AC/DC1000W Enclosed Switching Power Supply

LMF1000-20Bxx(-Q) Series

MORNSUN®

RoHS

5 years Warranty

FEATURES

- Wide range Input voltage 90 - 264VAC or 120 - 390VDC
- Accepts AC or DC input (dual-use of same terminal)
- Operating ambient temperature range: -40℃ to +70℃ (Non-condensing)
- High reliability, efficiency up to 94%
- 1 U height
- Wide range of adjustable output voltage
- Output short circuit, over-current, over-voltage protection, over-temperature protection
- Support 3+1 parallel redundancy, current sharing
- Built-in active PFC function
- Operating up to 5000m altitude
- Safety according to IEC/UL/EN62368, IEC/ES/EN60601, GB4943
- Fan speed automatic adjustable

LMF1000-20Bxx series is one of Mornsun's enclosed AC-DC switching power supply. It features universal AC input and at the same time accepts DC input voltage, cost-effective, low no load power consumption, high efficiency, high reliability and double or reinforced insulation. These converters offer excellent EMC performance and meet IEC/EN61000-4, CISPR32/EN55032, IEC/UL/EN62368, EN60335, EN60601, GB4943 standards and they are widely used in areas of industrial, LED, street light control, electricity, security, telecommunications, smart home, etc.

Selection Guide*

Certification	Part No.*	Output Power (W)		Nominal Output Voltage and Current (Vo/Io)	Main Output Voltage Adjustable Range ADJ (V)	Efficiency at 230VAC (%) Typ.	Max. Capacitive Load (μF)
/	LMF1000-20B12	960	Main	12V/80A	12-14.4	92	40000
		10	Auxiliary	5V/2A	/		1000
	LMF1000-20B24	1008	Main	24V/42A	24-28.8	94	10000
		10	Auxiliary	5V/2A	/		1000
	LMF1000-20B48	1008	Main	48V/21A	48-56		4000
		10	Auxiliary	5V/2A	/		1000

Note:1.*For all applications, please refer to LMF1000-20B(-Q) Series Power Supply Application Notes.
2.*Use suffix"-Q"for conformal coating.

Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Input Voltage Range	AC input		90	--	264	VAC
	DC input		120	--	390	VDC
Input Voltage Frequency			47	--	63	Hz
Input Current	115VAC		--	--	12	A
	230VAC		--	--	6	
Inrush Current	115VAC	Cold start	--	20	--	
	230VAC		--	40	--	
Power Factor	115VAC	Room-temperature, full load	PF≥0.99			
	230VAC		PF≥0.95			
Contact Leakage Current	240VAC		<0.5mA			

Output Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Output Voltage Accuracy	Main		--	±1	--	%
	Auxiliary		--	±2	--	
Line Regulation	Main output full load		--	±0.5	--	
	Auxiliary output full load		--	±1	--	
Load Regulation	Main (5%-100% load)		--	±0.5	--	
	Auxiliary (5%-100% load)		--	±1	--	
Ripple & Noise*	20MHz bandwidth (peak-to-peak value)	12V	--	150	--	mV
		24V	--	150	--	
		48V	--	200	--	
		Auxiliary	--	100	--	
Temperature Coefficient			--	±0.03	--	%/℃
Short Circuit Protection			Hiccups, continuous, self-recover			
Over Current Protection			≥110%Io, self-recover			
Over Voltage Protection	12V		≤16.5V (Output voltage turn off, re-power on for recover or PS_ON signal control recovery)			
	24V		≤33V (Output voltage turn off, re-power on for recover or PS_ON signal control recovery)			
	48V		<60V (Output voltage turn off, re-power on for recover or PS_ON signal control recovery)			
	Auxiliary		<7V (Output voltage turn off, re-power on for recover or PS_ON signal control recovery)			
Over-temperature Protection	Over-temperature Protection Activation		--	--	70	℃
	Over-temperature Protection Deactivation		50	--	--	
Minimum Load			0	--	--	%
Hold-up Time	Room-temperature, full load	115VAC	--	12	--	ms
		230VAC	--	12	--	
Fan	The fan speed is determined by the ambient temperature and output power and linearly adjusted					

Note: *The "Tip and barrel method" is used for ripple and noise test, output parallel 47uF electrolytic capacitor and 0.1uF ceramic capacitor, please refer to Enclosed Switching Power Supply Application Notes for specific information.

General Specifications

Item		Operating Conditions			Min.	Typ.	Max.	Unit
Isolation Test	Input - output	Electric Strength Test for 1min., leakage current <10mA			4000	--	--	VAC
	Input - ⏚				2000	--	--	
	Output - ⏚				1250	--	--	
Insulation Resistance	Input - output	Environment temperature: 25±5℃, Relative humidity: <95%RH, non-condensing Testing voltage: 500VDC			100	--	--	MΩ
	Input - ⏚				100	--	--	
	Output - ⏚				100	--	--	
Operating Temperature					-40	--	+70	℃
Storage Temperature					-40	--	+85	
Storage Humidity		Non-condensing			10	--	95	%RH
Operating Humidity					20	--	90	
Switching Frequency		PFC circuit			--	65	--	kHz
		LLC circuit			--	100	--	
Power Derating		Operating temperature derating	-40℃ to -30℃		5.0	--	--	%/℃
			+45℃ to +70℃	12V	1.6	--	--	
			+50℃ to +70℃	24V/48V	2.0	--	--	
		Input voltage derating	90VAC to 100VAC		2.0	--	--	%/VAC
Safety Standard					Meet IEC/UL/EN62368 IEC/ES/EN60601-1-2:2015 Edition 4			
Safety Class					CLASS I			

Isolation level	Input - output		2 x MOPP
	Input - ⏚		1 x MOPP
	Output - ⏚		1 x MOPP
MTBF		MIL-HDBK-217F@25℃	≥250,000 h

Mechanical Specifications

Case Material	SUS 304
Dimensions	190.0 x 127.0 x 40.5 mm
Weight	1.25Kg (Typ.)
Cooling Method	Forced cooling

Electromagnetic Compatibility (EMC)

Emissions	CE	CISPR32/EN55032 CLASS B	
	RE	CISPR32/EN55032 CLASS B	
	Harmonic current	EN61000-3-2 CLASS A	
	Flicker	IEC/EN61000-3-3	
Immunity	ESD	IEC/EN 61000-4-2 Contact ±6KV/Air ±8KV	perf. Criteria A
	RS	IEC/EN 61000-4-3 10V/m	perf. Criteria A
	EFT	IEC/EN 61000-4-4 ±2KV	perf. Criteria A
	Surge	IEC/EN 61000-4-5 line to line ±2KV/line to ground ±4KV	perf. Criteria A
	CS	IEC/EN61000-4-6 10 Vr.m.s	perf. Criteria A
	Voltage dips, short interruptions and voltage variations	IEC/EN61000-4-11 0%, 70%	perf. Criteria B

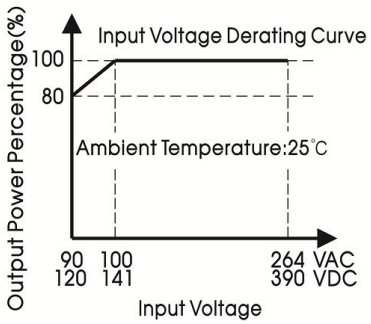
Note: *The power supply should be considered as a part of the components in the system. RE performance are been tested on a metal plate with a thickness of 1mm and a length of 360mm x 360mm. The power supply must be combined with the terminal equipment for electromagnetic compatibility confirmation.

