 for recommended circuit)	perf. Criteria A
	CS	IEC61000-4-6	0.15MHz-80MHz 10V r.m.s (see Fig. 4 for recommended circuit)	perf. Criteria A

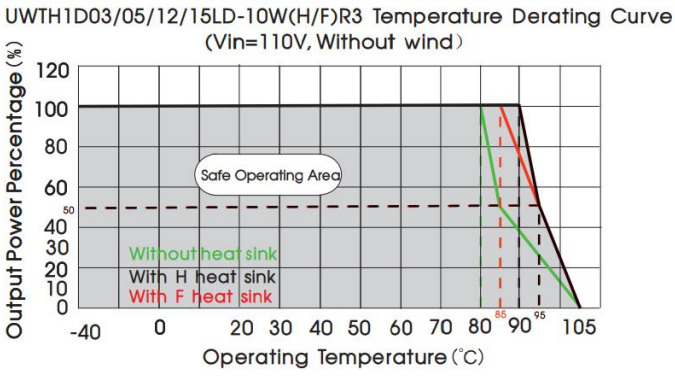
Typical Performance Curves

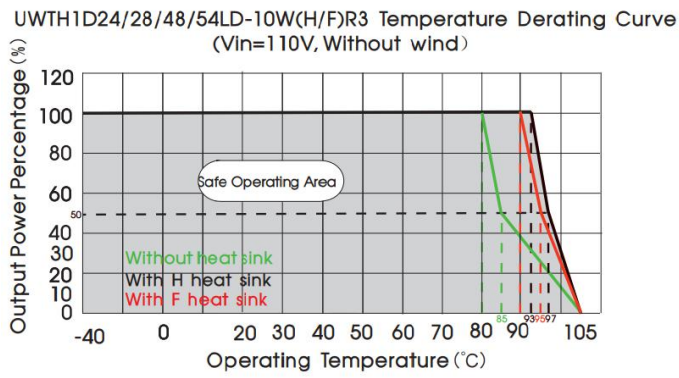


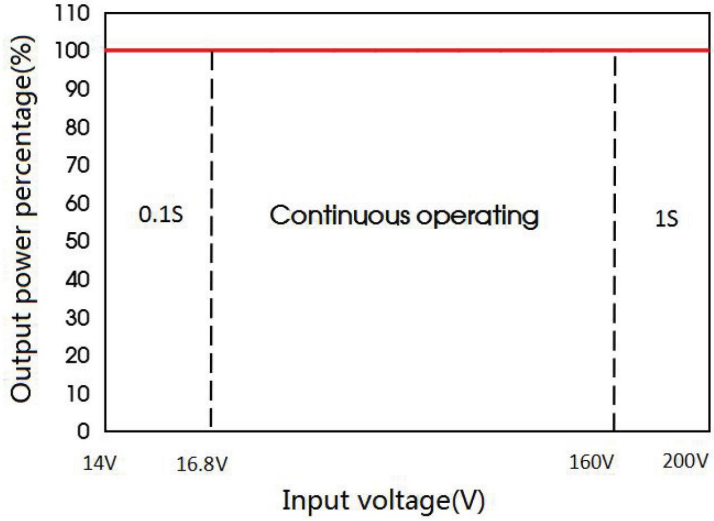
UWTH1D54LD-10WR3 Efficiency curve of input voltage (normal temperature)



UWTH1D54LD-10WR3 Efficiency curve of output load (normal temperature)







Design Reference

1. Ripple & noise

All the DC-DC converters of this series are tested before delivery using the recommended circuit shown in Fig. 1.

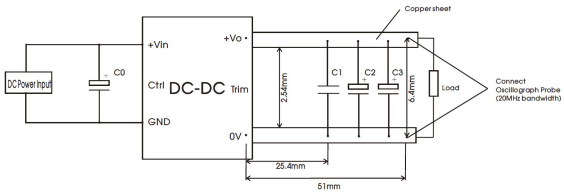


Fig.1

Output Voltage \ Capacitors Value	C0(μF)	C1(μF)	C2(μF)	C3(μF)
3.3V/5VDC	100μF /250V	1μF/10V	10μF/50V	680μF/16V
12VDC		1μF/16V		330μF/25V
15VDC		1μF/25V		
24VDC		1μF/50V		100μF/50V
28VDC				
48VDC		1μF/100V	10μF/63V	82μF/63V
54VDC		1μF/100V		

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.2.

