

# AC/DC1000W Enclosed Switching Power Supply

## LMF1000-20Bxx (-QQ) Series

# MORNSUN®



RoHS

UL US

CCC

CB

CE

Report

UK

UL62368-1

GB4943.1

IEC60601-1

EN 62368-1

BS EN 62368-1

013250 Part 1: 2015  
IEC 60362-1:2005  
8  
R-41202800  
www.mn.com.cn

## FEATURES

- Wide range Input voltage 90 - 264VAC or 120 - 370VDC
- Accepts AC or DC input (dual-use of same terminal)
- Operating ambient temperature range: -40°C to +70°C (Non-condensing)
- High reliability, efficiency up to 94%
- 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
- Fan speed automatic adjustable
- Safety according to IEC62368-1, ES/EN60601-1-2:2015 Edition 4

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) |
|-----------------------------|---------------|------------------|-----------|--------------------------------------------|----------------------------------------------|-------------------------------|---------------------------|
| UL/EN/IEC<br>CCC/BS/<br>BIS | LMF1000-20B12 | 960              | Main      | 12V/80A                                    | 12-14.4                                      | 92                            | 40000                     |
|                             |               | 10               | Auxiliary | 5V/2A                                      | /                                            |                               | 1000                      |
| UL/EN/IEC<br>BS/BIS         | LMF1000-20B15 | 960              | Main      | 15V/64A                                    | 15-18                                        |                               | 20000                     |
|                             |               | 10               | Auxiliary | 5V/2A                                      | /                                            |                               | 1000                      |
| UL/EN/IEC<br>CCC/BS/<br>BIS | LMF1000-20B24 | 1008             | Main      | 24V/42A                                    | 24-28.8                                      | 94                            | 10000                     |
|                             |               | 10               | Auxiliary | 5V/2A                                      | /                                            |                               | 1000                      |
| UL/EN/IEC<br>BS/BIS         | LMF1000-20B27 | 1007             | Main      | 27V/37.3A                                  | 27-32.4                                      |                               | 8000                      |
|                             |               | 10               | Auxiliary | 5V/2A                                      | /                                            |                               | 1000                      |
| UL/EN/IEC<br>CCC/BS/BIS     | LMF1000-20B36 | 1008             | Main      | 36V/28.8A                                  | 36-43.2                                      |                               | 6000                      |
|                             |               | 10               | Auxiliary | 5V/2A                                      | /                                            |                               | 1000                      |
|                             | LMF1000-20B48 | 1008             | Main      | 48V/21A                                    | 48-56                                        |                               | 4000                      |
|                             |               | 10               | Auxiliary | 5V/2A                                      | /                                            |                               | 1000                      |
| UL/EN/IEC<br>BS             | LMF1000-20B54 | 1009             | Main      | 54V/18.7A                                  | 54-58                                        |                               | 3000                      |
|                             |               | 10               | Auxiliary | 5V/2A                                      | /                                            |                               | 1000                      |

Note: 1.\*For all applications, please refer to LMF1000-20B (-QQ) Series Power Supply Application Notes.

2.\*Use suffix "QQ" for conformal coating.

3.\*Before powering on the product, please confirm whether the control signal connection terminal (CN2) Pin6 (PS\_ON) and Pin7 (GND) short-circuit jumper cap are connected. If not, the product without output. When the control signal connection terminal (CN2) of the product are external connected as a whole, please ensure that Pin6 and Pin7(or Pin14) are short-circuit connected. Please refer to LMF1000-20B (-QQ) Series Power Supply Application Notes: 2.10 Remote control.

4.\*When using the current sharing function for all models, do not directly increase the load on the system beyond the rated load of a single prototype when the power is turned on for the first time.

## Input Specifications

| Item                    | Operating Conditions | Min. | Typ. | Max. | Unit |
|-------------------------|----------------------|------|------|------|------|
| Input Voltage Range     | AC Input             | 90   | --   | 264  | VAC  |
|                         | DC Input             | 120  | --   | 370  | VDC  |
| Input Voltage Frequency |                      | 47   | --   | 63   | Hz   |

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Page 1 of 25

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## LMF1000-20Bxx (-QQ) Series

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|                         |        |                                |         |    |    |   |
|-------------------------|--------|--------------------------------|---------|----|----|---|
| Input Current           | 115VAC |                                | --      | -- | 12 | A |
|                         | 230VAC |                                | --      | -- | 6  |   |
| Inrush Current          | 115VAC | Cold start                     | --      | 20 | -- |   |
|                         | 230VAC |                                | --      | 40 | -- |   |
| Power Factor            | 115VAC | Room-temperature,<br>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                                                                                          |                     | --                                | ±0.5                                                                               | --   |      |
|                             | Auxiliary                                                                                     |                     | --                                | ±1                                                                                 | --   |      |
| Ripple & Noise*             | 20MHz bandwidth<br>(peak-to-peak value)                                                       | 15V/27V             | --                                | 150                                                                                | --   | mV   |
|                             |                                                                                               | 12V/24V/36V/48V/54V | --                                | 200                                                                                | --   |      |
|                             |                                                                                               | Auxiliary           | --                                | 100                                                                                | --   |      |
| Temperature Coefficient     |                                                                                               |                     | --                                | ±0.03                                                                              | --   | %/°C |
| 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 recover) |      |      |
|                             | 15V                                                                                           |                     | ≤ 21V                             |                                                                                    |      |      |
|                             | 24V                                                                                           |                     | ≤ 35V                             |                                                                                    |      |      |
|                             | 27V                                                                                           |                     | ≤ 35V                             |                                                                                    |      |      |
|                             | 36V                                                                                           |                     | ≤ 48V                             |                                                                                    |      |      |
|                             | 48V                                                                                           |                     | < 60V                             |                                                                                    |      |      |
|                             | 54V                                                                                           |                     | ≤ 63V                             |                                                                                    |      |      |
|                             | Auxiliary                                                                                     |                     | < 7V (hiccup, self-recover)       |                                                                                    |      |      |
| Over-temperature Protection | Over-temperature Protection Activation                                                        |                     | --                                | --                                                                                 | 70   | °C   |
|                             | Over-temperature Protection Deactivation                                                      |                     | 50                                | --                                                                                 | --   |      |
| Minimum Load                |                                                                                               |                     | 0                                 | --                                                                                 | --   | %    |
| Dynamic minimum load        |                                                                                               |                     | 10                                | --                                                                                 | --   |      |
| Hold-up Time                | Room-temperature,<br>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 47 $\mu$ F electrolytic capacitor and 0.1 $\mu$ F 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 - ⊕     |                                                                                                         | 1500 | --   | --   |      |
| Insulation Resistance | Input - output | Environment temperature: 25±5℃,<br>Relative humidity: <95%RH, non-condensing<br>Testing voltage: 500VDC | 100  | --   | --   | M Ω  |
|                       | Input - ⊕      |                                                                                                         | 100  | --   | --   |      |
|                       | Output - ⊕     |                                                                                                         | 100  | --   | --   |      |
| Operating Temperature |                |                                                                                                         | -40  | --   | +70  | ℃    |
| Storage Temperature   |                |                                                                                                         | -40  | --   | +85  |      |
| Storage Humidity      |                | Non-condensing                                                                                          | 10   | --   | 95   | %RH  |

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## LMF1000-20Bxx (-QQ) Series

