DC/DC Converter

SURF1D_QB-50WR3 Series

50W isolated DC-DC converter
Ultra-wide input and regulated single output

Patent Protection RoHS

FEATURES

- Ultra-wide input voltage range: 43-160VDC
- High efficiency up to 89%
- Low no-load power consumption
- Reinforced insulation, input - output isolation test voltage: 3k VAC, input - case isolation test voltage: 2.1k VAC
- Operating ambient temperature range: -40℃ to +105℃
- Input under-voltage protection, output short-circuit, over-current, over-voltage, over-temperature protection
- Industry standard 1/4 brick
- Meets EN50155 railway standard

SURF1D_QB-50WR3 series is a high-performance product specifically designed for a variety of railway applications. The DC-DC converters feature 50W output power with no requirement for minimum load, wide input voltage from 43-160VDC, and allowing operating out-case temperature as high as 105℃. The products also provide input under-voltage protection, output over-voltage, short-circuit and over-temperature protection. Additional functions include remote On/Off control, remote sense compensation and output voltage trim adjustment. Meets railway of EN50155 standard and they are widely used in railway systems and associated equipment.

Selection Guide

Part No.①	Input Voltage (VDC)		Output		Full Load Efficiency (%) Min./Typ.	Max. Capacitive Load(μF)
	Nominal (Range)	Max.②	Voltage (VDC)	Current (mA) Max./Min.		
SURF1D03QB-50W(H)R3	110 (43-160)	170	3.3	11364/0	84/86	20000
SURF1D05QB-50W(H)R3			5	10000/0	85/87	10000
SURF1D12QB-50W(H)R3			12	4167/0	86/88	3000
SURF1D15QB-50W(H)R3			15	3333/0	86/88	2350
SURF1D24QB-50W(H)R3			24	2083/0	87/89	1500
SURF1D48QB-50W(H)R3			48	1041/0	85/87	240

Note: ① Use "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;
② Exceeding 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	3.3VDC output	--	397/10	406/20	mA
		24VDC output	--	511/10	523/20	
		12VDC, 15VDC output	--	517/10	529/20	
		05VDC, 48VDC output	--	523/10	535/20	
Reflected Ripple Current	Nominal input voltage		--	50	--	
Surge Voltage (1sec. max.)			-0.7	--	180	VDC
Start-up Voltage			--	--	43	
Under-voltage Protection			--	40	--	
Input Filter			Pi filter			
Hot Plug			Unavailable			
Ctrl*	Module on		Ctrl pin open or pulled high (3.5-12VDC)			
	Module off		Ctrl pin -Vin or pulled low (0-1.2VDC)			
	Input current when off		--	2	10	mA

Note: *The Ctrl pin voltage is referenced to input -Vin.

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Output Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Voltage Accuracy	Nominal input voltage, 0%-100% load		--	±1	±3	%
Linear Regulation	Input voltage variation from low to high at full load	3.3VDC, 5VDC output	--	--	±0.5	
		Others	--	±0.1	±0.3	
Load Regulation	Nominal input voltage, 10%-100% load	3.3VDC, 5VDC output	--	±0.5	±1.0	
		Others	--	±0.3	±0.5	
Transient Recovery Time	25% load step change		--	200	500	μs
Transient Response Deviation		3.3VDC, 5VDC output	--	±6	±9	%
		Others	--	±3	±5	
Temperature Coefficient	Full load		--	--	±0.03	%/℃
Ripple & Noise *	20MHz bandwidth, 10%Io-100%Io load	48VDC output	--	200	300	mVp-p
		Others	--	100	200	
Trim			90	--	110	%
Output Voltage Remote Compensation(sense)			--	--	105	
Over-voltage Protection	Input voltage range	3.3VDC, 5VDC output	110	--	160	%Vo
		Others	110	--	140	
Over-current Protection	Input voltage range		110	140	190	%Io
Short-circuit Protection			Hiccup, continuous, self-recovery			

Note: *Ripple & Noise for 48VDC output at 0%Io-100%Io load ⩽ 400mV, others outputs at 0%Io-100%Io load ⩽ 300mV, the measuring method of ripple and noise, please refer to Fig. 1 .

