DC/DC Converter

VRF48_HB-400W(H)R3-N Series

MORNSUN®

400W isolated DC-DC converter

Wide input and regulated single output

Patent Protection RoHS

CE Report EN62368-1

UKCA Report BS EN62368-1

FEATURES

- Wide input voltage range: 36 -75VDC
- High efficiency up to 95%
- Basic insulation, 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
- Industry standard 1/2-Brick package and pin-out

VRF48_HB-400W(H)R3-N series of isolated 400W DC-DC converter products with a wide 36-75VDC input voltage range. Output power with no requirement for minimum load. They efficiencies of up to 95%, input to output isolation is tested with 2250VDC and the converter safety operate ambient temperature of -40℃ to +85℃. Additional product features include input under-voltage protection, output over-voltage, over-current, short-circuit protection and over-temperature protection, remote On/Off control, remote sense compensation, output voltage trim adjustment. They meet CLASS B of CISPR32/EN55032 EMI standards by adding the recommended external components. They are widely used in applications such as battery power supplies, industrial control, electricity, instruments, communication, intelligent robot fields.

Selection Guide

Certification	Part No.①	Ctrl Logic②	Input Voltage (VDC)		Output		Full Load Efficiency(%) Min./Typ.	Capacitive Load (μF)Max.	Capacitive Load④ (μF)Min.
			Nominal (Range)	Max.③	Voltage (VDC)	Current (mA) Max./Min.			
EN/BS EN	VRF4812HB-400W(H)R3-N	N	48 (36-75)	80	12	33000/0	92/94	10000	470
	VRF4815HB-400W(H)R3-N	N			15	26500/0	93/95	6800	470
	VRF4824HB-400W(H)R3-N	N			24	16500/0	93/95	3300	470
	VRF4828HB-400W(H)R3-N	N			28	14200/0	92/94	3300	470

Note:

①Use "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 "N" means negative logic;

③Exceeding the maximum input voltage may cause permanent damage;

④To ensure the stability of the output voltage, the ouput side of the product must be externally connected with a minnimun capacitive load.

Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Input Current (full load/no-load)	Nominal input voltage	12V output	--	8865/80	9058/120	mA
		15V output	--	8772/100	8961/150	
		24V output	--	8772/80	8961/120	
		28V output	--	8865/100	9058/150	
Reflected Ripple Current	Nominal input voltage		--	200	--	
Surge Voltage (1sec. max.)			-0.7	--	90	VDC
Start-up Voltage			--	--	36	
Input Under-voltage Protection			30	32	--	
Start-up Time	Nominal input voltage, constant resistance load		--	--	100	ms
Input Filter			PI filter			
Hot Plug			Unavailable			
Ctrl①	Module on		Ctrl pin connected to -Vin or low level (0-1.2VDC)			
	Module off		Ctrl pin open or pulled high (TTL 3.3-12VDC)			
	Input current when off		--	10	20	mA

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

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		--	±0.2	±0.5	
Load Regulation	Nominal input voltage, 5%-100% load		--	±0.5	±0.75	
Transient Recovery Time	25% load step change, nominal input voltage		--	300	500	μs
Transient Response Deviation			--	±3	±5	%
Temperature Coefficient	Full load		--	--	±0.03	%/℃
Ripple & Noise①	Nominal input voltage, 5%-100% load	12V, 15V output	--	80	150	mVp-p
		24V, 28V output	--	100	220	
Trim			90	--	110	%Vo
Sense			--	--	105	
Over-temperature Protection	Max. Case Temperature		--	110	--	℃
Over-voltage Protection	Input voltage range		110	120	140	%Vo
Over-current Protection			110	140	180	%Io
Short-circuit Protection			Hiccup, continuous, self-recovery			

Note: ①By measuring method is used for Ripple and Noise test, please refer to Fig. 4. for recommended circuit.

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-case	2250	--	--	
		Output-case	2250	--	--	
Insulation Resistance	Input-output resistance at 500VDC		100	1000	--	MΩ
Isolation Capacitance	Input-output capacitance at 100kHz/0.1V		--	2500	--	pF
Operating Temperature	See temperature derating curves		-40	--	+85	℃
Storage Temperature			-55	--	+125	
Storage Humidity	Non-condensing		5	--	95	%RH
Pin Soldering Resistance Temperature	Wave-soldering, 10 seconds		--	--	260	℃
	Soldering spot is 1.5mm away from case for 10 seconds		--	--	300	
Shock And Vibration			10-150Hz, 5G, 0.75mm. along X, Y and Z			
Switching Frequency	PWM mode		--	280	--	kHz
MTBF	MIL-HDBK-217F@25℃		500	--	--	k hours

