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

Patent Protection RoHS

FEATURES

- Wide input voltage range: 16-40VDC
- High efficiency up to 92%
- I/O isolation test voltage: 2250 VDC
- Input under-voltage, output short-circuit, over-current, over-voltage, over-temperature protection
- Operating ambient temperature range: -40℃ to +105℃
- Industry standard 1/8-Brick package and pin-out

VRF24_EB-150W(F)R3 series of isolated 150W, DC-DC products with 16-40VDC input voltage range. They feature efficiencies of up to 92%, 2250VDC input to output isolation, operating ambient temperature range of -40℃ to +105℃. The products also provide Input under-voltage, output short-circuit, over-current, over-voltage, over-temperature protection. They meet CLASS A of CISPR32/EN55032 EMI standards. They are widely used in applications such as battery power supplies, industrial control, electric power, instrumentation and telecommunication fields.

Selection Guide

Certification	Part No①	Input Voltage (VDC)		Output		Full Load Efficiency③ (%) Min./Typ.	Max. Capacitive Load(μF)
		Nominal	Max.②	Voltage (VDC)	Current (A) Max./Min.		
--	VRF2405EB-150W(F)R3	24 (16-40)	40	5	30/0	89/91	10000
	VRF2412EB-150W(F)R3			12	12.5/0	90/92	5000
	VRF2415EB-150W(F)R3			15	10/0	89/91	4000
	VRF2419EB-150W(F)R3			19	7.895/0	90/92	4000
	VRF2424EB-150W(F)R3			24	6.25/0	90/92	2000
	VRF2428EB-150W(F)R3			28	5.375/0	89/91	2000

Note:
①Product model "F" suffix for heat sink mounting
② Exceeding the maximum input voltage may cause permanent damage;
③ Efficiency is measured in nominal input voltage and rated output load.

Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Input Current (full load / no-load)	Nominal input voltag	5/15/28V output	--	6868/15	7022/30	mA
		12/19/24V output	--	6793/15	6944/30	
Reflected Ripple Current	Nominal input voltage		--	50	--	
Surge Voltage (1sec. max.)			-0.7	--	50	VDC
Start-up Voltage			--	--	16	
Input Under-voltage Protection			12	14	--	
Input Filter			Pi filter			
Hot Plug			Unavailable			
Ctrl*	Module on		Ctrl pin open or pulled high TTL (3.5-12VDC)			
	Module off		Ctrl pin -Vin or pulled low (0-1.2VDC)			
	Input current when off		--	10	20	mA
Ctrl Start-up Delay Time			--	30	50	ms

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

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	±0.75	
Transient Recovery Time	25% load step change, nominal input voltage		--	200	400	μs
Transient Response Deviation	25% load step change	5V output	--	±6	±10	%
		Other output		±3	±5	
Temperature Coefficient	Full load		--	--	±0.03	%/℃
Ripple & Noise *	20MHz bandwidth, 5%-100%Io load		--	180	250	mVp-p
Trim	Input voltage range		90	--	110	%Vo
Sense			--	--	105	
Over-temperature Protection	Surface max. temperature		--	115	--	℃
Over-voltage Protection			110	125	160	%Vo
Over-current Protection			110	140	190	%Io
Short-circuit Protection			Continuous, self-recovery			

Note: 0%-5% Ripple & Noise at 5V output≤5%Vo max, other output≤5%Vo max. *The "Tip and barrel" 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	electric strength test for 1 minute with a leakage current of 1mA max.	Input-output	2250	--	--	VDC
		Input/Output-case	1500			
Insulation Resistance	Input-output resistance at 500VDC		1000	--	--	MΩ
Isolation Capacitance	Input-output capacitance at 100KHz/0.1V		--	1000	--	pF
Insulation type	Input-output		Basic insulation			
Operating Temperature Range	see Fig. 1		-40	--	+105	℃
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
Vibration			10-55Hz, 10G, 30 Min. along X, Y and Z			
Switching Frequency①	PWM mode		--	300	--	kHz
Altitude			Altitude: ≤2000m, Atmospheric pressure: 80～110KPa			
MTBF	MIL-HDBK-217F@25℃		1000	--	--	k hours

Note: ① This series of products adopts the frequency reduction technology, the switching frequency value is the test value at full load, when the load is reduced to less than 50%, the switching frequency decreases with the reduction of the load.

