User Manual of ANRGS Series Regenerative Grid Simulator V1.0

Inventory code:

Valid	From the date of issue		
Prepare	何建龙	Date	2023-12-27
Audit	陈仲先	Date	2023-12-27
Quality co-sign	刘艳涛	Date	2023-12-27
Process Director	许可	Date	2023-12-27
Standard	胡蒙蒙	Date	2023-12-27
Approve	许可	Date	2023-12-27

Note: This is the page for approval. No print.

ANRGS Series

Regenerative Grid Simulator Power Supply User Manual (V1.0)

User Manual of ANRGS Series Regenerative Grid Simulator

Product name

Bidirectional Grid Simulation Power Supply

Model of Product in this user manual:

ANRGS005S-350(F) 、 ANRGS010S-350(F) 、 ANRGS006A-350(F) 、 ANRGS009A-350(F) 、 ANRGS012A-350(F) 、 ANRGS015A-350(F) 、 ANRGS018A-350(F) 、 ANRGS020A-350(F) 、 ANRGS025A-350(F) 、 ANRGS030A-350(F) Picture of product

ANRGS Series Picture of product

Notice

Any change to this manual will not be informed additionally.

Read this manual carefully before using this instrument. Keep the manual near the instrument for convenient reference. Keep this manual accompanying this instrument during delivery.

Error may occur for this manual. For any errors or questions, contact Ainuo Instrument Company Service Center or the agent in time. We will not be responsible for any direct, indirect, accident or consequential damage caused by errors in this manual or using of this manual.

Warrantee

1, We (Ainuo Instrument Company) guarantee that all products produced by us have passed strict quality inspection. The warrantee period for our products is twelve (12) months. Any defect or faults occurred within this period due to manufacturing will be repaired free of charge.

2, For any faults caused by modification to the circuits or function by the user without permission or after the warrantee period, we will charge the cost accordingly. For failure and damage caused by force majeure, we will not provide free warranty service.

Safety Instructions

The safety instructions in this manual must be followed during operation, maintenance and repair of the power supplies. Failure to follow these safety precautions, the manufacturer will not be responsible for any operation failing to follow the safety instructions by the user.

Safety symbols

1, Electric Symbols, Safety Marks and Warning Marks

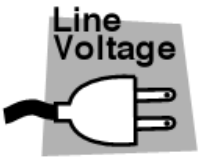
<table>
<tr><th>Symbol</th><th colspan="2">Description</th><th>Symbol</th><th>Description</th></tr>
<tr><td></td><td>AC</td><td>Alternating Current</td><td>  </td><td>Forbidden</td></tr>
<tr><td></td><td>DC</td><td>Direct Current</td><td></td><td>Power ON</td></tr>
<tr><td>  </td><td>AC/DC</td><td>AC/DC</td><td>  </td><td>Power OFF</td></tr>
<tr><td>N</td><td>N</td><td>Neutral conductor</td><td rowspan="2">  </td><td rowspan="2">Switch that turns on/off the power supply with the same device. There are two positions for common keys.</td></tr>
<tr><td>  </td><td>PE</td><td>Earth (Ground) Terminal</td></tr>
<tr><td>  </td><td colspan="2">Earth</td><td>  </td><td>High Temp.: The Temp. is higher than the limit for human body. Do not touch to avoid injury.</td></tr>
<tr><td>  </td><td colspan="2">Precautions: Refer to the instructions in the manual to avoid damage to the device or personnel injury.</td><td>  </td><td>Electricity shock!</td></tr>
<tr><td>  </td><td colspan="2">Fail to follow the instruction will cause personal injury. Do not operate the instrument before understanding the instruction.</td><td>  </td><td>Risks! Fail to follow the instruction may cause death or injury. This mark prompts for procedures, practices and conditions etc.</td></tr>
</table>

2, Safety Instructions

Pay attention to the precautions in this manual during operation or maintenance. We will not be responsible for any personnel injury or damage to the machine due to failing to observing these precautions.

Read this manual carefully before using this equipment and keep it well.

Do not use this product for purpose other than those described in this manual.
This product is only used for purpose described in this manual.



Check the power ratings before power ON. Make sure the switch is at OFF position.

Earth: Ground the device firmly before power on.

Precautions (earth): Never disconnect the internal/external earth wires or earth terminals to avoid personnel injury due to shock.

Fuse: Only use fuse with required rated current/voltage or special one (normal fuse, time delay etc). Never use fuse of other size or short-connect the fuse to avoid shock or fire.

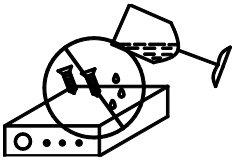
Do not remove the house.
The operator shall not dismantle the case. Only qualified engineers can change or adjust the parts.

Never operate the device in explosive or corrosive environment

- **Never operate the device in flammable gas or corrosive environment**
- **Turn off the power before handling the unit, and disconnect all wires.**
- **This unit weights 20Kg or more, which can be found in the manual. Handle the unit by two persons or more.**
- **Be careful during handling this unit to avoid falling.**
- **Deliver this product accompanied with this manual.**

- **Check if the AC power supply is consistent with the size of the fuse. Check the power line. Disconnect the power line or turn off the power switch before inspection.**
- **Stop operation immediately in case of any abnormities or faults. Disconnect the power line or turn off the power switch in the distribution box. Do not use it before it is repaired.**
- **Use cables with high overcurrent capability for output or load lines.**
- **please do not disassemble or change the product. If necessary, please contact AINUO instrument Company.**

Keep water or metal objects out of this product.



Warning! **Any damage to the instrument due to improper power input is not covered within the warrantee period.**

Attention. After the voltage/current is set and the output starts, high voltage exists at the output terminal. Never touch it to avoid personnel injury or even death.

Table of Contents

Section 1 Overview

Guide:

- Introduction
- Features
- Functions
- Principle

1.1 Principle

The ANRGS series power supply is a regenerative grid simulator with exquisite appearance, superior performance, powerful functions, and simple operation, adopting advanced pulse width modulation, providing low distortion waveform output. In addition, it has three output modes: AC, DC, and AC+DC, providing various measurements such as voltage, current, power, peak current, etc., with protections such as overvoltage, overcurrent, overpower, overheat, overvoltage and undervoltage. This power supply can communicate with the PC via RS-232C/RS485/GPIB/LAN interface.

1.2 Features

1.2.1 Functions

- Advanced SPWM technology, FPGA digital processing technology, and high-power switching power supply technology, high power density.
- Three-phase/single-phase output, to output AC, DC, AC+DC power supply, providing precise power input for AC loads VWW, DC loads, and rectifier loads.
- Parallel operation, adopting equal current parallel operation to achieve parallel operation of multiple power supplies.
- Low output distortion, strong load adaptability, high crest factor.
- Complete protection and self-diagnosis, high reliability.
- 100% energy feedback point, operate in four quadrants.
- Multiple measurements such as voltage, current, power, peak current, etc.
- Pulse output for voltage dips test and simulation actual grid interference.
- Step output: In Step test mode, provide simple automatic switching to change the output voltage, which changes in steps rather than gradually.
- List output. In sequence test mode, the output waveform is the combination of all serial number configuration. The user can edit the desired output voltage sequence on demand.
- Interharmonic output. In interharmonics output mode, in addition to providing common voltage output, another frequency adjustable voltage component can be added for certain anti-interference tests.
- Analog signal input interface for amplification of external signal.
- Output impedance programming. The output impedance of the test power supply can be changed as needed.
- Harmonic synthesis, any output of periodic voltage waveforms.
- Standard chassis, LCD display, compact, light, meeting the installation requirements.
- External communication.

1.2.2 Panels

Set and control the output mode, voltage and frequency through the soft keyboard of touch screen, and display the output state on the LCD. The specific functions include:

- Select output mode (Common, Pulse, Step, List, Harmonics, Interharmonics)
- Set the output parameters and output mode in each output mode
- Start/stop output. In Common mode, press the button on the front panel to start/stop. In other modes,

press ON/OFF in the upper right corner of the display to start/stop.

- Set common protection values, output waveforms, output relays, and remote measurement (S terminal) settings
- Display output voltage, frequency, current, active power, apparent power, power factor, crest factor, peak current and other measurements
- Display power state: standby/run/alarm (display alarm code)/ etc.

1.3 Functions

1. Four-quadrant power output capacity

Positive voltage positive current (first quadrant), negative voltage positive current (second quadrant), negative voltage negative current (third quadrant) and positive voltage negative current (fourth quadrant) output.

2. Wide range of voltage and frequency output

Output voltage: 0.00~350.00V, output frequency: 30.000~100.000Hz.

3. Programmable test

Auto group step programming test, storage of 200 steps, inter-step List test. Ramp up control of the output voltage is achieved via setting the ramp up time of the output voltage.

4. Output

Three output modes: AC output, DC output, and AC+DC output.

5. Measurement

Powerful measurements of voltage/current RMS, DC voltage/current, peak current value, surge current, current crest factor, active power, reactive power, apparent power and power factor.

6. Customized wave

A variety of wave outputs including sine wave, triangle wave, clamped sine wave and system built-in wave can be customized.

7. Start/end angle control

Control the start/end angle of the output voltage wave by setting the start/end angle.

8. Output ramp control

The output voltage can be changed to the setting according to the set rate of change.

9. Pulse output

The voltage sag and surge notch test can be realized by setting the pulse voltage output.

10. Step output

In Step test mode, provide simple automatic switching to change the output voltage, which changes in steps rather than gradually.

