



VFP Series Three-phase
Variable-frequency Power Supply
User's Manual



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Important

- △ This equipment is designed with reference to the following standards:
 - IEC60950-1 and IEC62040-1-1 General and safety requirements for UPS used in operator access areas
 - IEC/EN62040-2 EMC requirements
 - IEC62040-3 Performance requirements and test methods

The equipment shall be installed according to the foregoing requirements and the manufacturer-designated accessories shall be used.

- △ This Manual involves the installation and operation of VFP variable-frequency power supply. Please read this Manual carefully before installation.
- △ The equipment has a rectifier and filter capacitor inside as an energy storage element. After the input AC power supply is disconnected, the DC part may still have a voltage. Take care of personal safety.
- △ This equipment is mounted with a radio-frequency interference (RFI) filter. The earth leakage current is between 3.5mA and 1,000mA. To select the residual current circuit breaker (RCCB) or other residual current detectors (RCD), it is necessary to consider the possible transient and stable earth leakage current upon equipment starting. The RCCB that is insensitive to unidirectional DC pulse (Class A) and transient current pulse must be adopted. Please note that the load's earth leakage current will also flow through RCCB or RCD.

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Declaration

This Manual is only applicable for variable-frequency power supply products and it is a general version. Please see the technical contract or product nameplate for the detailed technical indexes.

1. Product introduction

1.1 General descriptions

VFP series intelligent variable-frequency power supply is the new-generation variable-frequency and stable-frequency power supply equipment developed by our Company. It satisfies the special requirements on the use of imported equipment in China as it can simulate the power supply environment of different countries in the world. It can also provide power supply for test of exported domestic equipment.

1.2 Design philosophy

The primary circuit of VFP series variable-frequency power supply is designed according to the working principle of AC-DC-AC and mainly comprises rectifier, DC filter capacitor bank, inverter, output resistor, isolation transformer and AC filter capacitor bank, as Figure 1 shows.

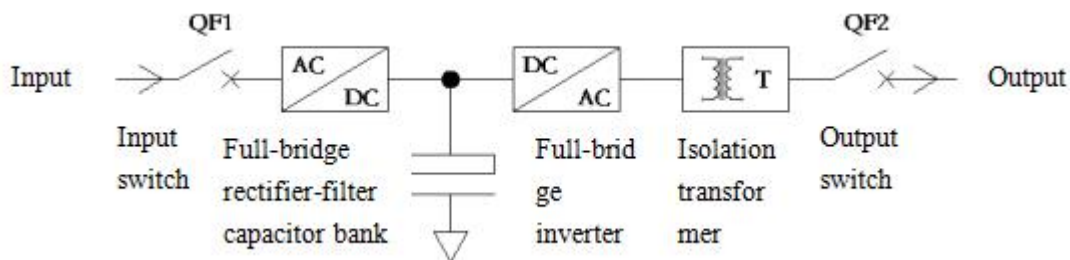


Figure 1 General Design Plan

1st-stage AC-DC rectifier part: the input AC voltage is buffered by the current-limiting resistance and converted into DC voltage via the full-bridge rectifier module.

2nd-stage DC-AC inverter part: heavy-duty IGBT (insulated gate bipolar transistor) is adopted as the inversion element. Advanced sine-wave pulse-width modulation (SPWM) technology is adopted to compare the modulation wave (base sine-wave power supply) and carrier wave (base triangular wave power supply). When the carrier wave and the modulation wave cross each other, the switching time of the inverter switch tube IGBT and its on/off status are determined via the crossing point to acquire a series of positive and negative rectangular SPWM with different widths. This series of pulses is characterized by equal breadth and unequal width. Its width changes in a sine wave. In half cycle of sine wave, the total area of positive and negative pulses is the same as the area of sine wave. The

output pulse width modulation wave is filtered via the LC filter circuit to obtain pure sine wave AC voltage. The output is furnished with an isolation transformer to increase the general stability of the equipment.