Mechanical Specifications

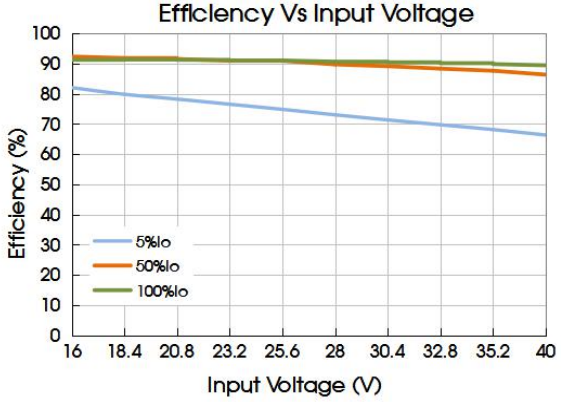
Case Material	Black plastic; flame-retardant and heat-resistant (UL94 V-0) & Aluminum alloy case	
Dimensions	VRF24_EB-150WR3	60.80mm*25.00mm*12.70mm
	VRF24_EB-150WFR3	60.80mm*36.83mm*12.70mm
Weight	VRF24_EB-150WR3	50.6g (Typ.)
	VRF24_EB-150WFR3	55.6g (Typ.)
Cooling Method	Natural convection or forced air convection	

Electromagnetic Compatibility (EMC)

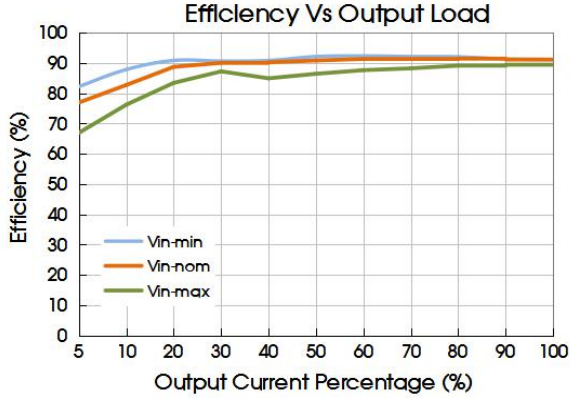
Emissions	CE	CISPR32/EN55032	Class A (see Fig. 3-1 for recommended circuit)/ Class B (see Fig. 3-2 for recommended circuit)
	RE	CISPR32/EN55032	Class A (see Fig. 3-1 for recommended circuit)/ Class B (see Fig. 3-2 for recommended circuit)
Immunity	ESD	IEC/EN61000-4-2	Contact ±6KV perf. Criteria B
	RS	IEC/EN61000-4-3	10V/m (see Fig. 3-1 for recommended circuit) perf. Criteria A
	EFT	IEC/EN61000-4-4	100KHz ±2KV (see Fig. 3-2 for recommended circuit) perf. Criteria B
	Surge	IEC/EN61000-4-5	line to line ±2KV (see Fig. 3-2 for recommended circuit) perf. Criteria B
	CS	IEC/EN61000-4-6	10 Vr.m.s (see Fig. 3-1 for recommended circuit) perf. Criteria A

Typical Characteristic Curves

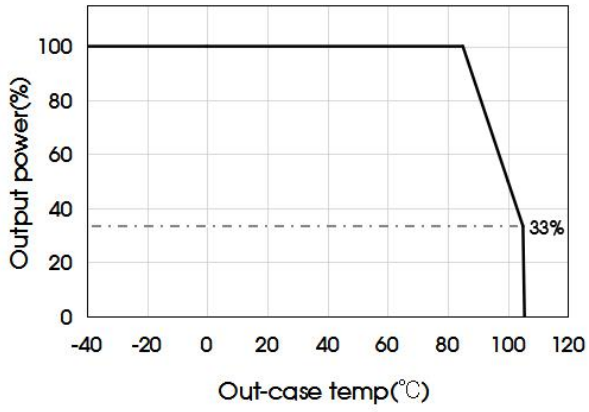
VRF2405EB-150W(F)R3
Efficiency Vs Input Voltage



