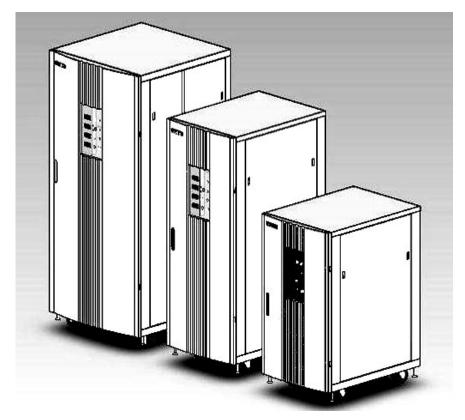
# AC POWER SOURCE Variable Frequency Power System AFC SERIES Product Manual

If you meet any problem, you should seek immediate assistance from branches of Preen that the equipment was purchased or customer service & support department of Preen.

Preen pursues policy of continual product development and reserves the right to change the equipment design without notice.



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### Safety Notice

1. High voltage is in equipments. If the person does not belong to Preen or is not authorized by Preen, he is refused to open the cover, or he will be at the risk of electric shock.

2. When variable frequency power supply needs to be moved or rewired, input should be broken, and the power supply is completely shut down for 10 minutes; otherwise internal capacitors may still have electricity, so it is dangerous to get electric shock.

3. To protect users' safety, this series power supply must have good grounding protection. Before use it should be reliable grounding.

4. The environment and preservation method affect life and reliability of the power supply. Therefore, the product should be avoided long-term working in the following environment:

- High, low and damp places beyond provisions of technical parameters (temperature: 0°C~45°C, relative humidity: 0%~90%);
- Direct sunlight or near heat source sites;
- Vibrating and vulnerable sites;
- Places with dust, corrosive materials, salt and flammable gas.

5. Keep vent clean. If not, the inter temperature of the power supply will rise, then shorten components life, and affect the equipment life.

6. Liquid or other objects are not allowed to enter the power supply cabinet.

7. In case of fire break out, use the dry powder fire extinguishers. Use of liquid fire extinguishers will cause electric shock.

8. If not use for a long time, the variable frequency power supply must be stored in dry condition. Standard storage temperature range:  $-40^{\circ}C \sim +70^{\circ}C$ .

## Index

| Chapter 1 Product Intruduction                                |   |
|---|---|
| 1.1 Why use it?   |   |
| 1.2 Static variable frequency power source introduction       |   |
| 1.3 Classification  |   |
| 1.4 Feature   |   |
| Chapter 2 Working Principle and Structure of AFC Series       | 2 |
| 2.1 PWM control technology                                    |   |
| 2.2 PWM calculation and modulating method                     |   |
| 2.3 AFC series variable frequency power supply work principle |   |
| 2.4 System function frame                                     |   |
| 2.5 Specification   |   |
| 2.6 Front panel   |   |
| 2.7 Operation Part Instruction                                |   |
| 2.8 Structure and Size  |   |
| Chapter 3 Installation  |   |
| 3.1 Unpacking and Inspection                                  |   |
| 3.2 Installation Procedure                                    |   |
| 3.2.1 Installation notice                                     |   |
| 3.2.2 Installation step                                       |   |
| Chapter 4 Operation   |   |
| 4.1 Operation mode  |   |
| 4.1.1 AC power inversion mode                                 |   |
| 4.1.2 Fault mode  |   |
| 4.2 Normal operation  |   |
| 4.2.1 Systme initial start                                    |   |
| 4.2.2 Normal operation  |   |
| 4.2.3 Out of power and shut down                              |   |
| Chapter 5 Maintenance   |   |
| 5.1 Maintenance notice  |   |
| 5.2 Fan   |   |
| 5.3 System inspection by eyes                                 |   |
| 5.4 Quarterly maintenance                                     |   |
| 5.5 Yearly maintenance  |   |
| Chapter 6 Troubleshooting                                     |   |
| Appendix Guarantee Card                                       |   |

### **Chapter 1 Product Intruduction**

### 1.1 Why use it?

Because the utility around the world are different, the exported electrical products need that the power supply stimulate the power system in different countries, the imported also need the power supply transferred the voltage and frequency in our country to ensure the normal operation. In the past, to achieve the above objective, generators have been used. But low efficiency, noise, cost, poor stability, and a certain degree of environment pollution, the generator is gradually replaced by a static variable frequency power source.

### 1.2 Static variable frequency power source introduction

Static variable frequency power supply contrast to the power source named from the motor-driven generator operation mode. With the rapid development of the electronic technology in the world and the large-scale application of high-power semiconductor switching devices, the static variable frequency power source has gradually become the main product in the market. It has gone through from mechanical to electronic transformation. With the rapid development of the global industry, variable frequency power supply applications are increasingly widespread.

### 1.3 Classification

At present, variable frequency power supply on the market can be divided into three kinds from the principles. One of them is under the control of sinusoidal pulse width modulation, and use IGBT devices, which was characterized by power, high efficiency (greater than 90%), small size, good stability. It has become the mainstream in the market; the second is a linear amplification as a variable frequency power source, which was characterized by small-power, high precision, small interference in some of the higher accuracy occasion. It is no substitute product. The third is to use resonant transformer to have a certain frequency and voltage as the power supply, but its frequency be fixed and adjustment difficulty, poor stability, be subject to interference, so its application has been limited in the market.

### 1.4 Feature

AFC series, the same as the other series variable frequency power supply, transfer the voltage and frequency of the utility to another through the power conversion circuit. It is one series of products which have adapted laminated bus bar technology, been redesigned control system, and realized the modular configuration. We not only simplify the production process and reduce the production costs, but also improve reliability. The features include:

- Capacity: 0.5kVA $\sim$ 2000kVA;
- Input power factor>0.85;
- Adapt laminated bus bar technology, reduce the inductance of the inverter circuit, and improve reliability;
- Individual air channel;
- Reliable control
- Full and steady protection;
- Judge and display error;
- Humanized design.

### **Chapter 2 Working Principle and Structure of AFC Series**

### 2.1 PWM control technology

The four parts of AFC series variable frequency power supply: input, rectifier, inverter and output. Inverter is core technology in the four parts. Taking into account the complexity of the control algorithms and control circuit, PWM control technology will be described in detail.

**PWM (Pulse Width Modulation) control** - Pulse width modulation technology is a control method that equally gets required waveform (including shape and amplitude) by modulating serial pulse width. PWM control technology is widely used in inverter circuit.

**Theoretical basis of PWM control** – When narrow pulse with same impulse (impulse is area of narrow pulse) and different shape plus to inertial tache, the effects are basically same (the output response waveform basically the same to low frequency, only little difference in high frequency). As shown in Figure 2-1.