Mechanical Specifications

Case Material	Black plastic; flame-retardant and heat-resistant (UL94 V-0), Aluminum alloy bottom	
Dimension	VRF48_HB-400WR3-N	61.0 x 57.9 x 12.7 mm
	VRF48_HB-400WHR3-N	61.8 x 58.0 x 32.7 mm
Weight	VRF48_HB-400WR3-N	135g(Typ.)
	VRF48_HB-400WHR3-N	215g(Typ.)
Cooling Method	Free air convection (20LFM) or forced air convection	

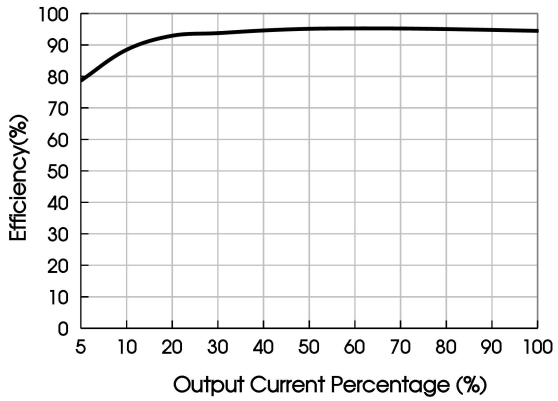
Electromagnetic Compatibility (EMC)

Emissions	CE	CISPR32/EN55032	CLASS A (see Fig.5-1 for recommended circuit)	
		CISPR32/EN55032	CLASS B (see Fig.5-2 for recommended circuit)	
	RE	CISPR32/EN55032	CLASS A (see Fig.5-1 for recommended circuit)	
		CISPR32/EN55032	CLASS B (see Fig.5-2 for recommended circuit)	
Immunity	ESD	IEC61000-4-2	Contact ±6KV/Air ±8KV	perf. Criteria B
	RS	IEC61000-4-3	10V/m	perf. Criteria A
	EFT	IEC61000-4-4	±2KV (see Fig.5-1 or Fig.5-2 for recommended circuit)	perf. Criteria A
	Surge	IEC/EN61000-4-5	line to line ±2kV (see Fig.5-1 or Fig.5-2 for recommended circuit)	perf. Criteria B
	CS	IEC61000-4-6	10 Vr.m.s	perf. Criteria A

Typical Performance Curves

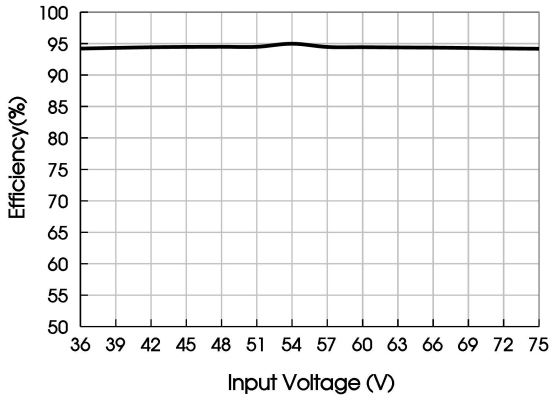
VRF4812HB-400W(H)R3-N

Efficiency Vs Output Load (Vin=48V)



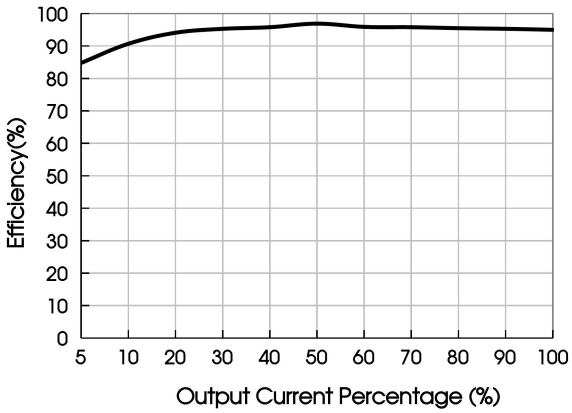
VRF4812HB-400W(H)R3-N

Efficiency Vs Input Voltage (Full Load)



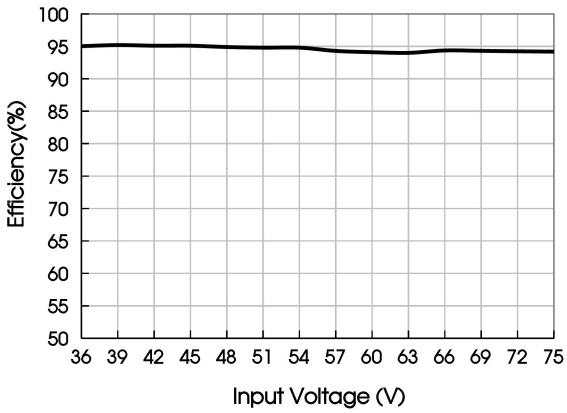
VRF4815HB-400W(H)R3-N

Efficiency Vs Output Load (Vin=48V)