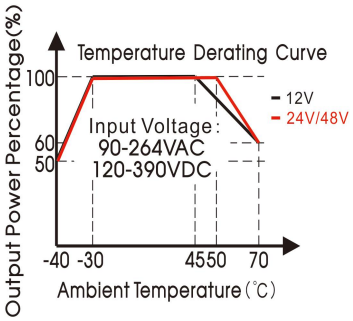
Functional Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Remote Control Switch	All Input Voltage Range All load range	Power On	PS_ON (CN2 Pin6) and GND (CN2 Pin7/14) are short			/
		Power Off	PS_ON (CN2 Pin6) and GND (CN2 Pin7/14) are open			
DC_OK Signal	All Input Voltage Range All load range	Power On	2.5	--	5	V
		Power Off	--	--	0.5	
Oring			Support direct parallel use, achieve 3+1 parallel redundancy			
Current Sharing Accuracy	When multiple are connected in parallel, the Sub-module shunts a single machine above 50% of the rated load		-5	--	+5	%
LED Signal	Main output status indication	Normal Output	Steady green			/
		Abnormal Output, protected	Steady red			
		Power Off (AC Without Input)	Turn-off			
Remote Sense	Total compensate voltage (Vs+/Vs- shorted to Vo+/V0- respectively)		--	200	--	mV
SDA, SCL for I 2 C			Internal 2.4 kΩ pull-up resistor to internal 3.3 V			

Note: *Please refer to LMF1000-20Bxx(-Q) Series Power Supply Application Notes for relevant function control logic and instructions.

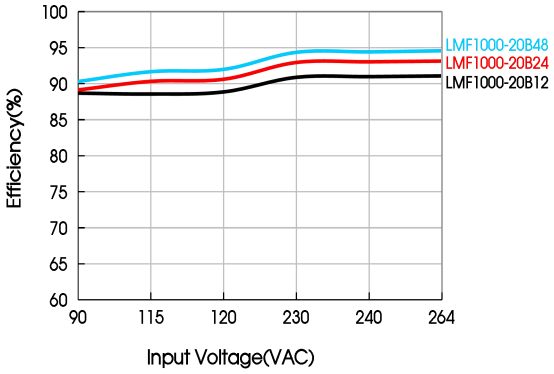
Product Characteristic Curve



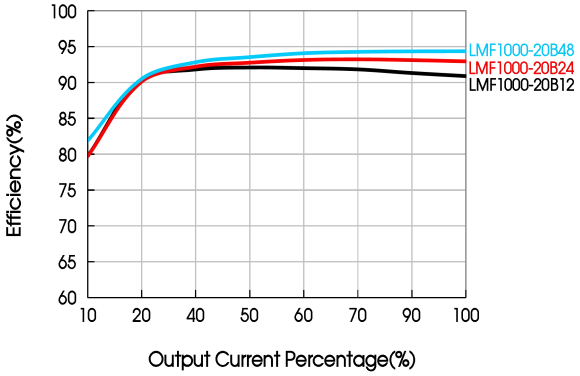


Note: With an AC input voltage between 90-100VAC and a DC input between 120-141VDC the output power must be derated as per the temperature derating curves.

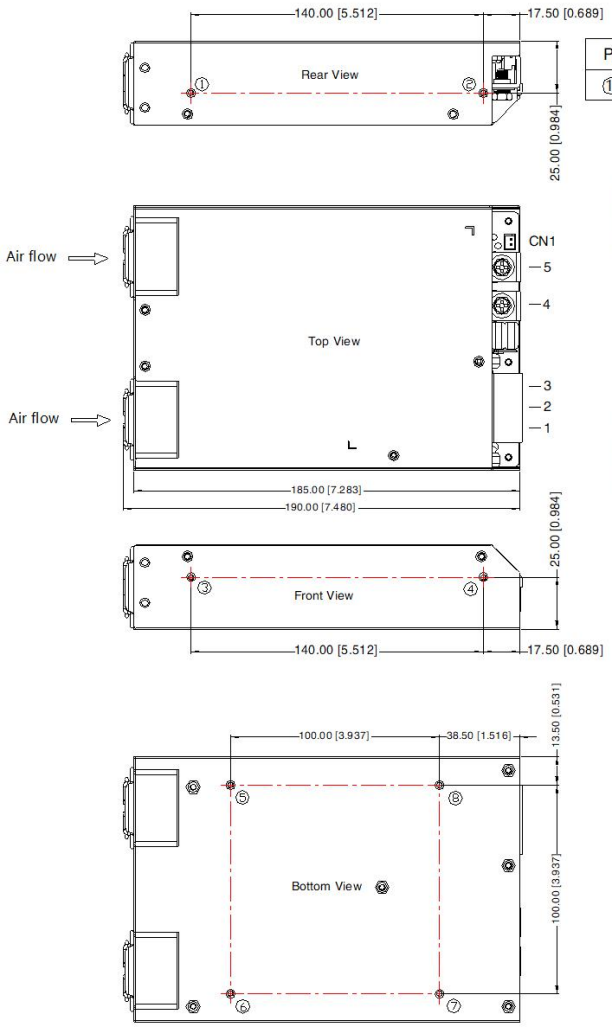
Efficiency Vs Input Voltage (Full Load)

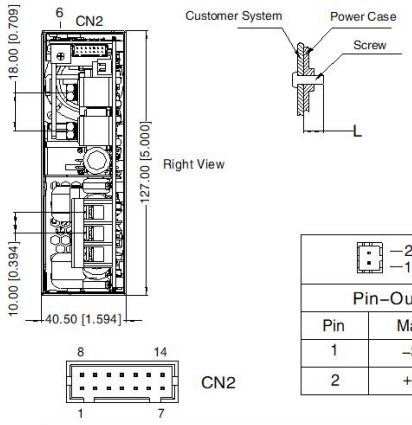


Efficiency Vs Output Load (Vin=230VAC)



Dimensions and Recommended Layout





Position	Screw Spec.	L(Recommend)	Torque(max)
①–⑧	M3	3mm	0.8N · m

Pin-Out	
Pin	Mark
1	AC(L)
2	AC(N)
3	⏚
4	–Vo Main output
5	+Vo Main output
6	ADJ Output adjustable resistor

CN1 (Auxiliary output)

Pin-Out		Customer Connector
Pin	Mark	
1	–S	Connector: XHS2.5–2Y (KANGDAO) or equivalent Terminal: XH2.5–TE (KANGDAO) or equivalent
2	+S	

Pin-Out				Customer Connector
Pin	Mark	Pin	Mark	
1	VS+	8	VS–	Connector: JST PHDR–14VS or equivalent Terminal: JST SPHD–002T–P0.5 or equivalent
2	CURRENT SHARE	9	ADDRESS0	
3	DC_OK	10	ADDRESS1	
4	SCL	11	ADDRESS2	
5	SDA	12	RXD	
6	PS_ON	13	TXD	
7	GND	14	GND	

Note:
Unit: mm[inch]
Pin1,2,3 wire range: 22-12AWG
Pin1,2,3 connector tightening torque: M4, 1.2N ▪ m(max)
Pin4,5 connector tightening torque: M5, 2.3N ▪ m(max)
General tolerances: ±1.00[±0.039]

Note:

1. For additional information on Product Packaging please refer to www.mornsun-power.com. Packaging bag number: 58220175;
2. 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;
3. The room temperature derating of 5℃/1000m is needed for operating altitude greater than 2000m;
4. All index testing methods in this datasheet are based on our company corporate standards;
5. In order to improve the efficiency at high input voltage, there will be audible noise generated, but it does not affect product performance and reliability;
6. We can provide product customization service, please contact our technicians directly for specific information;
7. Products are related to laws and regulations: see "Features" and "EMC";
8. The out case needs to be connected to PE (⏚) of system when the terminal equipment in operating;
9. The output voltage can be adjusted by the ADJ, clockwise to decrease;
10. Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units;
11. The power supply is considered a component which will be installed into a terminal equipment. All EMC tests should be confirmed with the final equipment. Please consult our FAE for EMC test operation instructions.
12. In the appearance dimension drawing, ±Vo represents the main output, ±S represents the auxiliary output, and the auxiliary output can be selected by the customer, which has no effect on the main output.

