500W isolated DC-DC converter
Ultra-wide input and regulated single output

Patent Protection RoHS

FEATURES

- Wide 2:1 input voltage range
- High efficiency up to 94%
- I/O isolation test voltage 2.25k VDC
- Input under-voltage protection, output short-circuit, over-current, over–voltage, over-temperature protection
- Parallel current sharing function
- Shell operating temperature range Tc: -40℃ to +100℃
- Industry standard 1/2 brick

VRF24_HB-500WR3-N series product output power is 500W. It features 2:1 wide voltage input range, efficiency up to 94%, 2250VDC isolation voltage, allowable working temperature 40° C-100° C, with input under-voltage protection and output over-voltage protection, output over-current protection, output short-circuit protection, over-temperature protection, remote control and compensation, output voltage adjustment, parallel current sharing and other functions. Through the additinoal circuit, it can meet CISPR32/EN55032 Class A, and it is widely used in battery-powered equipment, industrial control, electric power, instrumentation, communication, intelligent robots and other fields.

Selection Guide

Certification	Part No.	ON/OFF logic①	Input Voltage (VDC)		Output		Full Load Efficiency (%) Min./Typ.	Capacitive Load (μF)Max.	Capacitive Load (μF)Min.
			Nominal (Range)	Max.②	Voltage (VDC)	Current(mA) Max./Min.			
--	VRF2412HB-500WR3-N	N	24 (18-36)	40	12	42000/0	91/93	12000	470
	VRF2415HB-500WR3-N	N	24 (18-36)	40	15	34000/0	92/94	10000	470
	VRF2424HB-500WR3-N	N	24 (18-36)	40	24	21000/0	91/93	6000	470
	VRF2428HB-500WR3-N	N	24 (18-36)	40	28	18000/0	92/94	5000	470

Notes:
①"P" means positive logic, "N" means negative logic;
②Exceeding the maximum input voltage may cause permanent damage;
③In order to ensure the stability of the output voltage, the output side of the product must be connected with a minimum capacitive load.

Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Input Current (full load / no-load)	24VDC input	12V, 24V output	-	22581/340	23077/380	mA
		15V, 28V output	-	22607/340	23098/380	
Reflected Ripple Current	24VDC input		--	500	--	
Surge Voltage (1sec. max.)			-0.7	--	50	VDC
Start-up Voltage			--	--	18	
Input under-voltage protection			15.5	--	--	
Start-up Time	Nominal input voltage & constant resistance load		--	--	100	ms
Input Filter			Capacitance filter			
Hot Plug			Unavailable			

ON/OFF*	Module on	ON/OFF pin open or pulled high (TTL 3.5-12VDC)			
	Module off	ON/OFF pin pulled low to GND (0-1.2VDC)			
	Input current when off	--	25	40	mA

Note: *The ON/OFF pin voltage is referenced to input -Vin.

Output Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Voltage Accuracy	0% -100% load		--	±1	±3	%Vo
Linear Regulation	Input voltage variation from low to high at full load		--	±0.2	±0.5	
Load Regulation	5% -100% load		--	±0.25	±0.75	
Transient Recovery Time	25% load step change, 2A/us		--	300	500	μs
Transient Response Deviation			--	±3	±5	%Vo
Temperature Coefficient	Nominal full load		--	--	±0.03	%/℃
Ripple & Noise①	24VDC nominal input voltage 20MHz bandwidth, 5%-100% load	12V, 15V output	--	--	150	mVp-p
		24V, 28V output	--	--	220	
Parallel current sharing accuracy②	24VDC nominal input voltage, 100% load, 2pcs parallel		--	±8	±10	%Io
Trim	Input voltage range		90	--	110	%Vo
Sense			--	--	110	
Over-voltage Protection			110	115	130	
Over-current Protection			110	115	130	%Io
Short circuit Protection			Hiccup, continuous, self-recovery			
Over-temperature Protection	Product surface temperature		--	110	120	℃

Note:
①Under 0% -5% load conditions, ripple & noise does not exceed 5%Vo. The "Tip and barrel method" is used for ripple and noise test, output parallel 1uF ceramic capacitor+10uF tantalum capacitor+minimum capacitive load;
②Number of parallel connections: 4pcs max, the current sharing accuracy is only for reference when 2pcs products are connected in parallel.