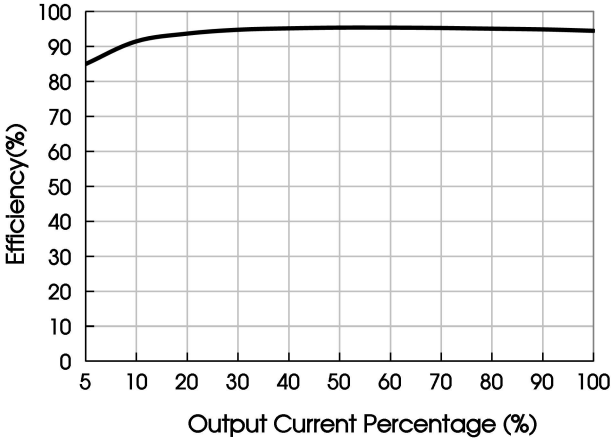


VRF4815HB-400W(H)R3-N

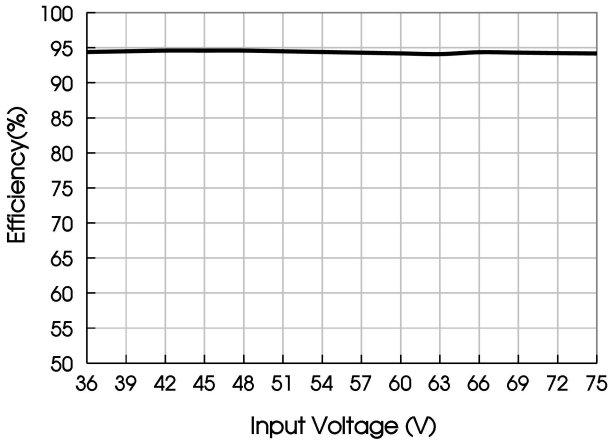
Efficiency Vs Input Voltage (Full Load)



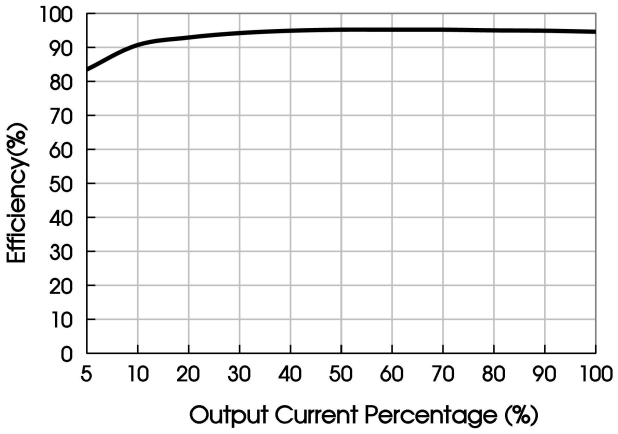
VRF4824HB-400W(H)R3-N
Efficiency Vs Output Load (Vin=48V)



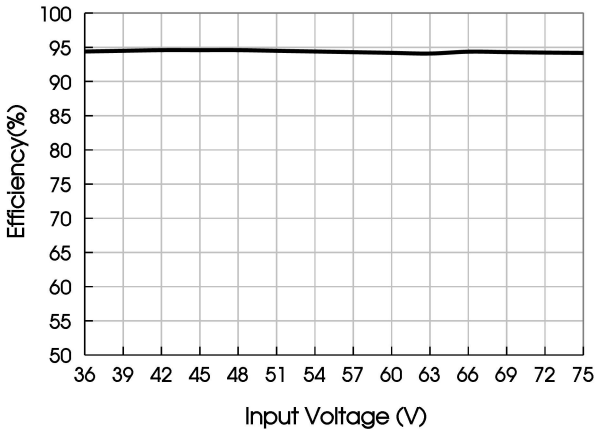
VRF4824HB-400W(H)R3-N
Efficiency Vs Input Voltage (Full Load)