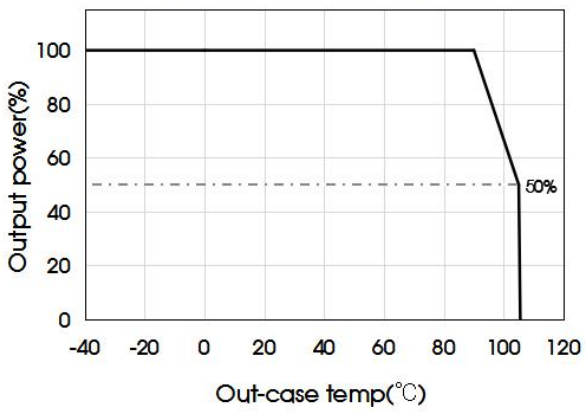
VRF2405EB-150W(F)R3
Efficiency Vs Output Load



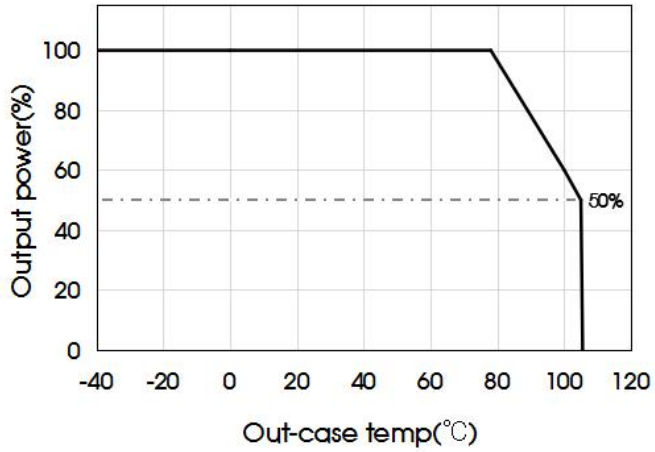
VRF2405EB-150W(F)R3
Temperature Derating curve



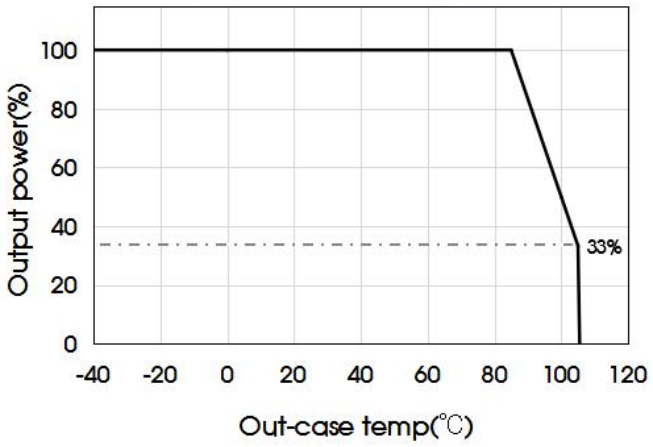
VRF2412EB-150W(F)R3
Temperature Derating curve



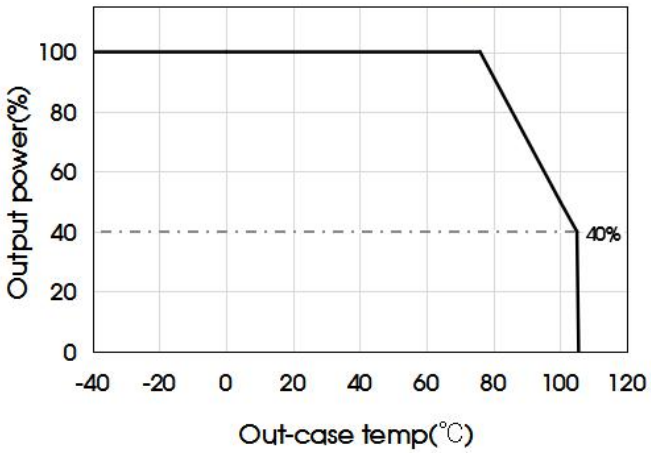
VRF2415EB-150W(F)R3
Temperature Derating curve