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/output-Case Electric Strength Test for 1 minute with a leakage current of 1mA max.	2250	--	--	
Insulation Resistance	Input-output resistance at 500VDC	100	--	--	MΩ
Isolation Capacitance	Input-output capacitance at 100KHz/0.1V	--	3000	--	pF
Operating Temperature	Shell temperature Tc	-40	--	+100	℃
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
Vibration		10-150Hz, 5G, 0.75mm. along X, Y and Z			
Switching Frequency *	PWM mode	--	280	--	kHz
MTBF	MIL-HDBK-217F@25℃	1000	--	--	k hours

Mechanical Specifications

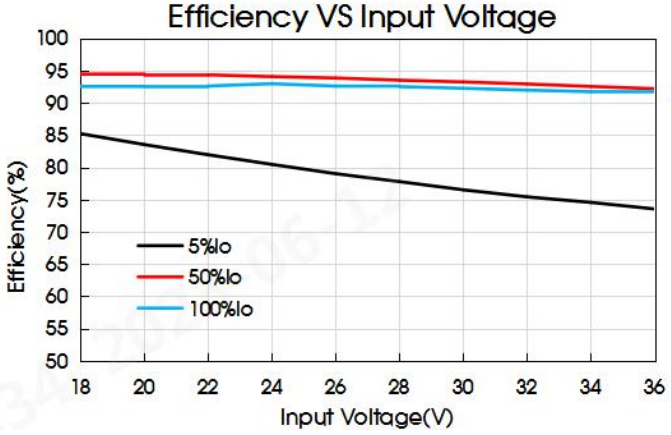
Case Material	Aluminum alloy + black flame retardant and heat resistant plastic
Dimensions	61.00 x 57.90 x 12.70 mm
Weight	130.0g (Typ.)
Cooling Method	Free air convection or forced convection

Electromagnetic Compatibility (EMC)

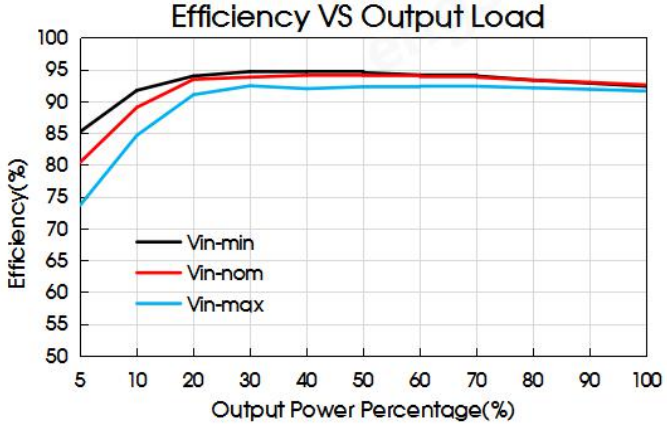
Emissions	CE	CISPR32/EN55032	CLASS A (additional circuit) (see Fig.4 for recommended circuit)	
	RE	CISPR32/EN55032	CLASS A (additional circuit) (see Fig.4 for recommended circuit)	
Immunity	ESD	IEC/EN61000-4-2	Contact ±6kV, Air ±8kV	perf. Criteria B
	RS	IEC/EN61000-4-3	10V/m (see Fig.4 for recommended circuit)	perf. Criteria A
	EFT	IEC/EN61000-4-4	±2kV (see Fig.4 for recommended circuit)	perf. Criteria A
	Surge	IEC/EN61000-4-5	line to line ±2kV (see Fig.4 for recommended circuit)	perf. Criteria B
	CS	IEC/EN61000-4-6	10 Vr.m.s (see Fig.4 for recommended circuit)	perf. Criteria A

Typical Characteristic Curves

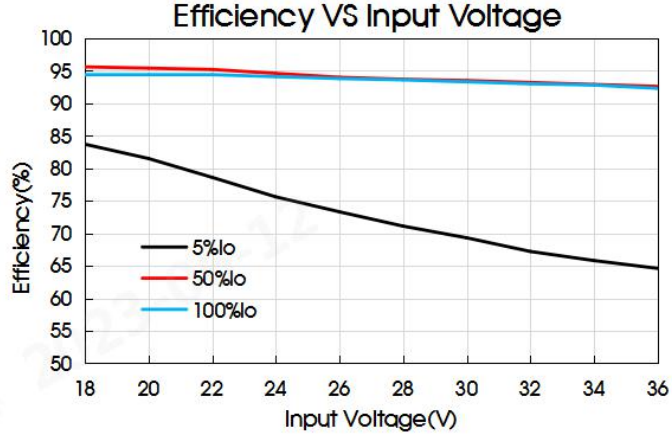
VRF2412HB-500WR3-N
Efficiency VS Input Voltage