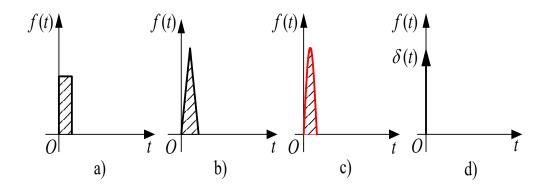


Figure 2-1 various narrow pulse with different shape and same impulse

**Using series pulse with same amplitude and different width to replace a half sine wave---** this half sine wave is divided into N with same width and different amplitude, and is instead by rectangular pulse with same amplitude and different width. The midpoints are coincidence, the area (impulse) is equal, and the width changes according to sine rule. PWM waveform is that, pulse width changes according to sine rule and the waveform is equal to sine wave. The amplitude of sine waveform will change by modulating pulse width in proportion. As shown in Figure 2-2.

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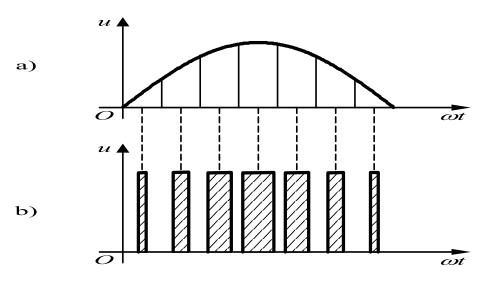


Figure 2-2 PWM wave brings sine wave

**PWM wave is equal to sine wave---**PWM wave is instead of sine wave according to the equivalent area principle. PWM wave with same amplitude can be easily generated by DC power, so currently most inverter circuits of medium and small power are used PWM technology. Inverter circuit is PWM control technology typical application. PWM inverter circuit can be divided into voltage and current type, but practical almost PWM inverter circuit is voltage circuit.

### 2.2 PWM calculation and modulating method

**Illustrate for modulation method combining with IGBT single-phase bridge inverter circuit of voltage type (shown in Figure 2-3)**. At work, V1 and V2 alternant on-off, V3 and V4 also do. In Uo positive half cycle, V1 on and V2 off, V3 and V4 alternant on-off. Load current lag than voltage, and the positive and negative alternate for some time. When Load current is in positive range with V1 and V4 on, Uo=Ud. If V4 off, load current continued flow through V1 and VD3, Uo=0. When Load current is negative with V1 and V4 still on, Io is negative. In fact Io flow from VD1 and VD4, still Uo=Ud. If V4 off and V3 on, Io continued flow from V3 and VD1, Uo=0. Uo can get two levels of Ud and zero. In Uo negative half cycle, V2 on and V1 off, V3 and V4 alternant on-off, so Uo can get two levels of –Ud and zero.

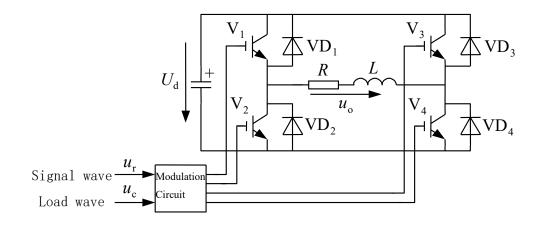


Figure 2-3 single phase bridge type PWM inverter circuit

Unipolar PWM control mode (single-phase bridge inverter): Control on-off of IGBT at ur and uc intersection.

In Ur positive half cycle, V1 on and V2 off. When ur>uc, V4 on and V3 off, uo = Ud. When ur<uc, V4 off and V3 on, uo = 0.

In Ur negative half cycle, V1 off and V2 on. When ur<uc, V3 on and V4 off, uo = Ud. When ur>uc, V3 off and V4 on, uo = 0. The broken line uof is fundamental component.

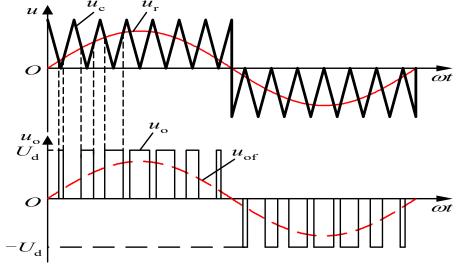


Figure 2-4 unipolar PWM control mode wave

4

### 2.3 AFC series variable frequency power supply work principle

AFC series variable frequency power control system mainly include six units: signal unit, PWM wave unit, feedback control unit, display unit, logic control unit, and protection unit. Every cell includes circuit function module.

Signal unit includes:

- Base frequency circuit
- Sine wave circuit

PWM wave unit includes:

- Triangle wave circuit
- PWM wave synthetical circuit

Feedback control unit includes:

■ Voltage negative feedback circuit

Display unit includes:

■ Voltage, frequency, current, power display circuit

Logic control unit includes:

- Soft start circuit
- Fault disposal circuit
- RESET circuit

Protection unit includes:

- Over load checking circuit
- Over voltage checking circuit
- Over temperature checking circuit
- Over current checking circuit
- Fuse checking circuit

### 2.4 System function frame

According to function frame from input to output, AFC series variable frequency control system can be divided into 23 function cells. (Shown in figure 2-5)

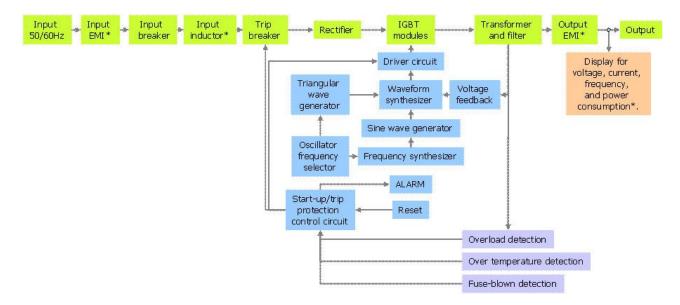


Figure 2-5 AFC series function frame

<Note> The AFC-500W is transistor amplifier type. The circuit and principle are different from IGBT circuit and system frame.

<Note2> This user manual only covers up to 200kVA. For higher kVA AFC series products, this manual does not cover. Please consult factory for above 200kVA user manual.