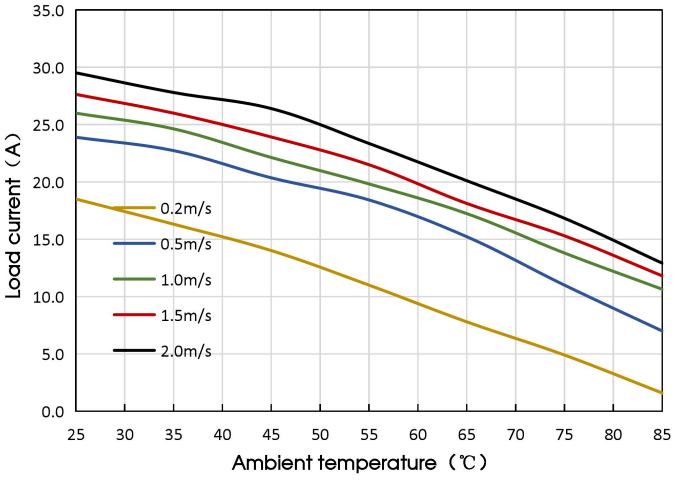
VRF4828HB-400W(H)R3-N
Efficiency Vs Output Load (Vin=48V)



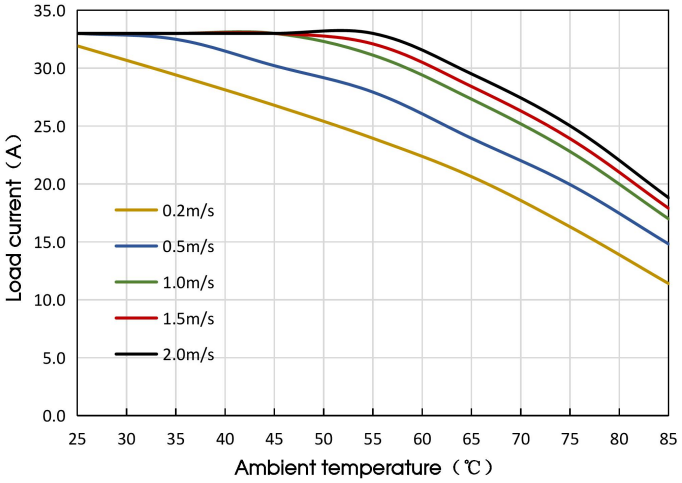
VRF4828HB-400W(H)R3-N
Efficiency Vs Input Voltage (Full Load)



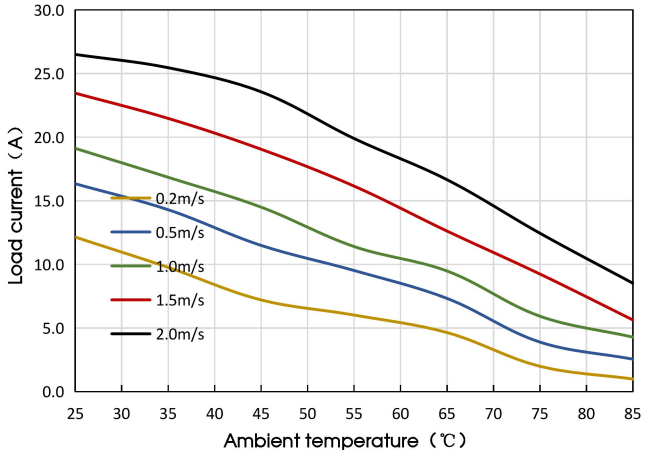
VRF4812HB-400WR3-N
Temperature Derating Curves (Vin=48V)



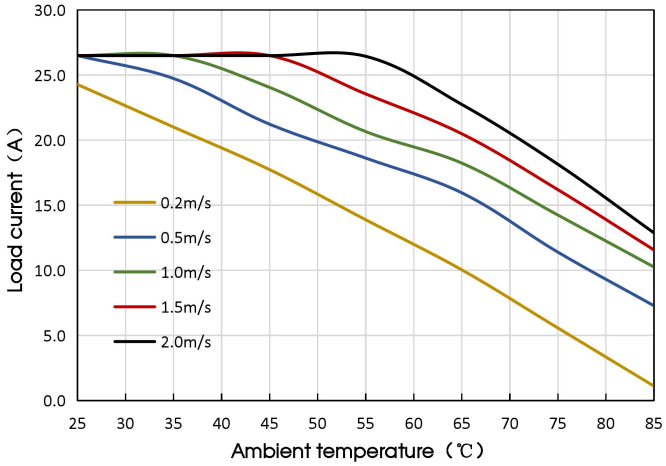
VRF4812HB-400WHR3-N
Temperature Derating Curves (Vin=48V)