11. List output

In List mode, the output waveform is a combination of all list number configurations. Users can edit the order of the required output voltage as required.

12. Interharmonics output

In interharmonics output mode, in addition to providing common voltage output, another frequency adjustable voltage component can be added for certain anti-interference tests.

13. External setting

Control the output voltage of the power supply by inputting external analog signals, achieving power amplification of the input signals. (optional)

14. Output impedance control

By setting the output impedance of the test power supply, meet the test needs of specific loads. (optional)

15. Harmonic output

Harmonic synthesis output up to 50th order.

16. Communication

Communicate with the host through the communication interface, convenient for operation.

17. Protection

Complete protection and self diagnosis, provide protection such as overcurrent, overvoltage, undervoltage, output short circuit, bus input abnormal, overheat, etc., and prompt fault diagnosis information for easy maintenance of product.

1.4 Principle

Figure 1.1 shows the structure of the test power supply, which consists of 9 modules. First, the main circuit of the power supply passes through input filtering and input control board, enters the input bottom PWM rectification and bidirectional LLC module, and then enters the DC-AC circuit through the capacitor board. After output filtering, it finally generates standard sinusoidal AC output voltage. The PWM rectifier converts AC input into DC voltage, which serves as the input for the next level bidirectional LLC converter, generating the isolated DC output for the input of final DC-AC module, and the AC voltage is ultimately output from the DC-AC converter.

The main control and measurement module is responsible for controlling the DC-AC converter, adjusting the output voltage and frequency, and measuring the output voltage and current. The power supply is remotely controlled through the synchronous control module and RS-485/RS232/GPIB/LAN modules, and HMI is achieved via keyboard and display.

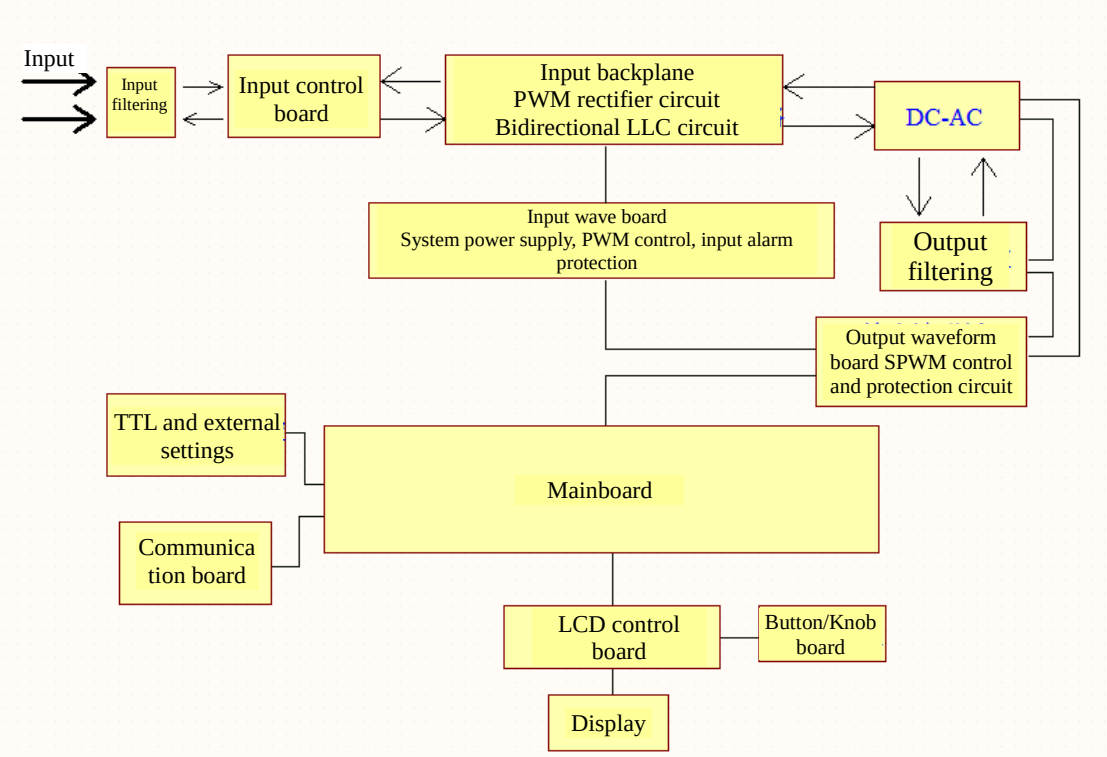


Figure 1.1 ANRGS Series Composition of system

Section 2 Model of Product

Guide:

- Designation of model
- Output voltage and current
- Performance parameters

2.1 Model designation

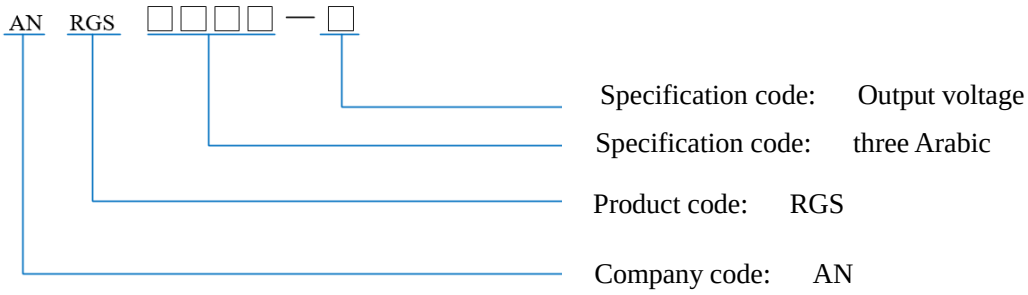


Figure 2.1 Designation of model

Specification code: Indicates the function and output capacity of the power supply.

1) 005S: Output capacity is 5KVA,single-phase output
2) 015A: Output capacity is 15kVA, three-phase output
3) 030A: Output capacity is 30kVA, three-phase output
4) -350: Output capacity is 350V

2.2 Corresponding relationship between output voltage and current

The relationship between the output voltage and the maximum output current is shown in Figure 2.2.

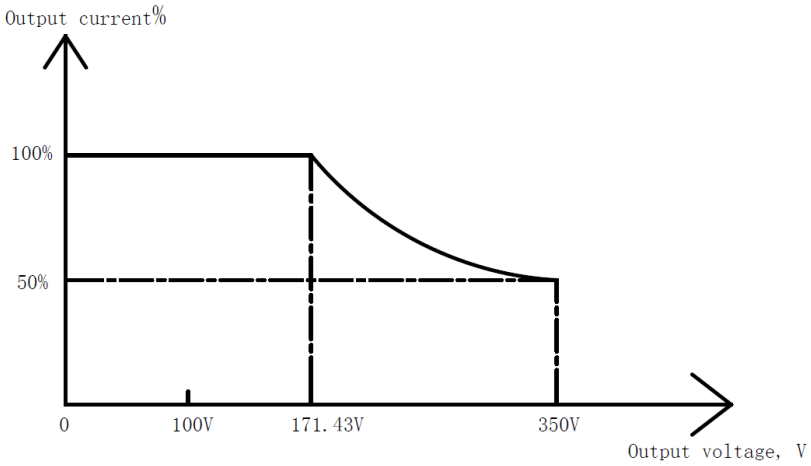


Figure 2.2 Relationship between power supply output voltage and current

2.3 Performance Parameters

Model			ANRG S005S-350 (F)	ANRG S010S-350 (F)	ANRG S006A-350 (F)	ANRG S009A-350 (F)	ANRG S012A-350 (F)	ANRG S015A-350 (F)	ANRG S018A-350 (F)	ANRGS 020A-350 (F)	ANRG S025A-350 (F)	ANRG S030A-350 (F)
Battery capacity			5000 VA	10000 VA	6000 VA	9000 VA	12000 VA	15000 VA	18000 VA	20000 VA	25000 VA	30000 VA
AC input	Voltage		Line voltage: 342V-480V 3-phase 4-wire +PE									
	Current		35A Max@342V									
	Frequency		47～63Hz									
	Power factor[*1]		≥0.98									
AC output	Phase		Single-phase		Three-phase & Single-phase							
	Power	Total power	5000 VA	10000 VA	6000 VA	9000 VA	12000 VA	15000 VA	18000 VA	20000 VA	25000 VA	30000 VA
		Phase power	5000 VA	10000 VA	2000 VA	3000 VA	4000 VA	5000 VA	6000 VA	6667VA	8333VA	10000 VA
	Voltage	Range	0.00～350.00V									
		Resolution	0.01 V									
		Precision	0.1%F.S.									
		Distortion[*2]	0.3%@50/60Hz; 1%@30-100 Hz									
		Source effect[*3]	≤0.02%									
		Load effect[*2]	≤0.02%									
	Current	RMS range (phase)	35A	60A	35A (three-phase); 105A (single-phase);					60A (three-phase); 180A (single-phase);		
		Peak range (phase)	105A	180A	105A (three-phase); 315A (single-phase);					180A (three-phase); 540A (single-phase);		
	Frequency	Range	30.000～100.000Hz									
		Resolution	0.001 Hz									
		Precision	0.01%									
DC output	Power	Maximum power	total power 5000W	total power 10000 W	2000W per circuit, total power 6000W	3000W per circuit, total power 9000W	4000W per circuit, total power 12000 W	5000W per circuit, total power 15000 W	6000W per circuit, total power 18000 W	6667W per circuit, total power 20000W	8333W per circuit, total power 25000 W	10000 W per circuit, total power 30000 W
	Voltage	Range	-495.00～495.00V									
		Resolution	0.01 V									