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|                     |                                |                                        |                                                                                                                                                                      |     |    |        |
|---------------------|--------------------------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|--------|
| Operating Humidity  |                                |                                        | 20                                                                                                                                                                   | --  | 90 |        |
| Switching Frequency | PFC circuit                    |                                        | --                                                                                                                                                                   | 65  | -- | kHz    |
|                     | LLC circuit                    |                                        | --                                                                                                                                                                   | 100 | -- |        |
| Power Derating      | Operating temperature derating | -40°C to -30°C                         | 5.0                                                                                                                                                                  | --  | -- | % / °C |
|                     |                                | +45°C to +70°C    12V/15V              | 1.6                                                                                                                                                                  | --  | -- |        |
|                     |                                | +50°C to +70°C    24V/27V/36V /48V/54V | 2.0                                                                                                                                                                  | --  | -- |        |
|                     | Input voltage derating         | 90VAC to 100VAC                        | 2.0                                                                                                                                                                  | --  | -- | %/VAC  |
| Safety Standard     | 12V/24V/36V/48V                |                                        | EN/UL62368-1, GB4943.1, IEC60601-1, IS13252 (Part1) safety approved & EN62368-1, BS EN 62368-1 (Report)<br>Design refer to IEC62368-1, ES/EN60601-1-2:2015 Edition 4 |     |    |        |
|                     | 15V/27V                        |                                        | EN/UL62368-1, IEC60601-1, IS13252 (Part1) safety approved & EN62368-1, BS EN 62368-1 (Report)<br>Design refer to IEC62368-1, ES/EN60601-1-2:2015 Edition 4, GB4943.1 |     |    |        |
|                     | 54V                            |                                        | EN/UL62368-1, IEC60601-1, safety approved & EN62368-1 (Report)<br>Design refer to IEC62368-1, GB4943.1, IS13252 (Part1), 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°C             |                                        | ≥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 ±8KV/Air ±15KV                | 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 3mm and a length of 450mm x 450mm. The power supply must be combined with the terminal equipment for electromagnetic compatibility confirmation.

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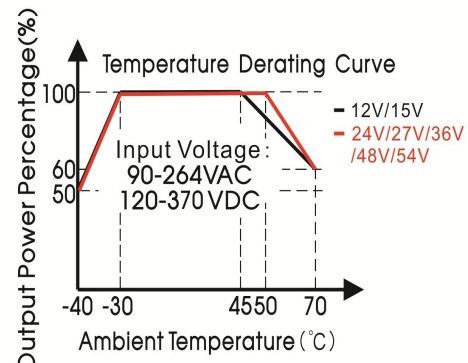
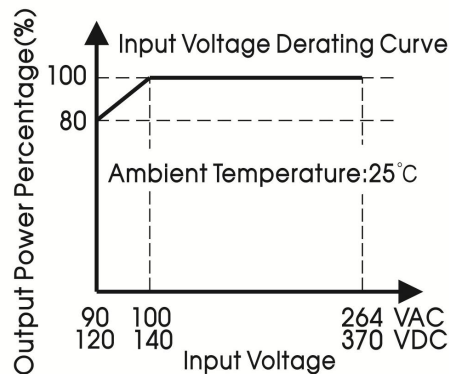
Page 3 of 25

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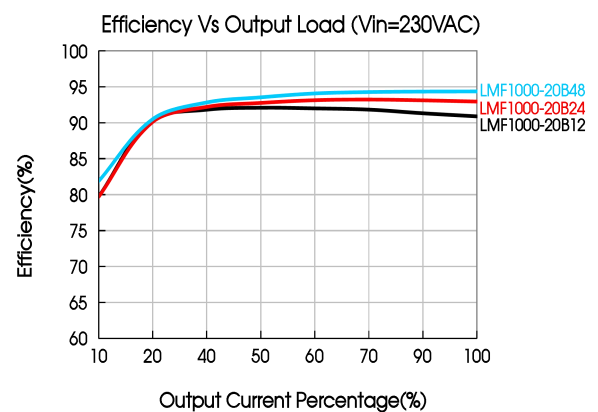
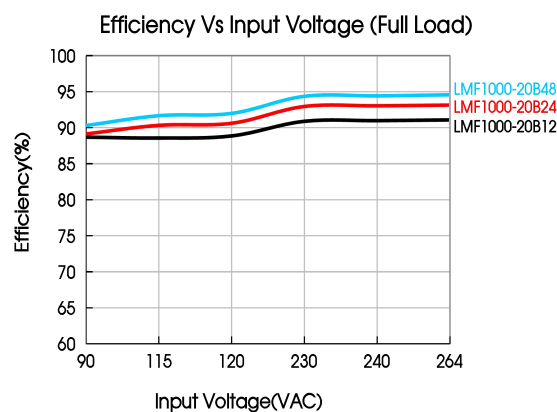
### Functional Specifications

| Item                                                                                                                                                                                                                                                                                                                                                                                 | Operating Conditions                                                                   |                              | Min.                                                         | Typ. | Max. | Unit |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------|--------------------------------------------------------------|------|------|------|
| Remote Control Switch                                                                                                                                                                                                                                                                                                                                                                | All Input Voltage Range<br>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<br>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 units in parallel, each power supply needs to carry a rated load of more than 50% |                              | --                                                           | ±5   | --   | %    |
| LED Signal*                                                                                                                                                                                                                                                                                                                                                                          | Main output status indication                                                          | Normal Output                | Green on                                                     |      |      | /    |
|                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                        | Abnormal Output, protected   | Red on                                                       |      |      |      |
|                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                        | Power Off (AC Without Input) | Light off                                                    |      |      |      |
| Remote Sense                                                                                                                                                                                                                                                                                                                                                                         | Total compensate voltage (Vs+/Vs- shorted to Vo+/Vo- respectively)                     |                              | --                                                           | 200  | --   | mV   |
| SDA, SCL for I2C                                                                                                                                                                                                                                                                                                                                                                     |                                                                                        |                              | Internal 2.4 kΩ pull-up resistor to internal 3.3 V           |      |      |      |
| Note:1. *If the product is used in medical equipment, the terminal system should shield the LED signal light to meet the medical certification requirements that operators should not see the indicator light after the product is installed.<br>2. *Please refer to LMF1000-20Bxx (-QQ) Series Power Supply Application Notes for relevant function control logic and instructions. |                                                                                        |                              |                                                              |      |      |      |