### 2.5 Specification

| Mode1                           | AFC   |  |  |  |  |
|---------------------------------|---|--|--|--|--|
| Circuit type                    | IGBT Pulse Width Modulation Type  |  |  |  |  |
|                                 | (Only 0.5kVA and 1kVA Transistor Amplifier Type)  |  |  |  |  |
| Output capacity                 | $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$   |  |  |  |  |
| Input voltage                   | phaseV ±15 % 	[ Other   |  |  |  |  |
| Input frequency                 | $\Box$ 47Hz~63Hz $\Box$ Other   |  |  |  |  |
|                                 | □ 5V~300V continuously adjustable   |  |  |  |  |
| Output voltage                  | $\Box$ HI/LO changeable: (HI) 10~300V, (LO) 5V~150V   |  |  |  |  |
| Output voltage                  | $\Box$ Standard setting voltage +10% ~+25%, -10% ~-30% can pre-set  |  |  |  |  |
|                                 | □ Other   |  |  |  |  |
|                                 | □ Adjustable frequency : 47~63H   |  |  |  |  |
|                                 | □ Adjustable frequency : 45~500H  |  |  |  |  |
| Output frequency                | $\Box$ Fixed frequency: 50 / 60Hz   |  |  |  |  |
|                                 | $\Box$ Fixed frequency: 50/60/2F/4F/400Hz   |  |  |  |  |
|                                 | □ Fixed frequency: 400Hz  |  |  |  |  |
|                                 | □ Other   |  |  |  |  |
| Load regulation                 | $\Box \leq 1\%$ $\Box$  |  |  |  |  |
| Frequency stability             | $\Box \leq 0.01\% \qquad \Box$  |  |  |  |  |
| Wave                            | Standard sine wave  |  |  |  |  |
| Total harmonic<br>distortion    | $\Box \leq 2\% \text{ (linear load)} \qquad \Box \_\_\_\_$  |  |  |  |  |
| Efficiency                      | $\geq$ 90% (with full load)   |  |  |  |  |
| Protection                      | Over-load, short circuit, over-current, over-temperature, input under-voltage, lack of input phase protection, etc. |  |  |  |  |
|                                 | Voltage meter: Res $\Box 0.1V$ $\Box$   |  |  |  |  |
| Danal diamlary                  | Current meter: Res $\Box 0.01A$ $\Box 0.1A$ $\Box$  |  |  |  |  |
| Panel display                   | Frequency meter: Res  0.1Hz   |  |  |  |  |
|                                 | Power meter: Res $\Box 0.001$ kW $\Box 0.01$ kW $\Box 0.1$ kW $\Box 1$ kW $\Box$                                    |  |  |  |  |
| Output/input<br>connection mode | □ Terminal row □ Other  |  |  |  |  |
| Ambient temperature             | Working temperature: $0^{\circ}C \sim 45^{\circ}C$  |  |  |  |  |
|                                 | Relative Humidity: $0 \sim 90\%$ (non-condensing)   |  |  |  |  |
| Altitude                        | <1500m  |  |  |  |  |

### 2.6 Front panel

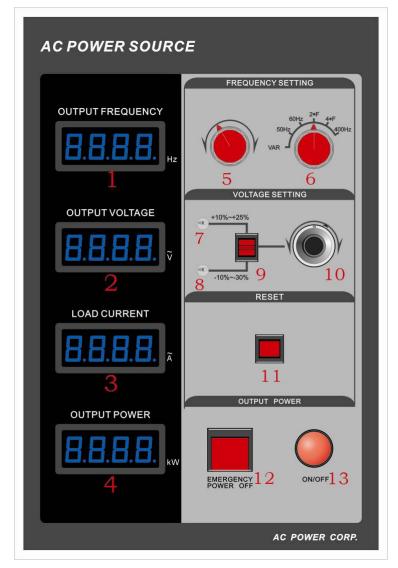
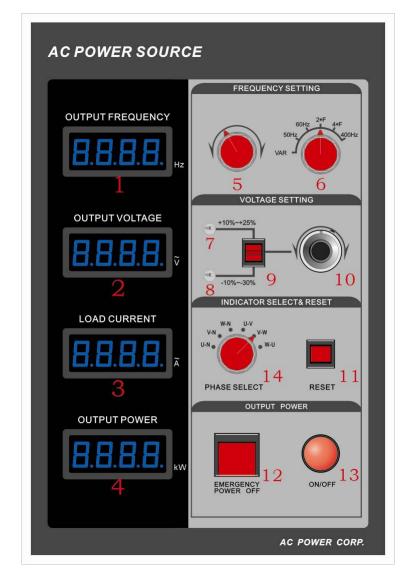


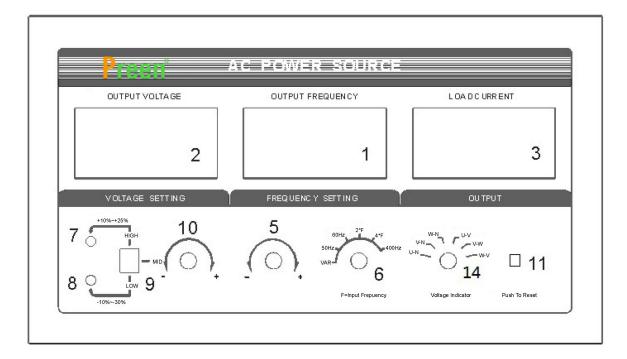
Figure 2-6 panel of AFC single-phase



(a) 6-75kVA series

## THREE PHASE FRONT PANEL

### **IGBT TYPE**



(b) 100-200kVA series

Figure 2-7 panel of AFC three-phase

- $\lceil 1 \rfloor$  —Output frequency display.
- $\lceil 2 \rfloor$  —Output voltage display.
- $\lceil 3 \rfloor$  —Output current display.
- $\lceil 4 \rfloor$  —Output power display.

 $\lceil 5 \rfloor$  —Adjustable frequency knob: Fine tuning for VAL (within default 47-63Hz or based on ordered factory option).

 $\lceil 6 \rfloor$  —Frequency band switch: For selecting output frequency band including: VAL(default 47-63Hz or based on ordered factory option), 50Hz, 60Hz, and optional: 2F, 4F, 400Hz.

 $\lceil 7 \rfloor$  —High-voltage range: output voltage be +10% ~ +25% higher than set.

 $\lceil 8 \rfloor$  -Low-voltage range: output voltage be -10% ~ -30% lower than set.

 $\lceil 9 \rfloor - 3$  voltage selection switch: High: Set output voltage at range High.

Middle: General mode.

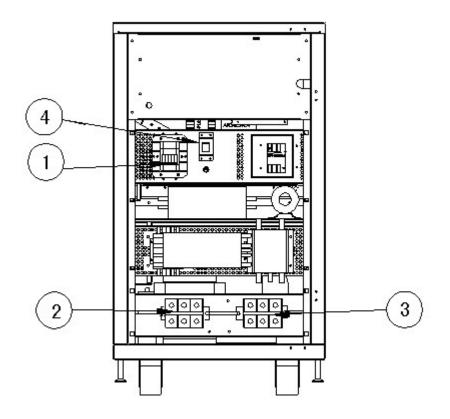
Low: Set output voltage at range LOW.

- $\lceil 10 \rfloor$  —Output voltage adjusting knob: adjust output voltage continuously.
- [11] -RESET key: Soft-start when turn on the machine or re-start after fault protection.
- $\lceil 12 \rfloor$  —Emergency power off button: For emergency shutdown.
- $\lceil 13 \rfloor$  —On/Off button: For output on or off.