		Precision	0.1%F.S.			
	Current	RMS range	35A	60A	35A (single output); 105A (parallel output);	60A (single output); 180A (parallel output);
Measurement accuracy	Voltage	Range	AC: 350V; DC: 495.00V			
		Resolution	0.01 V			
		Precision :	0.1%F.S.			
	Current	Range	35A (RMS) ; 105A (Peak)	60A (RMS) ; 180A (Peak)	105A (RMS range); 315A (Peak Range)	180A (RMS range); 540A (Peak Range)
		Resolution	0.01A			
		RMS accuracy[*6]	0.2%F.S.			
		Peak accuracy[*6]	0.5%F.S.			
	Power	Resolution	0.01W			
		Precision :	0.3%F.S.			
Function	Display		5" color touch LCD			
	Waveform selection		Sine wave, triangular wave, square wave, clamped sine wave, 30 sets of built-in waves, and 6 sets of custom waves			
	Start/stop angle		0-359.9 °			
	Knobs		In Common mode, voltage/frequency setting can be adjusted via the knob.			
	Parallel		Multiple parallel operation available			
	Harmonic		2~50th			
	Harmonics/Interharmonics simulation bandwidth		3000 Hz			
	SEQUENCE mode		200 steps of 9999 cycles, voltage/frequency/phase angle programmed freely for output			
	Pulse mode		9999 cycles, changing voltage amplitude, frequency and angle periodically			
	Step mode		9999 cycles, change the voltage/frequency according to the set voltage/frequency step			
	Online adjustment function		Online adjusting of output voltage/frequency and switch of wave in normal mode			
	Line voltage crop compensation		With Sense terminal, achieving remote sampling compensation			
	Communication		RS485 (standard), Ethernet (standard), synchronous signal (standard), RS232 (optional), GPIB (optional)			
	Remote control		ANALOG CONTROL (optional)			
Operating envir	Temperature		0～40℃			
	Humidity		30～90%RH			

onment			
Efficiency *8		≥92%	
Protection		Input abnormal, bus overvoltage, output undervoltage, output overcurrent, output overload, module overheat	
Dimensions	Height	4U	
	Outline dimension W×H×D (mm)	432×176×700	432×176×735 (020A\025A\030A)
		The width of 432mm is the size of standard 19" chassis without handles; and the width is 482mm with handle The height of 176mm is the size without the equipment foot, and the height with the equipment foot is 188mm. The equipment foot is detachable. The depth of 700mm is the size between the front and rear panels, excluding terminals and protective parts. The depth with the terminals is 779mmor814mm(020A\025A\030A).	
CasePermissive; NoPrefix (Kg)		45	

Note:

*1. The power factor is the measurement with input rated voltage of 380VLL, and output using resistive load at rated power.

*2. The distortion is the measurement using resistive load at rated power with output voltage of 250V.

*3. The source effect is calculated by measuring the output voltage without load under two conditions: input rated voltage of 380VLL and voltage of 420VLL.

*4. The load effect is calculated by output voltage of 250V, the output voltage measured at no load and the output measurements of the resistive load at rated power.

*5. The FS related to AC voltage in the parameter table refer to the maximum output voltage of the equipment of corresponding model.

*6. FS appearing in parameters related to current in the parameter table refers to the maximum measured current value of the corresponding model machine;

*7. The FS related to power in the parameter table refers to the maximum power measurement of the equipment of corresponding model.

*8. The efficiency is measured at the rated power using resistive load with rated input voltage of 380VLL and output voltage of 250V.

* The above parameter specifications are subject to change without prior notice.

Section 3 Dismantle and Installation

Guide:

- Unpacking Inspection
- Installation Environment
- Front Panel
- Rear Panel
- External Wiring

3.1 Unpacking Inspection

After unpacking, check the product nameplate first to confirm whether the model matches the order; then check the accessories and documents according to the "packing list" in the user service manual; Take out the power supply and check for damage caused in transport, loose fasteners, or other abnormalities.

Read the user manual carefully before using the product. Confirm the input power requirements. Connect the power supply, turn on the switch, start the power output, and check the function.

If any one of the above items is abnormal, contact the service center of the company in time, and keep the packaging materials for future transportation.

3.2 Location

Mount the unit in place with good ventilation and cooling. The inlet/outlet shall be at least 30cm away from the wall or obstacles. Keep it away from direct sunlight or damp. No rain.

3.3 Front Panel

The front panel of ANRGS series AC Test Power Supply is shown in Figure 3.1.

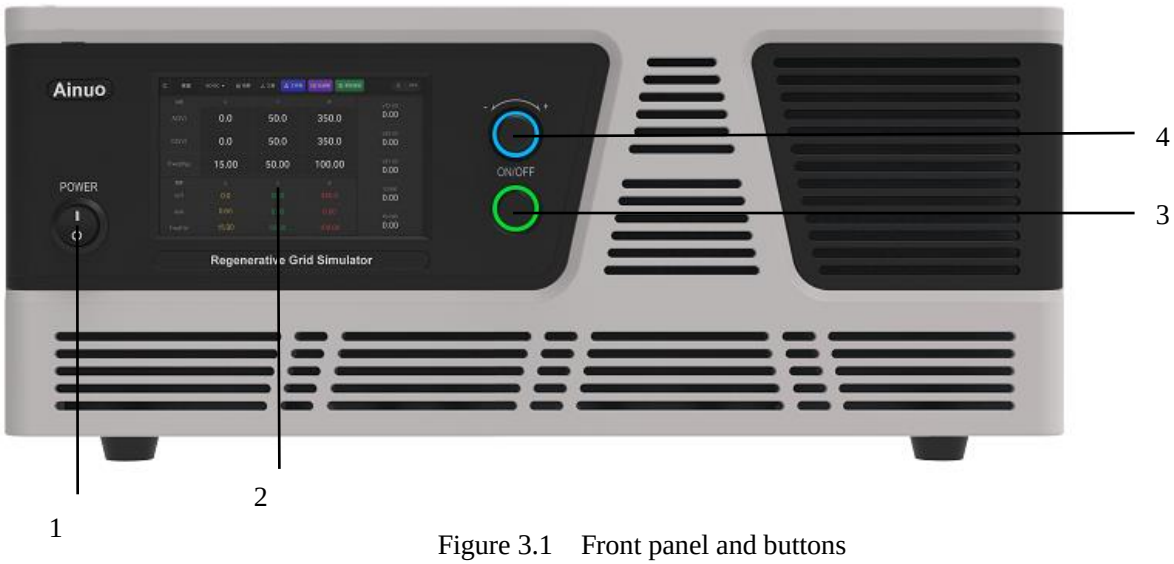


Figure 3.1 Front panel and buttons

1. Main power switch: Turn on/off the power.

2. LCD: through touch, set parameters and display test results.

3. ON/OFF: start/stop in Common mode.

4. Knob: Press it once to enable the knob, and the blue lamp will be on when start. Refer to Section 5.2.2 for specific steps.

3.4 Rear Panel

The rear panel of ANRGS series Regenerative Grid Simulator is shown in Figure 3.2 and Figure 3.3.

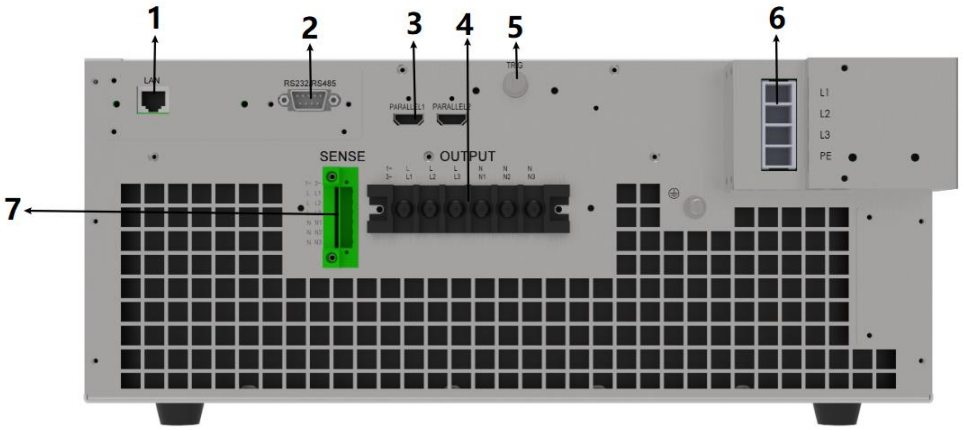


Figure 3.2 Rear panel of ANRGS

1. GPIB/LAN: GPIB bus interface or LAN network interface, standard network interface, GPIB is optional.
2. RS232/RS485: 9-pin serial port, for remote communication and control with PC. Standard RS485 port, optional RS232 port.
3. PARALLEL1/PARALLEL2: Parallel interface, used when multiple equipment is connected in parallel. When the power supply is connected in parallel, multiple power supplies are connected through this interface.
4. Output terminals L1~L3, N1~N3: Power supply output terminal, directly connected to the load. When the output voltage contains DC component, the output terminal "L" is the "+" terminal and "N" is the "-" terminal. For three-phase output, N1~N3 is short circuited. For single-phase output, L1~L3 and N1~N3 are both short circuited.
5. TRIG: Digital output signal. When changing the output voltage, the digital output will be changed (optional).
6. Power input terminal: L1, L2, L3, used to connect external AC voltage inputs. The input is three-phase AC power.
7. Measurement terminal L and N: Used for four-wire test when considering lead drop compensation. L1~L3 and N1~N3 are connected to the L and N input terminals of the load correspondingly, and shall not be reversed.

