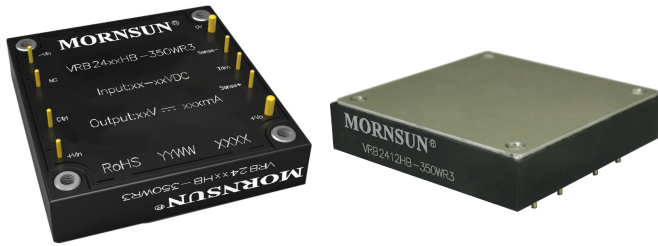# DC/DC Converter
VRB24_HB-350WR3 Series

MORNSUN®

350W isolated DC-DC converter
Ultra-wide input and regulated single output

FEATURES

- Wide input voltage range (2:1)
- High efficiency up to 89%
- I/O isolation test voltage: 1.5k VDC
- Output voltage adjustment Trim: 60%-110%Vo
- Output over-voltage, short-circuit, over-current protection, over-temperature protection
- Operating ambient temperature range: -40℃ to +100℃
- Industry standard 1/2 brick
- Meet EN62368 standards

Patent Protection RoHS

VRB24_HB-350WR3 series of isolated 350W DC-DC products with a 2:1 input voltage range. They feature efficiencies of up to 89%, 1500VDC input to output isolation, operating ambient temperature range of -40℃ to +100℃. The products also provide output over-voltage, short-circuit protection. They meet CLASS A of CISPR32/EN55032 EMI standards. Additional functions include remote On/Off control, they are widely used in applications such as battery power supplies, industrial control, electric power, instrumentation and telecommunication fields.

Selection Guide

Certification	Part No.	Input Voltage (VDC)		Output		Full Load Efficiency ② (%) Min./Typ.	Max. Capacitive Load(µF)
		Nominal	Max.①	Voltage (VDC)	Current (mA) Max./Min.		
--	VRB2412HB-350WR3	24 (20-36)	40	12	24000/0	83/86	6800
	VRB2424HB-350WR3			24	14500/0	85/87	4000
	VRB2428HB-350WR3			28	12500/0	87/89	3300
	VRB2432HB-350WR3			32	11000/0	87/89	2700

Note: ① Exceeding the maximum input voltage may cause permanent damage;
② 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)	12V output	--	13953/30	--	mA
	24V output	--	16667/30	--	
	28V output	--	16400/30	--	
	32V output	--	16480/30	--	
Reflected Ripple Current	Nominal input voltage, 100% load	--	300	--	
Surge Voltage (1sec. max.)		-0.7	--	40	VDC
Start-up Voltage		--	--	20	
Input Filter	C filter				
Hot Plug	Unavailable				
Ctrl*	Module on	Ctrl pin -Vin or pulled low (0-1.2VDC)			
	Module off	Ctrl pin open or pulled high TTL (3.5-12VDC)			
	Input current when off	--	6	10	mA

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	±1	
Transient Recovery Time	25% load step change	--	300	500	µs

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			±5	±8	%
Transient Response Deviation		--	±5	±8	%
Temperature Coefficient	Full load	--	--	±0.03	%/℃
Ripple & Noise *	20MHz bandwidth, 5%-100%Io load	--	200	300	mVp-p
Trim		60	--	110	%
Sense		--	--	105	
Over-temperature Protection	Surface max. temperature	--	125	--	℃
Over-voltage Protection		Hiccup			
Over-current Protection	Input voltage range	110	--	190	%Io
Short-circuit Protection		Continuous, self-recovery			

Note: *The "Tip and barrel" method is used for ripple and noise test, Ripple & Noise at <5% load is 5%Vo max.

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.		1500	--	--	VDC
	Input-case			1500	--	--	
	Output-case	electric strength test for 1 minute with a leakage current of 5mA max.		500	--	--	VAC
Insulation Resistance	Input-output resistance at 500VDC			1000	--	--	MΩ
Isolation Capacitance	Input-output capacitance at 100kHz/0.1V			--	1500	--	pF
Operating Temperature Range (product surface temperature)	Forced water convection or other heat dissipation methods			-40	--	100	℃
Storage Temperature				-55	--	125	
Storage Humidity	Non-condensing			5	--	95	%RH
Pin Soldering Resistance Temperature	Soldering spot is 1.5mm away from case for 10 seconds			--	--	300	℃
Vibration				10-150Hz, 5G, 0.75mm. along X, Y and Z			
Switching Frequency	PWM mode			--	270	--	kHz
MTBF	MIL-HDBK-217F@25℃			1000	--	--	k hours