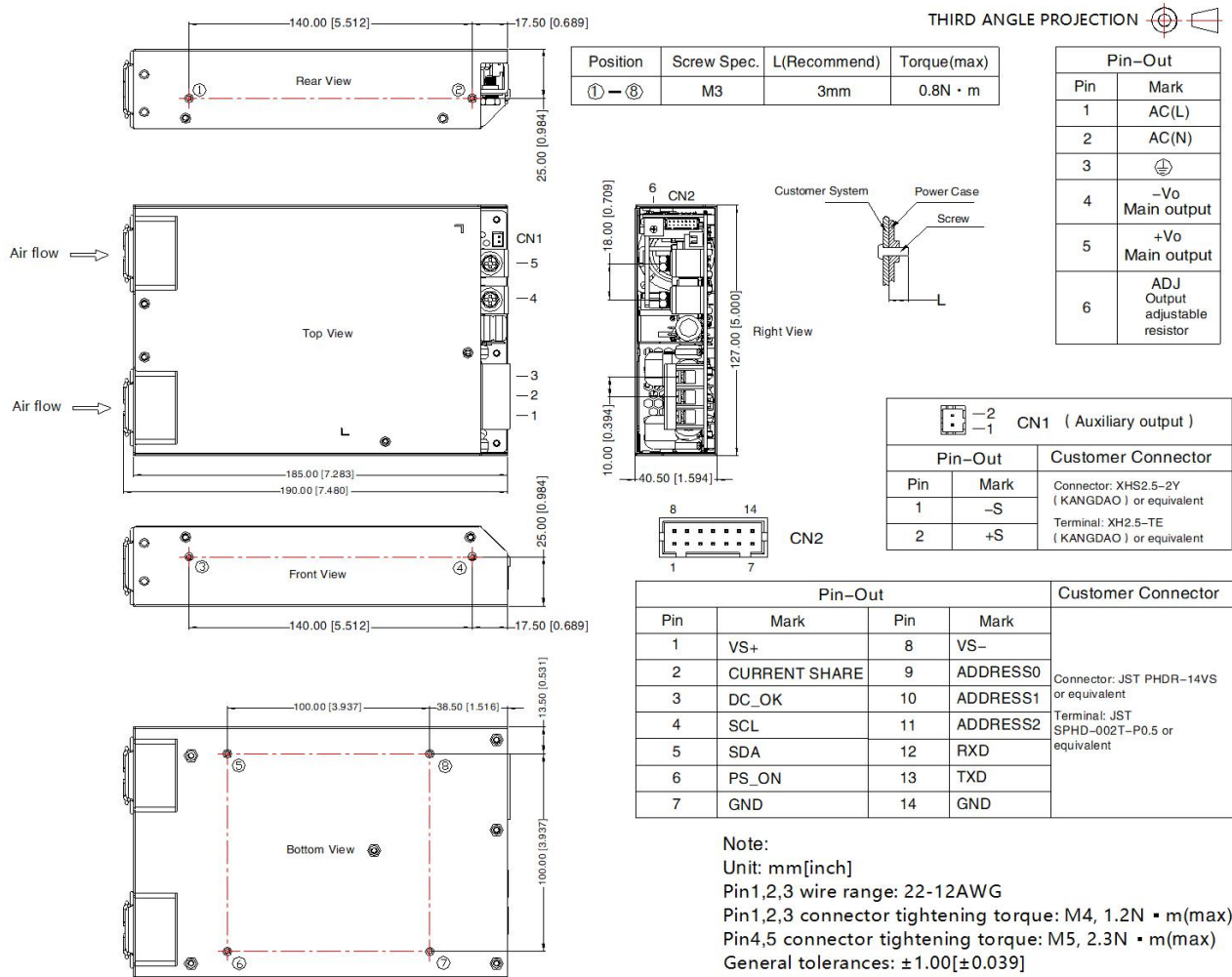
### Product Characteristic Curve



Note: With an AC input voltage between 90-100VAC and a DC input between 120-140VDC the output power must be derated as per the temperature derating curves.



### Dimensions and Recommended Layout



#### Note:

- For additional information on Product Packaging please refer to [www.mornsun-power.com](http://www.mornsun-power.com). Packaging bag number: 58220175;
- 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;
- The room temperature derating of 5℃/1000m is needed for operating altitude greater than 2000m;
- All index testing methods in this datasheet are based on our company corporate standards;
- 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;
- We can provide product customization service, please contact our technicians directly for specific information;
- Products are related to laws and regulations: see "Features" and "EMC";
- The out case needs to be connected to PE (⊕) of system when the terminal equipment in operating;
- The output voltage can be adjusted by the ADJ, clockwise to decrease;
- Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units;
- 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.
- 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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Page 5 of 25

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## LMF1000-20Bxx (-QQ) Series Power Supply Application Notes

## Content

|                                                |    |
|------------------------------------------------|----|
| 1. Overview.....                               | 8  |
| 2. Function Manual.....                        | 12 |
| 2.1 Input Requirements.....                    | 12 |
| 2.2 Output Requirements.....                   | 12 |
| 2.3 Start-up timing.....                       | 12 |
| 2.4 Fan Speed Control.....                     | 13 |
| 2.5 Output over-voltage protection (OVP).....  | 13 |
| 2.6 Output over-current protection (OCP).....  | 13 |
| 2.7 Output short circuit protection (SCP)..... | 14 |
| 2.8 Over temperature protection (OTP).....     | 15 |
| 2.9 Output power derating.....                 | 15 |
| 2.10 Remote control.....                       | 16 |
| 2.11 DC_OK Signal.....                         | 17 |
| 2.12 Remote compensation.....                  | 18 |
| 2.13 Parallel operation.....                   | 18 |
| 2.13.1 Redundancy.....                         | 18 |
| 2.13.2 Current sharing.....                    | 19 |
| 2.14 I2C communication address.....            | 21 |
| 3. Installation requirements.....              | 22 |
| 3.1 Safety introduction.....                   | 22 |
| 3.2 Safety requirements.....                   | 22 |
| 3.3 Installation method.....                   | 23 |
| 4. Communication protocol.....                 | 24 |

## 1. Overview

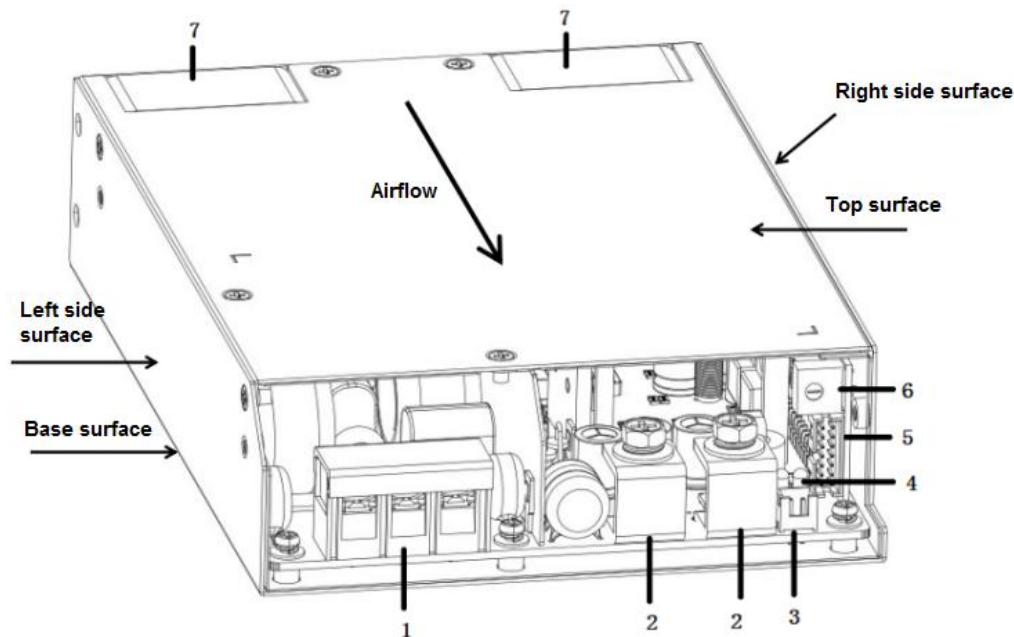


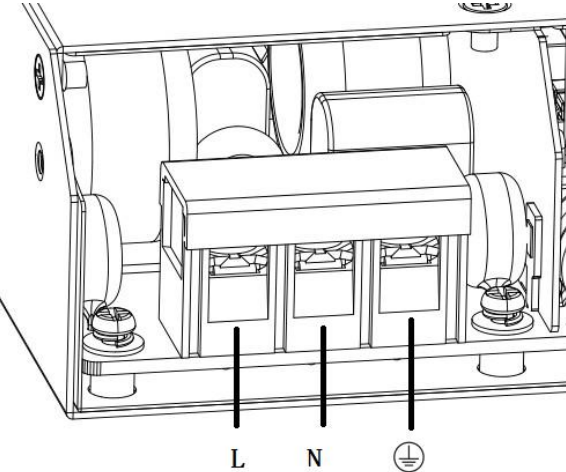
Fig. 1: Appearance information of LMF1000-20Bxx

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)

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

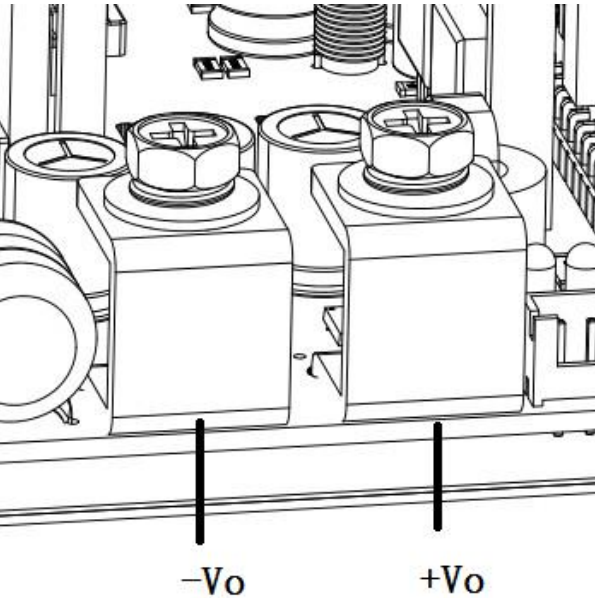


| Pin                                                                               | Features     |
|-----------------------------------------------------------------------------------|--------------|
| L                                                                                 | Line (Phase)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

Wire size: 12-18 AWG  
Torque: 1.8Nm

1.2 Main DC output terminal (J2)

The output terminal J2, with two standard screw lock type metal terminals, the pin spacing between each is 18mm.