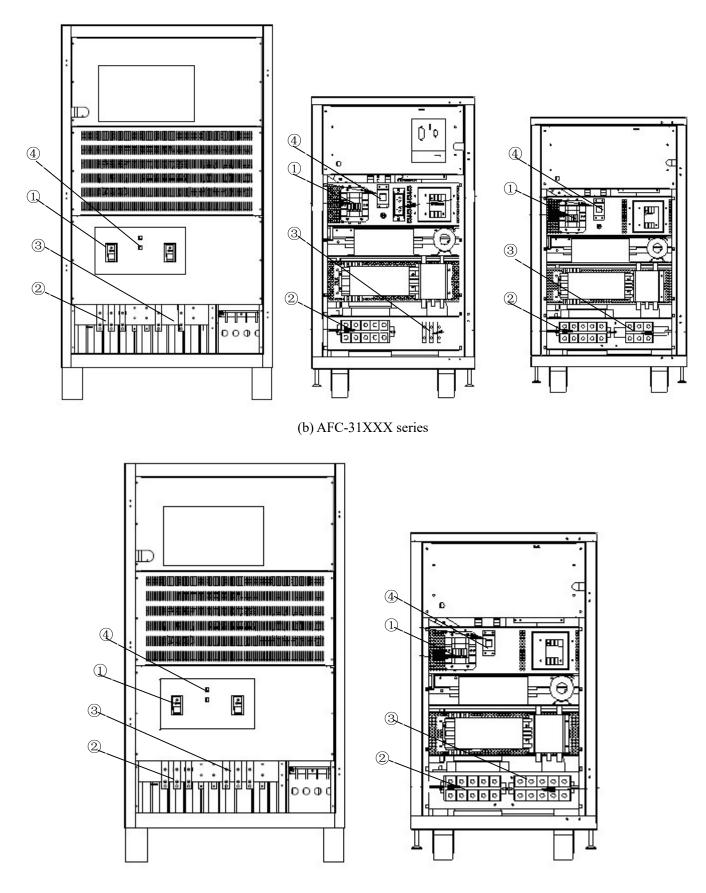
 $\lceil 14 \rfloor$  —Phase select button: Select a phase for its reading in L-N or L-L.

### 2.7 Operation instruction

- $\lceil 1 \rfloor$  —Input breaker.
- $\lceil 2 \rfloor$  —Input terminal block.
- $\lceil 3 \rfloor$  —Output terminal block.
- $\lceil 4 \rfloor$  -HI/LO selecting switch: Press  $\lceil HI \rfloor$  then output voltage 10V~300V; and press  $\lceil LO \rfloor$  then output voltage 5V~150V. The output current in  $\lceil LO \rfloor$  is double than  $\lceil HI \rfloor$ .

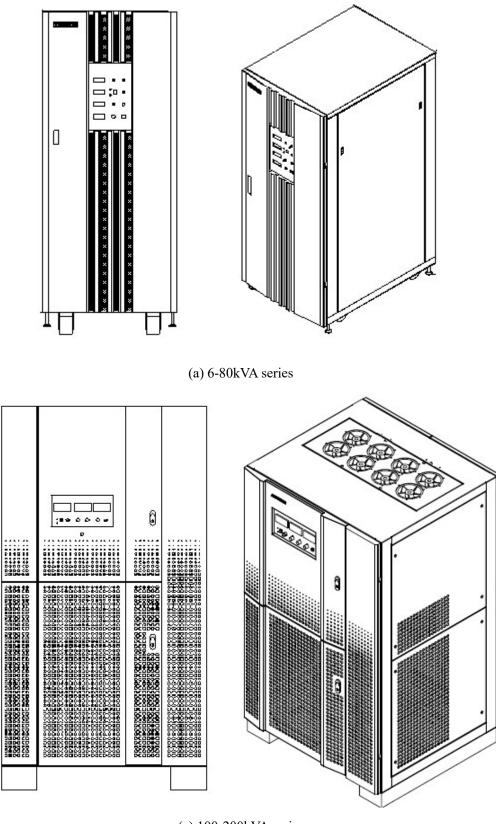


(a) AFC-11XXX series

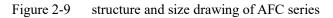


(c) AFC-33XXX series Figure 2-8 operation part sketch

### 2.8 Structure and size



(a) 100-200kVA series



Cabinet size table of AFC series:

| Machine model         |       | Size   |        |
|-----------------------|-------|--------|--------|
|                       | W(mm) | D (mm) | H (mm) |
| AFC-500W              | 430   | 520    | 200    |
| AFC-11003/11005       | 430   | 520    | 720    |
| AFC-11010             |       |        |        |
| AFC-31010/            | 600   | 850    | 945    |
| AFC-33005             |       |        |        |
| AFC-11015/11030       |       |        |        |
| AFC-31015/31030       | 600   | 850    | 1340   |
| AFC-33010/33015/33030 |       |        |        |
| AFC-31045/31060       | 800   | 860    | 1545   |
| AFC-33045/33060       | 800   | 800    | 1545   |
| AFC-31080             | 1050  | 970    | 1800   |
| AFC-33080/33100       | 1050  | 270    | 1000   |
| AFC-31100/31120       | 1150  | 1240   | 1900   |
| AFC-33120/33160/33200 | 1150  | 1240   | 1900   |

### **Chapter 3 Installation**

### 3.1 Unpacking and inspection

(1). Open the wooden box, bubble and bubble bags with variable frequency power supply in them. The equipment is too heavy, so it should be particularly careful to avoid falling or dumping when removes the equipment.

(2). Inspect whether the equipment collision and damage during transport. If finding defective, do not turn on the machine and contact with distributors.

(3). Examine random annex according to shipment annex list. If lack of any, please contact with distributors.

### 3.2 Installation procedure

### 3.2.1 Installation notice

- (1). Don't put the variable frequency power supply on uneven or gradient place to avoid abnormal operation.
- (2). Keep the distance from back of the machine to other equipments above 80cm; keep the distance from back of the machine to the wall at least 10cm; and put the variable frequency power supply near ventilation hole to prevent the inverter overheating and damage.
- (3). Avoid putting the inverter in sunlight, rain, or wet place.
- (4). Avoid placing the inverter in the place where contains corrosive gas.
- (5). Don't put out of doors.
- (6). Use correct power distribution mode, to guarantee safety of variable frequency power supply and user's equipments.