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-case		2100	--	--	
	Output-case	Electric Strength test for 1 minute with a leakage current of 1mA max.	1500	--	--	VDC
Insulation Resistance	Input-output resistance at 500VDC		1000	--	--	MΩ
Isolation Capacitance	Input-output capacitance at 100KHz/0.1V		--	2200	--	pF
Switching Frequency	PFM mode		--	170	--	KHz
MTBF	MIL-HDBK-217F@25℃		500	--	--	K hours

Environmental Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Operating Temperature Range	See temperature derating curves	-40	--	+105	℃
Over-temperature Protection	Out-case temperature	--	--	+115	
Storage Humidity	Non-condensing	5	--	95	%RH
Storage Temperature		-55	--	+125	℃
Pin Soldering Resistance Temperature	Soldering spot is 1.5mm away from case for 10 seconds	--	--	+300	
Cooling Test		EN60068-2-1			
Dry Heat		EN60068-2-2			
Damp Heat		EN60068-2-30			
Shock and Vibration Test		IEC/EN61373 - Category 1, Grade B			

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Mechanical Specifications

Case Material	Aluminum alloy case; Black plastic bottom, flame-retardant and heat-resistant (UL94 V-0)	
Dimensions	Without heatsink	60.80 x 39.20 x 12.70mm
	With heatsink	60.80 x 39.20 x 27.80mm
Weight	Without heatsink	78.0g(Typ.)
	With heatsink	109.0g(Typ.)
Cooling Method	Free air convection or forced convection	

Electromagnetic Compatibility (EMC)

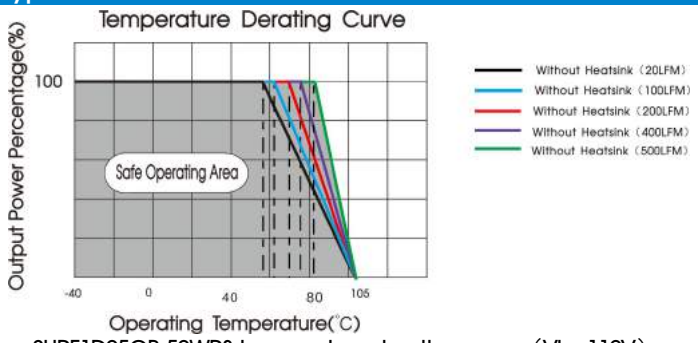
Emissions	CE	CISPR32/EN55032	150KHz-30MHz	Class B (see Fig. 3 for recommended circuit)	
	RE*	CISPR32/EN55032	30MHz-1GHz	Class B (see Fig. 3 for recommended circuit)	
Immunity	ESD	IEC/EN61000-4-2	GB/T17626.2	Contact ±6KV, Air ±8KV	perf.Criteria A
	RS	IEC/EN61000-4-3	GB/T17626.3	20V/m	perf.Criteria A
	CS	IEC/EN61000-4-6	GB/T17626.6	10Vr.m.s	perf.Criteria A
	EFT	IEC/EN61000-4-4	GB/T17626.4	±2KV (5KHz, 100KHz) (see Fig. 3 for recommended circuit)	perf.Criteria A
	Surge	IEC/EN61000-4-5	GB/T17626.5	line to line ±2KV (1.2μs/50μs 2Ω) (see Fig. 3 for recommended circuit)	perf.Criteria A

Note: *The standard only suit for SURF1D_QB-50WR3 series (without heatsink).

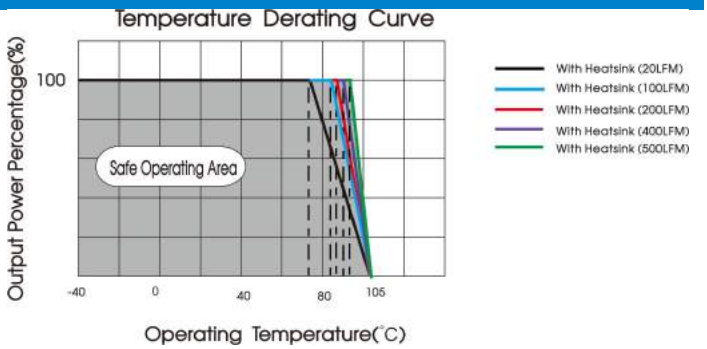
Electromagnetic Compatibility (EMC) (EN50155)