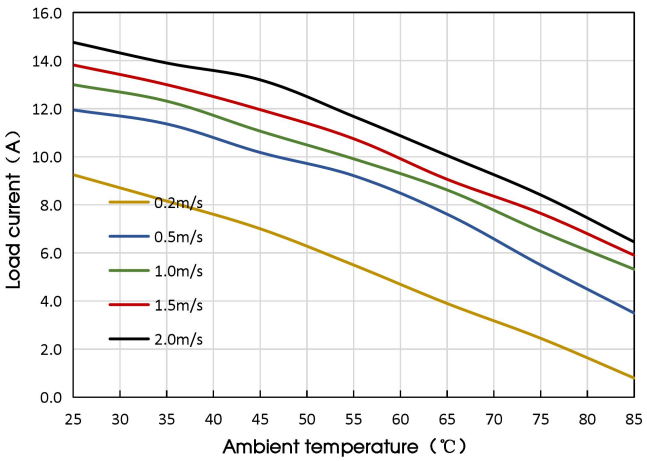
VRF4815HB-400WR3-N
Temperature Derating Curves (Vin=48V)



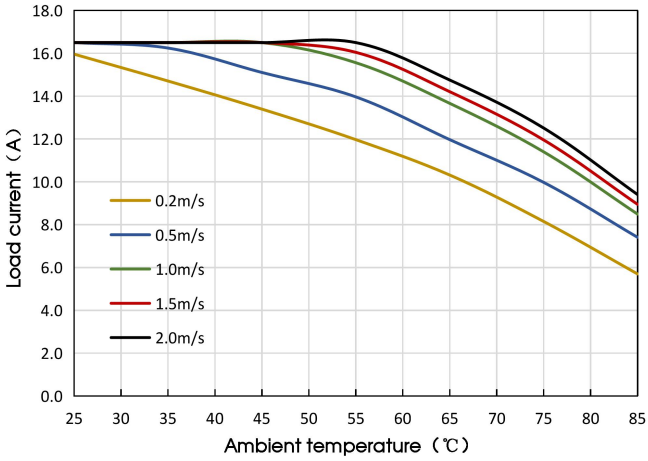
VRF4815HB-400WHR3-N
Temperature Derating Curves (Vin=48V)



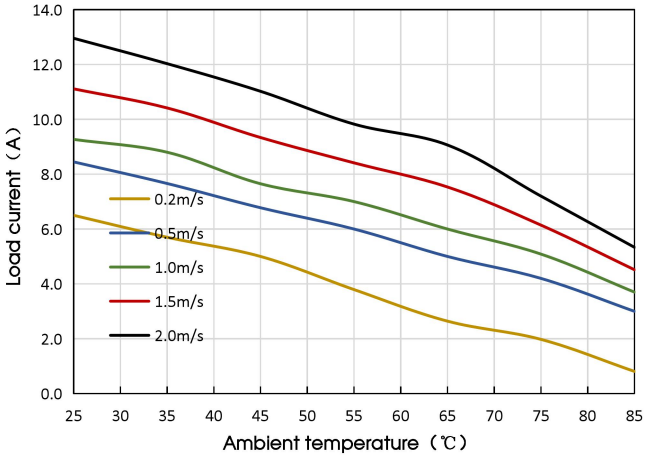
VRF4824HB-400WR3-N
Temperature Derating Curves (Vin=48V)



VRF4824HB-400HR3-N
Temperature Derating Curves (Vin=48V)



VRF4828HB-400WR3-N
Temperature Derating Curves (Vin=48V)



VRF4828HB-400WHR3-N
Temperature Derating Curves (Vin=48V)

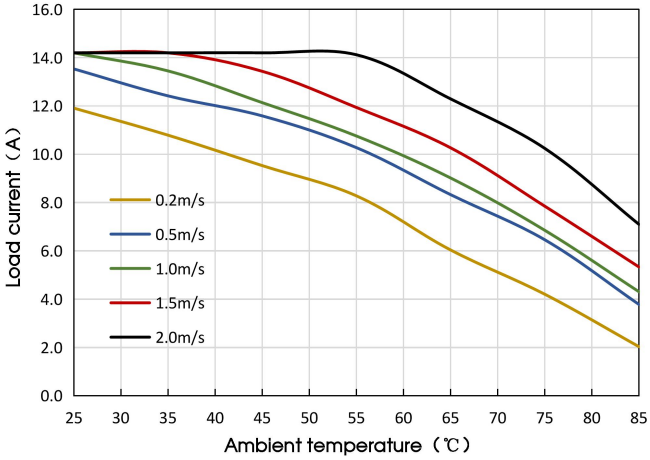


Fig. 1

Remote Sense Application

1. Remote Sense Connection if not used

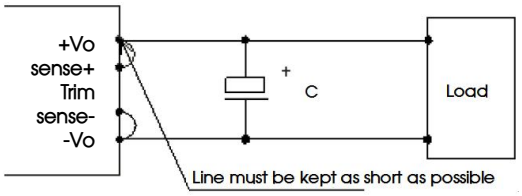


Fig. 2

Notes:

(1) If the sense function is not used for remote regulation the user must connect the +Sense to +Vo and -Sense to -Vo 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

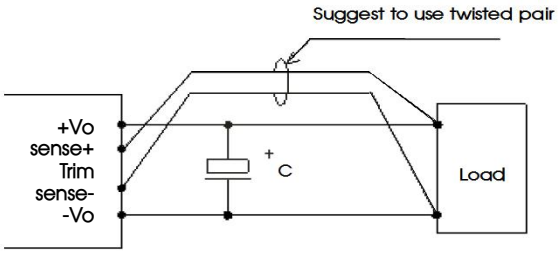


Fig. 3

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

We recommended using Mornsun's EMC circuit, 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.