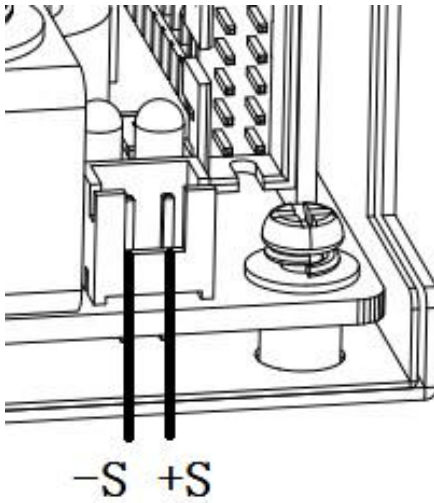


| Pin | Features      |
|-----|---------------|
| +Vo | Main Output - |
| -Vo | Main Output + |

Wire size: 4 - 12 AWG  
Torque: 2.3Nm

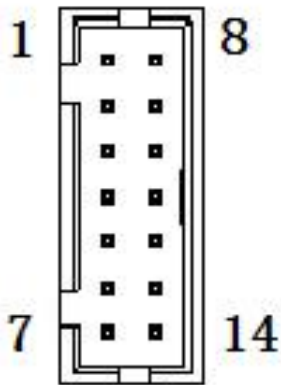
### 1.3 Auxiliary DC Output Terminal (CN1)

The auxiliary output terminal with a standard terminal of 2.5mm pitch.



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

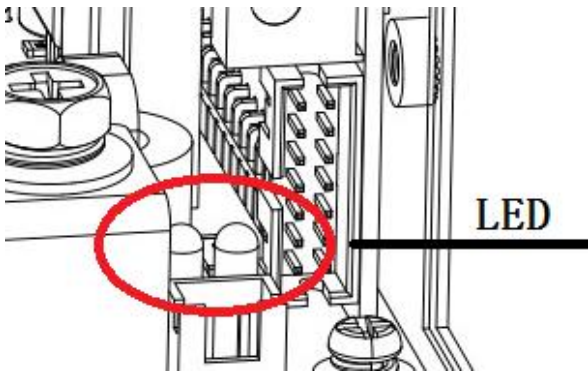
### 1.4 Signal port (CN2)



| 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

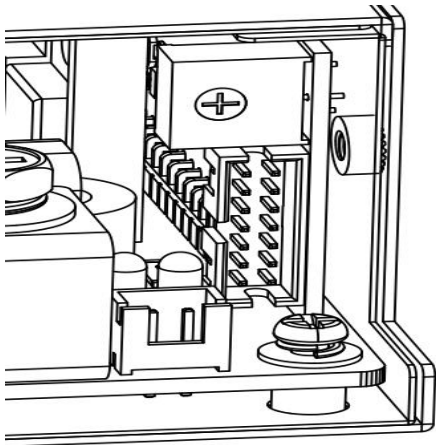


Two kinds of LED lights indicate difference working states of the power supply :

| 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                         |
| LMF1000-20B15 | 15V                 | 15 - 18V                           |
| LMF1000-20B24 | 24V                 | 24 - 28.8V                         |
| LMF1000-20B27 | 27V                 | 27 - 32.4V                         |
| LMF1000-20B36 | 36V                 | 36 - 43.2V                         |
| LMF1000-20B48 | 48V                 | 48 - 56V                           |
| LMF1000-20B54 | 54V                 | 54-58V                             |

## 2. Function Manual

### 2.1 Input Requirements

The AC input voltage and DC input voltage must be within the defined voltage range (refer to datasheet), otherwise the power supply may not work properly or even malfunction.

The internal L and N line of the power module have been connected in series with a 250V 20A fuse. For better protection, it is recommended that customers use a circuit breaker not greater than 20A. (Non-mandatory requirement).

### 2.2 Output Requirements

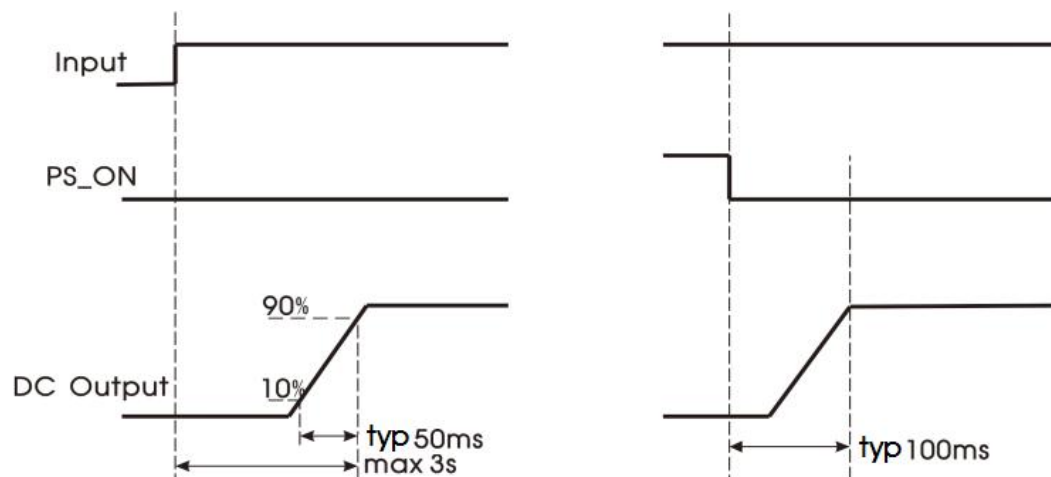
#### Main Output

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-off Hold Time | Room temperature,<br>full load | 115VAC | --   | 12   | --   | ms   |
|                     |                                | 230VAC | --   | 12   | --   |      |
| Start Delay Time    | 230VAC, full load              |        | --   | --   | 3    | s    |

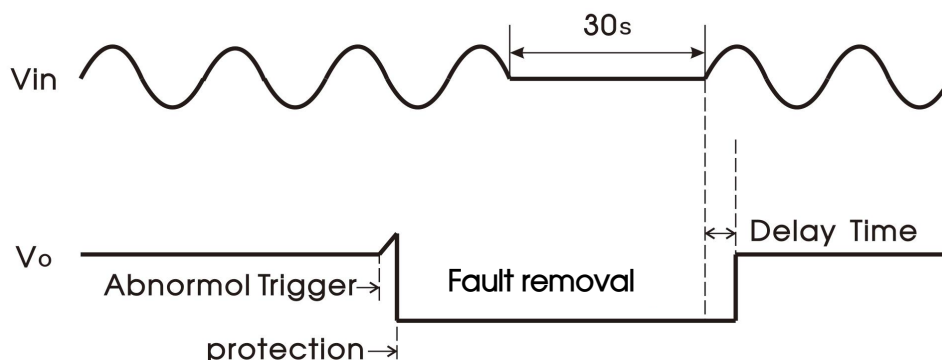
## 2.4 Fan Speed Control

The fan speed is determined by the ambient temperature and output power and linearly adjusted. When the ambient temperature is greater than 45°C and the output power is greater than 600W, the fan reaches 100% speed. In order to improve the reliability of the power supply module, the fan keeps a minimum speed of 10% when the ambient temperature is higher than -5°C under no load; the fan will stop rotating when the ambient temperature is lower than -5°C.