3.5 External wiring

(I) Input wiring

1. Input-voltage

Voltage: 342~480V line voltage, three-phase four-wire system Y;

Frequency: 47~63Hz

Maximum current: 35A (single-phase)；（Applicable Models:005S\010S\006A\009A\012A\015A\018A）

Maximum current: 70A (single-phase)；（Applicable Models:020A\025A\030A）

Attention: If the input voltage of AC Test Power Supply exceeds the range, it will cause damage.

It is recommended to connect input wiring in conjunction with circuit breakers: the minimum specification of each selected circuit breaker shall be 380V/35Aor380V/70A.

2 Input Line

The rated current of the input power cable selected by the user shall be greater than or equal to the maximum input

current of the AC Test Power Supply, and the rated temperature of the wire shall not be less than 85℃.

(II) Output wiring

Pay attention to the mark of output terminal L and N to ensure correct connection. To ensure safe and accurate testing, tighten the screws connecting the load, and the connection wire diameter between the load and the power supply shall be large enough, and a wiring protective cover shall be installed. The diameter of selected load connecting wire shall have large enough to avoid overheating of the wire when the output current is high.

(III) Wiring for remote measurement

The AC Test Power Supply can monitor the voltage at the load end through remote measurement, rather than monitoring the voltage on its output terminal, so as to automatically compensate for the voltage drop on the connecting cable to ensure that the voltage transmitted to the load end is consistent with the set voltage.

Remove the connecting wire between the telemetry terminal and the output terminal, and connect the telemetry lead to the load terminal. The telemetry lead is a part of the AC test power supply voltage measurement circuit, and it is preferable to select low resistance lead with current passing through it of a few milliamperes. It is best to use multiple twisted wires for telemetry leads to reduce external voltage interference and be as close to the connected load as possible. To ensure reliable connection of telemetry leads, if there is no connection or in case of open circuit during operation, the power supply will not be able to output.

The power cable selected or replaced by the user shall at least meet the following requirements:

(1) Rated voltage: 500V

(2) Wire diameter: ≥10mm^2

(3) Internal insulation: PVC

(4) External insulation: PVC

(5) Rated temperature: > 70 ℃

In addition, the power output line selected or replaced by the user should at least meet the following requirements:

(1) Rated voltage: 500V

(2) Wire diameter: ≥10mm^2

(3) Internal insulation: PVC

(4) External insulation: PVC

(5) Rated temperature: > 70 ℃

Attention

The power supply must be connected to the ground wire (marked with "PE" or the terminal), otherwise the casing is easily charged, causing injury of person and damage to the device under test. In order to ensure personal safety, before disconnecting the input power, do not touch the parts that are prone to electric shock, such as the input/output terminals. When wiring the output terminal, select the power cable and other fittings suitable for the output current and power. If the inlet/outlet terminal block is damaged, contact the manufacturer immediately to arrange for replacement and avoid electric shock.

Attention

When the output voltage contains a DC component, the output terminal "L" is the "+" terminal and "N" is the "-" terminal.

Section 4 Quick Operation

Guide:

- Preparation and inspection
- Power on
- Operation
- Shutdown

4.1 Preparation and Inspection

(2) Read the safety instruction and warnings on the instrument carefully before operation.
(2) No articles blocking ventilation at the vent
(3) Ensure that the power line and the input/output lines are properly connected.

Attention.
Make sure to connect the I/O lines correctly.

Warning! Before the power is turned on, all earth terminals, extension line and devices connected to the instrument must be grounded. Any disconnection of earth line will cause potential shock, or even injury to persons.

4.2 Start

After the input/output cables are connected correctly, turn on the power switch POWER, the power panel will enter the start screen. During the power startup process, internal self-check and soft start charging are required. If the self-check fails, it will switch to the corresponding alarm screen. If there is no problem with the self-check, the self-check and soft start charging process will end after about 10 seconds, and the display panel will switch to the corresponding standby screen.

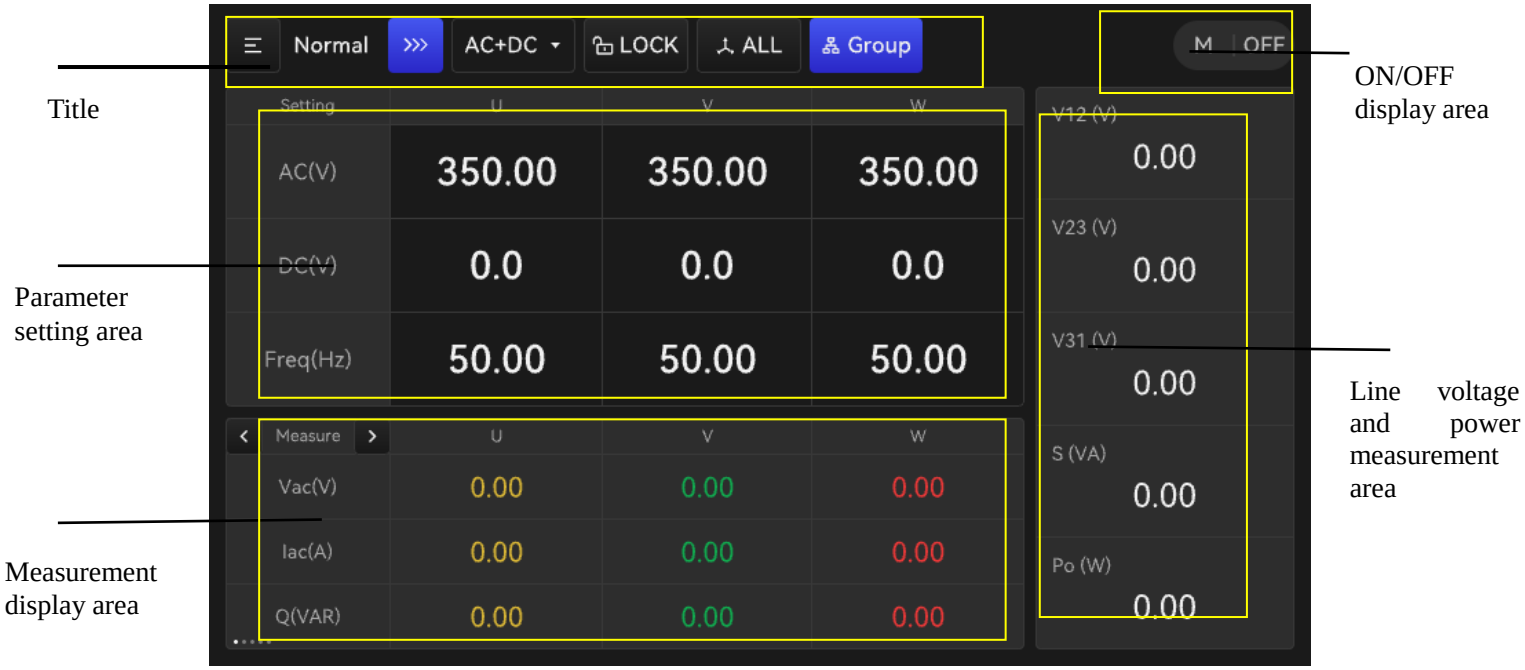


Figure 4.1 Three-phase power supply

As shown in Figure 4.1 of the main menu screen, the display is divided into 5 areas:
Title: display the state of current screen, and can modify parameters in the title bar.

Settings: display settings, operating measurements, etc.

Measurement: display measurements.

ON/OFF: display the state of power supply. When the power supply is in standby mode, it is displayed as gray OFF, and after start, it is displayed as green ON.

Note: When switching to the Standby screen in programming mode, the programming mode ON button will appear on the left, used to start programming mode. After start, this button changes to OFF, and press it to stop the output.

Line voltage and power measurement area: display the line voltage measurement calculation results, apparent power and active power.

When the power supply is in single-phase mode, the operation is the same as in three-phase mode. The display area is also divided into 5 areas, with only different contents, as shown in Figure 4.2.