#### 3.2.2 Installation step

(1). According to different models of variable frequency power supply, use correct input and output cables. Referring to tables 3-1 and 3-2.

| Table 3-1 | Input power | distribution | cable table |
|-----------|-------------|--------------|-------------|
|-----------|-------------|--------------|-------------|

,

(a) Input high voltage

| Model      | Input current | Inpu               | Input null<br>line  | Input<br>earth line |                     |                    |
|------------|---------------|--------------------|---------------------|---------------------|---------------------|--------------------|
| (Standard) | (A)           | R                  | s                   | Т                   | (mm <sup>2</sup> )  | (mm <sup>2</sup> ) |
| AFC-500W   | 15A           | 2mm <sup>2</sup>   |                     |                     | 2mm <sup>2</sup>    | $2$ mm $^{2}$      |
| AFC-11003  | 19A           | $2.5 \text{mm}^2$  |                     |                     | 2. 5mm <sup>2</sup> | 2. $5 \text{mm}^2$ |
| AFC-11005  | 32A           | 4mm <sup>2</sup>   |                     |                     | 2. 5mm <sup>2</sup> | 4mm <sup>2</sup>   |
| AFC-11010  | 65A           | 16 mm <sup>2</sup> |                     |                     | 10 mm <sup>2</sup>  | 16mm <sup>2</sup>  |
| AFC-11015  | 97A           | 25mm <sup>2</sup>  |                     |                     | 16mm <sup>2</sup>   | 16mm <sup>2</sup>  |
| AFC-11030  | 194A          | $70 \text{mm}^2$   |                     |                     | 35mm²               | $35 \text{mm}^2$   |
| AFC-31010  | 22A           | 2.5mm <sup>2</sup> | 2.5 mm <sup>2</sup> | 2.5 mm <sup>2</sup> | 2.5 $mm^2$          | 2.5 $\text{mm}^2$  |
| AFC-31015  | 32A           | 4mm <sup>2</sup>   | 4mm <sup>2</sup>    | 4mm <sup>2</sup>    | 2. 5mm <sup>2</sup> | 4mm <sup>2</sup>   |
| AFC-31030  | 65A           | 16 mm <sup>2</sup> | 16mm <sup>2</sup>   | 16mm <sup>2</sup>   | 10mm <sup>2</sup>   | 16mm <sup>2</sup>  |
| AFC-31045  | 97A           | 25mm <sup>2</sup>  | 25mm <sup>2</sup>   | 25mm <sup>2</sup>   | 16mm <sup>2</sup>   | 16mm <sup>2</sup>  |
| AFC-31060  | 129A          | 35mm²              | 35mm <sup>2</sup>   | 35mm <sup>2</sup>   | 25mm <sup>2</sup>   | 16mm <sup>2</sup>  |
| AFC-31080  | 197A          | $70 \text{mm}^2$   | 70mm <sup>2</sup>   | 70mm <sup>2</sup>   | 35mm <sup>2</sup>   | $35 \text{mm}^2$   |
| AFC-31100  | 247A          | 95mm <sup>2</sup>  | 95mm <sup>2</sup>   | 95mm <sup>2</sup>   | 50mm <sup>2</sup>   | $50 \text{mm}^2$   |
| AFC-31120  | 296A          | 120mm <sup>2</sup> | 120mm <sup>2</sup>  | 120 mm <sup>2</sup> | 70mm <sup>2</sup>   | $70 \text{mm}^2$   |
| AFC-33005  | 11A           | $1\mathrm{mm}^2$   | $1\mathrm{mm}^2$    | $1\mathrm{mm}^2$    | $1\mathrm{mm}^2$    | $1\mathrm{mm}^2$   |
| AFC-33010  | 22A           | $2.5 \text{mm}^2$  | 2.5 $mm^2$          | 2.5 mm <sup>2</sup> | 2.5 $mm^2$          | 2.5 $\text{mm}^2$  |
| AFC-33015  | 32A           | 4mm <sup>2</sup>   | 4 mm <sup>2</sup>   | 4mm <sup>2</sup>    | 2. 5mm <sup>2</sup> | 4 mm <sup>2</sup>  |
| AFC-33030  | 65A           | 16 mm <sup>2</sup> | 16mm <sup>2</sup>   | 16mm <sup>2</sup>   | 10mm <sup>2</sup>   | 16mm <sup>2</sup>  |
| AFC-33045  | 97A           | 25mm <sup>2</sup>  | 25mm <sup>2</sup>   | 25mm <sup>2</sup>   | 16mm <sup>2</sup>   | 16mm <sup>2</sup>  |
| AFC-33060  | 129A          | 35mm²              | 35mm <sup>2</sup>   | $35 \text{mm}^2$    | 25mm <sup>2</sup>   | 16mm <sup>2</sup>  |
| AFC-33080  | 197A          | 70mm <sup>2</sup>  | 70mm <sup>2</sup>   | $70 \text{mm}^2$    | 35 mm <sup>2</sup>  | 35 mm <sup>2</sup> |

| AFC-33100 | 247A | $95 \text{mm}^2$     | $95 \text{mm}^2$     | $95 \text{mm}^2$     | $50 \text{mm}^2$  | $50 \text{mm}^2$ |
|-----------|------|----------------------|----------------------|----------------------|-------------------|------------------|
| AFC-33120 | 296A | 120mm <sup>2</sup>   | 120 mm <sup>2</sup>  | 120 mm <sup>2</sup>  | $70 \text{mm}^2$  | $70 \text{mm}^2$ |
| AFC-33160 | 395A | 70mm <sup>2</sup> *2 | 70mm <sup>2</sup> *2 | 70mm <sup>2</sup> *2 | 70mm <sup>2</sup> | $70 \text{mm}^2$ |
| AFC-33200 | 493A | 95mm²*2              | 95mm <sup>2</sup> *2 | 95mm <sup>2</sup> *2 | $95 \text{mm}^2$  | $95 \text{mm}^2$ |

(b) Input low voltage

| Input: 115V,120V |               |                     |                       |                   |                         |                         |  |
|------------------|---------------|---------------------|-----------------------|-------------------|-------------------------|-------------------------|--|
| model            | Input current | Input               | Input live wire (mm2) |                   | Input null              | Input earth             |  |
|                  | (A)           | R                   | S                     | Т                 | line (mm <sup>2</sup> ) | line (mm <sup>2</sup> ) |  |
| AFC-11003        | 37A           | 6mm <sup>2</sup>    |                       |                   | 4mm <sup>2</sup>        | 6mm <sup>2</sup>        |  |
| AFC-11005        | 62A           | $10 \text{mm}^2$    |                       |                   | 6mm <sup>2</sup>        | $10 \text{mm}^2$        |  |
| AFC-11010        | 124A          | $35 \text{mm}^2$    |                       |                   | 25mm <sup>2</sup>       | 16mm <sup>2</sup>       |  |
| AFC-11015        | 185A          | $70 \text{mm}^2$    |                       |                   | 35mm <sup>2</sup>       | 35mm <sup>2</sup>       |  |
| AFC-11030        | 371A          | 150 mm <sup>2</sup> |                       |                   | $95 \text{mm}^2$        | $95 \text{mm}^2$        |  |
| AFC-31010        | 41A           | 6mm <sup>2</sup>    | 6mm <sup>2</sup>      | 6mm <sup>2</sup>  | 4mm <sup>2</sup>        | 6mm <sup>2</sup>        |  |
| AFC-31015        | 62A           | $10 \text{mm}^2$    | $10 \text{mm}^2$      | $10 \text{mm}^2$  | 6mm <sup>2</sup>        | $10 \text{mm}^2$        |  |
| AFC-31030        | 124A          | $35 \text{mm}^2$    | 35mm <sup>2</sup>     | $35 \text{mm}^2$  | 25mm <sup>2</sup>       | $16 \text{mm}^2$        |  |
| AFC-33005        | 21A           | $2.5 \text{mm}^2$   | $2.5 \mathrm{mm}^2$   | $2.5 \text{mm}^2$ | $2.5 \text{mm}^2$       | $2.5 \text{mm}^2$       |  |
| AFC-33010        | 41A           | 6mm <sup>2</sup>    | 6mm <sup>2</sup>      | 6mm <sup>2</sup>  | 4mm <sup>2</sup>        | 6mm <sup>2</sup>        |  |
| AFC-33015        | 62A           | $10 \text{mm}^2$    | 10mm <sup>2</sup>     | $10 \text{mm}^2$  | 6mm <sup>2</sup>        | $10 \text{mm}^2$        |  |
| AFC-33030        | 124A          | 35mm <sup>2</sup>   | 35mm <sup>2</sup>     | $35 \text{mm}^2$  | 25mm <sup>2</sup>       | 16mm <sup>2</sup>       |  |