VRF2419EB-150W(F)R3
Temperature Derating curve



VRF2424EB-150W(F)R3
Temperature Derating curve



VRF2428EB-150W(F)R3
Temperature Derating curve

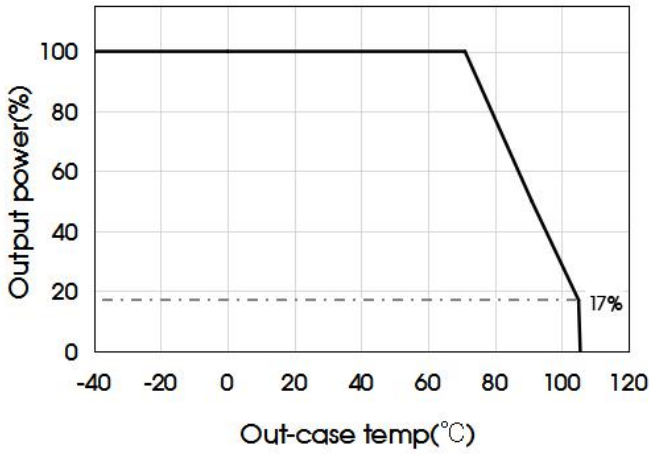
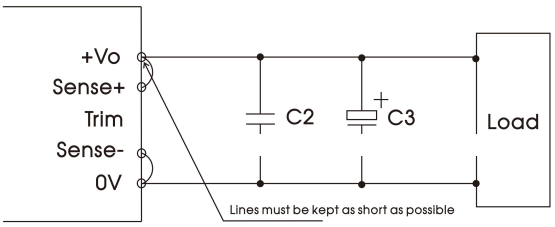


Fig. 1

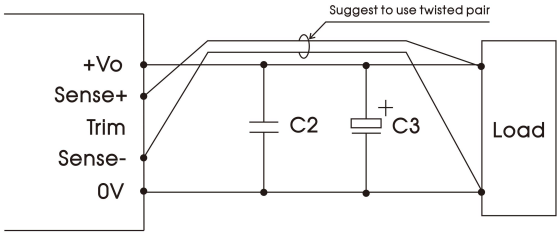
Remote Sense Application

1. Remote Sense Connection if not used



Note:
(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



Note:

(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 wires 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

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 specified max. capacitive load value of the product.

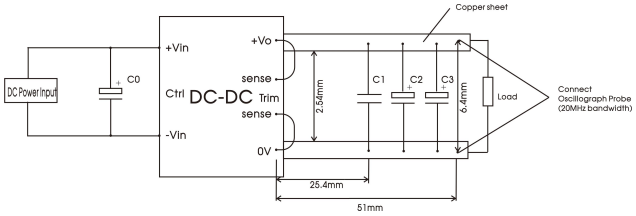
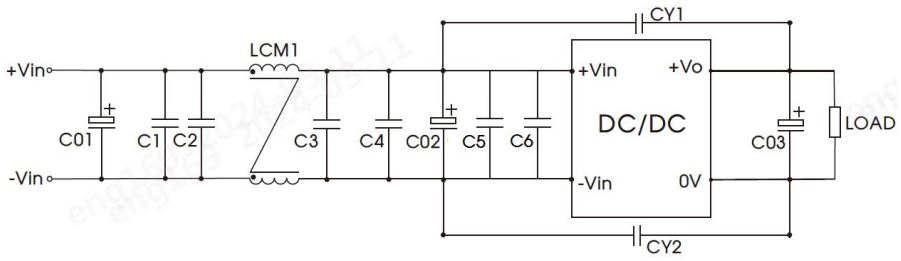


Fig. 2

Output voltage (VDC) \ Capacitor values	C0	C1	C2	C3
5/12/15/19/24/28 VDC	100μF/ 100V	1μF/ 50V	10μF/ 50V	470μF/50V