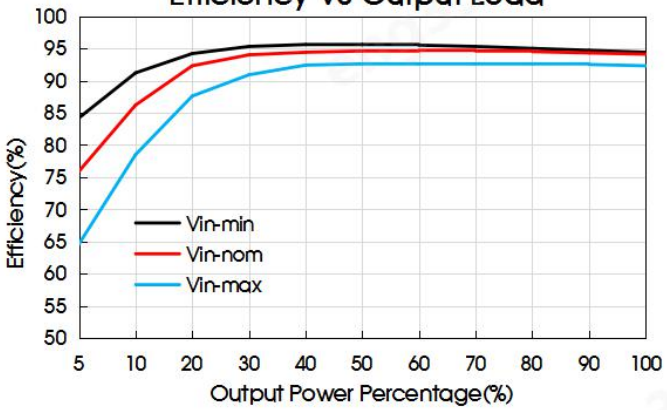
VRF2412HB-500WR3-N
Efficiency VS Output Load



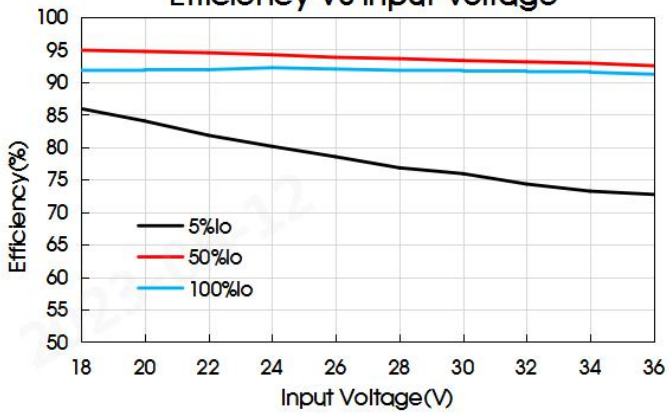
VRF2415HB-500WR3-N
Efficiency VS Input Voltage



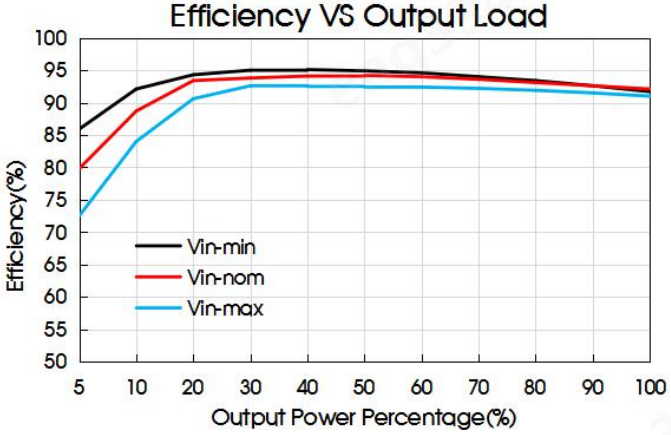
VRF2415HB-500WR3-N
Efficiency VS Output Load



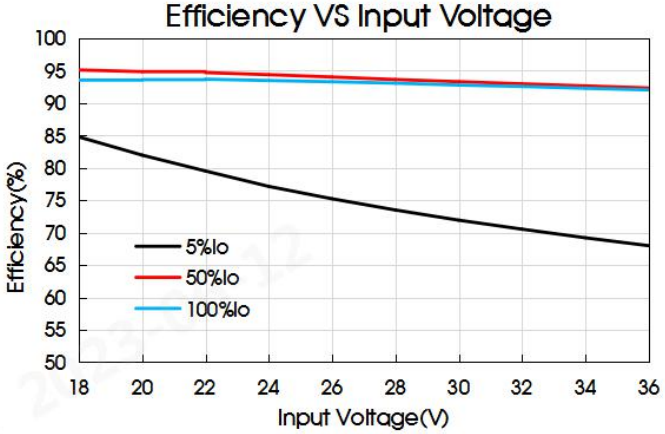
VRF2424HB-500WR3-N
Efficiency VS Input Voltage