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LMF1000-20Bxx(-Q) Series Power Supply Application Notes

Content

1. Overview

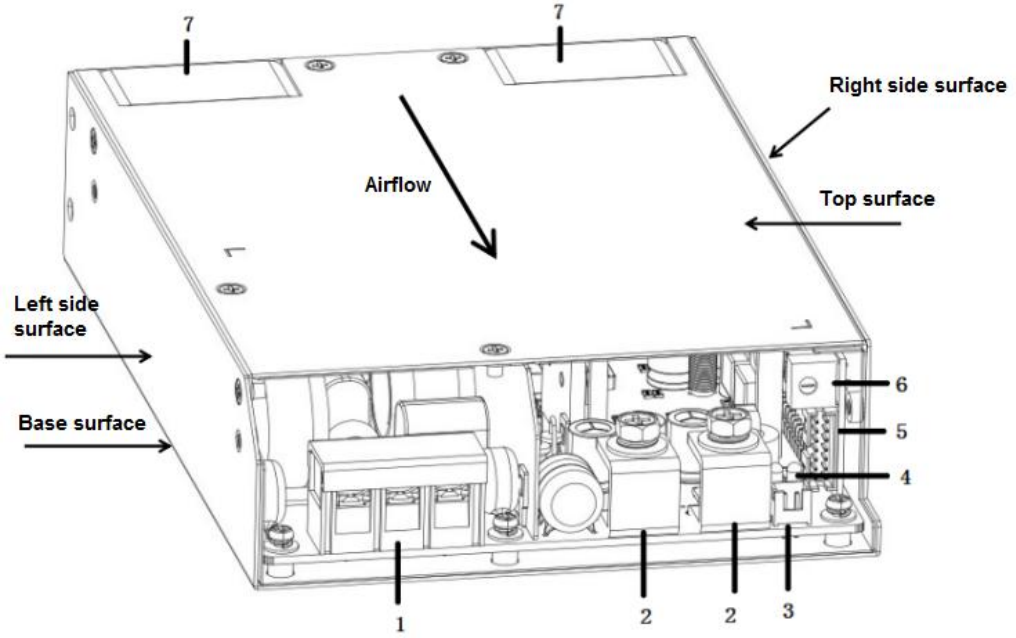


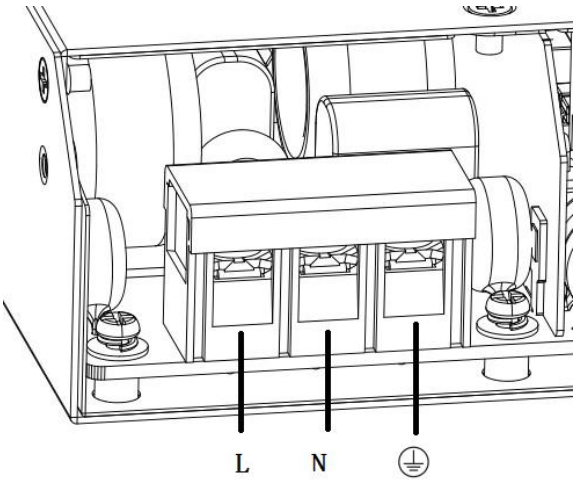
Fig. 1: Appearance information of LMF1000-20Bxx

Composition structure description

1. AC/DC input terminal (J1)
2. DC main output terminal (J2, J3)
3. Auxiliary road output terminal (CN1)
4. Green and red status display LED lights
5. Signal connection Press the terminal (CN2)
6. Output voltage regulation knob
7. Fans

1.1 AC/DC input terminal block (J1)

J1 is the input terminal adopts a standard 3-pin fence welding terminal with upper cover, and the center spacing of the pins is 10mm.

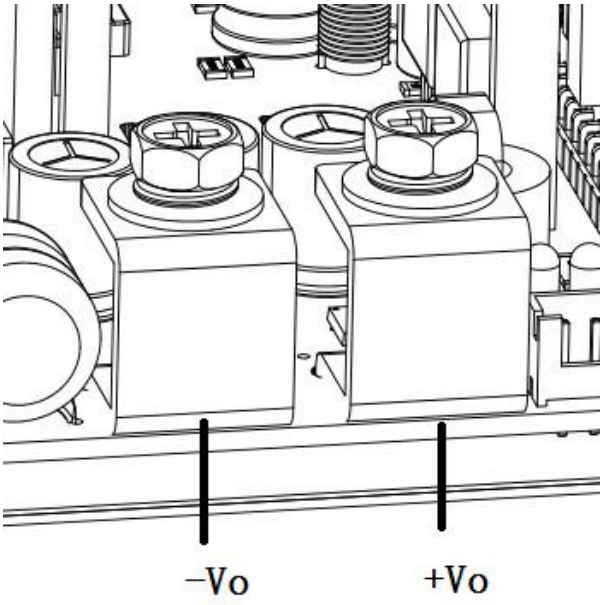


Pin	Features
L	Line (Phase)
N	Neutral
⏚	Ground/Earth

Wire size: 12-18 AWG
Torque: 1.8Nm

1.2 Main DC output terminal (J2)

J2 is the output terminal adopts two standard screw lock type metal terminals with a 2 Pin spacing of 18mm.

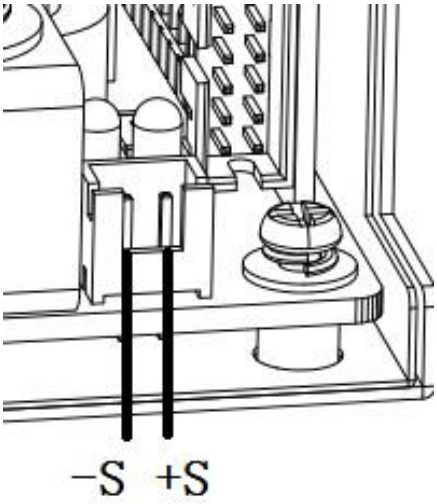


Pin	Features
+Vo	Main Output -
-Vo	Main Output +

Wire size: 4 - 12 AWG
Torque: 2.3Nm

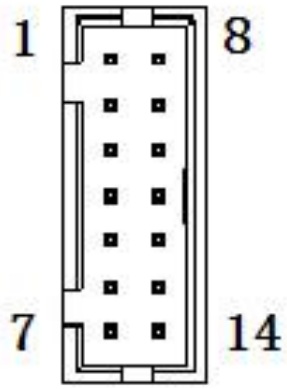
1.3 Auxiliary DC Output Terminal (CN1)

The auxiliary DC Output terminals adopt standard 2.5mm pitch terminals.