2. EMC compliance circuit

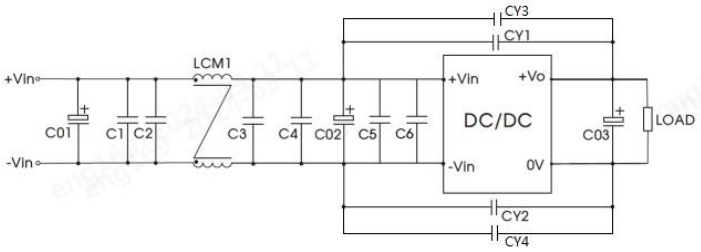
5V/12V/15V/19V/24V



Parameter description:

Components	Vin: 24VDC
C01/C02/C03	470uF/100V Electrolytic capacitor
C1/C2/C3/C4/C5/C6	4.7uF/100V
CY1/CY2	4.7nF/3KV
LCM1	2.0mH, Recommend use Mornsun P/N: FL2D-A2-202

28V



Parameter description:

C01、C02、C03	470uF/100V Electrolytic capacitor
C1、C2、C3、C4、C5、C6	4.7uF/100V
CY1、CY2、CY3、CY4	4.7nF/3KV
LCM1	2.0mH，Recommend use Mornsun P/N: FL2D-A2-202

Fig. 3-1

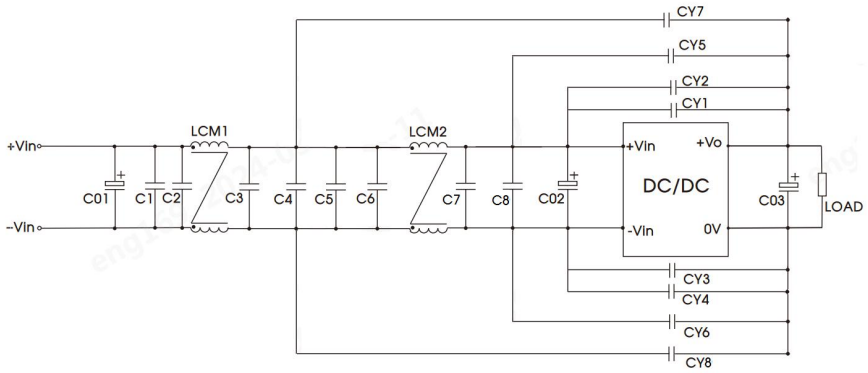
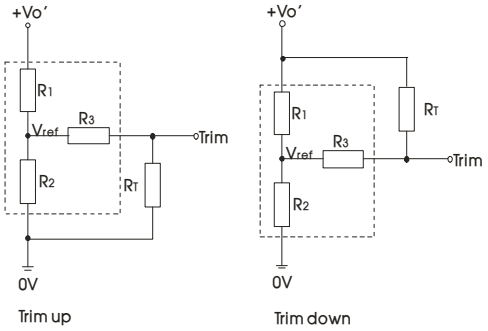


Fig. 3-2

Parameter description:

Components	Vin: 24VDC
C01/C02	1000uF/63V Electrolytic capacitor
C03	470uF/35V Electrolytic capacitor
C1/C2/C3/C4/C5/C6/C7/C8	4.7uF/100V
CY1/CY2/CY3/CY4/CY5/CY6/CY7/CY8	4.7nF/3KV
LCM1/LCM2	2.0mH, Recommend use Mornsun P/N: FL2D-A2-202

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



Trim resistor calculation:

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

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

Table1

Vout(V)	R1(KΩ)	R2(KΩ)	R3(KΩ)	Vref(V)
5	2.9	2.87	10	2.5
12	11	2.87	10	2.5
15	14.36	2.87	10	2.5
19	18.9	2.87	10	2.5
24	24.77	2.87	10	2.5
28	29.4	2.87	10	2.5

Note:
Value for R1/R2/R3/Vref, Vref refer to the above table 1. R_T: Resistance of Trim. a :Self-defined parameter;Vo' is designed percentage of trim up or trim down.