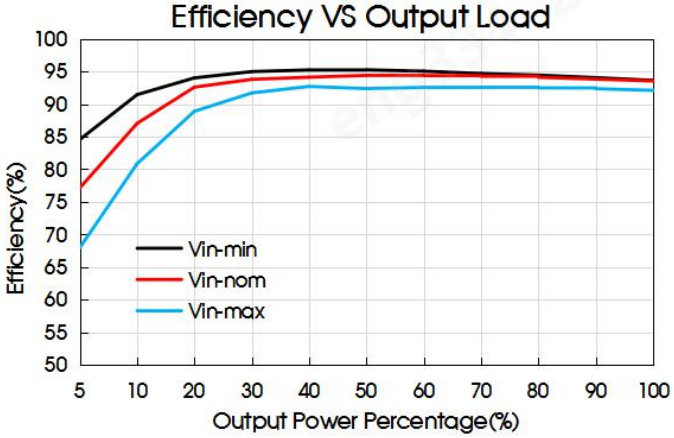
VRF2424HB-500WR3-N
Efficiency VS Output Load



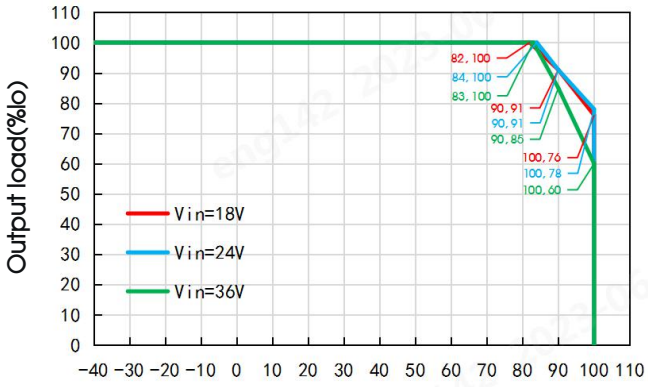
VRF2428HB-500WR3-N
Efficiency VS Input Voltage



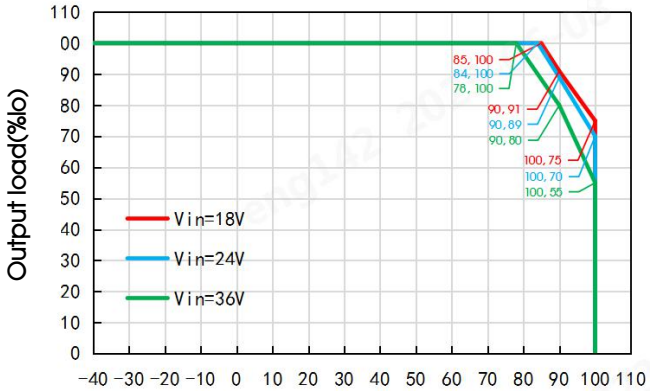
VRF2428HB-500WR3-N
Efficiency VS Output Load