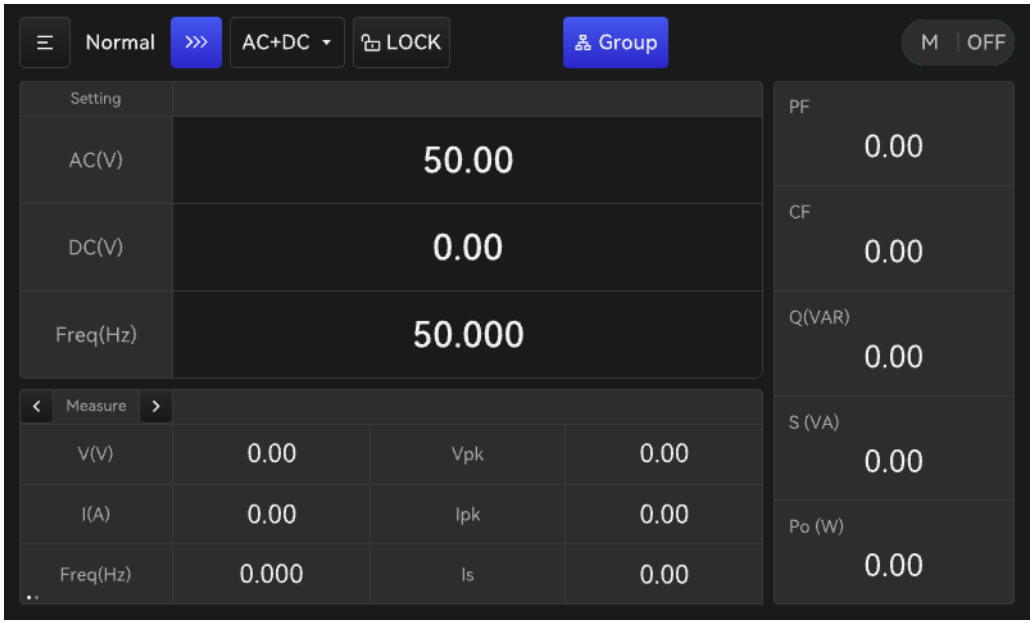


Figure 4.2 Single-phase power supply

4.3 Functions of Power Supply

Power state	Operations
Normal mode -Standby	The power will enter menus in Standby screen within 8~10 Sec. after booting.
	>>>: Press it to enter parameter editing in Common mode (page 2)
	☰: Press it to enter Common mode/Programming Mode/Common Setting/System Settings (Page 2)
	AC+DC: Select output state, single/three-phase AC, single/three-phase AC/DC, single/three-phase DC.
	Lock Screen: press the key to enter Lock Screen mode (page 2)
	Three-phase: set three-phase parameters simultaneously when on, and set each parameter separately when off (page 1)
	Shortcut Group: enter shortcut settings, 12 shortcuts can be set, common output parameters are saved (page 2)
	Measurement: press </> key to pageup/pagedown measurement display. Simple measurement display: display phase voltage, current, frequency, and total active power output; Details: Display each phase voltage, current, active power, apparent power, power factor, crest

	factor, peak current, frequency, total active power output
	ON/OFF on the front panel: start/stop the power supply. When running, the lamp on the knob is on in green. When an alarm is triggered, the lamp is on in red and the buzzer sounds.
Common Setting	Basic: set the upper limit three-phase AC/DC voltage and frequency. AC voltage: 0~350V; DC voltage: 0~495V; frequency: 30~100Hz.
	Protection: set the current protection of three-phase to 0~35A each phase, power protection to 0~6000W each phase, and set the protection delay time
	Waveform: set various output waveforms
	Others: set output relay on/off, remote measurement, remote inhibit, remote control, external input control signal, protection interval etc.
System Setting	Basic: set interface brightness, backlight, language, buzzer, communication method, communication protocol, and address.
	Interface: select communication interfaces
	State: Parallel Setting, Output Mode, Three-phase Output Positive Phase Sequence and Negative Phase Sequence setting, Three-phase Relationship, voltage setting
	Information: display power supply information and restoring factory settings
Sequence mode	Start: start output in List mode
	List <<<: edit parameters in List mode
	<<< key in the editing screen: edit specific parameters
Pulse mode	Start: start output in Pulse mode
	Pulse <<<: edit parameters in Pulse mode
	<<< key in the editing screen: edit specific parameters
	Waveform: set various waveform
Step mode	Start: start output in Step mode
	Step <<<: edit parameters in Step mode
	<<< key in the editing screen: edit specific parameters
	Waveform: set various waveform
Harmonic mode	Start: start output in Harmonic mode
	Harmonic <<<:edit parameters in Harmonic mode
	<<< key in the editing screen: edit specific parameters
Interharmonic mode	Start: start output in Interharmonics mode
	Interharmonic <<<: edit parameters in Interharmonics mode
	<<< key in the editing screen: edit specific parameters
	Waveform: set various waveform

4.4 Power off

(1) If the equipment is in Running state, press ON/OFF first to stop the output.

(2) Turn off Power switch on the front panel of the machine.

(3) Disconnect the input power cable.

(4) It is forbidden to quickly power on when the machine is shut down. At this time, the internal abnormality may be caused by the internal power failure of the machine. After the normal shutdown, wait for at least 5 seconds before turning on the machine again.

Never contact with live parts with body. Prevent electric shock. Do not open the cabinet by non-professionals! The power input is isolated from the output. Never connect the input N-wire with that of the output. Connect the PE cable of the power reliably!

After the power switch is turned off, the power supply to the power device cannot be disconnected. Therefore, you must disconnect the external power supply to the power supply before removing the input power cable.

Section 5 Operation

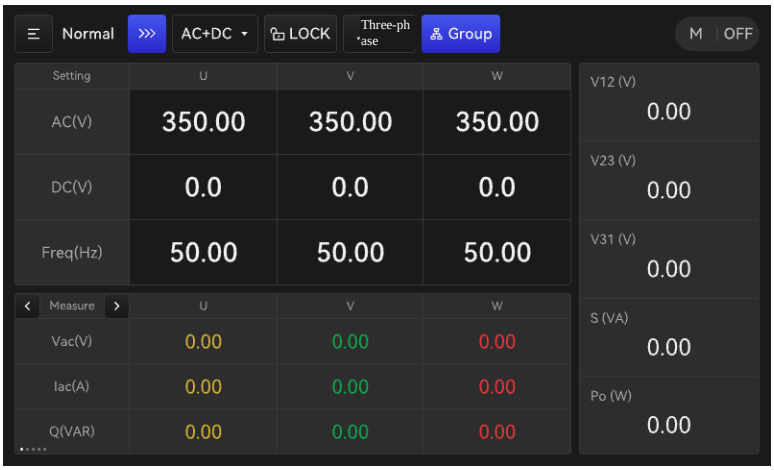
This section describes all functions of the test power supply, and will demonstrate the detailed operation. When using single-phase power supply, short-circuit connect output L1~L3 using short-circuit piece.

5.1 Main Menu screen

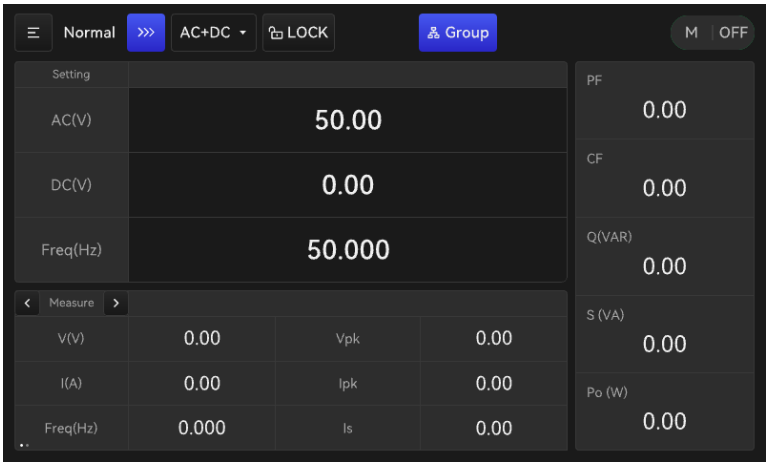
5.1.1 Common Standby/Start screen

1. Common Standby

After connecting the input/output cables to the power supply, turn on the power switch, the system starts self-check. After passing the self-check for 8~10 seconds, the power supply enters Standby mode, as shown in Figure 5.1.1 for three-phase/single-phase.



a) Three-Phase-Common Standby



b) Single-Phase-Common Standby

Figure 5.1.1 Three-phase/single-Phase-Common Standby

After passing the power self-check, enter the Standby screen. On this screen, parameter settings can be changed through touch screen, including single/three-phase AC voltage, single/three-phase DC voltage, and frequency.

In this state, the following operations can be performed:

1、 Press ☰ key in the upper left to select Common/Programming mode, Common Setting, and system settings.

2、 Press >>> to set the parameters in Common mode.

3、 Press AC+DC key to select various outputs in Common mode, including AC+DC, AC and DC outputs. Note: AC+DC: AC/DC superposition mode, AC: AC mode, DC: DC mode.

4、 Lock Screen or three-phase/separate parameter modification. Note: The Three-phase button in the

title bar does not refer to three-phase output, but means the ability to simultaneously modify U, V and W three-phase parameters in Three-phase Output mode when lit up. Otherwise, only single parameter can be modified separately.

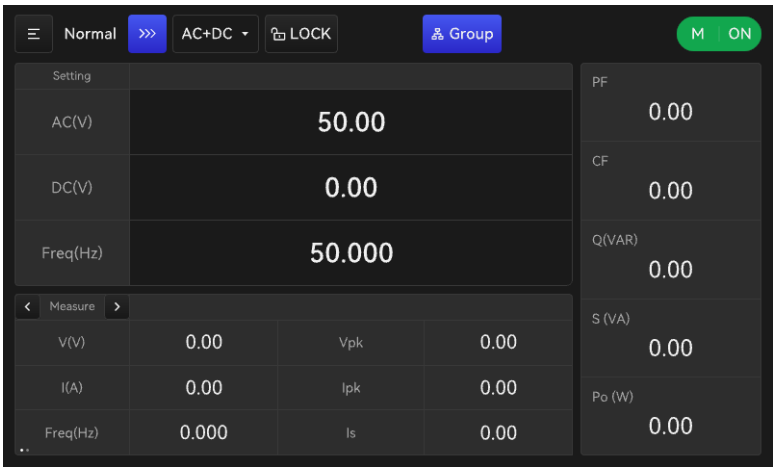
Note: This function is only available for three-phase power supply.

5、 You can set up shortcuts and select output via Group key.