1.3 Product features

- ★**High impact resistance:** Imported IGBT power module
- ★**High accuracy of stable frequency:** Spatial vector pulse width modulation, frequency stability $\leq 0.01\%$
- ★**High accuracy of stable voltage:** PID algorithm control, voltage stability $\leq 1.0\%$
- ★**Fast response:** AD synchronous sampling, response speed $\leq 2.0\text{ms}$
- ★**Good output waveform:** SPWM sine-wave pulse-width modulation, output sine wave THD $\leq 3.0\%$
- ★**Wide voltage range:** Step-up voltage output in an isolated manner
- ★**Good interference immunity:** Complete I/O isolation

2. Handling and placement

- 2.1 Please take care of safety during handling. Choose a forklift, tractor or hoist and other carrying tools in line with the product weight.
- 2.2 Pay attention to the position of the product's center of gravity; avoid wide-range swinging; take care to keep it level to avoid falling off.
- 2.3 Pay attention to the marks on the package or product, e.g. the mark that forbids upside-down handling or tilted handling.
- 2.4 Rest the product horizontally. Tilted placement may cause the equipment to deform and affect its profile and operation.
- 2.5 Take care of personal safety.

3. Working environment

The equipment shall be installed in a cool, dry, clean and well-ventilated environment. When the environment contains any conductive powders (e.g. metal powder, sulfide, sulfur dioxide, graphite, carbon fiber, conductive fiber, etc), acid mist or other conductive media (highly ionized substance), it is necessary to take preventive and protective measures and even stop using strictly according to relevant national standards.

- ◆**Altitude:** Not to exceed 1,000m; otherwise, the rated capacity shall be decreased in use.
- ◆**Environmental temperature:** -15 to 50°C.
- ◆**Relative humidity:** 10-90%.
- ◆**Ventilation environment:** The product's vent hole shall have an interval of at least 50cm from the wall surface.
- ◆**Vibration condition:** Do not use the product in a vibrating condition.
- ◆**Dust and inflammable gas:** Protective measures must be taken if this product is working in an environment with dusts and inflammable gases.
- ◆**Acid, alkali and salt fog:** Protective measures must be taken if this product is working in an environment with acid, alkali and salt fog.

4. Installing instructions

4.1 Pre-installation inspection

Perform the following inspections before equipment installation:

◆ **Unpacking inspection:** after unpacking, check product nameplate, make sure the product type, conformity certificate, warranty card and user's manual and accessories are included in the packing box and check if the equipment is damaged during transportation. Please contact with us or our local distributor if there is any anomaly.

◆ **Check insulating resistance:** Use a 1,000V megameter to measure the earth insulation resistance of various energized points (e.g. air switch, contactor and compensation transformer); insulation resistance $\geq 2.0\text{M } \Omega$ satisfies the requirements. If it does not satisfy the requirements, it is necessary to take heating, drying, ventilating and dehumidifying measures till the requirements are satisfied. Pay attention to the surge protector that may have high leakage current in the equipment (e.g. lightning protector, piezoresistor, capacitor, etc). It may be necessary to disconnect similar equipment and the earthwire during inspection of the insulation resistance to avoid affecting the measurement of insulation resistance.

4.2 Electric connection

Please connect as per the **wiring diagram**. Observe the instructions on the **wiring label** pasted next to the wiring terminal.

Input wire:

Three-phase-five-wire product, three phase wires L1, L2 and L3 + null wire N + earth wire PE are connected to the corresponding input terminals. If the factory adopts three-phase-four-wire system (shared null wire), please connect the null wire and the earth wire to the shared line of input in parallel.

Three-phase-four-wire product, three phase wires L1, L2 and L3 + earth wire PE are connected to the corresponding input terminals. **Output wire:** three-phase live wires U/V/W + null wire N + earth wire PE are connected to the corresponding output terminals.

Note:

1. The output null wire and the input null wire of the product are isolated and a floating voltage between the output null wire and the earth wire is normal. If the voltage between the output null wire and the earth wire is small, a 450V/10UF CBB capacitor may be connected between the output null wire and the earth wire via a bridge joint or the output null wire and the earth wire may be connected in a short circuit directly. 2. Some products may have a special earth wire block and a null wire block. Please connect the wires as indicated.