VRF2412HB-500WR3-N
Temperature Derating Curve

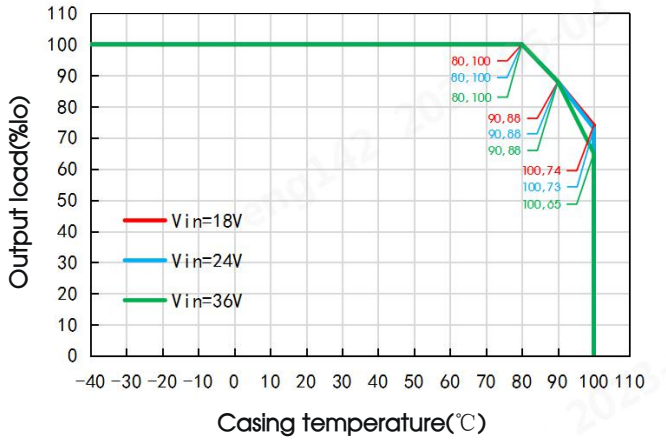


VRF2415HB-500WR3-N
Temperature Derating Curve



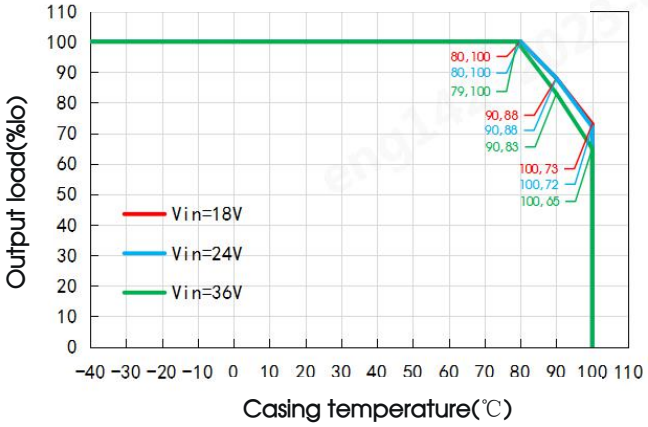
VRF2424HB-500WR3-N

Temperature Derating Curve



VRF2428HB-500WR3-N

Temperature Derating Curve



Remote Sense Application

1. Remote Sense Connection if not used

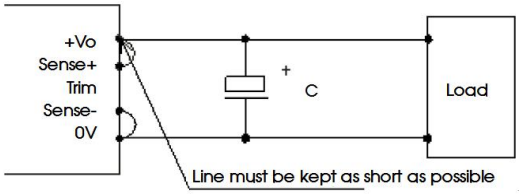


Fig. 1

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

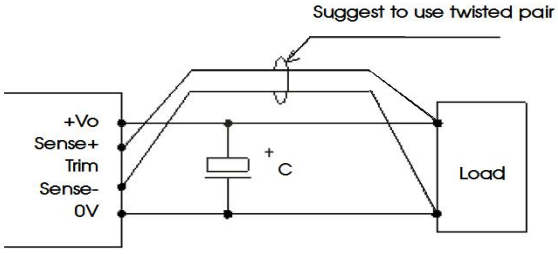


Fig. 2

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 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 DC-DC converters of this series are tested before delivery using the recommended circuit shown in Fig. 3.

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. 3

Capacitance value / Output voltage	Cout(min.)	Cin
12V/15V/24V/28V	470μF/35V	220 μF/63V

2. EMC compliance circuit

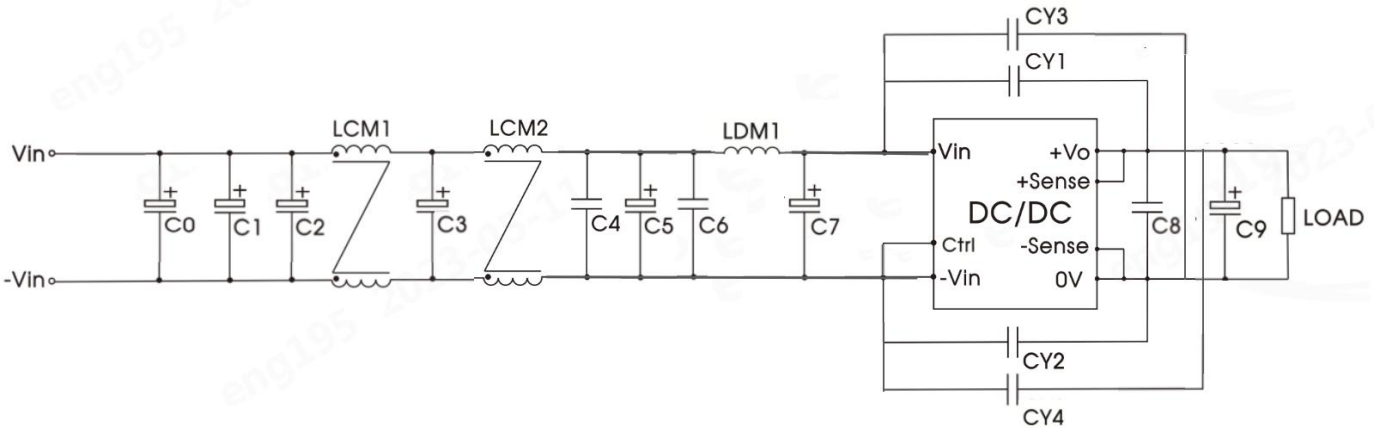
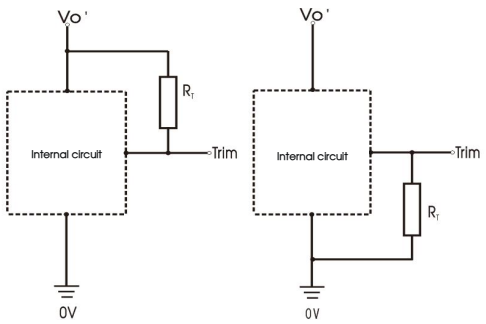