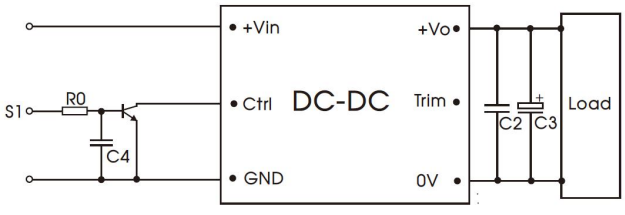


Fig.2

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)

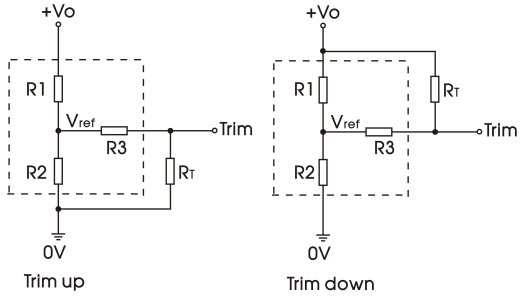


Fig.3

Trim resistor connection (dashed line shows internal resistor network)

Calculation formula of Trim resistance:

$$\text{Trim up}: R_T = \frac{a * R_2}{R_2 - a} - R_3 \qquad a = \frac{V_{ref} * R_1}{V_o - V_{ref}}$$

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

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;

Table1

Vo / Res	3.3(VDC)	5(VDC)	12(VDC)	15(VDC)	24(VDC)	28(VDC)	48(VDC)	54(VDC)
R1(KΩ)	3.974	9.09	11.57	15.12	16.08	24	46.79	59.73
R2(KΩ)	2.4	3	3	3	5	5	3.75	3.75
R3(KΩ)	4	4	12.4	12.4	18.2	20	20	11.2
Vref(V)	1.24	1.24	2.5	2.5	2.5	2.5	2.5	2.5

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

$$a = \frac{2.5 * 11.57}{13.2 - 2.5} = 2.7$$

$$R_T = \frac{2.7 * 3}{3 - 2.7} - 4 = 27K\Omega$$

R_T according to E24≈27kΩ

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

$$b = \frac{(10.8 - 2.5) * 3}{2.5} = 9.96$$

$$R_T = \frac{9.96 * 11.57}{11.57 - 9.96} - 12.4 = 59.18K\Omega$$

R_T according to E24≈62kΩ

4. EMC compliance circuit

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

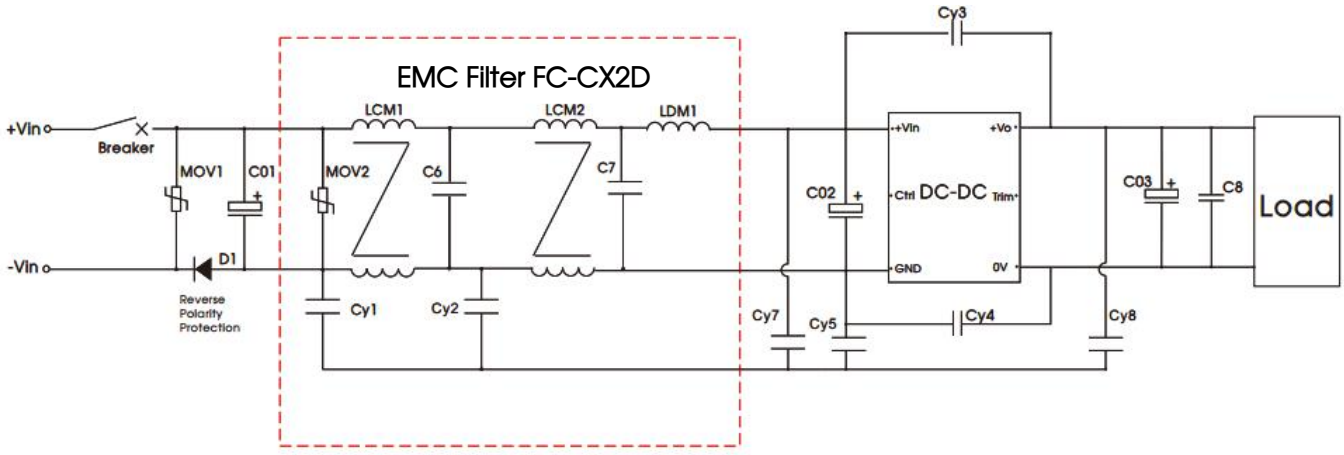


Fig.4

Components Value / Matching Power Output Voltage	CY3	CY4	CY5	CY7, CY8	MOV1	D1
3.3V	2200 pF /400VAC	4700 pF /400VAC	2200 pF /400VAC	1000 pF /400VAC	10D221K	16A Withstand voltage ≥600V
5V						
12V						
15V						
24V						
28V						
48V						
54V						
Breaker	The Breaker value varies with different power modules and must be selected in accordance with the specified input current of the corresponding power converter, but not exceeding the filter specifications.					
Note: A ferrite core on the power lines and load lines can ensures a better EMI test margin.						