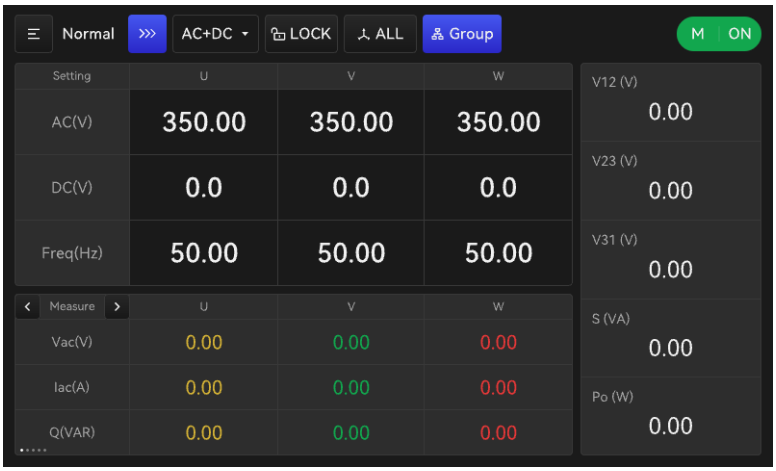
6、 Press ◁/▷ key on both sides of Measure key to view various measurement.

2. Common Start

After setting the parameters, press ON/OFF on the front panel to start. The output parameters can be changed by touching the interface or through the knob. The operation of knobs is described in Section 3.3. After the power is turned on, the three-phase/single-phase display is shown in Figure 5.1.2.



a) Three-Phase-Common mode Running state



b) Single-Phase-Common mode Running state

Figure 5.1.2 Common mode Running state

After startup, the button on the front panel is on. The upper right area of the display is on, changing from OFF to ON.

5.1.2 Common/Programming Mode Selection screen

Press ≡ key in the upper left to select Common/Programming mode, Common Setting, and system settings, as shown in Figure 5.1.3.

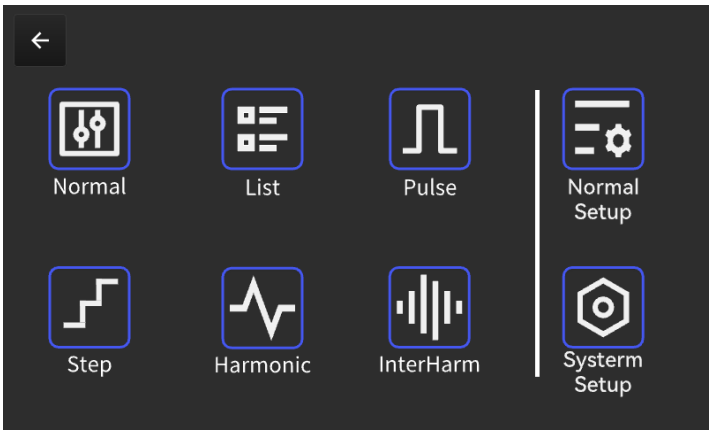


Figure 5.1.3 Common/Programming Selection screen

On this screen, various output modes and settings can be selected by touching the screen.

Note: The three-phase/single-phase screen is the same

5.1.3 Common Parameter Setting screen

1. Edit Parameters in Common mode

Press [>>>] to enter Edit Parameters screen in Common mode, and the three-phase/single-phase screen is shown in Figure 5.1.4.

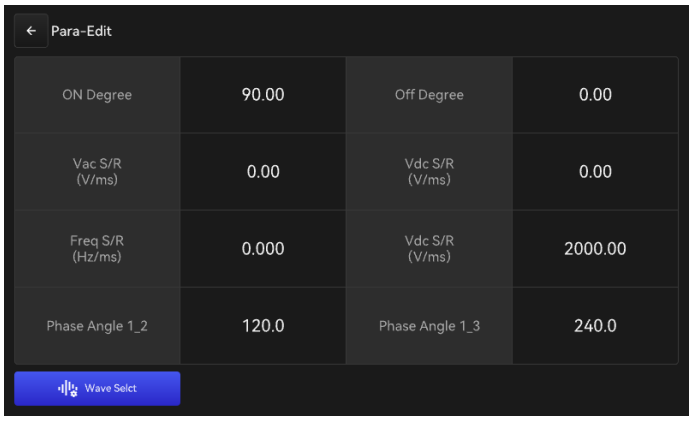


Figure 5.1.4 Edit Parameters in Common mode

On this screen, parameters such as the start angle, end angle, and phase difference can be set for three-phase output in Common output mode. The start angle is the U-phase start angle. The V/W-phase start angle is the U-phase start angle plus the set phase difference.

Start angle: control the start angle of output wave (0.0~359.9 °).

End angle: Control the end angle of output wave (0.0~360.0 °); as 0.0 is displayed as IMMED, it means end immediately.

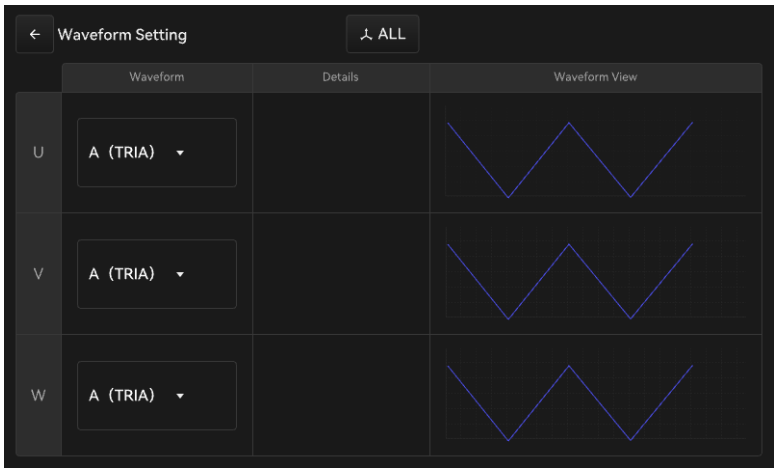
AC conversion rate: The voltage that rises every 1ms from 0 to the set voltage on the main screen.

DC conversion rate: The voltage that rises every 1ms from 0 to the set voltage on the main screen.

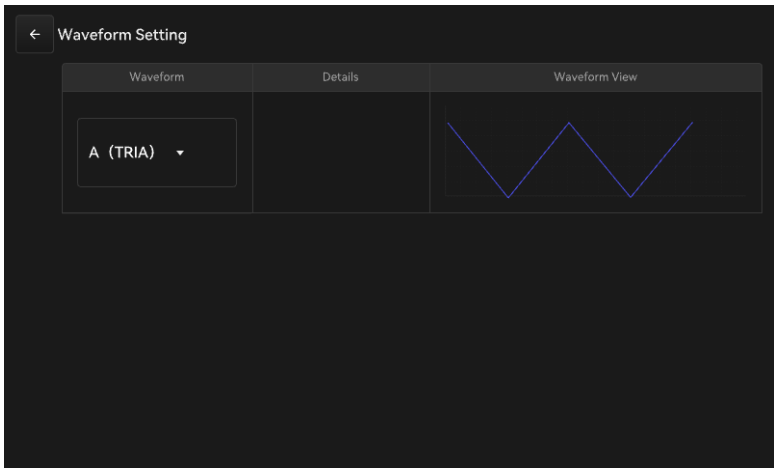
Frequency conversion rate: The frequency that rises every 1ms from 0 to the set frequency on the main screen.

End DC conversion rate: The voltage that drops every 1ms from the set voltage on the main interface to 0V.

Press [Wave Selct] in this interface to enter Set Waveform screen, including Waveform A and Waveform B. The Waveform A/B can be selected in System Settings. SIN (Sine wave), SQU (square wave), CSIN (clamped sine wave), built-in waveform DST1-DST30 (see Appendix II), and USER1-USER6 (set through communication) can be selected. Three-phase/single-phase is shown in Figure 5.1.5.



a) Three-phase output waveform setting

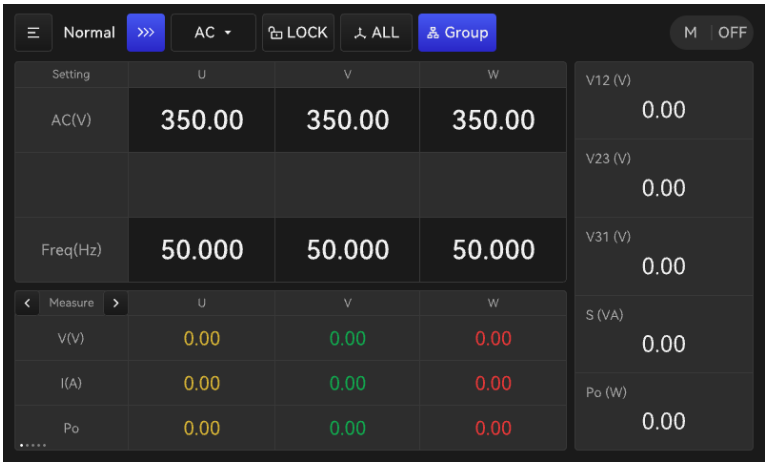


b) Single-phase output waveform setting

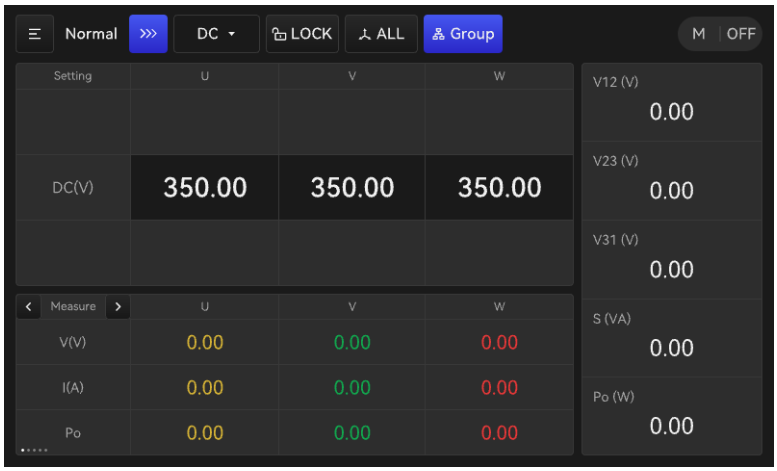
Figure 5.1.5 Common mode - Edit Parameter Set Waveform