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.

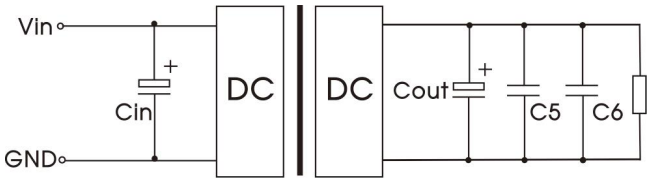


Fig.4

Vout (VDC)	Cin	Cout	C5	C6
12	220μF/ 100V	470μF/ 50V	1μF/25V	10μF/25V
15				
24			1μF/50V	10μF/50V
28				

2. EMC solution-recommended circuit

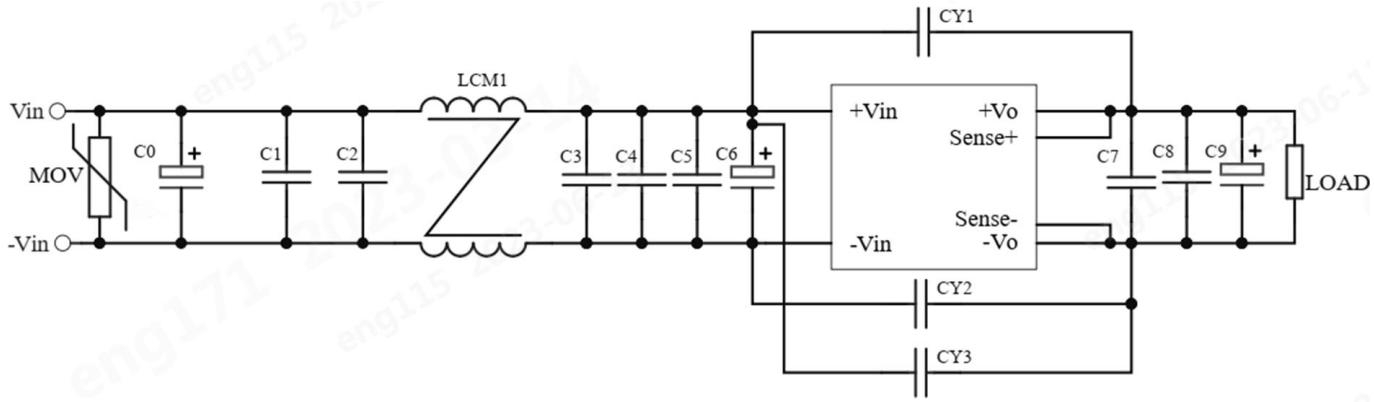


Fig. 5-1

Components	Recommended Component Value
MOV	S14K60 (Varistor)
C0	680μF/100V electrolytic capacitor
C6	470μF/100V electrolytic capacitor
C9	470uF/50V electrolytic capacitor
C1, C2, C3, C4, C5	4.7μF/100V ceramic capacitor
C7, C8	4.7μF/50V ceramic capacitor
LCM1	4mH/15A
CY1, CY2	2.2nF/400VAC Y1 safety capacitor
CY3	1nF/400VAC Y1 safety capacitor