| Model      | Output current           | Outp                  | ut live line (       | mm <sup>2</sup> )    | Output                          | Output<br>earth            |
|------------|--------------------------|-----------------------|----------------------|----------------------|---------------------------------|----------------------------|
| (Standard) | (A)                      | R                     | s                    | Т                    | null line<br>(mm <sup>2</sup> ) | line<br>(mm <sup>2</sup> ) |
| AFC-11003  | LO: 25.0A<br>HI: 12.5A   | $2.5 \text{mm}^2$     |                      |                      | 2. $5$ mm <sup>2</sup>          | $2.5 \text{mm}^2$          |
| AFC-11005  | LO: 41.7A<br>HI: 20.8A   | 6mm <sup>2</sup>      |                      |                      | 4mm <sup>2</sup>                | 6mm <sup>2</sup>           |
| AFC-11010  | LO: 83.3A<br>HI: 41.7A   | 16 mm <sup>2</sup>    |                      |                      | $10 \text{mm}^2$                | 16mm <sup>2</sup>          |
| AFC-11015  | LO: 125.0A<br>HI: 62.5A  | 35mm²                 |                      |                      | $25 \text{mm}^2$                | 16mm <sup>2</sup>          |
| AFC-11030  | LO: 250A<br>HI: 125A     | 95mm <sup>2</sup>     |                      |                      | $50 \text{mm}^2$                | 50mm <sup>2</sup>          |
| AFC-31010  | LO:83.3A<br>HI: 41.6A    | 16mm <sup>2</sup>     |                      |                      | $10 \text{mm}^2$                | 16mm <sup>2</sup>          |
| AFC-31015  | LO: 125A<br>HI: 62.5 A   | 35mm²                 |                      |                      | $25 \text{mm}^2$                | 16mm <sup>2</sup>          |
| AFC-31030  | LO: 250.0A<br>HI: 125.0A | 95mm <sup>2</sup>     |                      |                      | $50 \text{mm}^2$                | 50mm <sup>2</sup>          |
| AFC-31045  | LO: 375.0A<br>HI: 187.5A | 70mm <sup>2</sup> *2  |                      |                      | $70 \text{mm}^2$                | 70mm <sup>2</sup>          |
| AFC-31060  | LO: 500.0A<br>HI: 250.0A | 95mm <sup>2</sup> *2  |                      |                      | $95 \text{mm}^2$                | 95mm <sup>2</sup>          |
| AFC-31080  | LO: 666.7A<br>HI: 333.3A | 150mm <sup>2</sup> *2 |                      |                      | $150 \mathrm{mm}^2$             | 150 mm <sup>2</sup>        |
| AFC-31100  | LO: 833.3A<br>HI: 416.7A | 120mm <sup>2</sup> *3 |                      |                      | 95mm²*2                         | 95mm <sup>2</sup> *2       |
| AFC-31120  | LO: 1000A<br>HI: 500A    | 150mm <sup>2</sup> *3 |                      |                      | 120mm <sup>2</sup> *2           | 120mm <sup>2</sup> *2      |
| AFC-33005  | LO: 13.9A<br>HI: 6.9A    | 1 mm <sup>2</sup>     | $1\mathrm{mm}^2$     | $1 \text{ mm}^2$     | $1\mathrm{mm}^2$                | $1\mathrm{mm}^2$           |
| AFC-33010  | LO: 27.8A<br>HI: 13.9A   | 4mm <sup>2</sup>      | 4mm <sup>2</sup>     | 4mm <sup>2</sup>     | 2. $5 \text{mm}^2$              | 4mm <sup>2</sup>           |
| AFC-33015  | LO: 41.7A<br>HI: 20.8A   | 6mm <sup>2</sup>      | 6mm <sup>2</sup>     | 6mm <sup>2</sup>     | 4mm <sup>2</sup>                | 6mm <sup>2</sup>           |
| AFC-33030  | LO: 83.3A<br>HI: 41.7A   | $16 \text{mm}^2$      | 16mm <sup>2</sup>    | 16mm <sup>2</sup>    | $10 \text{mm}^2$                | 16mm <sup>2</sup>          |
| AFC-33045  | LO: 125.0A<br>HI: 62.5A  | 35mm²                 | 35mm²                | 35mm²                | 25mm <sup>2</sup>               | 16mm <sup>2</sup>          |
| AFC-33060  | LO: 166.7A<br>HI: 83.3A  | 50mm <sup>2</sup>     | 50mm <sup>2</sup>    | 50mm <sup>2</sup>    | 25mm <sup>2</sup>               | 25mm <sup>2</sup>          |
| AFC-33080  | LO: 222.2A<br>HI: 111.1A | 70mm <sup>2</sup>     | 70mm <sup>2</sup>    | 70mm <sup>2</sup>    | $35 \text{mm}^2$                | 35mm <sup>2</sup>          |
| AFC-33100  | LO: 277.8A<br>HI: 138.9A | 120mm <sup>2</sup>    | 120mm <sup>2</sup>   | 120mm <sup>2</sup>   | $70 \text{mm}^2$                | 70mm <sup>2</sup>          |
| AFC-33120  | LO: 333.3A<br>HI: 166.7A | 150 mm <sup>2</sup>   | 150mm <sup>2</sup>   | 150 mm <sup>2</sup>  | $95 \text{mm}^2$                | 95mm²                      |
| AFC-33160  | LO: 444.4A               | 70mm <sup>2</sup> *2  | 70mm <sup>2</sup> *2 | 70mm <sup>2</sup> *2 | $70 \text{mm}^2$                | $70 \text{mm}^2$           |

| Table 3-2 Output power | distribution | cable table |
|------------------------|--------------|-------------|
|------------------------|--------------|-------------|

|           | HI: 222.2A               |                       |                       |                       |                    |                    |
|-----------|--------------------------|-----------------------|-----------------------|-----------------------|--------------------|--------------------|
| AFC-33200 | LO: 555.6A<br>HI: 277.8A | 120mm <sup>2</sup> *2 | 120mm <sup>2</sup> *2 | 120mm <sup>2</sup> *2 | 120mm <sup>2</sup> | 120mm <sup>2</sup> |

### **Notice**

In the above table, suggest cables use multi-core soft copper cables. Users can choose different cables according to input and output current condition. When input or output length is more than 20m, diameter of cables should be doubled.

