DC/DC Converter
SURF2424QB-150W(F/H)R3

150W isolated DC-DC converter
Ultra-wide input and regulated single output

Patent Protection RoHS

FEATURES

- Ultra-wide 4:1 input voltage range
- High efficiency up to 89%
- I/O isolation test voltage: 2250VDC
- Operating ambient temperature range -40℃ to +85℃
- Input under-voltage protection, output over–voltage, over-current, short-circuit protection, over-temperature protection
- Five-sided metal shielded package
- Industry standard ¼-Brick package and pin-out

SURF2424QB-150W(F/H)R3 of isolated 150W DC-DC product with ultra-wide 4:1 input voltage. It features efficiency up to 89%, 2250VDC input to output isolation, operating ambient temperature of -45℃ to +85℃, input under-voltage, output over–voltage, over-current, short-circuit protection, over-temperature protection. The products meet CLASS A of CISPR32/EN55032 EMI standards by adding the recommended external components, and they are widely used in applications such as battery powered systems, industrial controls, electricity, instrumentation, railway, communication and intelligent robotic.

Selection Guide

Part No.	Input Voltage (VDC)		Output		Full Load Efficiency (%) Min./Typ.	Capacitive Load (μF) Max.
	Nominal (Range)	Max.①	Voltage (VDC)	Current (A) Max.		
SURF2424QB-150W(F/H)R3	24 (9-36)	40	24	6.25	87/89	1000

Note: ①Exceeding the maximum input voltage may cause permanent damage.

Input Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Input Current (full load/no-load)	Nominal input voltage	--	7023/100	7184/200	mA
Reflected Ripple Current	Nominal input voltage	--	100	--	
Surge Voltage (1sec. max.)		-0.7	--	50	VDC
Start-up Voltage		--	--	9	
Input Under-voltage Protection		5.5	6.5	--	
Input Filter		Pi filter			
Ctrl①	Module on	Ctrl open circuit or connected to TTL high level (3.5-12VDC)			
	Module off	Ctrl pin connected to -Vin or low level (0-1.2VDC)			
	Input current when off	--	2	10	mA
Hot Plug		Unavailable			

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

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Output Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Voltage Accuracy		--	±1	±3	%
Linear Regulation	Input voltage variation from low to high at full load	--	±0.2	±0.5	
Load Regulation	5%-100% load	--	±0.5	±1	
Transient Recovery Time	25% load step change @25℃	--	300	500	μs
Transient Response Deviation		--	--	±5	%
Temperature Coefficient	Full load	--	--	±0.03	%/℃
Ripple & Noise①	20MHz bandwidth	--	150	300	mVp-p
Trim		90	--	110	%Vo
Sense		--	--	105	
Over-voltage Protection	Input voltage range	110	130	160	%Vo
Over-current Protection		110	130	150	%Io
Short-circuit Protection		Continuous, self-recovery			

Note: ① The "parallel cable" method is used for ripple and noise test, please see DC-DC Converter Application Notes for specific operation.

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	2250	--	--	VDC
	Input-case		1500	--	--	
	Output-case		500	--	--	
Insulation Resistance	Input-output resistance at 500VDC		100	--	--	MΩ
Isolation Capacitance	Input-output capacitance at 100KHz/0.1V		--	2200	--	pF
Switching Frequency	PWM mode		--	250	--	KHz
MTBF	MIL-HDBK-217F@25℃		500	--	--	K hours

Environmental Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Operating Temperature Range		-40	--	+85	℃
Over-temperature Protection	Maximum Temperature of shell surface	95	105	115	
Storage Temperature		-55	--	+125	
Pin Soldering Resistance Temperature	Wave-soldering, 10 seconds	--	--	260	
	Soldering spot is 1.5mm away from case for 10 seconds	--	--	300	
Storage Humidity	Non-condensing	5	--	95	%RH
Shock and Vibration Test		IEC/EN61373 - Category 1, Grade B			

Mechanical Specifications

Case Material		Aluminum alloy case; Black plastic bottom, flame-retardant and heat-resistant (UL94 V-0)
Dimension	SURF2424QB-150WR3	61.8 x 40.2 x 12.7 mm
	SURF2424QB-150WFR3	62.0 x 56.0 x 14.6 mm
	SURF2424QB-150WHR3	61.8 x 40.2 x 27.7 mm
Weight	SURF2424QB-150WR3	89g(Typ.)
	SURF2424QB-150WFR3	109g(Typ.)
	SURF2424QB-150WHR3	120g(Typ.)
Cooling Method		Free air convection (20LFM) or forced air convection