3. Choose the wire diameter as per standards. Excessively small wire diameter would lead to wire heating and other safety hazards.

Note: In case of any conflict between national and international standards, the former shall prevail.

5. Basic electric principles

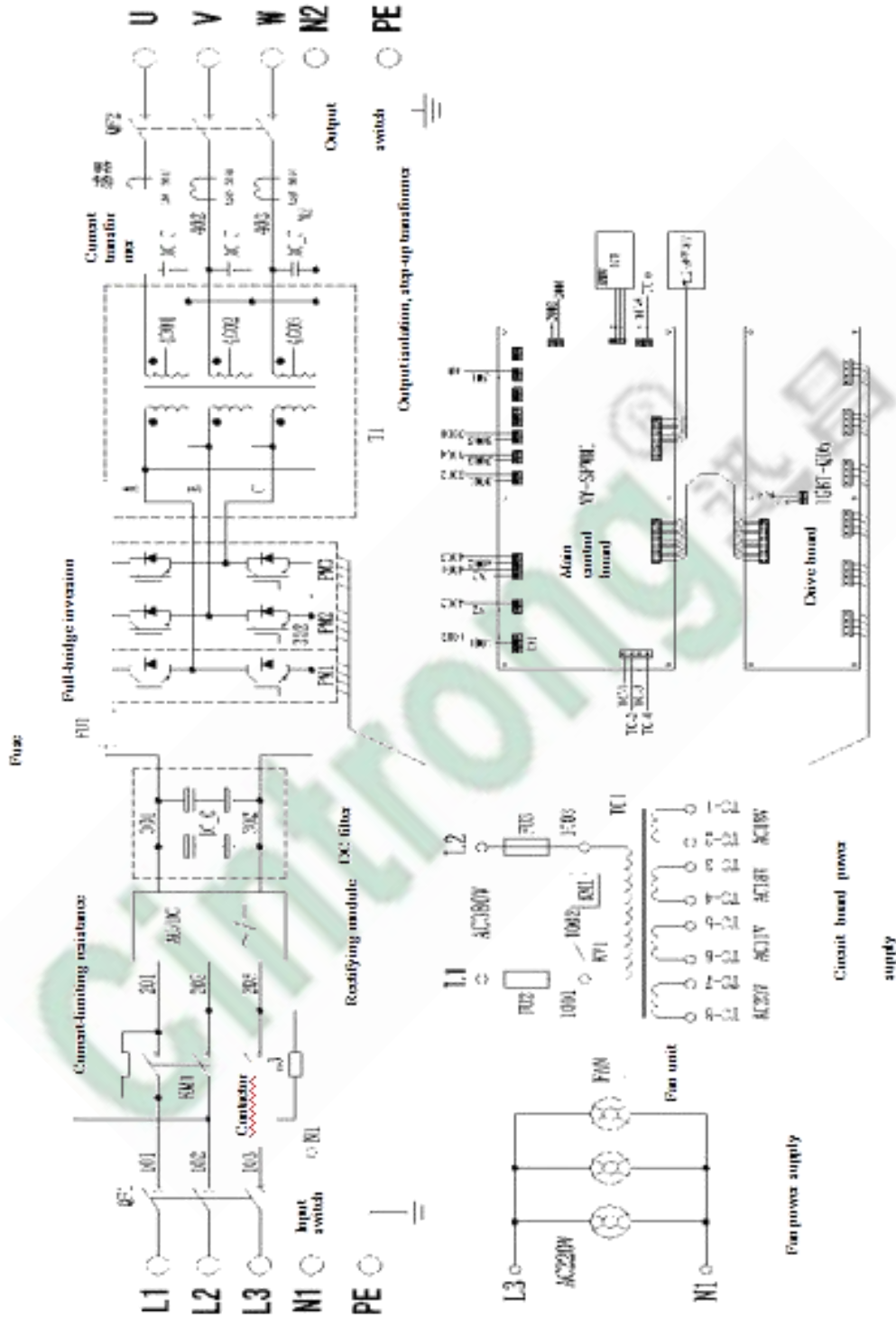


Figure 2 Schematic Diagram (for reference only)