Fig. 4

Device	Parameter description
C0, C1, C2, C3, C5, C7	330μF/63V Electrolytic capacitance
C4, C6, C8	2.2μF/100V Ceramic capacitor
C9	470μF/63V Electrolytic capacitance
LCM1	FL2D-D0-561：560uH
LCM2	FL2D-D0-201：200uH
LDM1	CPQ2918-100M：10uH
CY1, CY2, CY3, CY4	4.7nF/400VAC Safety Y capacitor

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



Trim up Trim down

Fig. 5
TRIM resistor connection (dashed line shows internal resistor network)

Calculating Trim resistor values:

Trim up

$$R_T = \left(\frac{5.11 V_{nom}(100+\Delta\%)}{1.225\Delta\%} - \frac{511}{\Delta\%} - 10.22 \right)(k\Omega)$$

Trim down

$$R_T = \left(\frac{511}{\Delta\%} \right) - 10.22(k\Omega)$$

Notes:

R_T is Trim resistance

$$\Delta\% = \left| \frac{V_{nom} - V_{out}}{V_{nom}} \right| \times 100$$

V_{nom} is the typical output voltage

V_{out} to set the output voltage

4. Reflected ripple current test circuit

All DC-DC converters of this series are tested using the recommended circuit shown in Fig. 6.

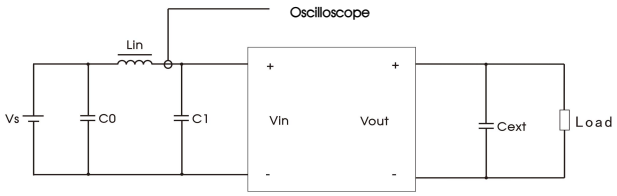


Fig. 6

Components	Recommended Component Value
C0	220μF/63V
Lin	10uH/40A
C1	470μF/63V
Cext	470μF/35V

5. The products do support parallel connection of their output

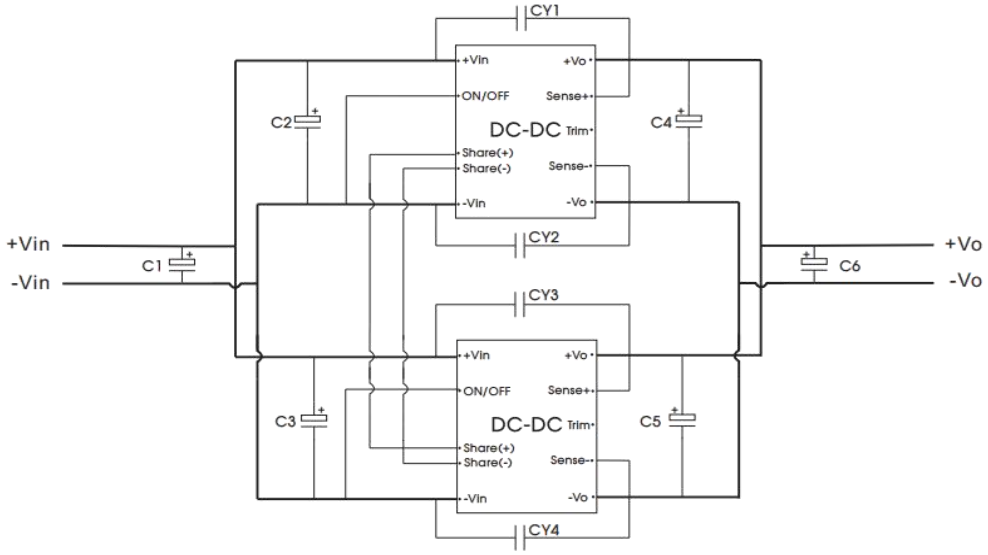


Fig. 7
Parallel current sharing wiring diagram

When the parallel current balancing function is used, ensure that the cable lengths of power modules are equal, the maximum number of parallel connections is 4 .

Vin (VDC)	Vout (VDC)	C1/C2/C3	C4/C5/C6	CY1/CY2/CY3/CY4
24	12/15/24/28	220uF/63V	470uF/35V	222M/Y2

6. Recommended solution for thermal testing

In the process of application, the thermal design of the product can be evaluated in combination with the product temperature derating curve, or the stable working interval of the product can be determined by the temperature of the thermal test point in Figure 8. When the temperature at point A is lower than 100℃, it is the stable working range of the product.