Electromagnetic Compatibility (EMC)

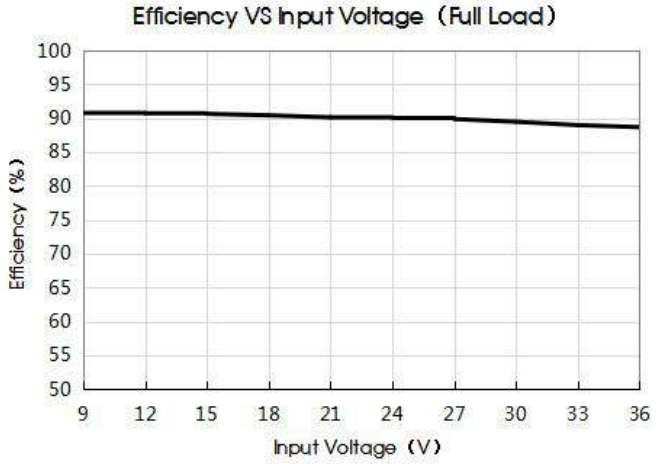
Emissions	CE	CISPR32/EN55032	CLASS A (see Fig. 2 for recommended circuit)	
	RE	CISPR32/EN55032	CLASS A (see Fig. 2 for recommended circuit)	
Immunity	ESD	IEC/EN61000-4-2	Contact ±6KV Air ±8KV	perf.Criteria B
	RS	IEC/EN61000-4-3	20V/m	perf.Criteria A

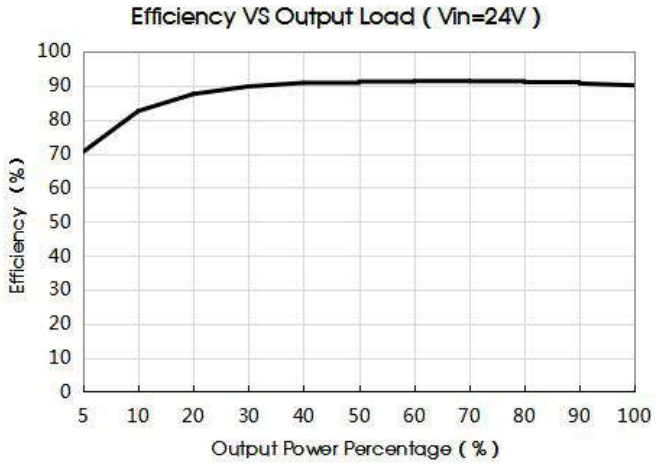
	CS	IEC/EN61000-4-6	10 Vr.m.s	perf.Criteria A
	EFT	IEC/EN61000-4-4	±2kV 5/50ns 5kHz (see Fig. 2 for recommended circuit)	perf.Criteria A
	Surge	IEC/EN61000-4-5	differential mode ±1KV, 1.2/50us, source impedance 2Ω (see Fig. 2 for recommended circuit)	perf.Criteria B

Electromagnetic Compatibility (EMC) (EN50155)

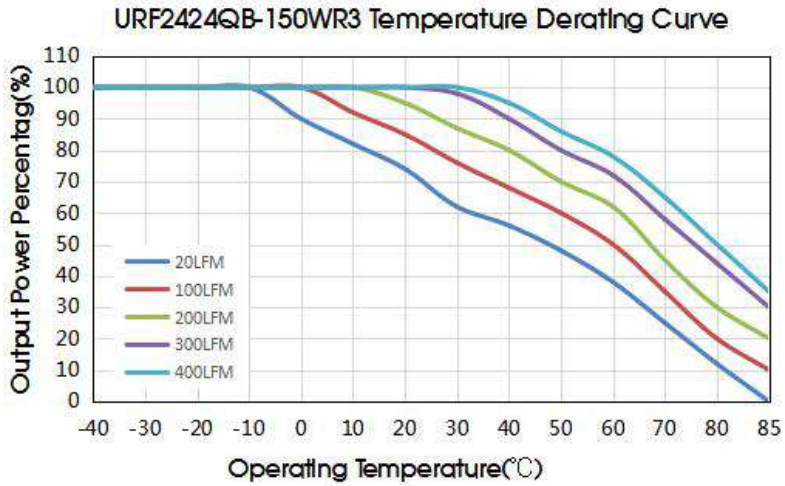
Emissions	CE	EN50121-3-2 150kHz-500kHz 99dBuV (see Fig. 2 for recommended circuit) EN55016-2-1 500kHz-30MHz 93dBuV	
	RE	EN50121-3-2 30MHz-230MHz 40dBuV/m at 10m (see Fig. 2 for recommended circuit) EN55016-2-1 230MHz-1GHz 47dBuV/m at 10m	
Immunity	ESD	EN50121-3-2 Contact ±6KV Air ±8KV	perf.Criteria B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