6. Parameters

Input	Rated voltage	AC380V/400V
	Range of fluctuation	Rated voltage \pm 15%
	Frequency	40-70Hz
Output	Modulation mode	IGBT/SPWM
	Voltage	3 Φ 4W+PE, AC0-520V
	Voltage stability	\leq 1.0%
	Total harmonic distortion (THD)	\leq 3.0% (linear load)
	Frequency	43-73Hz phaseless regulation; 50/60Hz phased regulation
	Frequency stability	\leq 0.01%
	Response time	2ms for input voltage fluctuation
Display diagnostic system	Electric parameter display	Input voltage and frequency; output phase voltage, mean line voltage, current, frequency, apparent power, active power, reactive power and power factor
	Electric parameter display resolution	Voltage resolution 0.1V, current resolution 0.1A
	Fault diagnosis and display	Overload fault, IGBT module fault, fuse fault, over-temperature fault
	Display media	Touch screen
Alarm function	Overload alarm, IGBT alarm, fuse alarm, temperature alarm (85°C \pm 5°C)	

Note: the foregoing technical parameters are for reference only and they shall be determined otherwise according to the technical requirements of order for non-standard products.

6. Touch screen and operating instructions

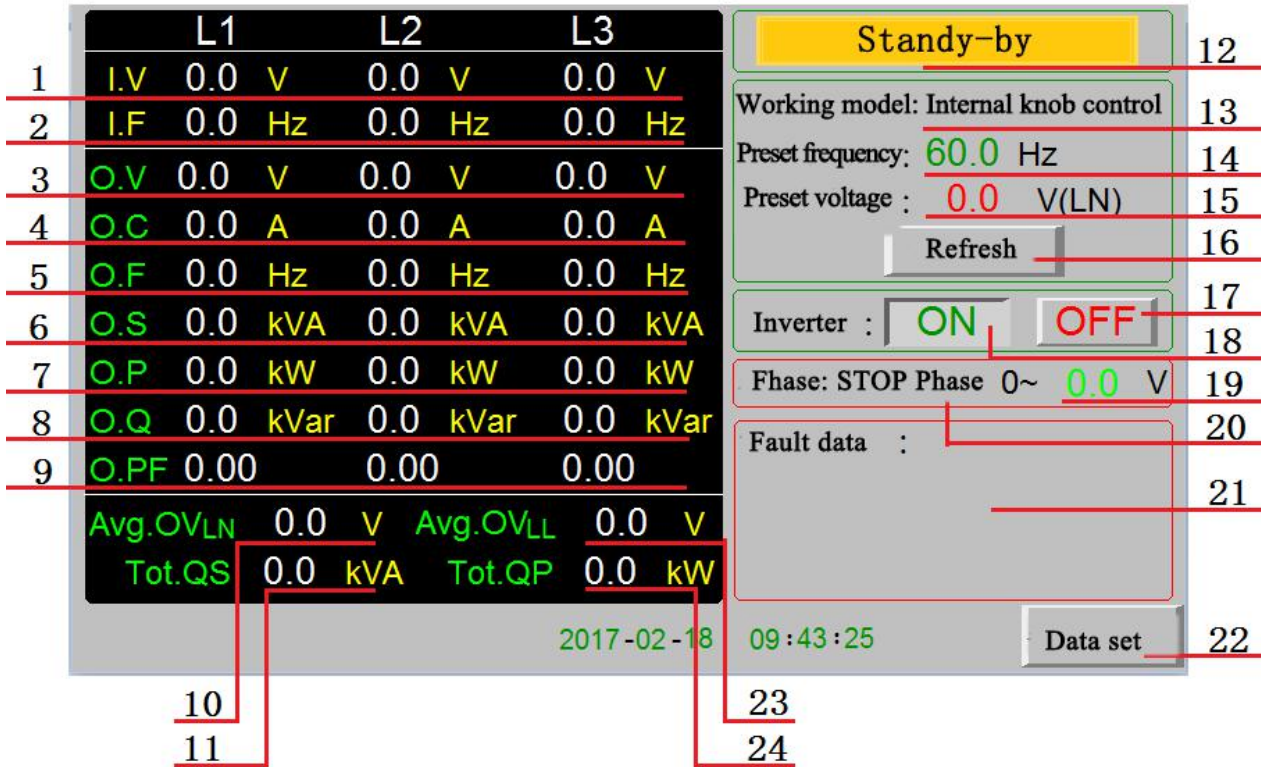


Figure 3 Main Display of Touch Screen

Designation	Meaning	Remarks
1	Display the input voltage of L1 (L1L2), L2 (L2L3) and L3 (L3L1)	
2	Display input grid frequency	
3	Display the output phase voltage L1, L2 and L3	
4	Display the output current L1, L2 and L3	
5	Display output frequency	
6	Display the apparent output power of each phase L1, L2 and L3	
7	Display the active output power of each phase L1, L2 and L3	The algorithm of these parameters is based on the method to measure power factor via phase angle and it is for reference only. There may be an error if the load has considerable harmonics.
8	Display the reactive output power of each phase L1, L2 and L3	
9	Display the output power factor of each phase L1, L2 and L3	
10	Display the mean of three phase voltages L1, L2 and L3	
11	Display total power of load and the sum of apparent powers of three phases L1, L2 and L3	

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12	Equipment working state (standby, operation, fault)	