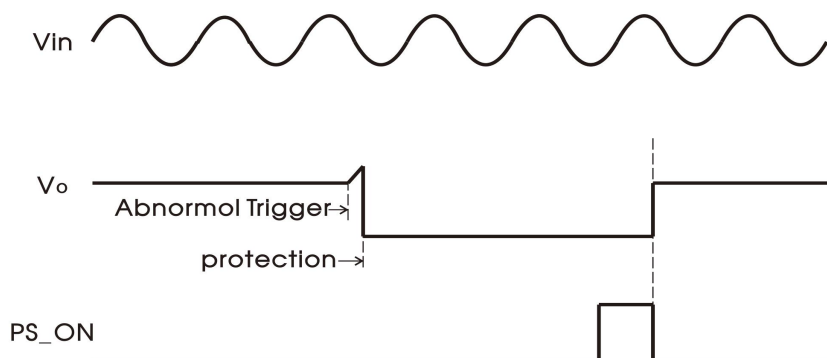
## 2.5 Output over-voltage protection (OVP)

### Main Output

The over-voltage protection function is to close the main output when the output voltage reaches the protection voltage value. When the main circuit over-voltage protection occurs, the main circuit output voltage of the module will be shut off, and the auxiliary circuit output will not be affected. The main circuit output can be restored after disconnecting the input power for at least 30 seconds.



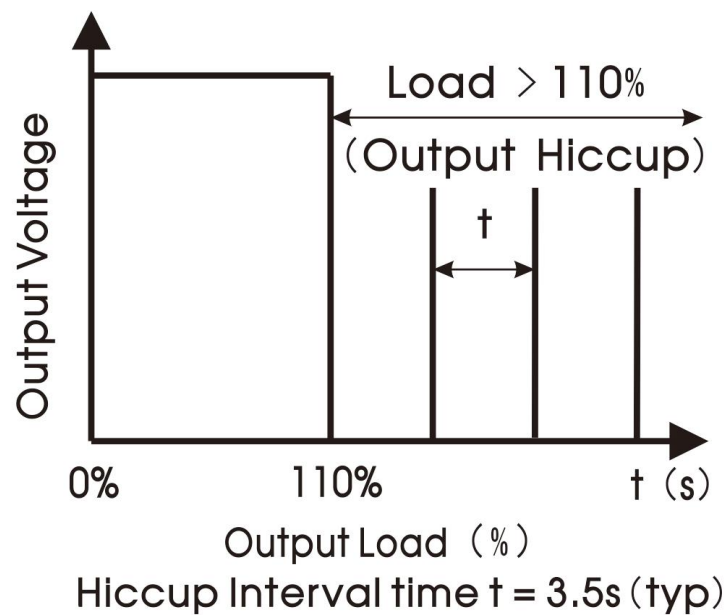
In addition, it can be quickly restarted by the PS\_ON signal:



### Auxiliary output

When the auxiliary circuit voltage reaches 7Vdc (maximum value), the auxiliary output will be in hiccup status, and the main circuit without output until the auxiliary output returns to normal after the fault is eliminated.

## 2.6 Output over-current protection (OCP)



### Main output

When the output current exceeds 110% (minimum) of the rated output current, the DC output will be off. The OCP protection function adopts hiccup mode. After the over-current condition is eliminated, the main output will automatically recover, and the auxiliary output will not be affected.

The main circuit output has OCP delay function. When the output current reaches 120% (typical value) of the rated load current 300ms, the main circuit output will be off; when the main circuit output reaches 150% (typical value) of the rated load current 15ms, the main circuit output will be off.

When the output current of the auxiliary circuit exceeds 120% (typical value) of the rated current, the main circuit output will be off. After the over-current state of the auxiliary circuit is eliminated, the main circuit automatically resumes output.

## 2.7 Output short circuit protection (SCP)

When the output is short-circuited, the power output in hiccup with interval 4.5s. After the short-circuit is removed, the power module will automatically return to normal, and the auxiliary output will not be affected.

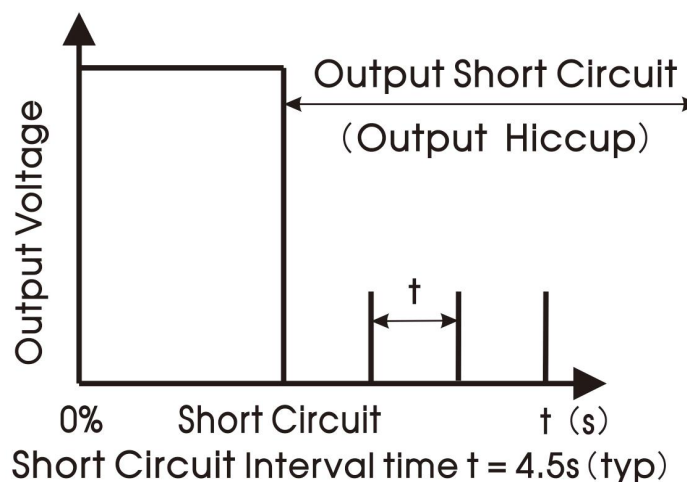
When the auxiliary circuit output is short-circuited, the main circuit without output.

## 2.8 Over temperature protection (OTP)

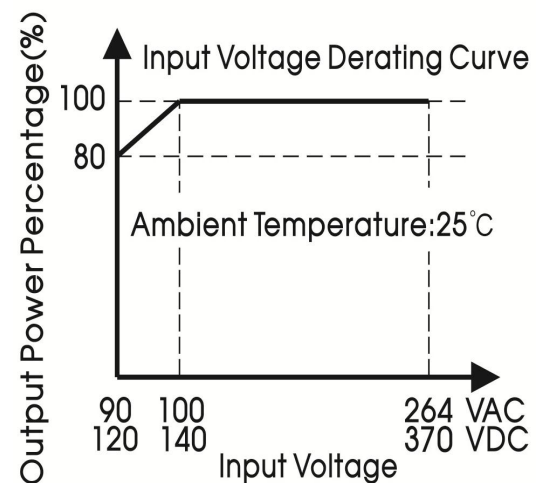
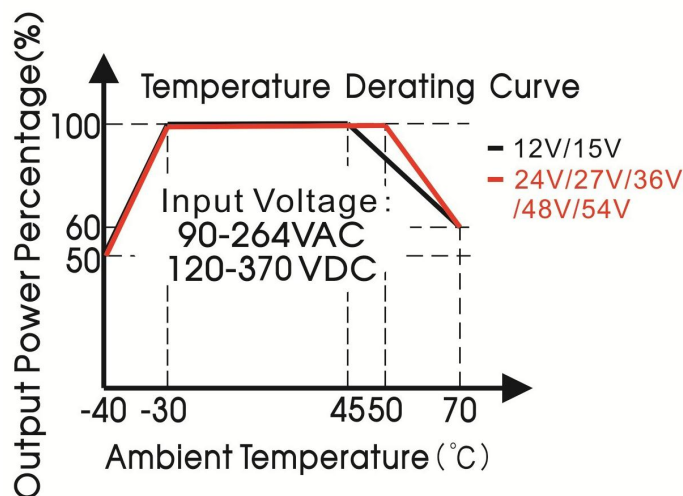
When the ambient temperature of the power supply exceeds the rated temperature for a period of time, the power supply will be turned off and the power supply will resume normal operation after the ambient temperature drops to the set value.