Emissions	CE	EN50121-3-2	150kHz-500kHz	99dBuV (see Fig. 2 for recommended circuit)
		EN55016-2-1	500kHz-30MHz	93dBuV (see Fig. 2 for recommended circuit)
	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 (see Fig. 2 for recommended circuit)
Immunity	ESD	EN50121-3-2	Contact ±6KV/Air ±8KV	perf. Criteria A
	RS	EN50121-3-2	20V/m	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. 2 for recommended circuit)	perf. Criteria A
	CS	EN50121-3-2	0.15MHz-80MHz 10V r.m.s	perf. Criteria A

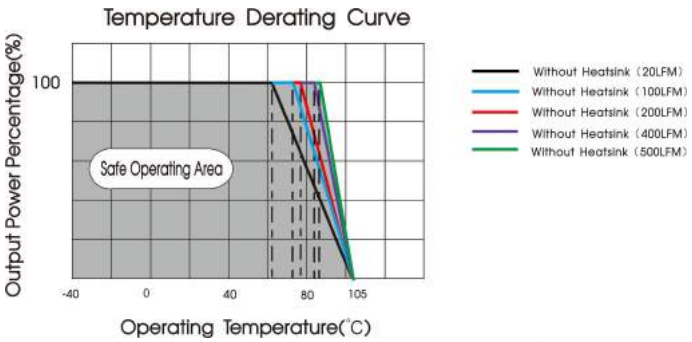
Typical Characteristic Curves



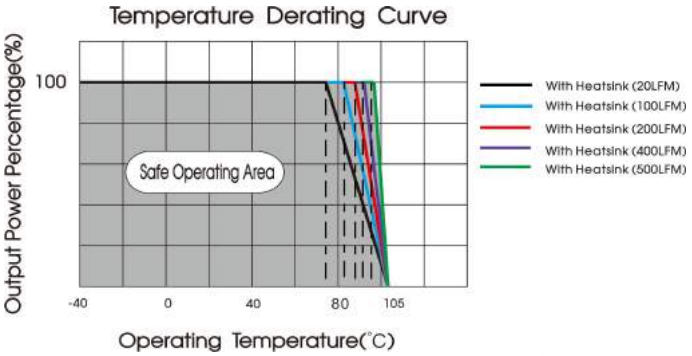
SURF1D05QB-50WR3 temperature derating curve（Vin=110V）



SURF1D05QB-50WHR3 temperature derating curve（Vin=110V）

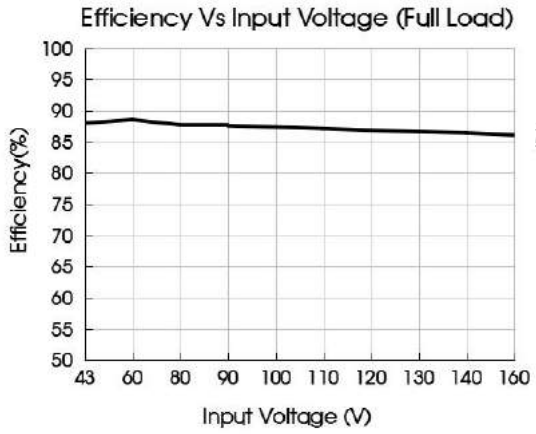


SURF1D12QB-50WR3 temperature derating curve（Vin=110V）

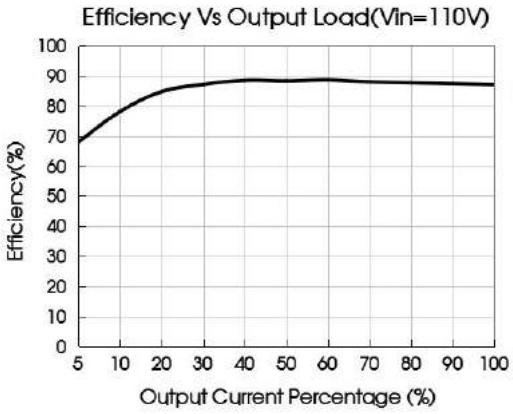


SURF1D12QB-50WHR3 temperature derating curve（Vin=110V）

Notes:
1、Temperature derating curves and efficiency curves are typical test values.
2、Temperature derating curve in accordance with our laboratory test conditions for testing, the actual use of environmental conditions if the customer is not consistent, to ensure that the product aluminum shell temperature does not exceed 100 ℃, can be used within any rated load range.