Efficiency Curves





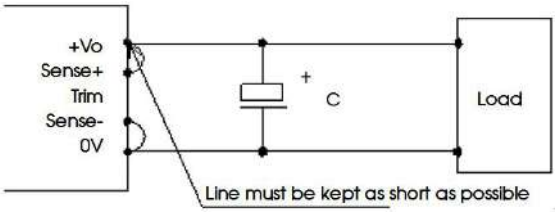
Typical Performance Curves



Notes:
(1) Product application thermal design should be referred to the recommended PCB layout and recommended heat dissipation structure, please see DC-DC Converter Application Notes for specific operation.

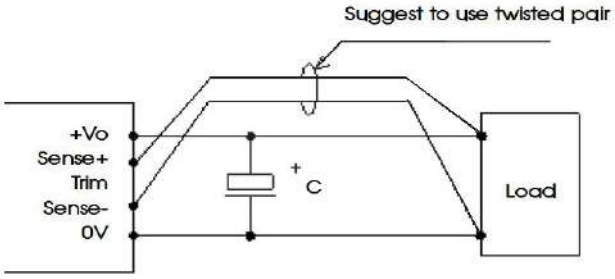
Remote Sense Application

1. Remote Sense Connection if not used



Notes:
(1) If the sense function is not used for remote regulation the user must connect the +Sense to +Vo and -Sense to 0V at the DC-DC converter pins and will compensate for voltage drop across pins only.
(2) The connections between Sense lines and their respective power lines must be kept as short as possible, otherwise they may be picking up noise, interference and/or causing unstable operation of the power module.

2. Remote Sense Connection used for Compensation



Notes:
(1) Using remote sense with long wires may cause unstable output, please contact technical support if long wires must be used.
(2) PCB-tracks or cables/wires for Remote Sense must be kept as short as possible. Twisted pair or shielded wairs are suggested for remote compensation and must be kept as short as possible.
(3) We recommend using adequate cross section for PCB-track layout and/or cables to connect the power supply module to the load in order to keep the voltage drop below 0.3V and to make sure the power supply's output voltage remains within the specified range.
(4) Note that large wire impedance may cause oscillation of the output voltage and/or increased ripple. Consult technical support or factory for further advice of sense operation.

Design Reference

1. Typical application

(1) We recommend using the recommended circuit shown in Fig.1 during product testing and application, otherwise please ensure that at least a 220μF electrolytic capacitors is connected at the input in order to ensure adequate voltage surge suppression and protection.
(2) We recommend increasing the value of Cin and pay attention to the unstable input voltage if the product input side is paralleled with motor drive circuit and/or larger energy transient circuits, to ensure the stability of input terminal and avoid repeatedly start-up problems due to input voltage lower than under-voltage protection point.
(3) We recommend increasing the output capacitance with limited to the capacitive load specification and/or increasing the voltage clamping circuit(such as TVS) if the output terminal is inductive device such as relay or a motor, to ensure adequate voltage surge suppression and protection.
(4) 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 specified max. capacitive load value of the product.

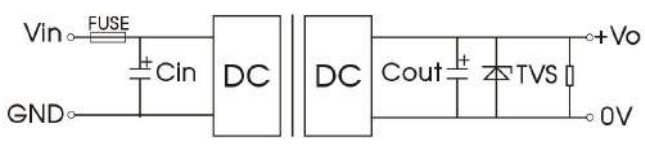


Fig.1

Vout(VDC)	Fuse	Cin①	Cout	TVS
20	20A, slow blow	220μF	100μF	SMDJ28A

Note: ①Please pay attention to the ambient temperature of the product when using an external capacitor, increase the electrolytic capacitor values to at least 1.5 times the original parameter if the ambient temperature is low.