2. Select AC/DC output

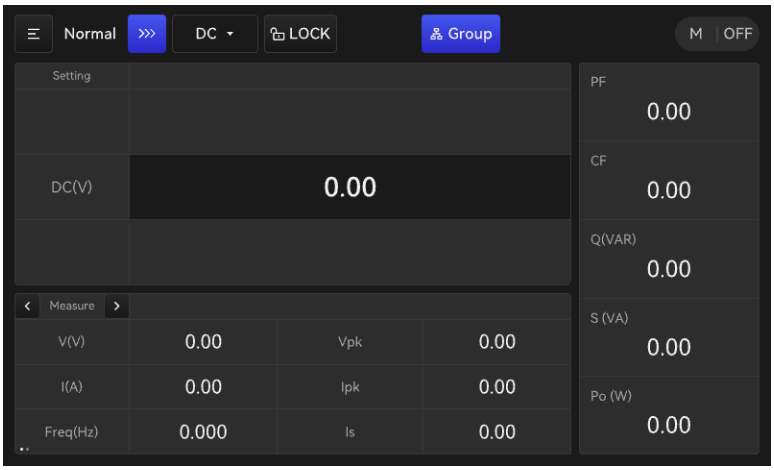
Press AC+DC to select various outputs in common state. When AC+DC is output, the main standby interface is displayed as shown in Figure 5.1.1. The three-phase/single-phase DC/AC output are shown in Figure 5.1.6.



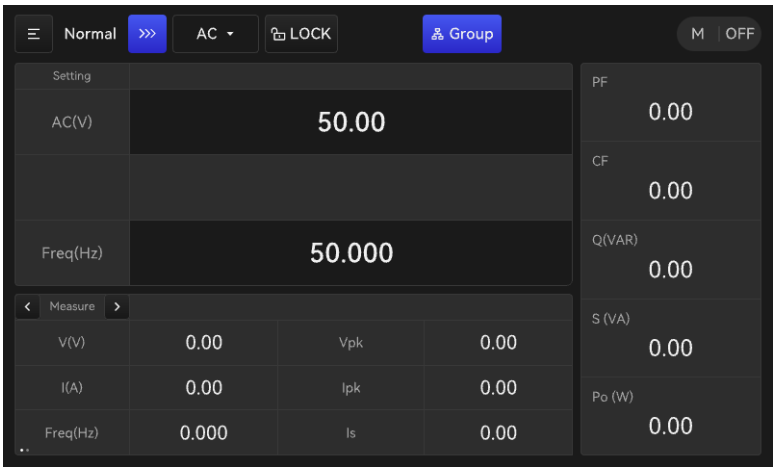
a) Three-phase DC output



b) Three-phase AC output



c) Single-phase DC output



d) Single-phase AC output

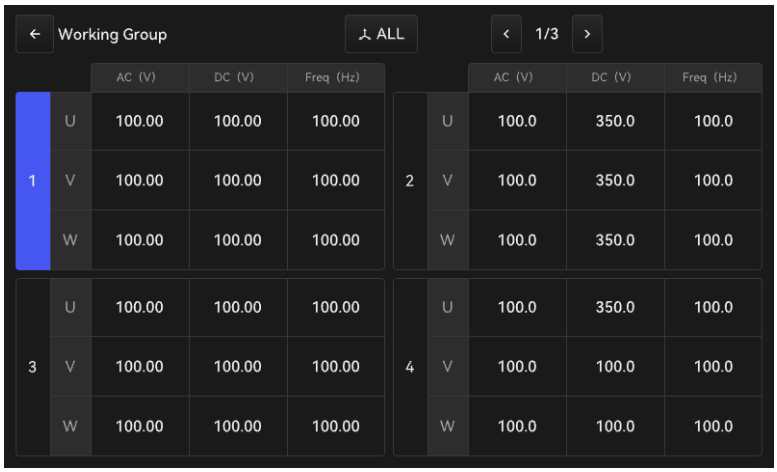
5.1.6 DC and AC output

When selecting DC output, only DC output parameters can be set in this screen.

When selecting AC output, only AC output parameters can be set in this screen.

3. Shortcut

Set the shortcut through Shortcut key, and the three-phase/single-phase screen is shown in Figure 5.1.7.



a) Three-phase shortcut setting

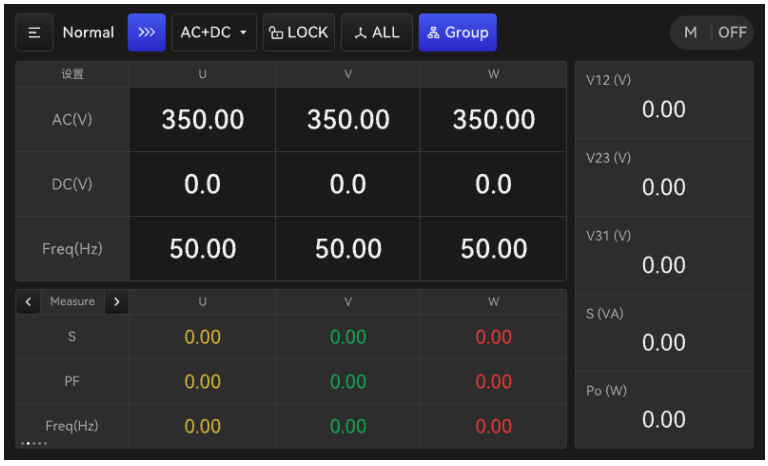
b) Single-phase shortcut setting

Figure 5.1.7 Shortcut Settings

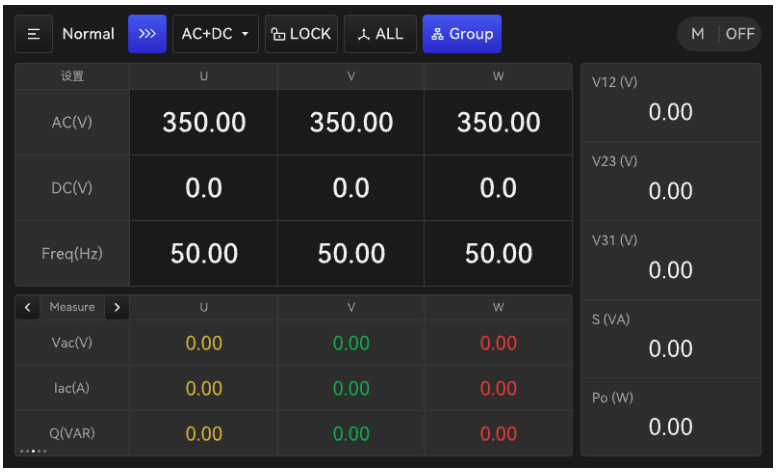
Common parameters can be saved in this screen, total 12 groups, which can be selected by pageup/pagedown button. Select the common shortcut after setting and return to the output.

4. Three-phase measurement display

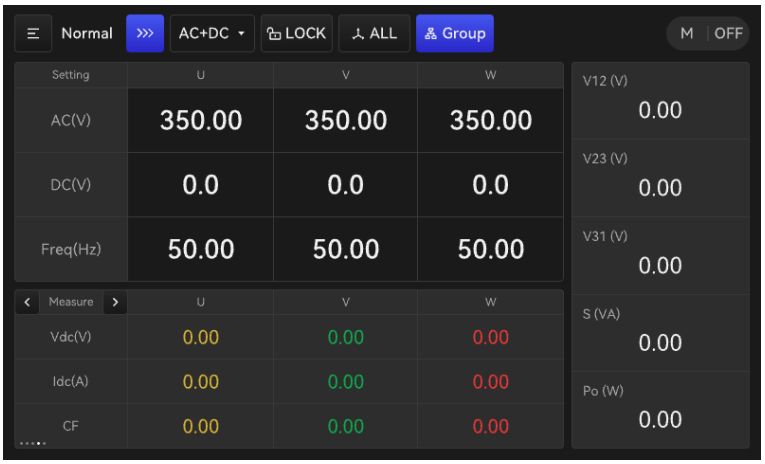
Press </> key on both sides of Measure key to view various measurements. For three-phase output, this area is displayed on total 5 pages (the current page can be displayed from the small white dot in the bottom left corner). Page 1 of the measurement area is shown in Figure 5.1.1, and after pageup/down, it is shown in Figure 5.1.8.