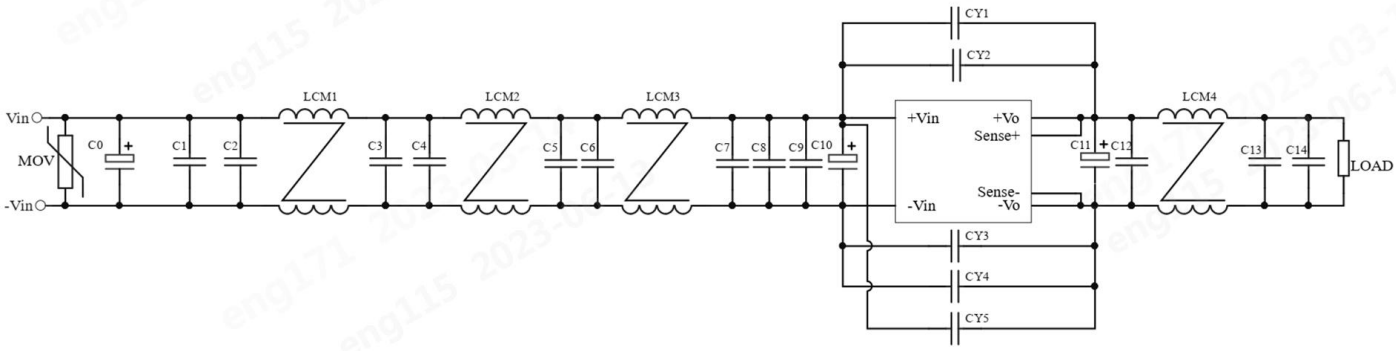


Fig. 5-2

Components	15VDC Output	Other Output
MOV	S14K60 (Varistor)	S14K60 (Varistor)
C0	680μF/100V electrolytic capacitor	680μF/100V electrolytic capacitor
C10	470μF/100V electrolytic capacitor	470μF/100V electrolytic capacitor
C11	470uF/50V electrolytic capacitor	470uF/50V electrolytic capacitor
C1, C2, C3, C4, C5, C6, C7, C8, C9	4.7μF/100V ceramic capacitor	4.7μF/100V ceramic capacitor
C12,C13,C14	4.7μF/50V ceramic capacitor	4.7μF/50V ceramic capacitor
LCM1	4mH/15A	4mH/15A
LCM2, LCM3	1mH/15A	1mH/15A
LCM4	100uH/40A	100uH/40A
CY1, CY3	2.2nF/400VAC Y1 safety capacitor	2.2nF/400VAC Y1 safety capacitor
CY2, CY4	2.2nF/400VAC Y1 safety capacitor	/
CY5	1nF/400VAC Y1 safety capacitor	1nF/400VAC Y1 safety capacitor

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

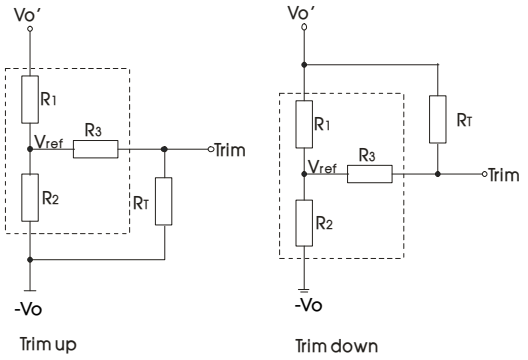


Fig. 6

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 Vref refer to the above table 1.
RT: Resistance of Trim.
a: User-defined parameter, no actual meanings.
Vo': The trim up/down voltage.

Tab 1

Resistance \ Vo	12(VDC)	15(VDC)	24(VDC)	28(VDC)
R1(KΩ)	24.77	31.53	52.19	61.11
R2(KΩ)	2.87	2.87	2.87	2.87
R3(KΩ)	17.1	17.1	17.1	17.1
Vref(V)	1.25	1.25	1.25	1.25

4. Reflected ripple current testing

All DC-DC converters of this series are tested using the recommended circuit shown in Fig. 7.