2. EMC solution-recommended circuit

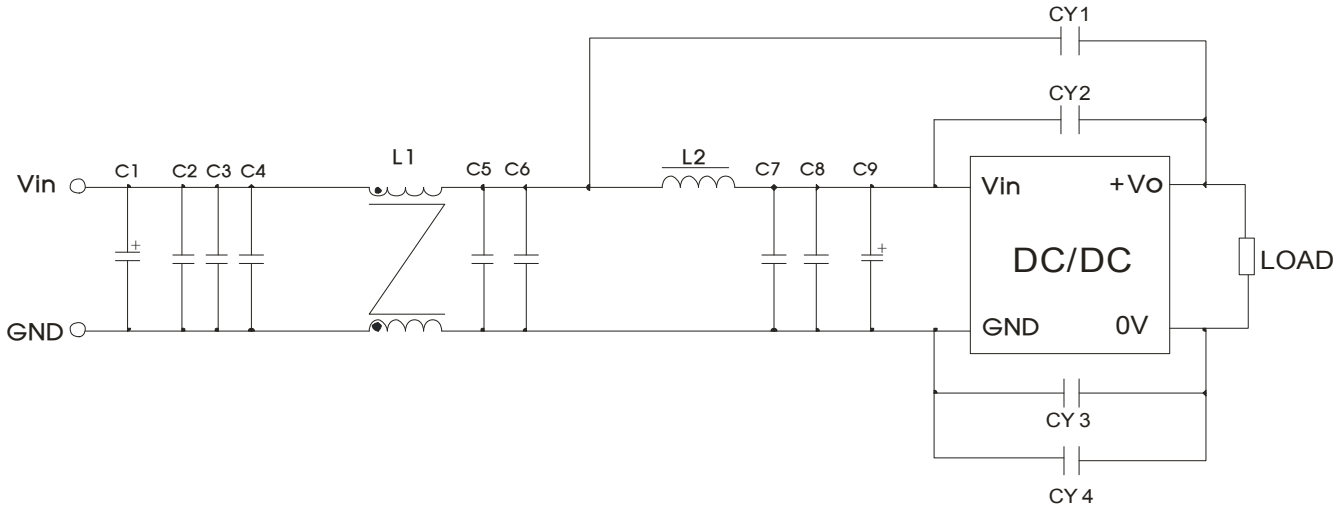
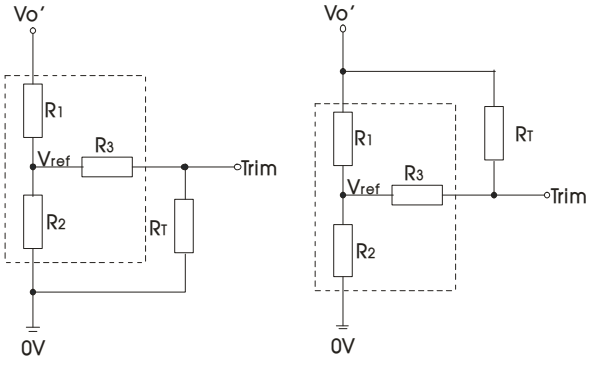


Fig. 2

Components	Recommended Component value
C1	150μF/100V electrolytic capacitor
C9	47μF/100V electrolytic capacitor
C2, C3, C4, C5, C6, C7, C8	2.2μF/100V ceramic capacitor
L1	1.0mH/20A common mode inductance
L2	1.5μH/20A inductance
CY1, CY2, CY3, CY4	1nF Y1 safety capacitor

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



TRIM resistor connection (dashed line shows internal resistor network)

Calculation formula of Trim resistance:

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

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

Note:
Value for R1, R2, R3, and V_{ref} refer to the above table 1.
R_T: Resistance of Trim.
a: User-defined parameter, no actual meanings.
Vo': The trim up/down voltage.