SURF1D05QB-50WR3



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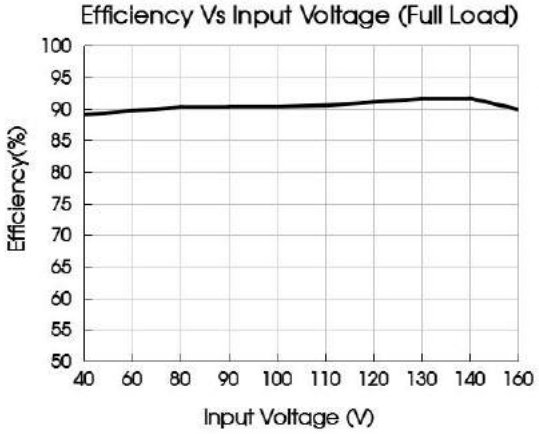
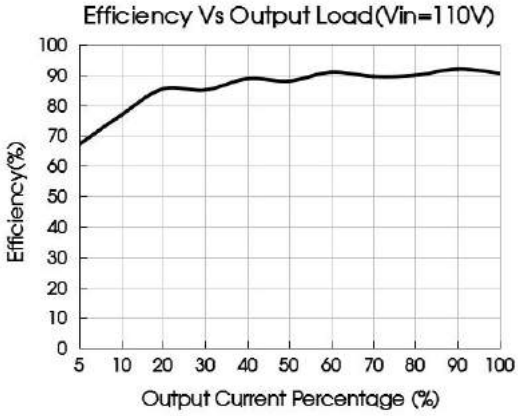


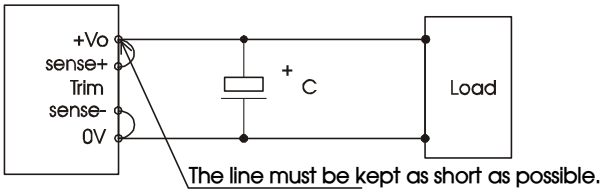
SURF1D24QB-50WR3



SURF1D24QB-50WR3

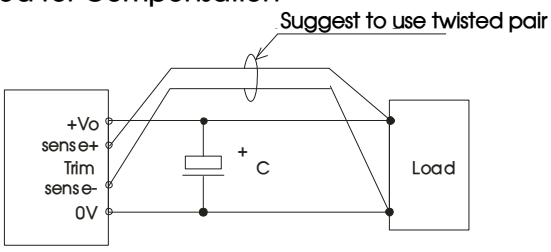
Remote Sense Application

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. Ripple & Noise

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

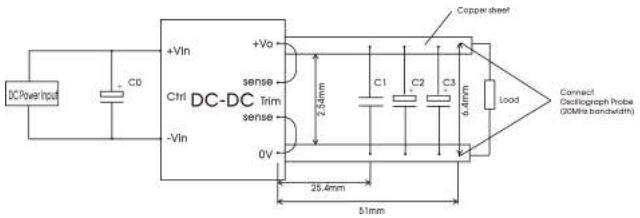


Fig.1

Output voltage \ Capacitors value	C0(μF)	C1(μF)	C2(μF)	C3(μF)
3.3VDC	100	1	10	1000
5VDC				680
12VDC				220
15VDC				
24VDC				
48VDC				

2. Typical application

We recommended using SCHMID-M'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.

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.