EMC Filter		
Component	Value	Recommended Component
C6, C7	0.1μF	Voltage≥250V
LCM1, LCM2	1.2mH	FT-ABX1D CM inductor
LDM1	4.7μH	PH-3152LF DM inductor
CY1, CY2	1000 pF /400VAC	Y1 safety capacitor
MOV1	TVR10221KSERW	Varistor
MOV2	7D221K	Varistor
Note: EMC filter recommended MORNSUN P/N: FC-CX2D.		

Surge Standard	Components	Value	Recommended Component
line to line ±1kV (42Ω, 0.5μF) line to line ±1kV (2Ω, 18μF)	C01	220μF	Voltage≥200V
	C02	220μF	Voltage≥200V
line to line ±2kV (2Ω, 18μF)	C01	330μF	Voltage≥200V
	C02	220μF	Voltage≥200V
Note : Reducing C01\C02 will affect the EMI margin, please select the reference value according to the actual situation.			

5. Recommended capacitance for holding time

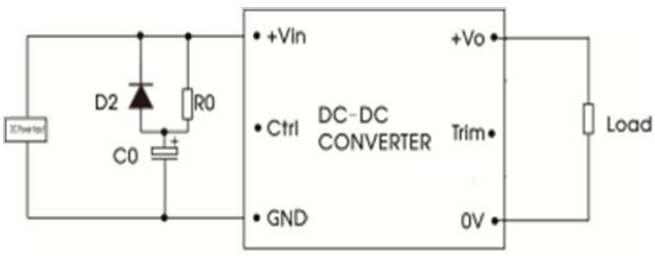


Fig.5

Recommended formula for calculating capacitance:

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

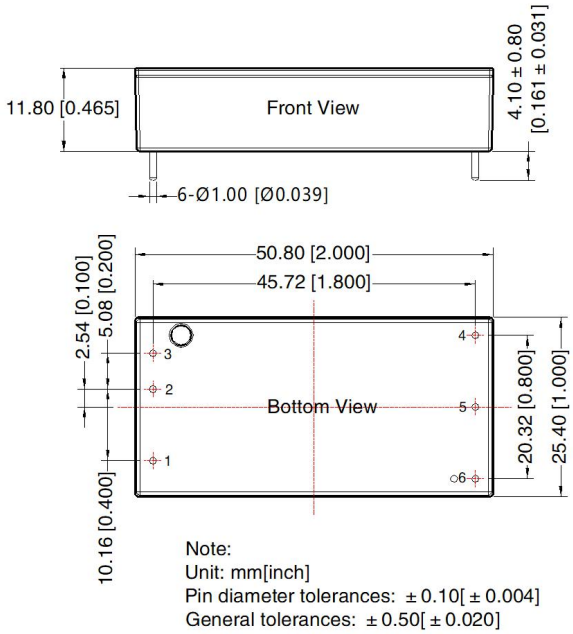
Remark:
PO(W): Output power;
η : Efficiency;
△t(ms): Power-down retention time

10ms power off holding time reference table:

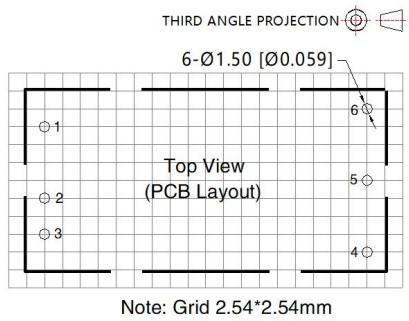
Vin (V)		24	36	48	72	96	110
Po (W)		10	10	10	10	10	10
Turn-off voltage (V)		14	14	14	14	14	14
D2		10A/250V					
R0		200Ω/10W					
C0 (μF)	△t: 10ms	1100	400	220	100	47	35
V_{C0}		35V	50V	63V	100V	150V	150V