Vout(VDC)	R1(KΩ)	R2(KΩ)	R3(KΩ)	Vref(V)
24	24.872	2.87	15	2.5

e.g. Trim up 10%:

$$a = \frac{2.5}{26.4 - 2.5} \times 24.872 = 2.6$$

$$R_T = \frac{2.6 \times 2.87}{2.87 - 2.6} - 15 = 12.637K\Omega$$

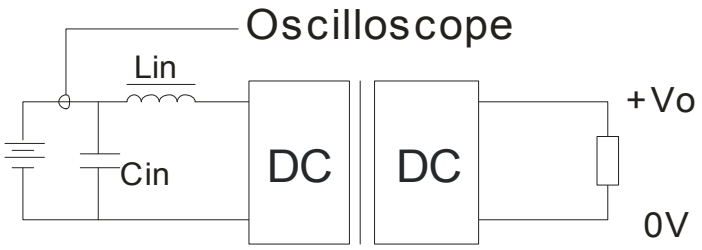
Trim down 10%:

$$a = \frac{21.6 - 2.5}{2.5} \times 2.87 = 21.9268$$

$$R_T = \frac{21.9268 \times 24.872}{24.872 - 21.9268} - 15 = 170.17K\Omega$$

When using the Trim down function make sure that the RT resistor value is calculated correctly. If the Trim pin is shorted with +Vo, or its value is too low, then the output voltage Vo would be lower than 0.9Vo, which may cause the product to fail.