Output voltage \ Capacitors value	Cout(μF)	Cin(μF)
3.3VDC	1000	100
5VDC	680	
12VDC	220	
15VDC		
24VDC		
48VDC		

3. EMC compliance recommended circuit

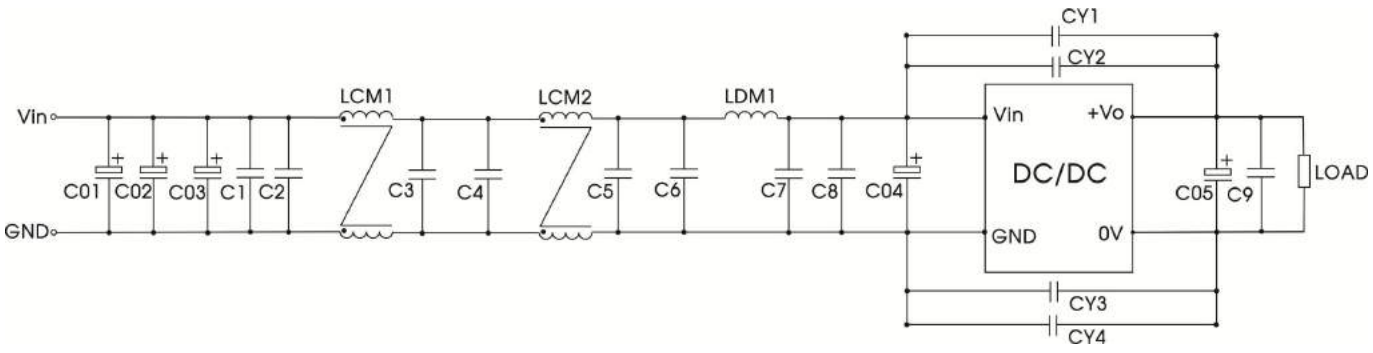


Fig.2

C01, C02, C03, C04	220uF/200V (electrolytic capacitor)
C05	220uF/63V (electrolytic capacitor)
LDM1	1.5uH (Shielded inductor)
C1, C2, C3, C4, C5, C6, C7, C8, C9	2.2uF/250V
CY1, CY2, CY3, CY4	2200 pF /400VAC (Y safety capacitor)
LCM1	FL2D-30-472
LCM2	FL2D-30-102

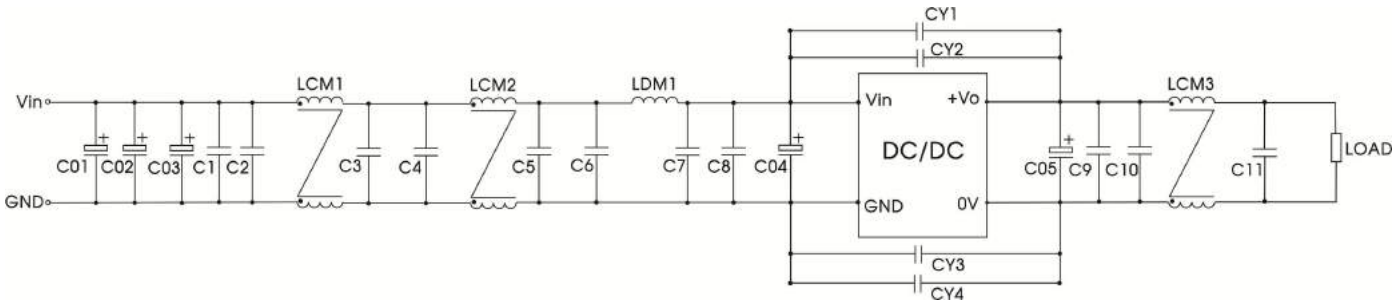
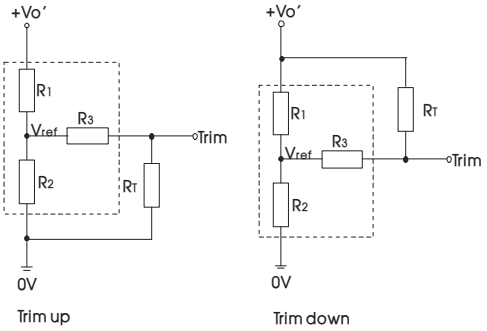