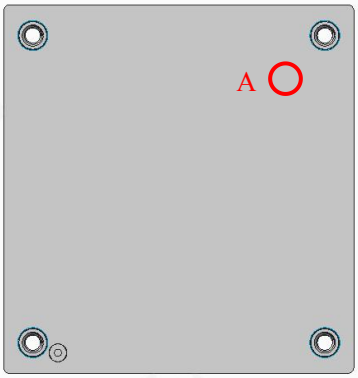
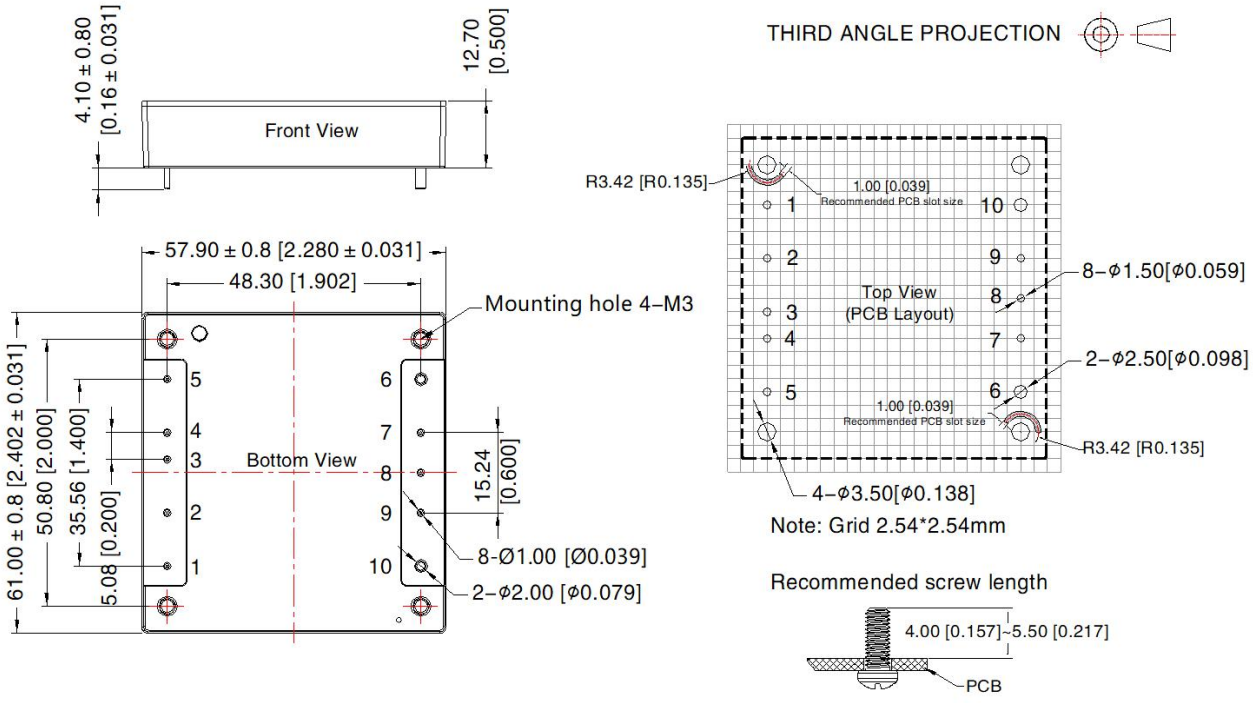


Fig. 8
Top view of the product

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

VRF24_HB-500WR3 Dimensions and Recommended Layout



Note:
Unit: mm[inch]
Pin1, 2, 3, 4, 5, 7, 8, 9diameter: 1.00[0.039]
Pin6, 10diameter: 2.00[0.079]
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]
Mounting hole screwing torque: Max 0.4 N · m

Pin–Out			
Pin	Mark	Pin	Mark
1	+Vin	6	–Vo
2	ON/OFF	7	Sense–
3	Share(+)	8	Trim
4	Share(–)	9	Sense+
5	–Vin	10	+Vo

Note:
1. For additional information on Product Packaging please refer to www.mornsun-power.com. Packaging bag number:58200069;
2. The maximum capacitive load offered were tested at input voltage range and full load;
3. 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;
4. All index testing methods in this datasheet are based on company corporate standards;
5. We can provide product customization service, please contact our technicians directly for specific information;
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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