13	<p>Working mode selection (1. Internal knob control; 2. Touch screen serial port control)</p> <p>1. Internal knob control mode: touch screen is not used for voltage and frequency control; instead, they are controlled via the internal manual knob and the selector switch. See 8.3 voltage and frequency regulation.</p> <p>2. Touch screen serial port control mode: internal knob is not used for control. Instead, voltage and frequency are controlled via the touch screen or serial port computer (with reference to notes in Items 14, 15 and 16).</p>	<p>The text can be clicked via touch. An option; the working mode is switched between knob control and touch screen serial port control (other working mode options are also available for unconventional products but not introduced here)</p>
14	Valid in the touch screen serial port control mode and for frequency setting; scope: 40-400HZ (conventional product)	The text can be clicked via touch for number input
15	Valid in the touch screen serial port control mode and for voltage setting; scope: 10-VMAX (maximum voltage displayed in Item 19) Note: this voltage is a phase voltage; input conversion is required when you need line voltage, $LL=1.732*LN$	The text can be clicked via touch for number input
16	Refresh button, valid in the touch screen serial port control mode; the touch screen setting is uploaded to the motherboard for setting purpose	The button can be clicked via touch
17	Inverter shutdown button	The button can be clicked via touch
18	Inverter starting button	The button can be clicked via touch
19	Display the maximum phase voltage that the equipment outputs	
20	Display the phases of output voltage of the equipment; a switch is provided in the cabinet for HV and LV switching. The selection is made as per the load voltage. Use the LV phase when the phase voltage you need is half of the maximum phase voltage in order to withstand higher current	An option and not a standard configuration; this feature can be selected upon ordering for 100KVA and lower rating under normal circumstances
21	Fault information display: Input under-voltage, fuse wire fault, IGBT fault, temperature fault, overload fault	
22	Parameter setting button; click to access the interface of Figure 4	This button can be clicked via touch
23	Display the mean of the three phase voltages of	

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	L1L2, L2L3 and L3L1	
24	Display the total active power of load and output the sum of the active powers of three phases L1, L2 and L3	