4. Reflected ripple current--test circuit

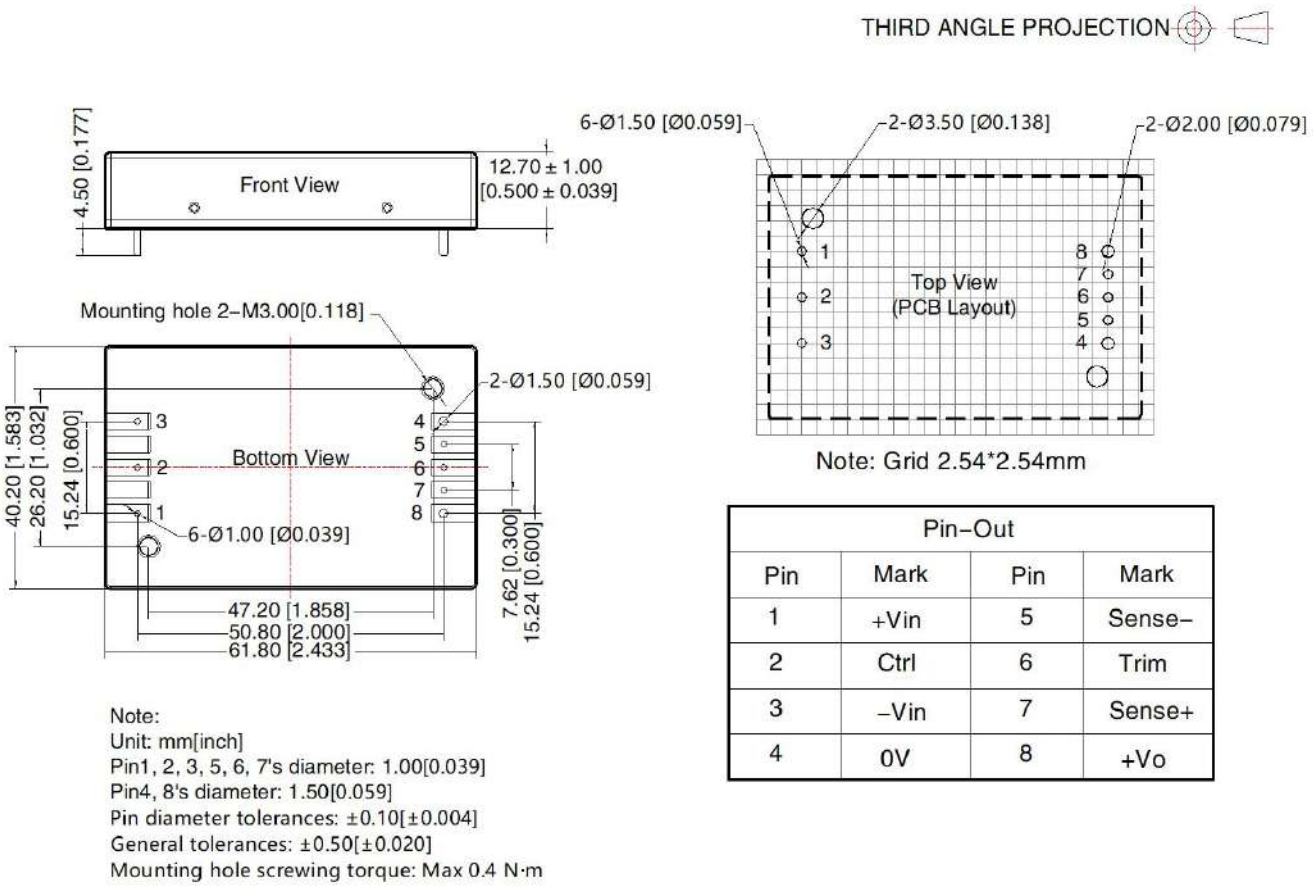


Note: Lin(4.7μH), Cin(220μF, ESR<1.0Ω at 100 KHz)

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

6. The product test process shall ensure that the current of the input terminal meets the requirements of the starting current to ensure that the power supply of the product does not suffer from under-power.

SURF2424QB-150WR3 Dimensions and Recommended Layout



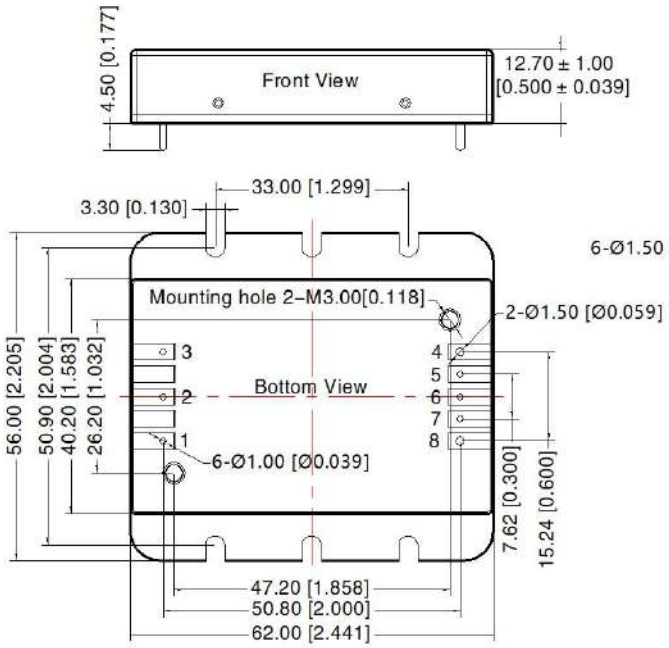
Note: Grid 2.54*2.54mm

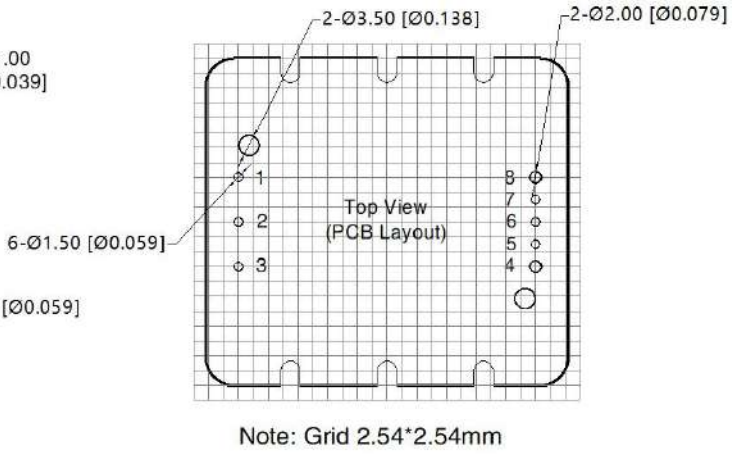
Pin-Out			
Pin	Mark	Pin	Mark
1	+Vin	5	Sense-
2	Ctrl	6	Trim
3	-Vin	7	Sense+
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1, 2, 3, 5, 6, 7's diameter: 1.00[0.039]
Pin4, 8's diameter: 1.50[0.059]
Pin diameter tolerances: ±0.10[±0.004]
General tolerances: ±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N·m