Pin	Function
-S	Auxiliary DC Output -
+S	Auxiliary DC Output +

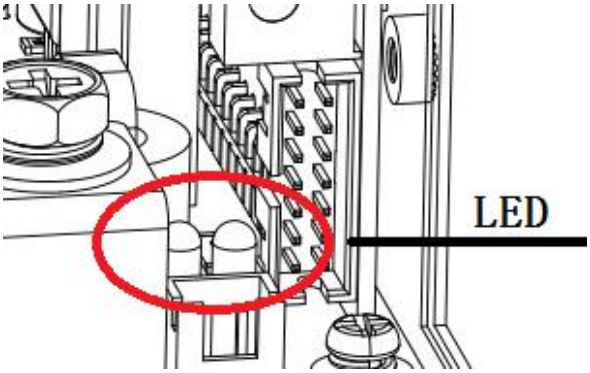
1.4 Signal port (CN2)



Pin	Label	Features
1	VS+	Remote compensation positive end
2	CURRENT SHARE	Current sharing bus
3	DC_OK	DC_OK Signal
4	SCL	I2C communication line
5	SDA	I2C communication line
6	PS_ON	Remote Control signal
7	GND	Signal terminal reference ground
8	VS-	Remote compensation negative terminal
9	ADDRESS0	ADDRESS code 0
10	ADDRESS1	ADDRESS code 1
11	ADDRESS2	ADDRESS code 2
12	RXD	Serial communication
13	TXD	Serial communication
14	GND	Signal terminal reference ground

Note: The reference ground of all pins on the signal terminal is pin7 and pin8.

1.5 Green and red status display LED lights

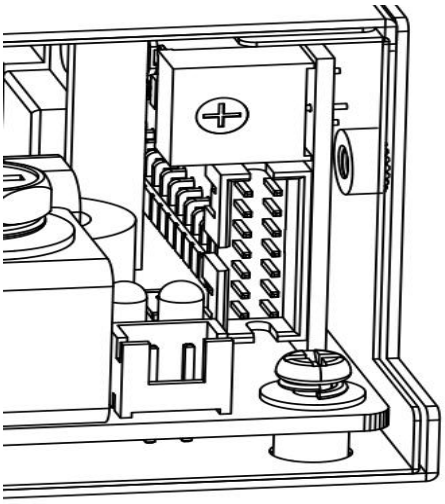


Two kinds of LED lights indicate difference working states of the power supply :

Green LED	Red LED	Status
ON	OFF	Normal work
OFF	ON	Main or auxiliary road alarm
OFF	OFF	No AC input

1.6 Output voltage adjustment knob

Turn counterclockwise to increase output voltage



Model	Rated Ouput Voltage	Adjustable Range Of Output Voltage
LMF1000-20B12	12V	12 -14.4V
LMF1000-20B24	24V	24 - 28.8V
LMF1000-20B48	48V	48 - 56V

2. Function Manual

2.1 Input Requirements

The AC input voltage and DC input voltage must be at the specified voltage (refer to the number table), and the power supply may not work properly or even malfunction. The internal L line and N line of the power module have been connected in series with a 250V 20A fuse. For better protection of the module, it is recommended that customers use a circuit breaker not greater than 20A. (Non-mandatory requirements)

2.2 Output Requirements

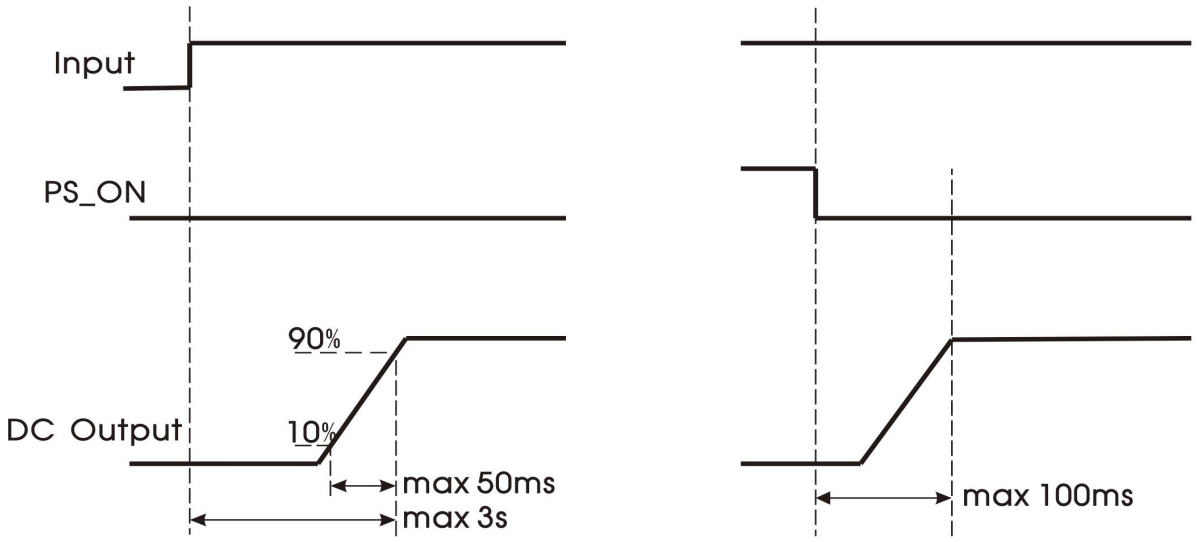
Main Output

At any voltage value, the maximum output current and power must not exceed the rated/specified value. The output current must not exceed the maximum output current value.

Auxiliary output

The auxiliary circuit supports a maximum current of 2A.

2.3 Start-up timing



Item	Operating Conditions		Min.	Typ.	Max.	Unit
Power-down Hold Time	Room temperature, full load	115VAC	--	12	--	ms
		230VAC	--	12	--	
Start Delay Time	230VAC, full load		--	--	3	s
Output Rise Time	Output Voltage From 10%-90%		--	--	50	ms

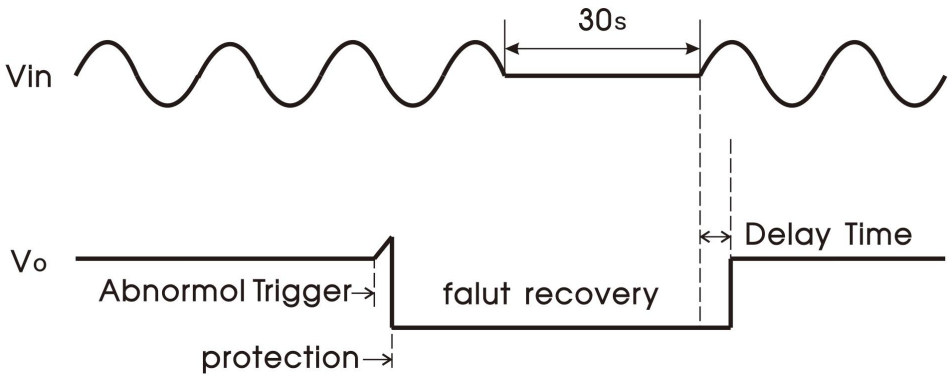
2.4 Fan Speed Control

The fan speed is determined by the ambient temperature output power, and linearly adjusts, when the ambient temperature is greater than 45℃ and the output is greater than 600W, the fan reaches 100% speed. In order to improve the feasibility of the power supply block, in the no-load state and the ambient temperature is higher than -5℃, the fan maintains a minimum speed of 10%, and the ambient temperature is lower than -5℃, the fan will stop rotating.