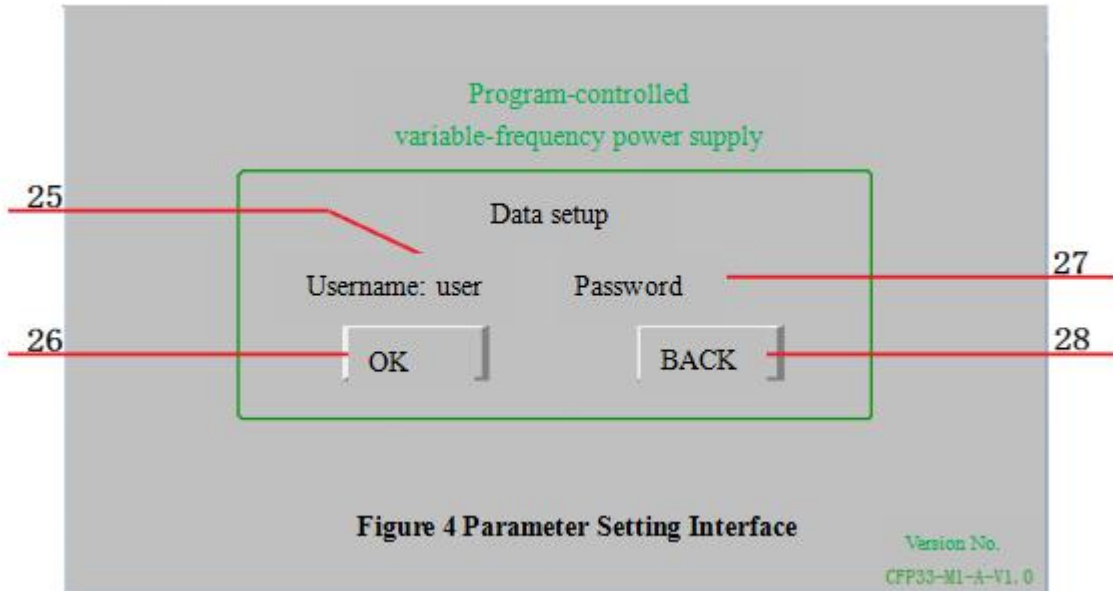


Figure 4 Parameter Setting Interface

Designation	Meaning	Remarks
25	Display authorized operator, user and administrator; administrator authority is only for the manufacturer's equipment commissioning;	This text can be clicked via touch for switching of operator
26	OK button; when the password is input correctly, click this button to access Figure 5 user parameter setting interface	This text can be clicked via touch
27	Password, user password: 11111	This text can be clicked via touch for number input
28	Back button, click to return and exit	This text can be clicked via touch