SURF2424QB-150WFR3 Dimensions and Recommended Layout

THIRD ANGLE PROJECTION



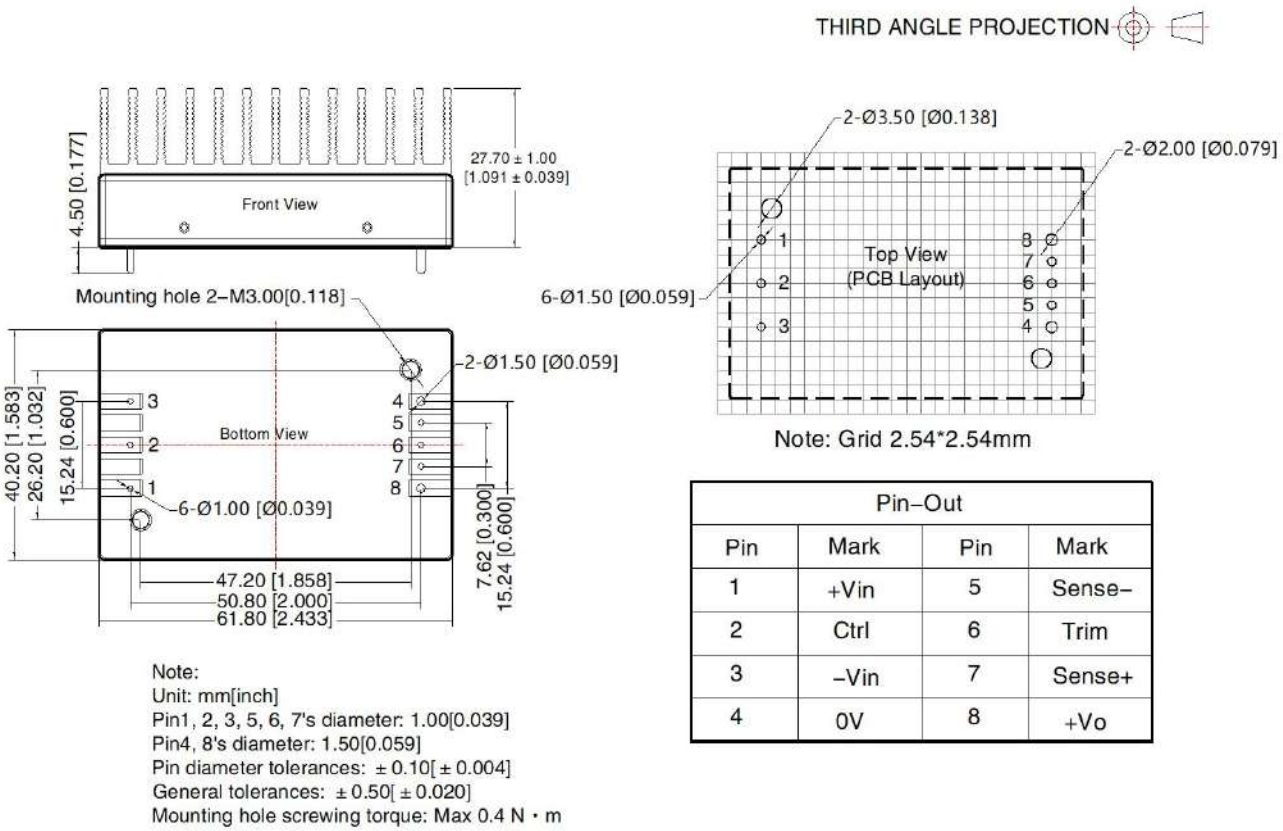


Note: Grid 2.54*2.54mm

Pin–Out			
Pin	Mark	Pin	Mark
1	+Vin	5	Sense–
2	Ctrl	6	Trim
3	–Vin	7	Sense+
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1, 2, 3, 5, 6, 7's diameter: 1.00[0.039]
Pin4, 8's diameter: 1.50[0.059]
Pin diameter tolerances: ±0.10[±0.004]
General tolerances: ±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N·m

SURF2424QB-150WHR3 Dimensions and Recommended Layout



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Pin–Out			
Pin	Mark	Pin	Mark
1	+Vin	5	Sense–
2	Ctrl	6	Trim
3	–Vin	7	Sense+
4	0V	8	+Vo

Notes:

1. The maximum capacitive load offered were tested at input voltage range and full load;
2. 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;
3. All index testing methods in this datasheet are based on company corporate standards;
4. We can provide product customization service, please contact our technicians directly for specific information;
5. Products are related to laws and regulations: see "Features" and "EMC";
6. Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units.