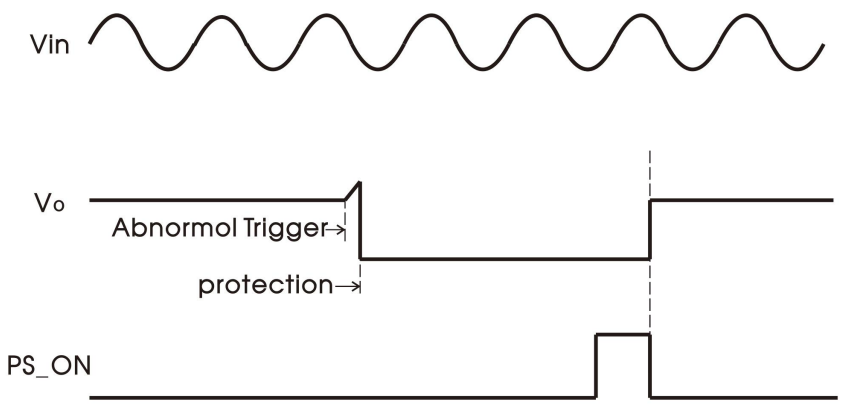
2.5 Output over-voltage protection (OVP)

Main Output

The over-voltage protection function is to close the main circuit output when the output voltage reaches the protection voltage value. After the main circuit over-voltage protection occurs, the main circuit output of the building block is disconnected, and the auxiliary circuit output is not affected. The input power supply needs to be disconnected for at least 30S to resume main output.



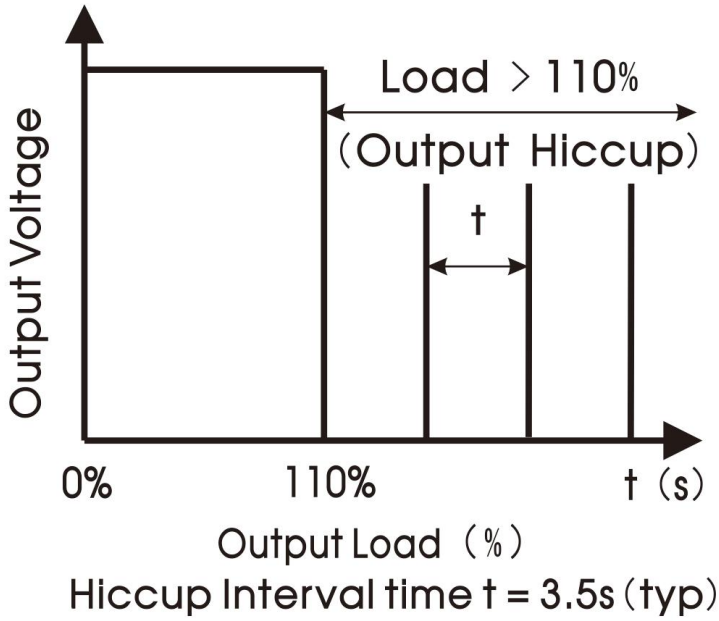
In addition, it can be quickly restarted by the PS_ON signal:



Secondary output

When the auxiliary circuit reaches 7Vdc (maximum value), the auxiliary circuit output is in the playing state, and the circuit has no output until the paving output returns to normal after the elimination of the fault.

2.6 Output over-current protection (OCP)



Hiccup Interval time t = 3.5s (typ)

Main output

When the output current exceeds 110%(minimum), the DC output is turned off. The OCP protection function is to use snoring mode. After the over-current state is eliminated, the main path output is automatically recovered, and the auxiliary output will not be affected.

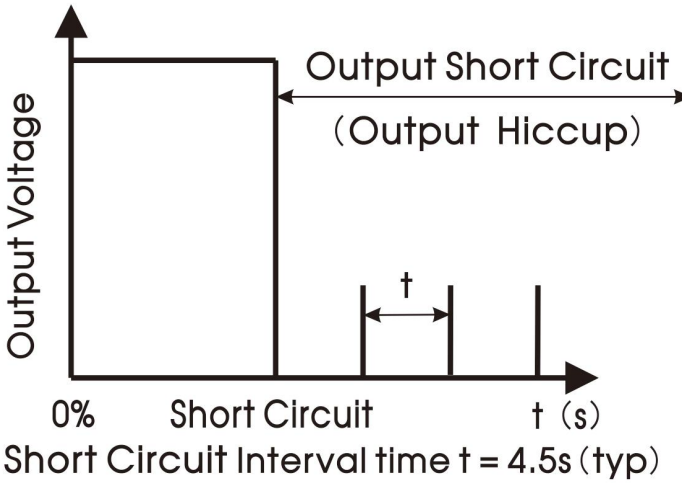
The main output has an OCP delay function, and the main output is turned off after the output current reaches 120% (typical value) of the rated load current for 300ms. After the main circuit is programmed to reach 150% (typical value) of rated load current 15ms, turn off the main circuit output.

When the output current of the auxiliary circuit exceeds 120% (typical value) of the rated current, the main circuit output will be closed. After the auxiliary circuit over-current condition is eliminated, the main circuit will automatically return to the output.

2.7 Output short circuit protection (SCP)

When the output is short-circuited, the power output is in hiccup mode normal, and the lubrication interval is 4.5S, after the short-circuit is eliminated, the power block automatically return to normal, the auxiliary output is not affected.

When the road output a short circuit, the main road has no output.



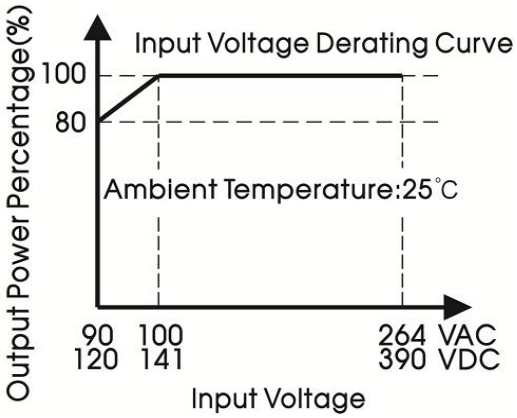
2.8 Over temperature protection (OTP)

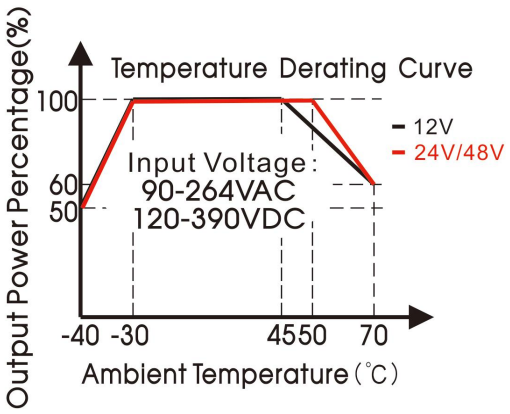
When the ambient temperature of the power supply exceeds the rated temperature for a period of time, the power supply will be turned off and the power supply will resume normal operation after the ambient temperature drops to the set value.