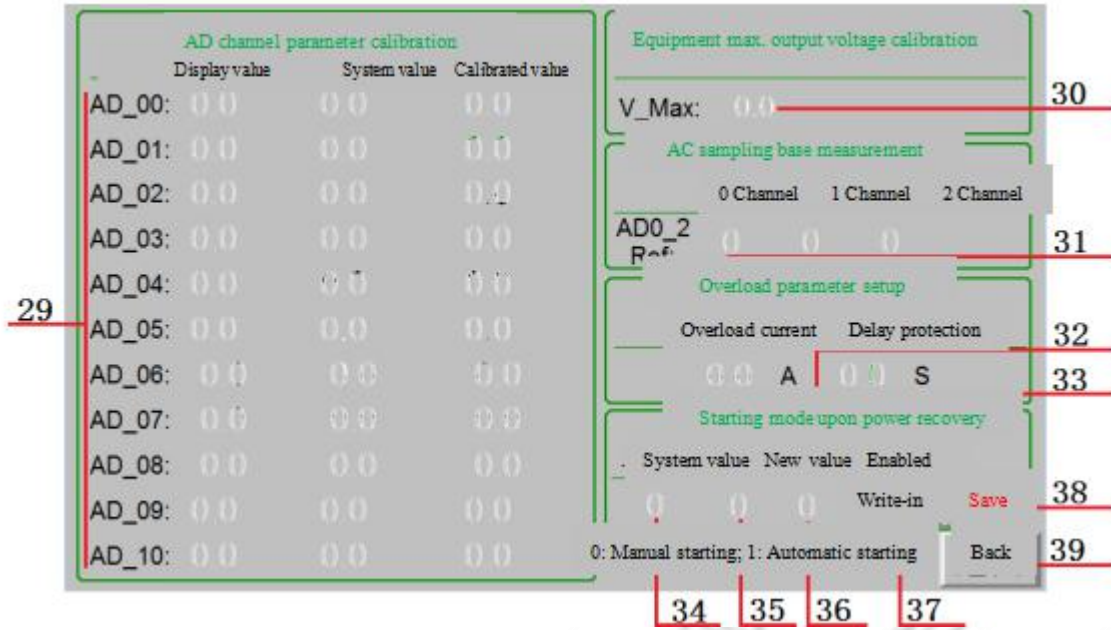


Figure 5 User Parameter Setting Interface

Designation	Meaning	Remarks
29	The data are for reference only. They are internal AD collected data and used for troubleshooting and communication with the manufacturer	
30	Display the maximum output phase voltage of the equipment	
31	The data are for reference only. They are internal AD collected data and used for troubleshooting and communication with the manufacturer	
32	Overload current setting, for reference only	
33	Overload time setting, for reference only	
34	Current setting if the equipment automatically restarts upon recovery of power supply 0: manual starting 1: automatic starting	
35	Input port for setting of restarting upon power recovery 0: manual starting 1: automatic starting	The text can be clicked via touch for number input
36	Enable to modify mark of restarting upon power recovery 0: disabled 1: enabled	The text can be clicked via touch for number input
37	Write-in button; write the new value of restarting upon power recovery into the motherboard after it is clicked	The button can be clicked via touch
38	Save button; click for permanent storage	The button can be clicked via touch

8. Operating instructions

8.1 Prepare for starting

Check if the **input/output wires are correctly connected** before starting. Use a multimeter to **measure if the input voltage is within the permitted range** before starting. It is allowed to start only when the foregoing requirements are satisfied.

8.2 Starting process

After the input switch is closed, it takes about 0 to 20 seconds for AC-DC **rectification**, about 20-25 seconds for the embedded inverter's **reversion** process and about 30 seconds for the DC-AC **inversion output** to be ready successively.

When Item 13 working mode on the touch screen is selected as "internal knob adjustment mode": click the "ON" button on the touch screen and the equipment will output voltage (capable of automatic starting and automatic output). Please refer to 8.3 for adjustment of the required output frequency and voltage. When the output voltage satisfies the loaded equipment requirements, turn on the **output switch** to start the equipment.

When Item 13 working mode on the touch screen is selected as "touch screen or serial port control": input the required frequency at Item 14 on the touch screen and input the required phase voltage at Item 15 on the touch screen; click "refresh" button at Item 16 on the touch screen; and then click "ON" button on the touch screen so that the equipment starts voltage output.

8.3 Voltage/frequency regulation

◆ **F.SET: output frequency phase selection**: there are three phases, i.e. F.ADJ/50/60Hz which correspond to an output voltage frequency of 43-73Hz phaseless frequency adjustment, 50Hz fixed frequency and 60Hz fixed frequency respectively (**the same adjustment mode is applicable if any new frequency phase is added**).

◆ **F.ADJ: phaseless adjustment of output frequency**: rotate "F.SET" knob to "F.ADJ" phase and then adjust "F.ADJ" knob to realize phaseless adjustment of output frequency between 43 and 73Hz (**the same adjustment mode for other frequency ranges; there is one coarse button and one fine button for frequency adjustment if the frequency range is wide**).

◆ **V.ADJ: phaseless adjustment of output voltage**: AC10V-modify maximum output voltage of equipment (**the same adjustment mode for other output voltage rating**)

Note: in order to protect the reliable operation of the user loaded equipment, please firstly confirm the **output voltage and output frequency** of the power supply and then turn on the **output switch**. If it is necessary to adjust the **output voltage and output frequency**, please close the power supply **output switch** or **shut down the load**. After adjustment, turn on the **output switch** of power supply.

8.4 HV/LV switching

(optional; under normal circumstances, LV and LV phases are available for products with a capacity of 100kVA or lower).

Choose the appropriate working phase according to the required voltage. The output voltage is double and the overload current is the rated current at the HV phase compared with the LV phase. The output voltage is half and the overload current is double the rated current at the LV phase compared with the HV phase (**other output voltage rating and features remain the same**).

8.5 Shutdown process

For the purpose of shutdown, please **turn off the load, turn off the output switch** and finally **turn off the input switch** successively to avoid spike impact of inductive load upon shutdown.