(2). Use voltage meter to confirm distribution lines without voltage output.

(3). Confirm all switches of variable frequency Power supply in "OFF" position.

(4). Connect input distribution lines to corresponding input terminals of variable frequency power supply, output load lines should be connected to corresponding output terminals of variable frequency power supply.

### **Notice**

Wiring relation (R, S and T general correspond common red, white and blue; N line must be well connected). It is strictly forbidden to install while at AC Power "ON" status. Consider voltage drop when the distance of input and output wiring is long.

### **Chapter 4 Operation**

### 4.1 Operation mode

Two types: AC power inversion mode and fault mode.

#### 4.1.1 AC power inversion mode

After installation and connect variable frequency power supply to AC power, turn on input air breaker. After a few seconds the buzzer sounds, then press RESET button on the operation panel for more than one second. When hear the buzzer stop buzzing, the power enters inversion mode. When input AC power is in normal range, the frequency meter and voltage meter on control panel show the current setting output value.

#### 4.1.2 Fault mode

After connecting to AC power but not pressing RESET key, or appearing output over-load, input low-voltage, output over-voltage, over-temperature, FUSE break, and inverter over-current when turning on the machine, the buzzer will sound continually, and voltage and current show no value on operation panel.

### Del Notice

In fault mode, press RESET key to re-start. If RESET key is invalid, it says that the fault has not been eliminated, and troubleshooting needs to be done. When press RESET key, it is not recommended that re-start with load.

### 4.2 Normal operation

#### 4.2.1 Systme initial start

In term of the mentioned manner, connect the input and output line (if there is a load, please switch off the output external breaker). Close the input switch (please confirm that the utility is normal, before you close the input switch). From now on, the power system starts, and the main fans operate. The rectifier makes use of soft-start, and the control system checks by itself. After that, the buzzers sound (illuminate that the rectifier has start already and the control system has been checked by itself). At this moment, the tables in the panel light up (voltage\current\power table display "0", except the frequency table). After you click the RESET button in the operation panel more than 1 second, the buzzers don't sound any more. There is output power on the power source. Please confirm the frequency, voltage, current, and the power shows compliance with the use requirements (if not consistent, please configure the output voltage and frequency through the operation panel). Close the output switch. If there is the normal work with a load, the system initial use of power debugging completed.

### Notice

Before you close the input power switch, please confirm that the input voltage is in the normal range, and the phase sequence is right. To ensure that the initial boot security, it would be grateful if the panel voltage regulator knob counterclockwise transferred to the minimum, that is, anti-clockwise rotation in the end position.

#### 4.2.2 Normal operation

On the normal status, output should be configured on the normal use status by the users.

- (1). Connect the utility to the rectifier, click "RESET" button more than 1second. The buzzers don't sound any more, and the instrument in the panel directed the voltage and the frequency value after several seconds. Complete boot.
- (2). Choose the required output frequency. You can turn the frequency knob (not need shut down), until you have the required value.

Fixed output frequency: switch the frequency knob to the instructions on the "50Hz" or "60Hz", you can gain the required fixed output frequency.

Regulated output frequency: switch the frequency knob to the instructions on the "VAR", turn the frequency adjustable vernier knob, you can gain the required frequency range from "47Hz~63Hz".

- (3). Standard output voltage adjustment. Make the [Three-phase voltage selection switch] switch to the [MID], and then, turn the [frequency adjustable vernier knob]. You can gain the required output voltage. At this moment, high position of the [three-phase voltage selection switch] correspond to the 110~125 percent of the rated output voltage, low position correspond to the 90~70 percent of the rated output voltage.
- (4). Configure the voltage higher than the rated 10%~25%. Make [three-phase voltage selection switch] switch to the high position, and then, turn the little knob above the high position using a little slotted screwdriver until you get the required output voltage.
- (5). Configure the voltage lower than the rated 10%~30%. Make [three-phase voltage selection switch] switch to the low position, and then, turn the little knob below the low position using a little slotted screwdriver until you get the required output voltage.

If the required output voltage is "220V±15%", adjusted by the following steps:

 $220V \times 1.15 = 253V$ 

 $220V \times 0.85 = 187V$ 

Make [three-phase voltage selection switch] switch to the [MID], and then, vernier turn the [output voltage vernier knob], you can get 220V output voltage.

Switch [three-phase voltage selection switch] to [HIGH] position, and then, turn the knob above this position using a little slotted screwdriver until you gain the 253V output voltage.

Switch [three-phase voltage selection switch] to [LOW] position, and then, turn the knob below this position using a little slotted screwdriver until you gain the 187V output voltage.

For example

(6). After you complete above adjustment, you can close the output switch and external switch if there is nothing trouble.

### Dotice Notice

If you connect the load to the power source without setting the output voltage and the frequency, there be something wrong with your load. When the load specify the electromotor, if the motor starting current more than the over-current setting value, the variable frequency power source will be protected. Click the RESET button to restart after over-load situation be eliminated.

#### 4.2.3 Out of power and shut down

Shutdown order: disconnect your load, switch off the output external switch, and then, switch off the output breaker. At last, switch off input breaker. At this time, the displayed disappear, and the fans stop. The power system shut down.

### **Chapter 5 Maintenance**

### 5.1 Maintenance notice

#### (1). Read product manual

Maintenance should pay special attention to these measures and the contents described in the product manual.

(2). Avoid shock

Firstly, make sure that you have switched the input breaker in the panel to the "OFF" position to avoid shock; there is the electricity in the internal conductive copper, so you must not touch.

(3). Circuit integrality

When you replace the circuit parts, please ensure the use of specified components. In any cases, do not alter any circuit (do not suggest replace the components on the PCB board. When there is something wrong, you just replace the PCB board).

(4). Parts fixed and the rehabilitation of the entire line

Some parts are fixed with insulation tape and the rubberized fabric in order to isolate with the PCB board for security. In addition, the internal wiring need to collate, tighten up to prevent interference from heating parts, and high-voltage parts. So recovery action must do.

(5). Safety check after maintenance

#### Notice

Check the screw, parts, and wring placing after you complete the maintenance. You must make sure of the security of the variable frequency power source.