2.9 Output power derating

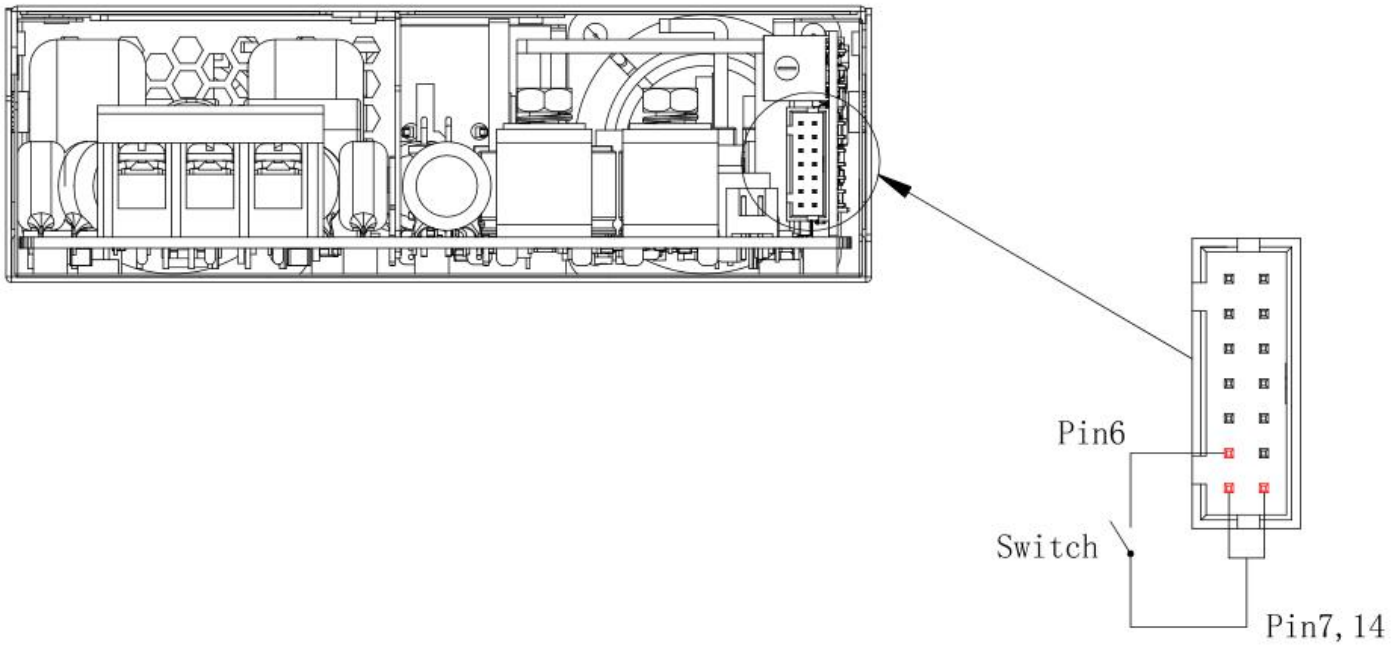
When the input voltage is greater than 100VAC (or 141VDC), only need to derate according to the temperature derating curve.

When the input voltage is lower than 100VAC (or 141VDC), the output power will be derated according to the following input voltage derating curve after temperature derating.





2.10 Remote control switch machine



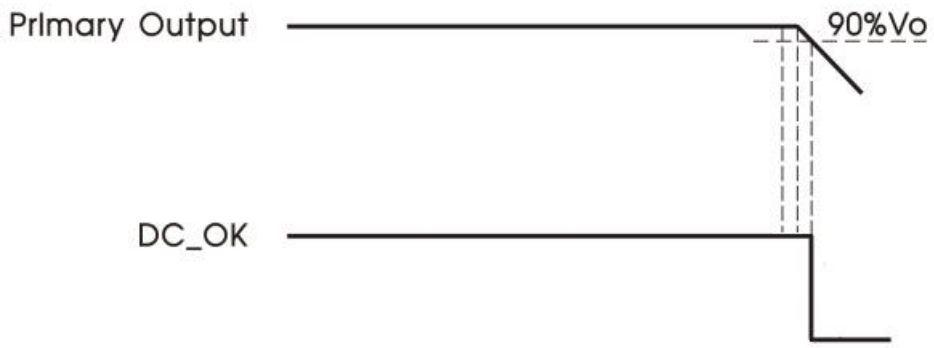
PS_ON (Pin6) and GND (Pin7or Pin14)	Output status
Short-Circuit	ON
Pin Floating	OFF

If the input of the power block has been connected to the power supply, the PS_ON signal pin can be used to control the on and off of its main output, the PS_ON signal does not affect the output voltage of the auxiliary circuit. Notes: PS_ON input positive resistance 5.1K inside the module.

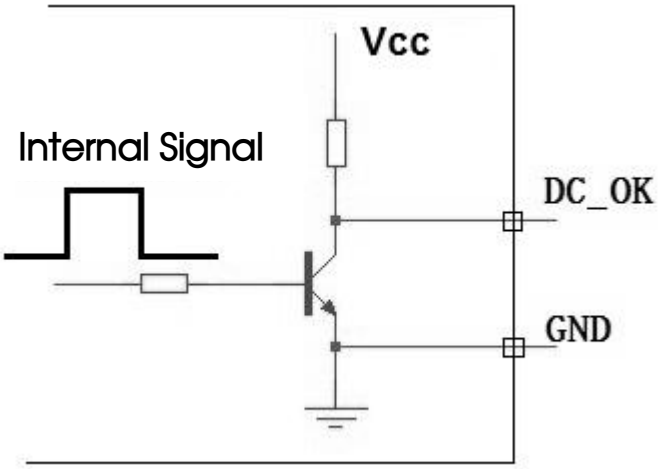
2.11 DC_OK Signal

The DC_OK signal is used to monitor whether the power supply is working normally, and the signal is at Pin3 of the signal terminal CN2.

Note: When the DC_OK signal is connected to the external circuit, the impedance of the external external circuit (i.e. between Pin3 and Pin7 or Pin14 of CN2) is not less than 10kΩ.

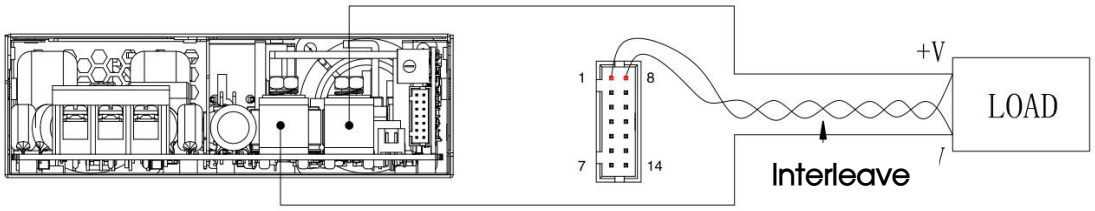


Output Current = 100%Rating



DC_OK (Pin3) and GND (Pin7or Pin14)	Output state
2.5 - 5V	ON
0 - 0.5V	OFF

2.12 Remote compensation



Note: VS+ and VS- cannot be short-circuited or reversely connected, incense will damage the power supply block.

Pin 1 and pin 8 of the signal terminal CN2 can compensate the voltage drop on the output cable.