Mechanical Specifications

Case Material	Black plastic; flame-retardant and heat-resistant (UL94 V-0) & Aluminum alloy case
Dimensions	61.0 x 57.9 x 12.7 mm
Weight	81.6g(Typ.)
Cooling Method	Forced water convection or other heat dissipation methods, ensuring product surface temperature less than 100℃

Electromagnetic Compatibility (EMC)

Emissions	CE	CISPR32/EN55032	Class A (see Fig. 3 for recommended circuit)	
	RE	CISPR32/EN55032	Class A (see Fig. 3 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. 3 for recommended circuit)	perf. Criteria A
	EFT	IEC/EN61000-4-4	±2kV (see Fig. 3 for recommended circuit)	perf. Criteria A
	Surge	IEC/EN61000-4-5	line to line ±2kV (see Fig. 3 for recommended circuit)	perf. Criteria B
	CS	IEC/EN61000-4-6	10 Vr.m.s (see Fig. 3 for recommended circuit)	perf. Criteria A

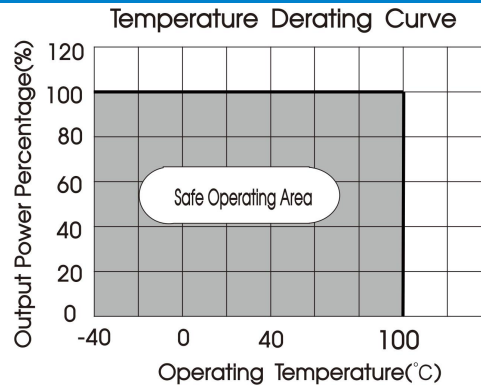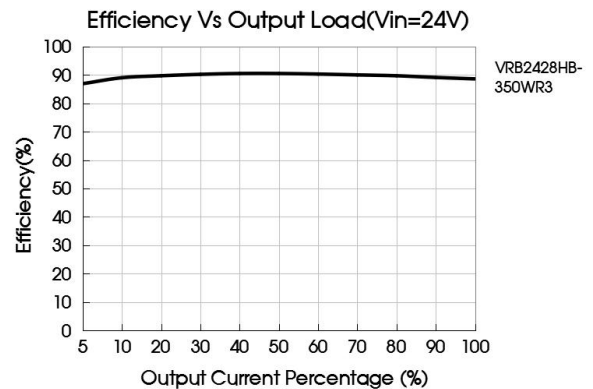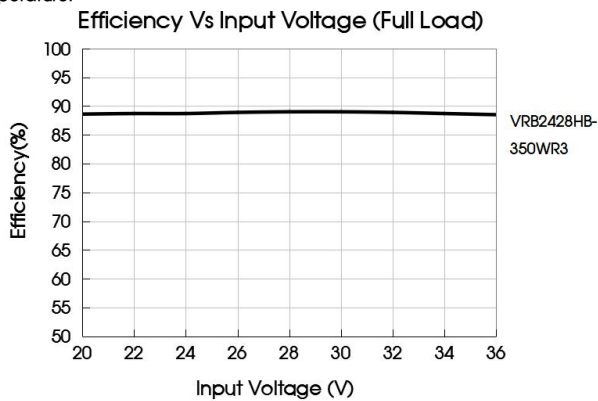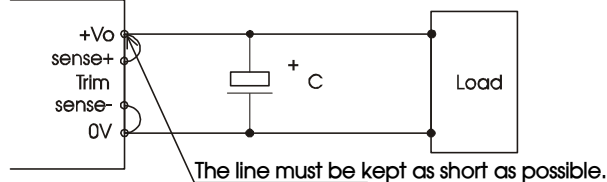## Typical Characteristic Curves

Temperature Derating Curve

Fig.1

Note：Temperature derating curve is tested at nominal input voltage, operating condition is forced water convection, operating temperature is product surface temperature.

Efficiency Vs Input Voltage (Full Load)

VRB2428HB-350WR3

Efficiency Vs Output Load(Vin=24V)

VRB2428HB-350WR3

Remote Sense Application

1. Remote Sense Connection if not used

The line must be kept as short as possible.