## 2.9 Output power derating

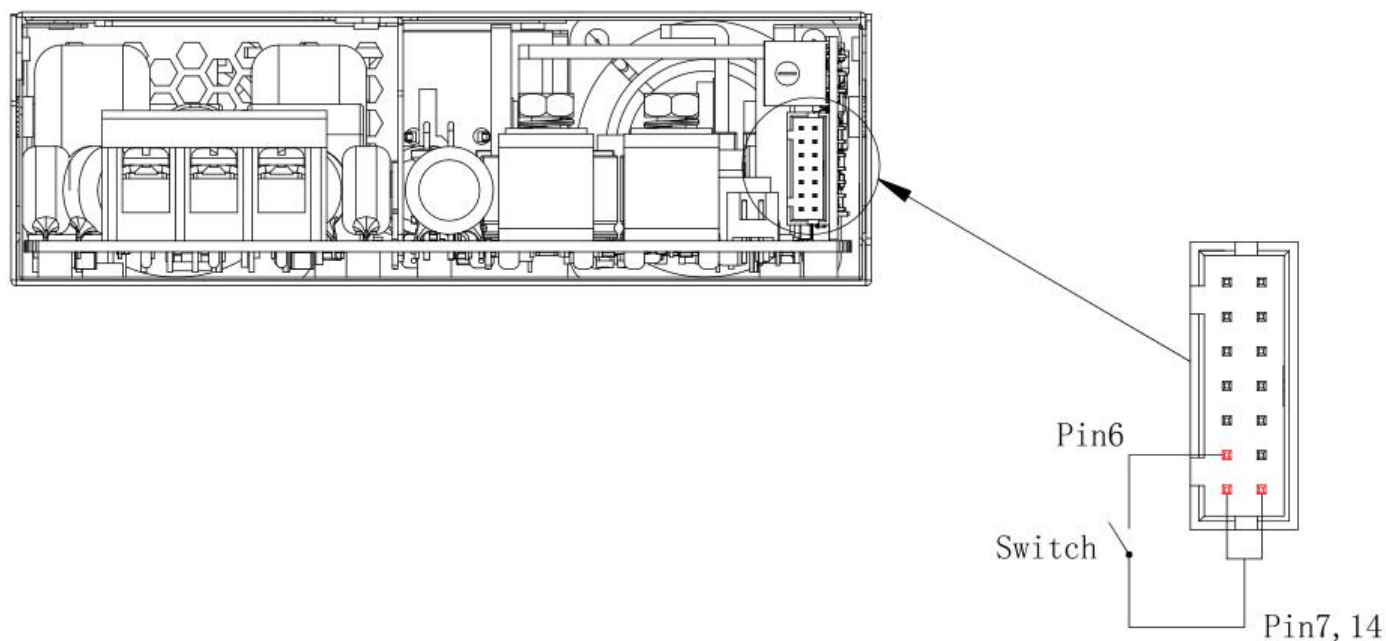
When the input voltage is greater than 100VAC (or 140VDC), only need to derate according to the temperature derating curve.



When the input voltage is lower than 100VAC (or 140VDC), the output power will be derated according to the following input voltage derating curve after temperature derating.



## 2.10 Remote control



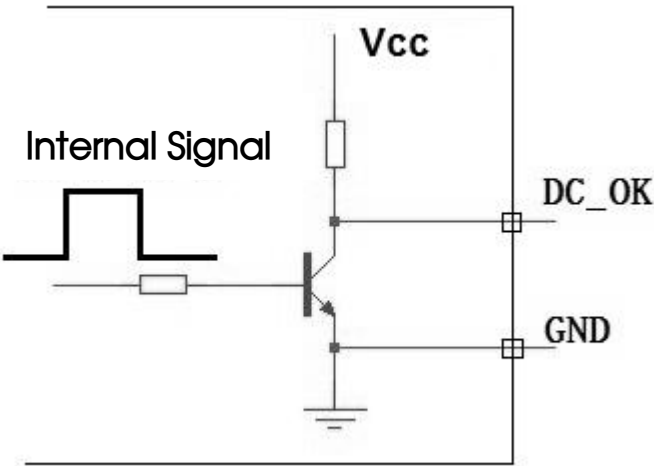
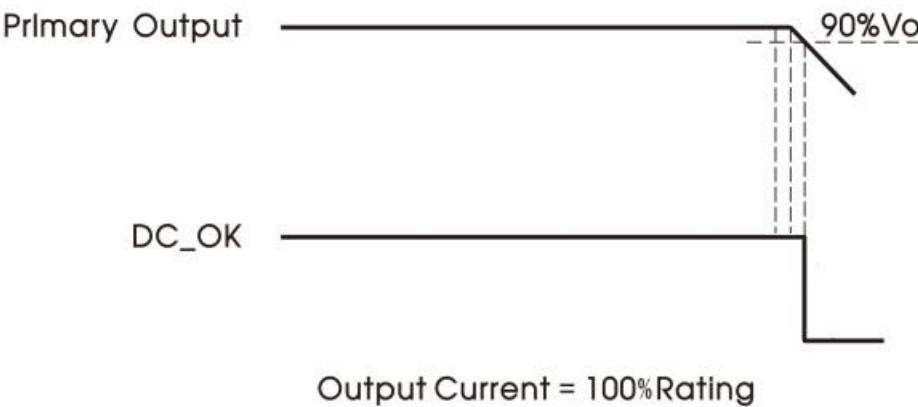
| PS_ON (Pin6) and GND (Pin7or Pin14) | Output status |
|-------------------------------------|---------------|
| Short-Circuit                       | Output on     |
| Pin Floating                        | Output off    |

If the input terminal of the power module has been connected to a power source, the PS\_ON signal pin can be used to control the on and off of the main output, and the PS\_ON signal does not affect the output voltage of the auxiliary circuit. Note: The internal PS\_ON input impedance of the module is 5.1K.

2.11 DC\_OK Signal

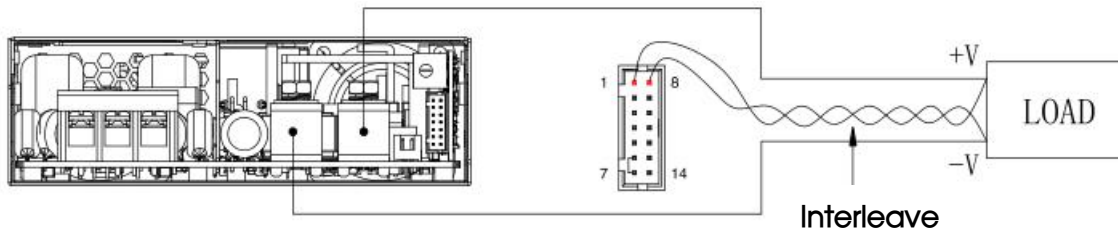
The DC\_OK signal is used to monitor whether the power supply is working normally, and the signal is at Pin3 of the signal terminal CN2.

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 .



| DC_OK (Pin3) and GND (Pin 7 or Pin 14) | Output state |
|----------------------------------------|--------------|
| 2.5 - 5V                               | Output on    |
| 0 - 0.5V                               | Output off   |

## 2.12 Remote compensation



Note: 1. VS+ and VS- cannot be shorted or reversed, otherwise the power module will be damaged.

2. Before powering on the product, please confirm whether the control signal connection terminal (CN2) Pin6 (PS\_ON) and Pin7 (GND) short-circuit jumper cap are connected. If not, the product without output. When the control signal connection terminal (CN2) of the product are external connected as a whole, please ensure that Pin6 and Pin7(or Pin14) are short-circuit connected. Please refer to LMF1000-20B (-QQ) Series Power Supply Application Notes: 2.10 Remote control.

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 remote compensation function, the signal pin needs to be connected with the load end with a twisted pair cable.

## 2.13 Parallel operation

### 2.13.1 Redundancy

The power module output can be connected in parallel to achieve redundancy, thereby improving system reliability. The maximum power of the redundant system needs to be derated to ensure that the redundant system can still meet the rated load requirements when a power supply module fails. The current common practice is to construct a redundant system by the N+1 method, that is, N+1 power supplies are connected in parallel, to support the maximum load current  $N \cdot I_{\text{omax}}$ , where  $I_{\text{omax}}$  is the rated output current of each power supply. For example, the rated output current of each power supply is 40A, and 3+1 units are connected in parallel to construct a  $3 \cdot 40\text{A} = 120\text{A}$  redundant system.

The power module supports 3+1 parallel redundant operation.

The ORing circuit is used inside the power module, and when any one of the power modules in the parallel fails, it will not affect the work of other power modules.