The remote compensation circuit can compensate up to 200mV cable voltage drop. This voltage includes the sum of the cable drop connected to the output positive terminal and the output negative terminal.

If you need to use the near-end compensation function, the signal pin needs to be connected with the load end with a twisted pair, otherwise the power module will be damaged.

2.13 Parallel operation

2.13.1 Redundancy

The power building has determined that it can be connected in parallel to achieve redundancy, thereby improving system reliability. The maximum power of the redundant system needs to be designed for reduction to ensure that the redundant system can meet the rated load requirements when a power module fails, at present, the general storage method is the N+1 method to construct a redundant system, that is N+1 power supply wells, supporting the maximum load current N*Iomax.

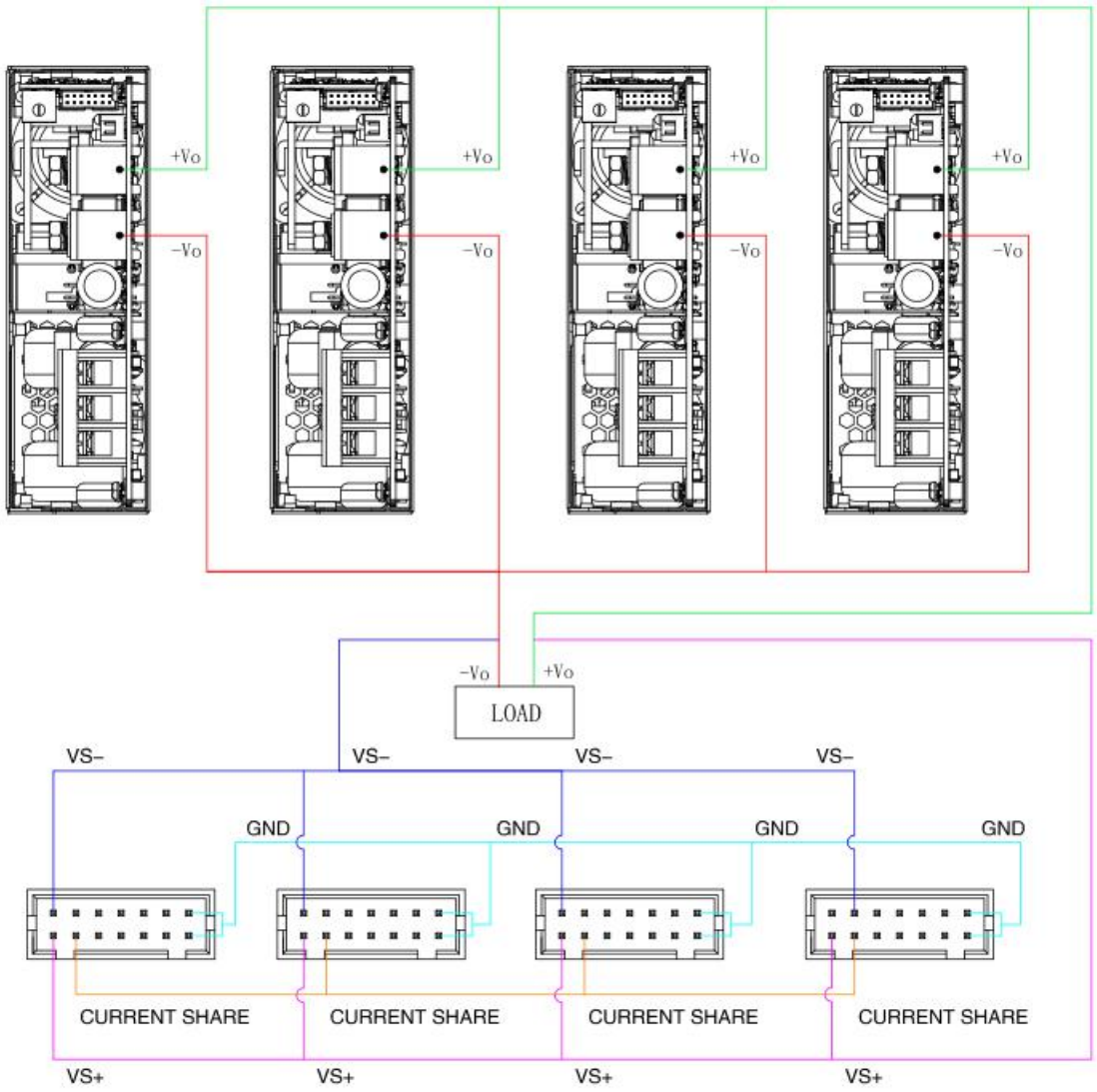
The power block supports 3+1 redundant work.

The ORing circuit is used inside the power building block, and when any power building block in parallel fails, it will not affect the operation of other power modules.

When used in parallel, the maximum load current cannot exceed the maximum output current of a single power supply module, otherwise the whole parallel power supply module will not start normally.

2.13.2 Current sharing

When using in parallel, the number of parallel modules cannot exceed 4.



When the power building block are working in parallel, there is an active current sharing circuit inside to ensure the current between each module is balanced.

The active current sharing circuit adopts an automatic master-slave current sharing method, and each power module has a sharing bus signal(CURRENT SHARE BUS). All power supplies of all power floors must be connected together while working in parallel. The average bus signal is located in the pin 2 of CN2.

The output voltage of each power supply block will affect the current sharing accuracy. The output voltage of the power module is rated voltage ±50mV. In practical applications, if the output voltage value needs to be adjusted, the output voltage of all parallel power supply blocks needs to be adjusted to the same voltage. The recommended voltage is: the target voltage value is ±50mV.

After the output load of each power module is greater than 50% of the rated load, the current sharing

accuracy should be ±5%. the current sharing calculation formula is:

$$\text{Current sharing accuracy}=\frac{Io\max - Io\min}{Io\max}*100\%$$

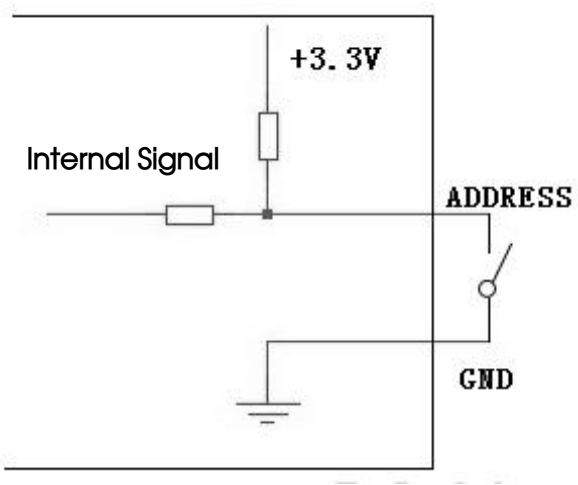
Iomax: the largest output current value in power building block.

Iomin: the smallest output current value in power building block.

2.14 I2C communication address

In the parallel system, if you need to identify the information of the power module, you need to set the I2C communication address for each parallel ton source school block, and through I2C and the host computer for data exchange. The setting of the communication address is determined by the 9, 10 and 11 pins of the signal terminal CN2, when these three pins are shorted with the pin7 or 14 of CN2, it is low level (L, voltage range: 0-1.31V), while it is high level (H, voltage range: 1.99V-3.3V) when these three pins are disconnected from Pin7 or Pin14. The specific address number is shown in the table below:

ADDRESS 2	ADDRESS 1	ADDRESS 0	Address number
L	L	L	0
L	L	H	1
L	H	L	2
L	H	H	3
H	L	L	4
H	L	H	5
H	H	L	6
H	H	H	7



The internal pull-up resistance of the power building block is 10kΩ, and the external resistance can be matched according to the actual application to meet the high and low voltage range.