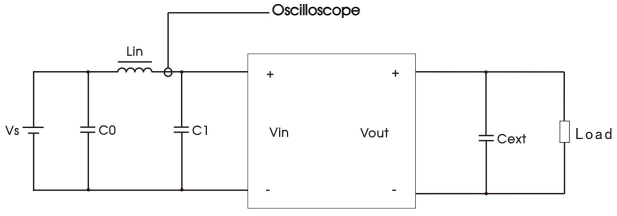


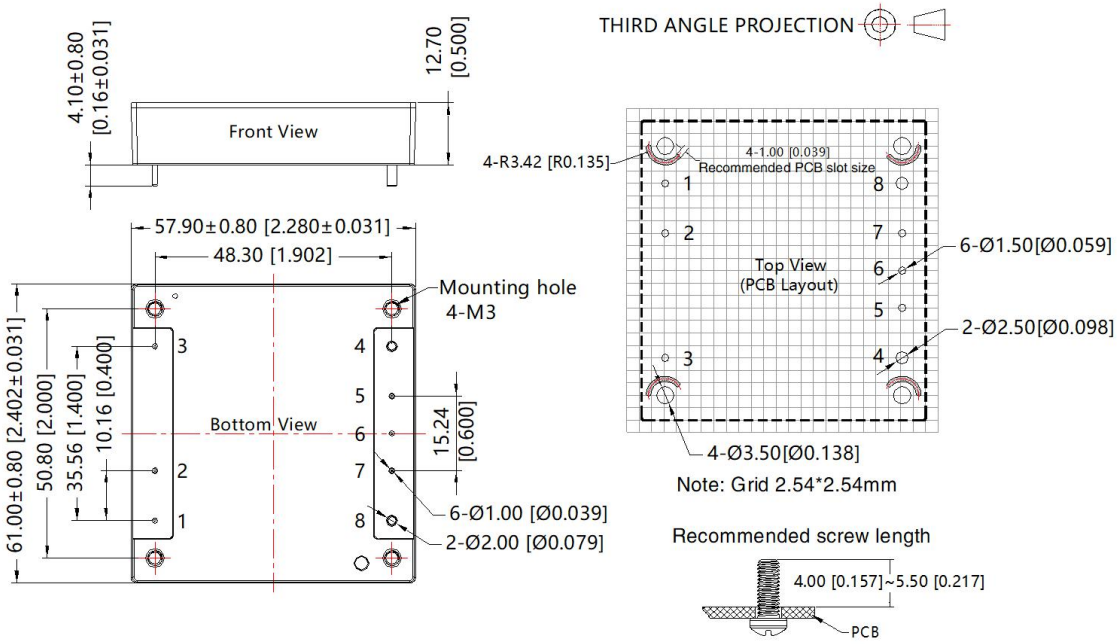
Fig. 7

Components	Recommended Component Value
C0	220μF/100V
Lin	10uH/15A
C1	470μF/100V
Cext	470μF/50V

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

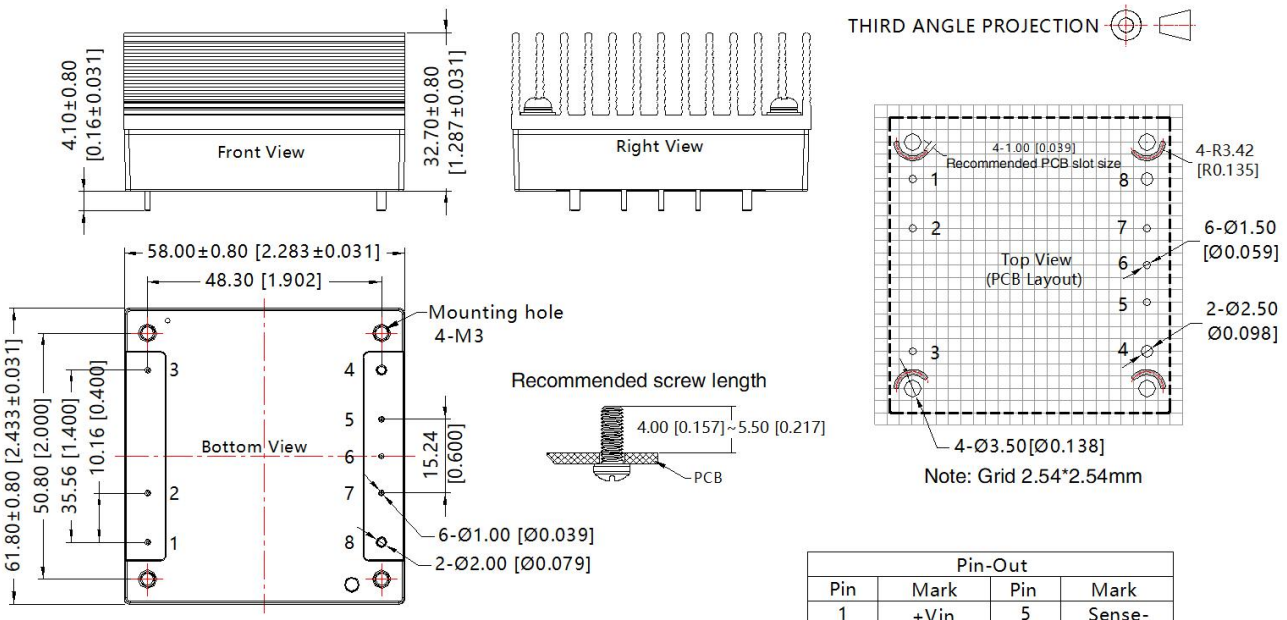
VRF48_HB-400WR3-N Dimensions and Recommended Layout



Note:
Unit: mm[inch]
Pin1, 2, 3, 5, 6, 7diameter: 1.00[0.039]
Pin4, 8diameter: 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	5	Sense-
2	Ctrl	6	Trim
3	-Vin	7	Sense+
4	-Vo	8	+Vo

VRF48_HB-400WHR3-N Dimensions and Recommended Layout



Note:
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General tolerances: ±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N・m

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

Notes:

1. For additional information on Product Packaging please refer to www.mornsun-power.com. Packaging bag number: 58200069(without heatsink), 58200061(with heatsink);
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.

Mornsun Guangzhou Science & Technology Co., Ltd.
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