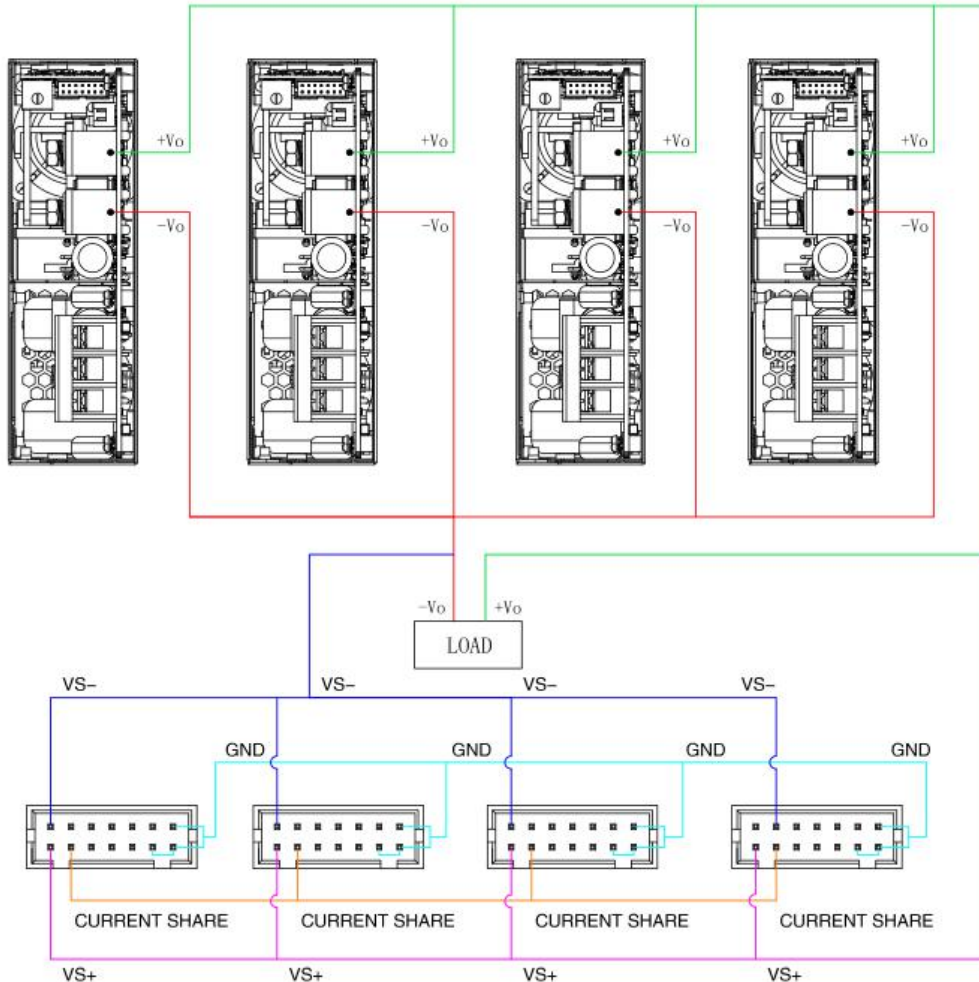
When used in parallel, the maximum load current cannot exceed the maximum output current of a single power supply module, otherwise the whole parallel power supply module will not start normally.

### 2.13.2 Current sharing

Method 1: current sharing bus and remote compensation lines are both connected.

For load line loss  $< 200\text{mV}$ , and the output voltage difference of each single module  $< 50\text{mV}$ , this type of connection is recommended to obtain a better line-end output voltage and current sharing effect.

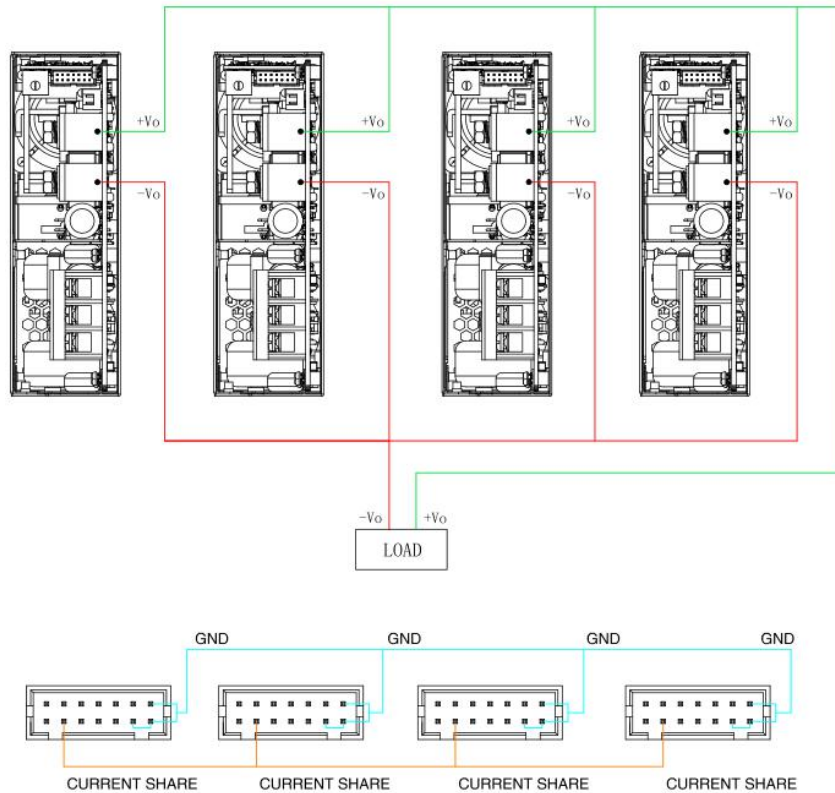
The wiring method of the current sharing function is shown in the figure below:



Method 2: Only the current sharing bus is connected, and the remote compensation is not connected.

For the load line loss  $> 200\text{mV}$ , or the output voltage difference of each single module cannot or does not need to be accurately adjusted to  $< 50\text{mV}$ , this type of connection is recommended to obtain a better current sharing effect of the parallel machine. In the same way, when the load loss is unknown or the current sharing fails to meet the specifications under the first connection method, it is recommended to replace it with this connected method.

The wiring method of the current sharing function is shown in the figure below:



Note: 1. When using in parallel, the number of parallel modules cannot exceed 4.

2. Before powering on the product, please confirm whether the control signal connection terminal (CN2) Pin6 (PS\_ON) and Pin7 (GND) short-circuit jumper cap are connected. If not, the product without output. When the control signal connection terminal (CN2) of the product are external connected as a whole, please ensure that Pin6 and Pin7(or Pin14) are short-circuit connected. Please refer to LMF1000-20B (-QQ) Series Power Supply Application Notes: 2.10 Remote control.

When power modules work in parallel, there is an internal active current sharing circuit to ensure that the current between each module is balanced.

The active current sharing circuit adopts the automatic master-slave current sharing method. Each power module has a current sharing bus signal (CURRENT SHARE BUS). When working in parallel, the current sharing bus of all power modules must be connected together. The current-sharing bus signal is located at pin 2 of CN2.

The output voltage of each power module will affect the current sharing accuracy. The output voltage of the power module is the rated voltage  $\pm 50\text{mV}$ . In practical applications, if the output voltage value needs to be adjusted, the output voltage of all parallel power supply modules needs to be adjusted to the same voltage. The recommended voltage range: target voltage value  $\pm 50\text{mV}$

After the output load of each power module is greater than 50% of the rated load, the current sharing accuracy should be  $\pm 5\%$ . The current sharing calculation formula is:

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

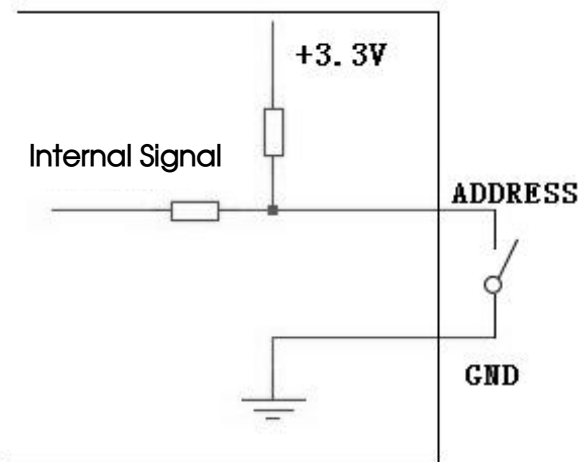
$I_{o \max}$ : the maximum output current value in parallel power supply modules.

$I_{o \min}$ : the minimum output current value in parallel power supply modules.