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

Suggest to use twisted pair
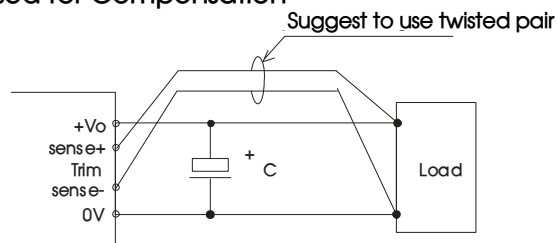
Notes:

(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 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.
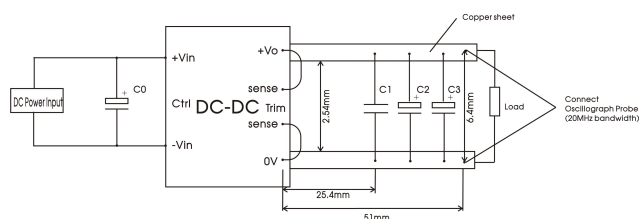

Fig. 2

Capacitor values / Output voltage （VDC）	C0	C1	C2	C3
12	100µF/ 200V	1µF/25V	10µF/25V	330µF/25V
24		1µF/50V	10µF/50V	330µF/50V
28		1µF/50V	10µF/50V	330µF/50V
32		1µF/50V	10µF/50V	330µF/50V

2. EMC compliance circuit
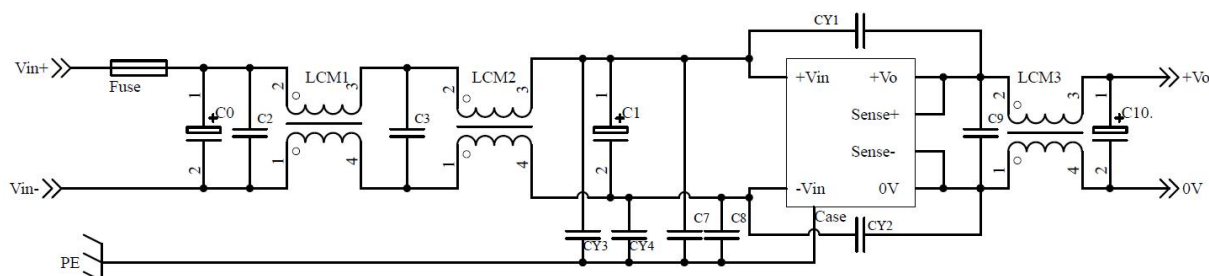
Fig. 3

Parameter description:

Components	Value
FUSE	Choose according to actual input current
C0	1000µF/100V
C1	470µF/100V
C2, C3, C9	2.2µF/250V
C7, C8	0.1µF/2000V
C10	220µF/63V
CY1, CY2, CY3, CY4	2.2nF/400VAC
LCM1	100uH/25A
LCM2	1mH/25A
LCM3	4uH/36A

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

Trim up   Trim down
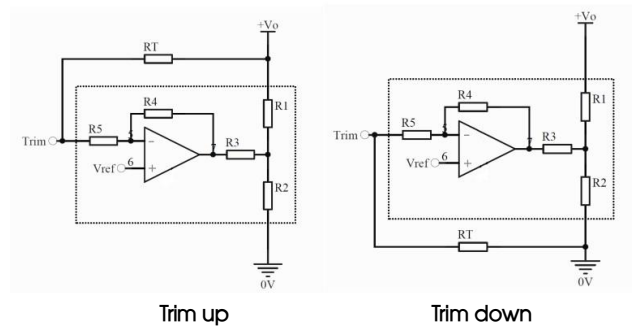
TRIM resistor connection (dashed line shows internal resistor network)

Trim resistor calculation:

$$\text{Up:} \quad RT = \frac{(\Delta\% + 100)R_1 R_4}{\Delta\% R_3} - \frac{100 V_{ref} R_1 R_4}{\Delta\% V_{out} R_3} - R_5$$

$$\text{Down:} \quad RT = \frac{100 V_{ref} R_1 R_4}{\Delta\% V_{out} R_3} - R_5$$

Table1

Vout(VDC)	R1(kΩ)	R3(kΩ)	R4(kΩ)	R5(kΩ)	Vref(V)
12	10.91	5	10	4.5	2.5
24	24.87	12	10	4.5	2.5
28	29.12	10	10	4.5	2.5
32	34.02	12	10	4.5	2.5

Note：
Value for R1, R3, R4, R5, Vref refer to the above table 1. RT: Resistance of Trim. △% is designed percentage of trim up or trim down.
Example: Take the 12V model as an example, if it needs to be reduced by 10%, then △% is substituted into the value of 10,