9. Troubleshooting

This product is capable of troubleshooting, please make judgment according to instructions on the screen. If the trouble can't be eliminated, please notify our After-sales Department or our local agent and they will provide after-sales services to your satisfaction.

◆Symptoms: **IGBT fault**

Reason: over-current like short-circuit

Solution: shut down and restart. Notify the manufacturer if the same trouble occurs.

◆Symptoms: **Over-temperature fault**

Reason: over-current or over-temperature of the environment

Solution: shut down and restart after the internal temperature falls down; reduce the load and provide a better environment temperature

◆Symptoms: **Fuse fault**

Reason: over-current like short-circuit

Solution: please notify the manufacturer of the fault.

◆Symptoms: **Overload fault**

Reason: load (starting) over-current

Solution: please reduce the load

10. Communication protocol

10.1 Communication

A product with an RS232 communication interface can be expanded to RS485 interface via an adaptor. This interface supports multi-unit communication among 128 units at the maximum.

10.2 Communication format

Satisfy MODBUS-RTU protocol format, baud rate: 9600BPS fixed.

Data format: one start bit, without check, 8 data bits and 1 stop bit; the format of data transmitted at the host computer is: "9600,N,8,1".

10.3 Communication datasheet

(this datasheet contains all features which may be different from those available to your equipment. Just check the features you need).

Address	Data descriptions	Type and calculation of parameters	Operation
0000	Phase A input voltage	Format 0.0(1 decimal places)	Read-only
0001	Phase B input voltage	Format 0.0(1 decimal places)	Read-only
0002	Phase C input voltage	Format 0.0(1 decimal places)	Read-only
0003	Phase A output current	Format 0.0(1 decimal places)	Read-only
0004	Phase B output current	Format 0.0(1 decimal places)	Read-only
0005	Phase C output current	Format 0.0(1 decimal places)	Read-only
0006	Phase A output voltage	Format 0.0(1 decimal places)	Read-only
0007	Phase B output voltage	Format 0.0(1 decimal places)	Read-only
0008	Phase C output voltage	Format 0.0(1 decimal places)	Read-only
0009-0024	Reserved		Invalid
0025	Fault alarm	Input under-voltage: BIT.1 IGBT alarm: BIT.2 Radiator temperature alarm: BIT.3 Fuse alarm: BIT.4 Output overload: BIT.9 (BIT=0 no fault, BIT=1 fault)	Read-only
0026	Output voltage period 16 bits higher	Unit: us	Read-only
0027	Output voltage period 16 bits lower		

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0028-0029	Reserved		Invalid
0030	Input voltage period 16 bits higher	Unit: us	Read-only
0031	Input voltage period 16 bits lower		
0032-0033	Reserved		Invalid
0034	Phase A output power factor	Format 0.0(2 decimal places)	Read-only
0035	Phase B output power factor	Format 0.0(2 decimal places)	Read-only
0036	Phase C output power factor	Format 0.0(2 decimal places)	Read-only
0037	Transformer over-temperature fault alarm	BIT.9=0 no fault, BIT.9=1 fault	Read-only
0038-0072	Reserved		Invalid
0073	Selection of working mode	0=Local knob control 1=Remote or touch screen control stable-frequency and stable-voltage mode 2=Remote or touch screen control VF curve soft starting mode 3=Remote or touch screen control constant-current mode (other data access denied)	Read and write
0074	Frequency control in automatic mode	Any between 400 and 700 (corresponding to 40-70HZ) 50,60,100,120, 200,400 fixed	Read and write
0075	Output voltage control	0-rated vale, 1 decimal place e.g. 220V, write in 2200 (HEX0898)	Read and write
0076	Inverter switch control	0=Off; 1=On	Read and write
0077	Start and stop in VF soft starting mode	0=Off; 1=On	Read and write
0078	Maximum frequency control in VF soft starting mode	1-rated value,1 decimal place	Read and write
0079	Maximum voltage control in VF soft starting mode	0-rated value,1 decimal place	Read and write
0080	Soft starting time control in VF soft starting mode	1-100S	Read and write
0081	Current control in constant current mode	0-rated value,1 decimal place	Read and write
0082-0100	Reserved		Invalid

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