## 2.14 I2C communication address

In the parallel system, if you need to identify the power module information, you need to set the I2C communication address for each parallel power module, and exchange data with the host computer through I2C. The setting of the communication address is determined by pins 9, 10 and 11 of the signal terminal CN2. When these three pins are short-circuited with pin 7 or 14 of CN2, it will be low level (L, voltage range: 0 ~ 1.31V). When disconnected, it is high level (H, voltage range: 1.99V~3.3V). 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 value of the power module is 10k $\Omega$ , and the external impedance 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

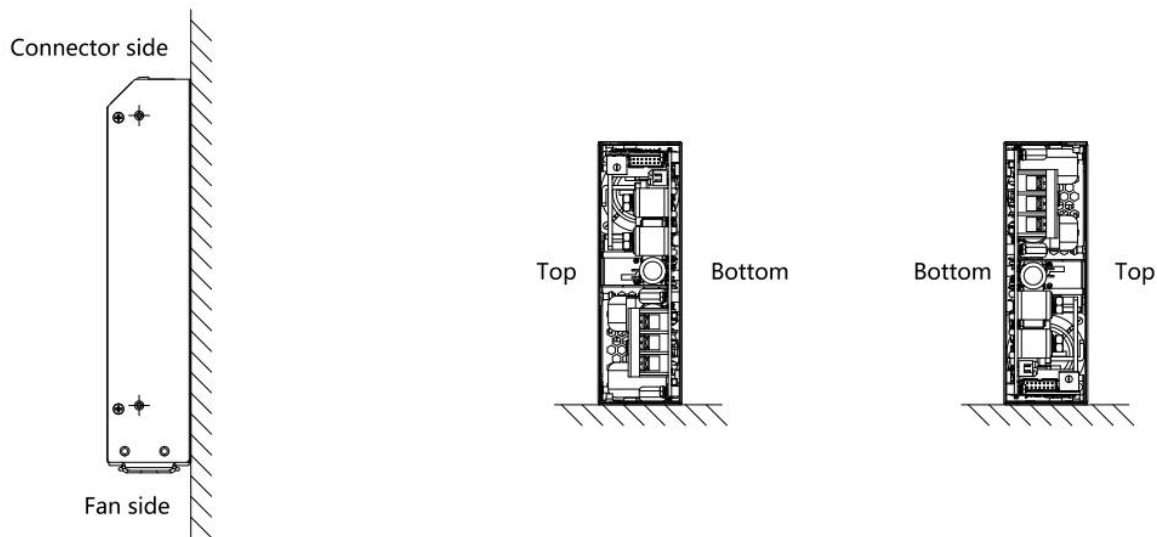
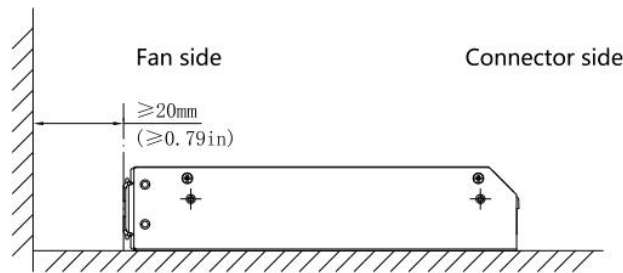
- The power supply module is disconnected from the input DC or the AC power and placed for at least one minute before starting to operate it.
- When installing the input wire to the power module, please connect the ground terminal first, and then connect the L line and the N line.
- When removing the input wire, please remove the L wire and the N wire first, and then remove the ground wire.
- When disassembling, make sure that no objects fall into the power module.
- 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

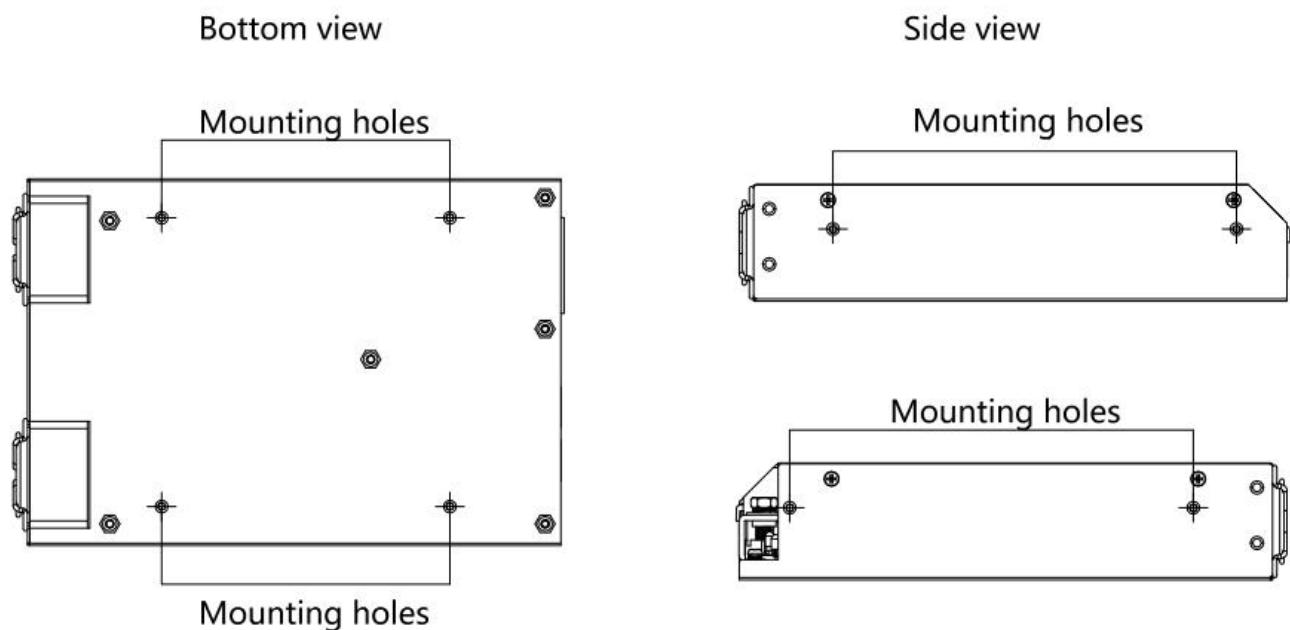
When installing, pay attention to the primary side and the protective ground, the creep distance and the electrical clearance of the primary side and the secondary side refer to EN60601-1.

### 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. Communication protocol

The LMF1000-20Bxx series power modules support standard communication protocols and manage and monitor the 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                                        | Description                                                                                  |
| BIT: 0                                             | 0: Fan 1 normal<br>1: Fan 1 fault                                                            |
| BIT: 1                                             | 0: Fan 2 normal<br>1: Fan 2 fault                                                            |
| BIT: 2                                             | 0: Auxiliary output normal<br>1: Auxiliary output abnormal                                   |
| BIT: 3                                             | 0: No over-voltage in main circuit<br>1: Over-voltage in main circuit                        |
| BIT: 4                                             | 0: No under-voltage in main circuit<br>1: Under-voltage in main circuit                      |
| BIT: 5                                             | 0: No level 1 over-current in main circuit<br>1: Level 1 over-current in main circuit        |
| BIT: 6                                             | 0: No level 2 over-current in main circuit<br>1: level 2 over-current in main circuit        |
| BIT: 7                                             | 0: No level 1 over-load in main circuit<br>1: Level 1 over-load in main circuit              |
| BIT: 8                                             | 0: No level 2 over-load in main circuit<br>1: Level 2 over-load in main circuit              |
| BIT: 9                                             | 0: No level 3 over-load in main circuit<br>1: Level 3 over-load in main circuit              |
| BIT: 10                                            | 0: Normal temperature<br>1: Over-temperature and over-load                                   |
| BIT: 11                                            | 0: No short circuit in main circuit<br>1: Short circuit in main circuit                      |
| BIT: 12                                            | 0: No hardware over-voltage in main circuit<br>1: Main circuit hardware over-voltage fault   |
| BIT: 13                                            | 0: No hardware under-voltage in main circuit<br>1: Main circuit hardware under-voltage fault |
| BIT: 14                                            | 0: Pre-charge normal<br>1: Pre-charge fault                                                  |
| BIT: 15                                            | 0: PFC soft start normal<br>1: PFC soft start fault                                          |

For more details, please consult the MORNSUN FAE.