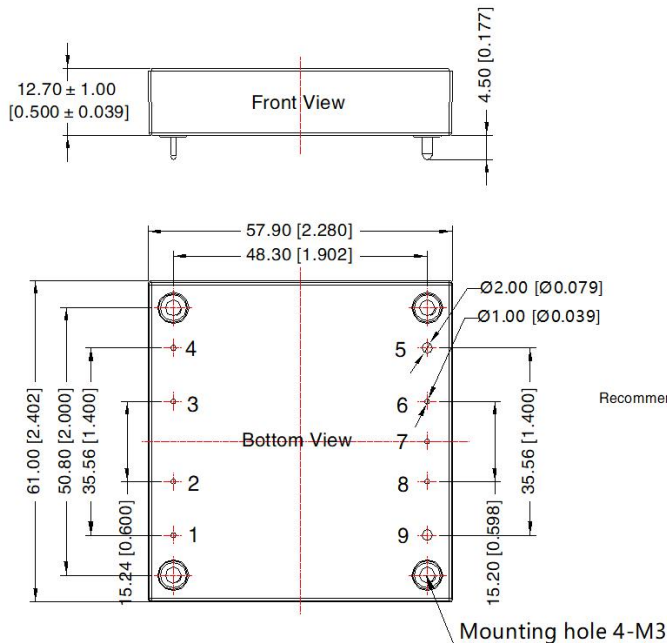$$RT = (\frac{100 \times 2.5 \times 10.91 \times 10}{10 \times 12 \times 5} - 4.5)^{k\Omega}$$

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

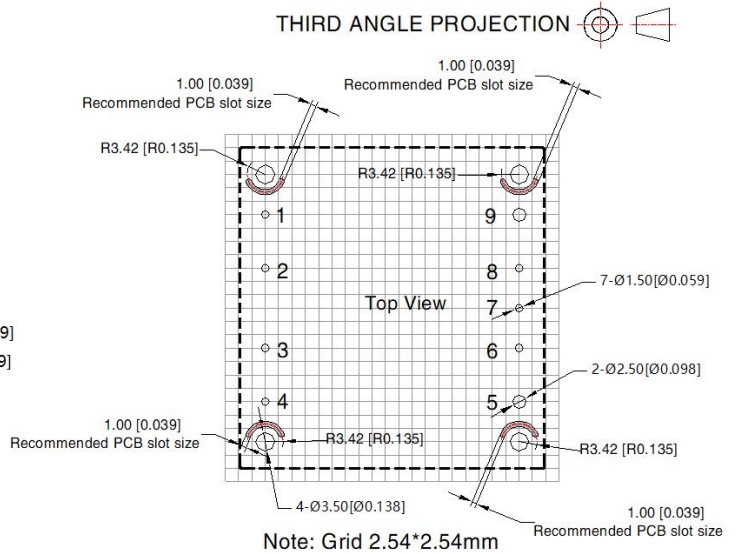## 5. For additional information please refer to DC-DC converter application notes on
www.mornsun-power.com

VRB24_HB-350WR3 Dimensions and Recommended Layout

Front View

12.70 ± 1.00 [0.500 ± 0.039]

4.50 [0.177]

57.90 [2.280]
48.30 [1.902]

Bottom View

Ø2.00 [Ø0.079]
Ø1.00 [Ø0.039]

61.00 [2.402]
50.80 [2.000]
35.56 [1.400]
35.56 [1.400]
15.24 [0.600]
15.20 [0.598]

Mounting hole 4-M3

Note:
Unit: mm[inch]
Pin1,2,3,4,6,7,8's diameter: 1.00[0.039]
Pin5,9's diameter: 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

THIRD ANGLE PROJECTION

1.00 [0.039]
Recommended PCB slot size

1.00 [0.039]
Recommended PCB slot size

R3.42 [R0.135]

R3.42 [R0.135]

Top View

7-Ø1.50[Ø0.059]

2-Ø2.50[Ø0.098]

1.00 [0.039]
Recommended PCB slot size

R3.42 [R0.135]

R3.42 [R0.135]

4-Ø3.50[Ø0.138]

1.00 [0.039]
Recommended PCB slot size

Note: Grid 2.54*2.54mm

Pin-Out			
Pin	Mark	Pin	Mark
1	+Vin	6	Sense-
2	Ctrl	7	Trim
3	NC	8	Sense+
4	-Vin	9	+Vo
5	0V		

Note:
1. For additional information on Product Packaging please refer to www.mornsun-power.com. The Packaging bag number of Horizontal packaging: 58200069;
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. The maximum capacitive load offered were tested at input voltage range and full load;
4. 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;
5. All index testing methods in this datasheet are based on company corporate standards;
6. We can provide customized and matched filter modules. For details, please contact our technical staff;
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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