3. Installation requirements

3.1 Safety introduction

Warning

Risk of electric shock
During high voltage operating

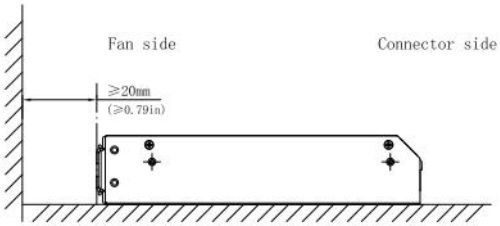
- The power supply module is disconnected from the input DC or the AC power and placed for at least one minute before starting to operate it.
- When installing the input wire to the power module, please connect the ground terminal first, and then connect the L line and the N line.
- When removing the input wire, please remove the L wire and the N wire first, and then remove the ground wire.
- Ensure that no objects fall into the power supply module during disassembly and assembly.
- Pay attention to high temperature
- After the power module is working in a high temperature environment, wait for its shell to cool down before operating.
- This product needs to be installed by professionals and needs to be used with other equipment.

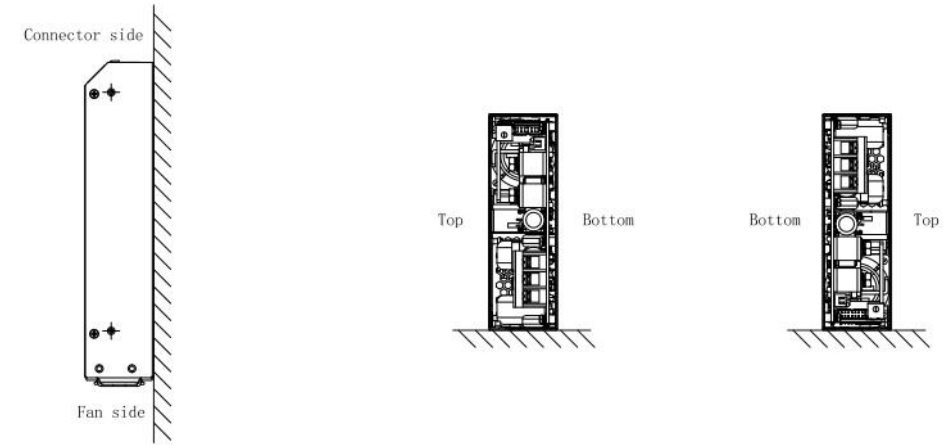
3.2 Safety requirements

When installing, pay attention to the primary side and the protective ground, the creep distance and the electrical clearance of the primary side and the secondary side refer to EN60601-1.

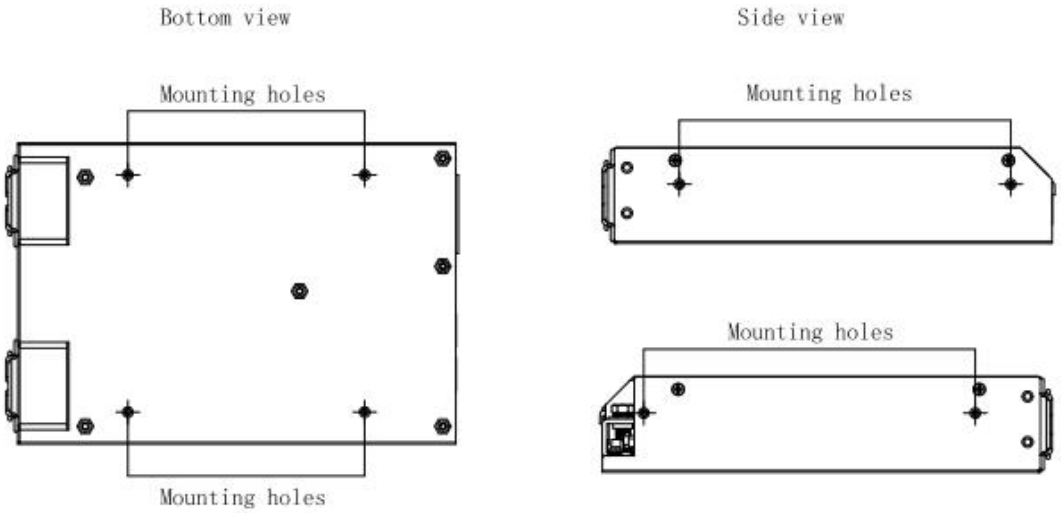
3.3 Installation method

Standard mounting orientation:





Position of mounting holes:



Note: The fan panel cannot be blocked by other objects, and a distance of at least 20mm must be maintained, otherwise it will affect the heat dissipation and performance of the power module.

4. PMBUS

Series LMF1000-20Bxx power modules support standard PMBUS protocol, manage and monitor power modules through I2C bus.

Command Code	Command Name	Access Type	Data Bytes	Data Format	Description
0x9A	PMB_MFR_MODEL	Block Read	32	ASCII	Product model
0x8B	PMB_READ_VOUT	Read Word	2	Direct	Main circuit output voltage (10mV)
0x8C	PMB_READ_IOUT	Read Word	2	Direct	Main output current (10mV)
0x96	PMB_READ_POUT	Read Word	2	Direct	Main output power (10mV)
0xC4	PMB_MFR_AUX_VOUT	Read Word	2	Direct	Auxiliary output voltage (10mV)
0xC5	PMB_MFR_AUX_IOUT	Read Word	2	Direct	Auxiliary output current (10mV)
0xC7	PMB_MFR_FAULT_BIT	Read Word	2	Bit Field	Fault status word

Describe Of Fault Status Through PMB_MFR_FAULT_BIT	
Bit segment	Describe
BIT: 0	0: Fan 1 normal 1: Fan 1 fault
BIT: 1	0: Fan 2 normal 1: Fan 2 fault
BIT: 2	0: Auxiliary output is normal 1: The output of auxiliary circuit is fault
BIT: 3	0: No over-voltage in main circuit 1: Over-voltage in the main circuit
BIT: 4	0: No under-voltage in main circuit 1: Under-voltage in the main circuit
BIT: 5	0: No primary over-current on the main circuit 1: Primary over-current in the main circuit
BIT: 6	0: No secondary over-current on the main circuit 1: Secondary over-current in the main circuit
BIT: 7	0: No primary overload on the main circuit 1: Overload in the main circuit
BIT: 8	0: No secondary overload on the main circuit 1: Secondary overload in the main circuit
BIT: 9	0: No three-level overload on the main circuit 1: Three-stage overload in the main circuit
BIT: 10	0: Normal temperature 1: Over-tempetature and overload
BIT: 11	0: No short circuit in the main circuit 1: Short circuit in the main circuit
BIT: 12	0: No hardware over-voltage on the main circuit 1: Hardware over-voltage in the main circuit
BIT: 13	0: No hardware under-voltage on the main circuit 1: Hardware under-voltage in the main circuit
BIT: 14	0: Pre-charge is normal 1: Precharge of the front stage is fault
BIT: 15	0: PFC soft start is normal 1: PFC soft start fault

For more details, please consult the MORNSUN FAE.