Fig.3

C01, C02, C03, C04	220uF/200V (electrolytic capacitor)
C05	220uF/63V (electrolytic capacitor)
LDM1	1.5uH (Shielded inductor)
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11	2.2uF/250V
CY1, CY2, CY3, CY4	2200 pF /400VAC (Y safety capacitor)
LCM1	FL2D-30-472
LCM2	FL2D-30-102
LCM3	TDG TN100B ϕ5X5 0.9mm

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



TRIM resistor connection (dashed line shows internal resistor network)

Trim resistor calculation:

$$\text{up: } R_T = \frac{aR_2}{R_2 - a} - R_3 \qquad a = \frac{V_{ref}}{V_o' - V_{ref}} \cdot R_1$$

$$\text{down: } R_T = \frac{aR_1}{R_1 - a} - R_3 \qquad a = \frac{V_o' - V_{ref}}{V_{ref}} \cdot R_2$$

table 1

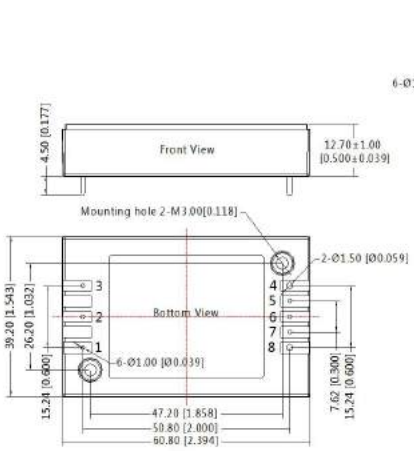
Vo / resistance	3.3(VDC)	5(VDC)	12(VDC)	15(VDC)	24(VDC)	48(VDC)
R1(KΩ)	4.83	8.80	11	14.49	24.87	58.7
R2(KΩ)	2.87	2.87	2.87	2.87	2.87	3.21
R3(KΩ)	9.66	11	11	16	21	11
Vref(V)	1.24	1.24	2.5	2.5	2.5	2.5

Note:

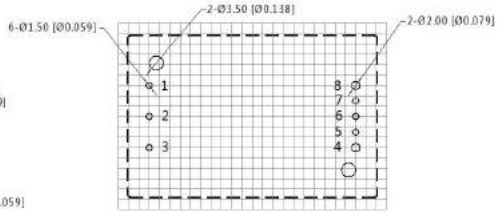
For R1, R2, R3 and Vref values refer to table 1. RT = Trim Resistor value; a = self-defined parameter Vo'= desired output voltage

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

SURF1D_QB-50WR3 Dimensions (without heatsink)



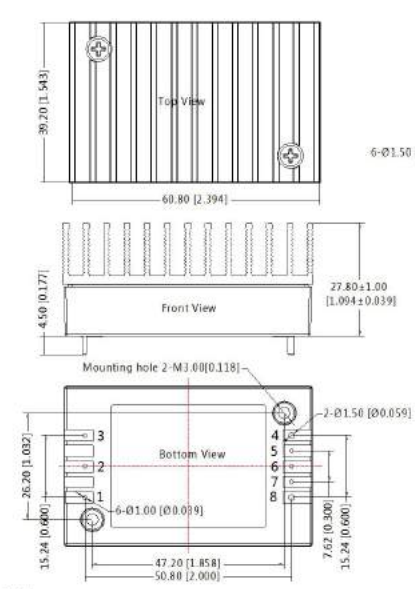
Note:
Unit:mm[inch]
Pin1,2,3,5,6,7's diameter:1.00[0.039]
Pin4,8's diameter:1.50[0.059]
Pin diameter tolerances:±0.10[±0.004]
General tolerances:±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N·m



Note:Grid 2.54*2.54mm

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

SURF1D_QB-50WHR3 Dimensions (with heatsink)



Note:
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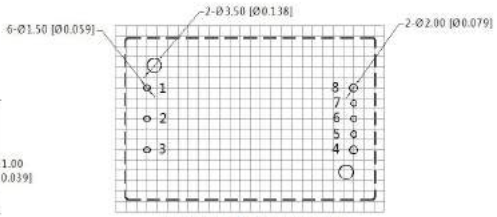

Note:Grid 2.54*2.54mm

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