4. Recommended solution for thermal test

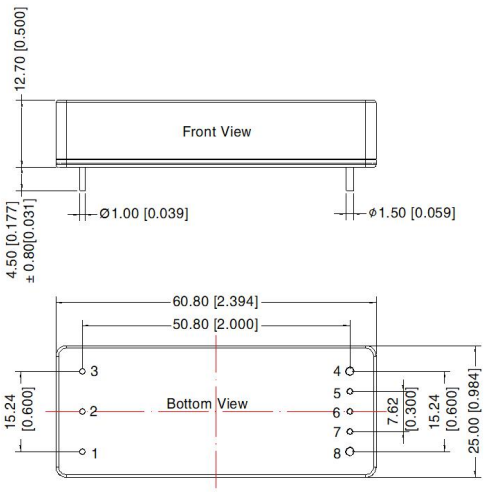
During the application process, the thermal design of the product can be evaluated in combination with the product temperature derating curve, in Figure 4 A is the temperature reference point

Fig. 4

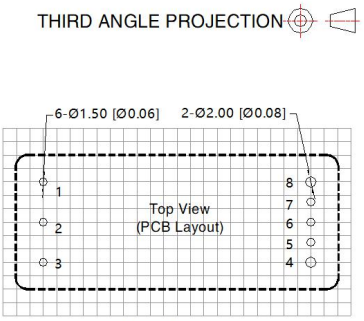
5. The products do not support parallel connection of their output

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

VRF24_EB-150WR3 Dimensions and Recommended Layout



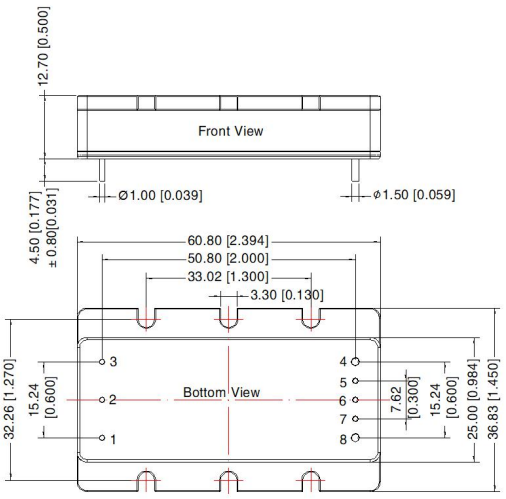
Note:
Unit: mm[inch]
Pin1,2,3,5,6,7 diameter: 1.00[0.039]
Pin4,8 diameter: 1.50[0.059]
Pin diameter tolerances: ± 0.10[± 0.004]
Pin spacing tolerance: ± 0.25[± 0.010]
General tolerances: ± 0.50[± 0.020]



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

VRF24_EB-150WFR3 Dimensions and Recommended Layout



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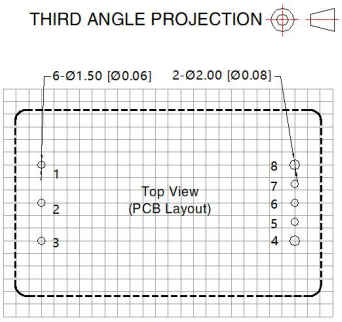

Note: Grid 2.54*2.54mm

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

Note:
1. For additional information on Product Packaging please refer to www.mornsun-power.com. The Packaging bag number of Horizontal packaging: 58010113;
2. Recommend to use module with more than 5% load, if not, the ripple of the product may exceeds the specification, but does not affect the reliability of the product;
3. It is recommended that the load imbalance of the dual output module is ≤±5%, if it exceeds ±5%, it cannot guarantee that the product performance meets all the performance indicators in this manual, and you can contact our technical personnel directly for details;
4. The maximum capacitive load offered were tested at input voltage range and full load;
5. 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;
6. All index testing methods in this datasheet are based on company corporate standards;
7. We can provide customized and matched filter modules. For details, please contact our technical staff;
8. Products are related to laws and regulations: see "Features" and "EMC";
9. 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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