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

UWTH1D_LD-10WR3 Dimensions and Recommended Layout



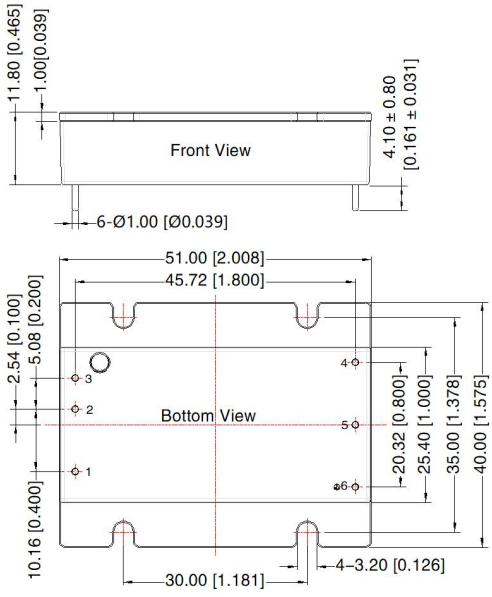
Note:
Unit: mm[inch]
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]



Note: Grid 2.54*2.54mm

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

UWTH1D_LD-10WFR3 Dimensions and Recommended Layout



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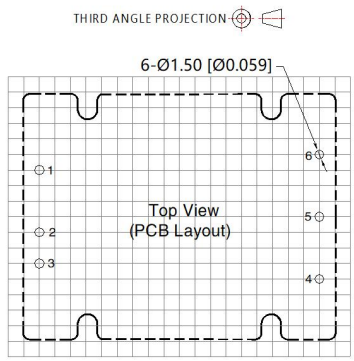
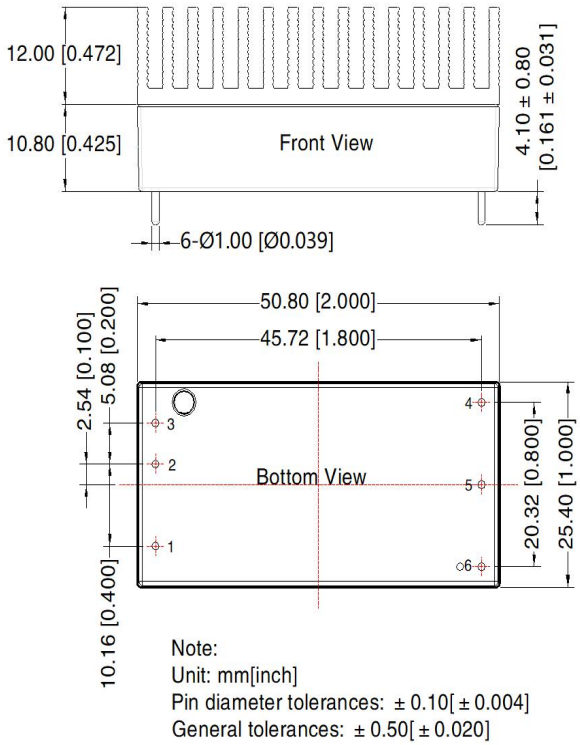
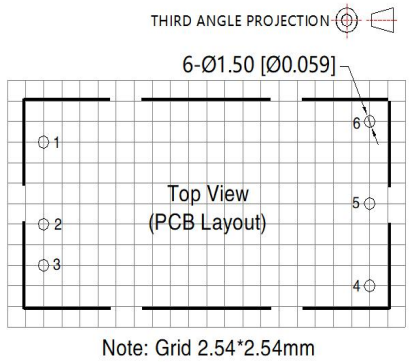


Note: Grid 2.54*2.54mm

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

UWTH1D_LD-10WHR3 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: UWTH1D_LD-10WR3：58200035、UWTH1D_LD-10WHR3: 58220005、UWTH1D_LD-10WFR3: 58010113;
2. The maximum capacitive load offered were tested at nominal input voltage16.8V-160V and full load;
3. It is recommended that the maximum working temperature of the product surface be < 125℃ , otherwise it may cause permanent and irreversible damage;
4. Unless otherwise specified, data in this datasheet should be tested under the conditions of Ta=25℃, humidity<75%RH with nominal input voltage and rated load;
5. All index testing methods in this datasheet are based on our company corporate standards;
6. We can provide product customization service and match filter module;
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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