### 5.2 Fan

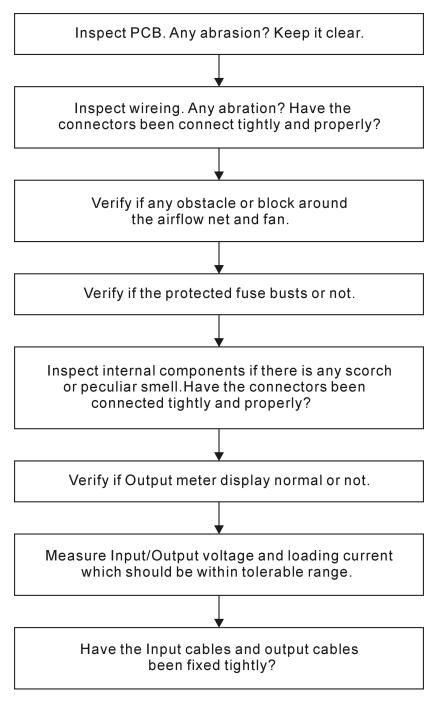
The fans expected time is 20000 to 40000 hours in the continuous operation. The higher ambient temperature, the shorter service lifetime. The fans should be checked regularly.

### 5.3 System inspection by eyes

(1). Clear regularly, specially, the input and the output air channel to ensure the air flow fluently. When necessary, use dust vacuum.

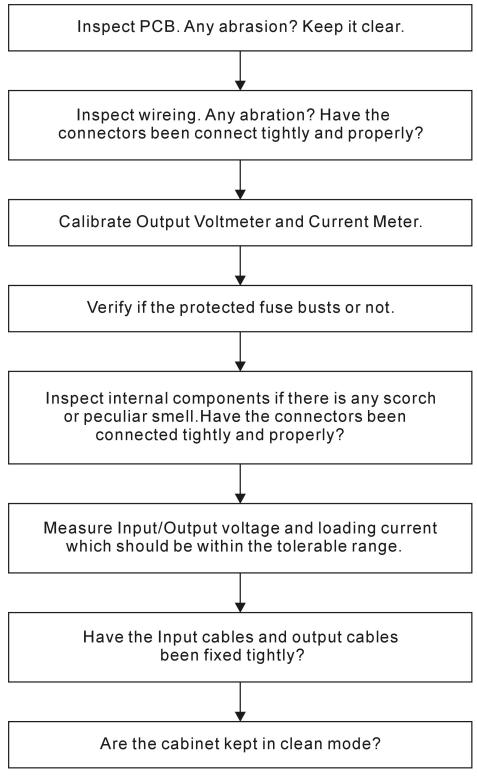
(2). Check that there is nothing on the air channel.

### 5.4 Quarterly maintenance



Quarterly maintenance flow chart

### 5.5 Yearly maintenance



Yearly maintenance flow chart

## **Chapter 6 Troubleshooting**

When AC power source operates abnormally, the possible causes could be narrowed down with the table below. The error code is available on PCB AFC-PROB-3P (3Phase product) or PCB AFC-1P (single phase 5kva above), after press "RESET" button.

Please report abnormal symptoms with error code to our branches or local distributors for after-service.

| NO. | description   | analysis  | solution  |
|-----|---|---|---|
| 1   | Don't start up, and no responses  | The utility is abnormal, or<br>connection is abnormal                           | Check the utility and the phase sequency of input voltage, eliminate the errors, and restart.         |
| 2   | Connect the utility to the input, but<br>cann't RESET. At this time, LED<br>indicator display "04" in the PCB<br>AFC-PROB-3P or PCB AFC-1P. | Input under-voltage   | Check the input voltage, eliminate the errors,and restart   |
| 3   | Connect the utility to the input, but<br>cann't RESET. At this time, LED<br>indicator display "07" in the PCB<br>AFC-PROB-3P or PCB AFC-1P. | <ul> <li>R phase module error;</li> <li>R phase circuit short.</li> </ul>       | Please inform our branches or local partners for services.  |
| 4   | Connect the utility to the input, but<br>cann't RESET. At this time, LED<br>indicator display "06" in the PCB<br>AFC-PROB-3P.               | <ul> <li>S phase module error;</li> <li>S phase circuit short.</li> </ul>       | Please inform our branches or local partners for services.  |
| 5   | Connect the utility to the input, but<br>cann't RESET. At this time, LED<br>indicator display "05" in the PCB<br>AFC-PROB-3P.               | <ul> <li>T phase module error;</li> <li>T phase circuit short.</li> </ul>       | Please inform our branches or local partners for services.  |
| 6   | Connect the utility to the input, but<br>cann't RESET. At this time, LED<br>indicator display "08" in the PCB<br>AFC-PROB-3P or PCB AFC-1P. | Over-load   | Remove the load till the max current within the specs of AC power source, and restart.                |
| 7   | Connect the utility to the input, but<br>cann't RESET. At this time, LED<br>indicator display "02" in the PCB<br>AFC-PROB-3P or PCB AFC-1P. | Internal FUSE blews   | Check whether the fuse blews, if so, please<br>inform our branches or local partners for<br>services. |
| 8   | Connect the utility to the input, but<br>cann't RESET. At this time, LED<br>indicator display "01" in the PCB<br>AFC-PROB-3P or PCB AFC-1P. | The output is over-voltage  | Please inform our branches or local partners for services.  |
| 9   | Connect the utility to the input, but<br>cann't RESET. At this time, LED<br>indicator display "03" in the PCB<br>AFC-PROB-3P or PCB AFC-1P. | The temperature protection circuit is abnormal                                  | Please inform our branches or local partners for services.  |
| 10  | There is something wrong with the fans  | Something is wrong with fans or air duct.                                       | Clear air duct.   |
| 11  | Display function is abnormal  | Malfunction on meter/display or<br>along the concerning circuit to<br>sampling. | Please inform our branches or local partners for services.  |

| Code | Definition                  | Code | Definition                      |
|------|-----------------------------|------|---------------------------------|
| 00   | Start normally              | 05   | IGBT over-current in<br>T phase |
| 01   | R、S、T phase<br>over-voltage | 06   | IGBT over-current in<br>S phase |
| 02   | Fault on the fuse breaker   | 07   | IGBT over-current in<br>R phase |
| 03   | Over-temperature            | 08   | over-load                       |
| 04   | Input under-voltage         | c0   | External error                  |

#### Error code definition on PCB AFC-PROB-3P or PCB AFC-1P:

# Appendix Guarantee Card



### **Guarantee Card**

Dear\_\_\_\_:

Thanks for your support and patronage, the card guarantee that if your purchasing variable frequency power supply product (Model:\_\_\_\_\_\_, serial number:\_\_\_\_\_\_) is in normal use, and the machine is failure because of careless mistake of program or degradation of component, Preen bears full responsibility for after-sales service with free of charge. within one year.

Notice:

Machine should be correct installation and use. It can not be to modified structure, circuit or spare parts by users.

1. If machine is failure, please call us or send the machine back to our company with proper packaged and indicating the fault. We will serve for you as soon as possible.

2. If continue to save the card after the warranty period, we will charge reasonable fee after completion maintenance.

Deputy:

Date: \_\_\_\_\_