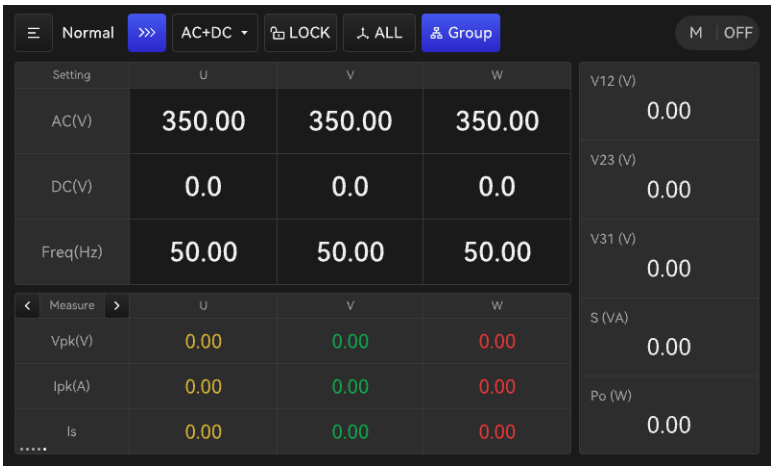
a) Measurement Area - Page 2



b) Measurement Area - Page 3



c) Measurement Area - Page 4



d) Measurement Area - Page 5

Figure 5.1.8 Display of three-phase measurement area

Below the title bar, AC (V): AC output voltage setting; DC (V): DC output voltage setting; Freq (Hz): AC output frequency setting;

Page 1: V: voltage measurement display; I: current measurement display; Po: active power display;

Page 2: S: apparent power display; PF: Power factor display; Freq (HZ): Frequency measurement display;

Page 3: Vac: AC voltage measurement display; Iac: AC current measurement display; Q (VAR): Reactive power display;

Page 4: Vdc: DC voltage measurement display; Idc: DC current measurement display; CF: Crest factor;

Page 5: Vpk: Peak voltage; Ipk: Peak current; Is: surge current;

On the right: V12: AC UV line voltage; V23: AC VW line voltage; V31: AC WU line voltage;

S (VA): total apparent power; Po (W): total active power;

Note: U, V and W three-phase parameters can be set simultaneously via Three-phase key on the upper of the screen. You can also turn off Three-phase button and set the parameters for one phase separately.

5. Single-phase measurement area

For single-phase output, this area is displayed on total 2 pages. Page 1 is shown in Figure 5.1.1 (b), and page 2 is shown in Figure 5.1.9.

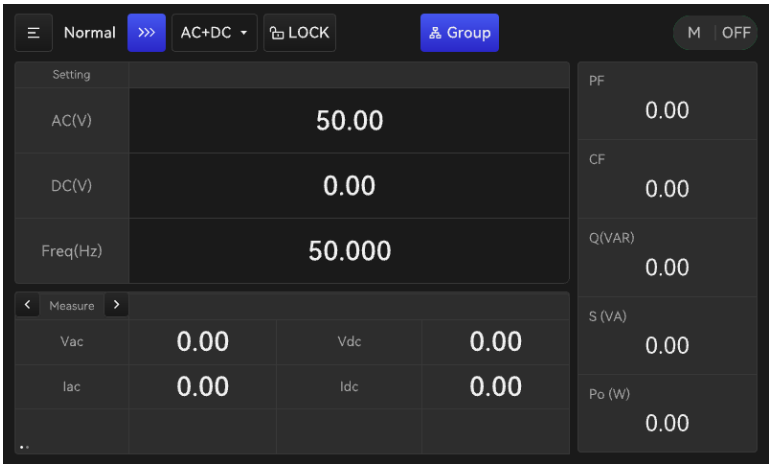


Figure 5.1.9 Single-phase measurement area

Below the title bar, AC (V): AC output voltage setting; DC (V): DC output voltage setting; Freq (Hz): AC output frequency setting;

Page 1: V: voltage measurement display; I: current measurement display; Po: Active power display; Vpk: Peak voltage; Ipk: Peak current; Is: surge current;

Page 2: Vac: AC voltage measurement display; Iac: AC current measurement display; Vdc: DC voltage measurement display; Idc: DC current measurement display;

On the right: PF: Power factor display; CF: Crest factor; Q (VAR): Reactive power display; S (VA): total apparent power; Po (W): total active power;

5.2 Online adjustment

5.2.1 Change Digital Input

During running in Common mode, users can directly input or adjust the voltage and frequency outputs of the power supply without stopping the power supply. This is called online adjustment. When changing via digital input on screen, a soft keyboard will pop up as shown in Figure 5.2.1.

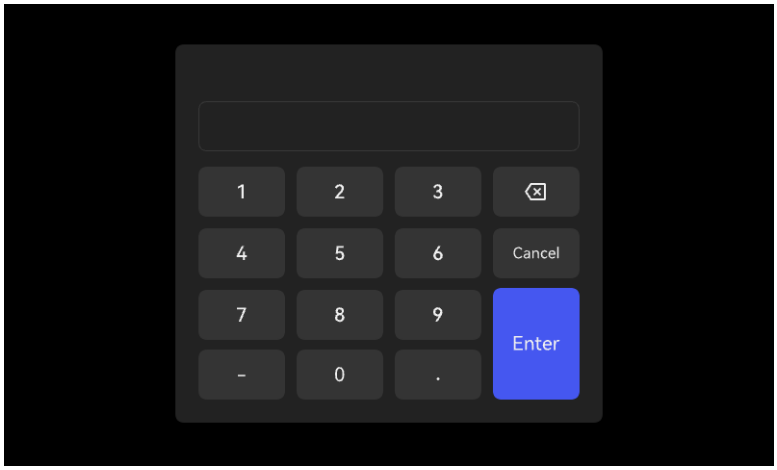


Figure 5.2.1 Change Digital Input

Online adjustment: After selecting the value for online adjustment, it can be adjusted online through the knob

and interface digital input. The output can be directly changed via the knob. After inputting the value on the screen, press OK to confirm the input or press Cancel to cancel. When the input is within the allowable range of the set value, perform online adjustment directly; otherwise, no adjustment will be made.

5.2.2 Change via Knob

The parameter can also be changed via the knob on the front panel. The operation is as follows:

1) Press the knob on the front panel, the lamp of the knob will be on in blue, and the knob is enabled.

2) Click the touch interface to select the parameter that needs to be adjusted. An underline will appear below the parameter, and the front panel will display as shown in Figure 5.2.2;

Note: If there is no operation for 10 seconds, the knob will be unselected, that is, the underline will disappear.

3) At this time, press the knob again and select the digit to be adjusted. Rotate the knob to change the parameter.

4) Touch the parameter to adjust again to cancel the underline. Press the knob to disable the knob, and the blue lamp is off.

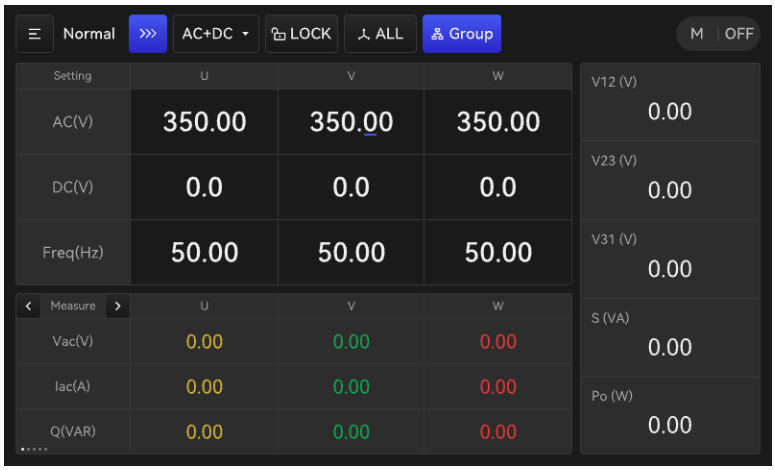
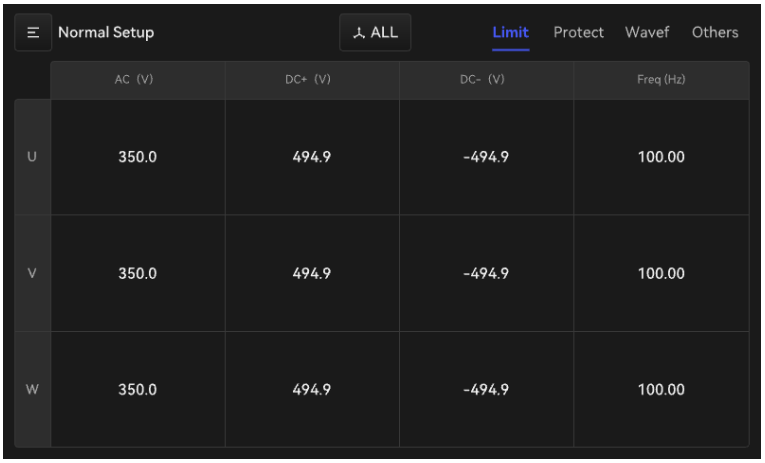


Figure 5.2.2 Knob Function - Display Screen

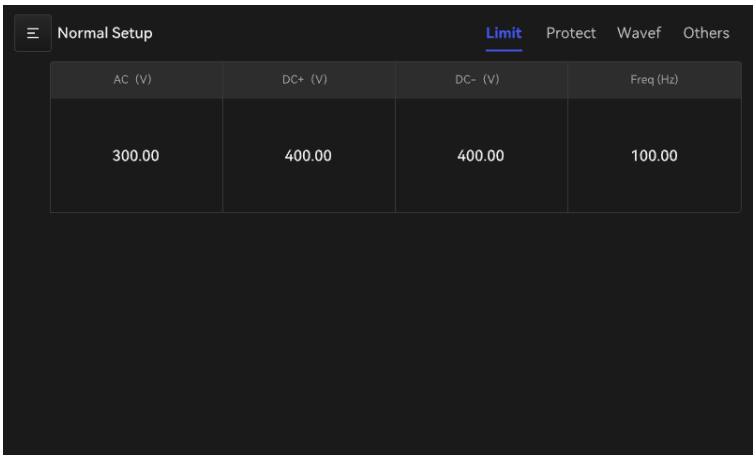
5.3 Common Setting

5.3.1 Limit and Protection Settings

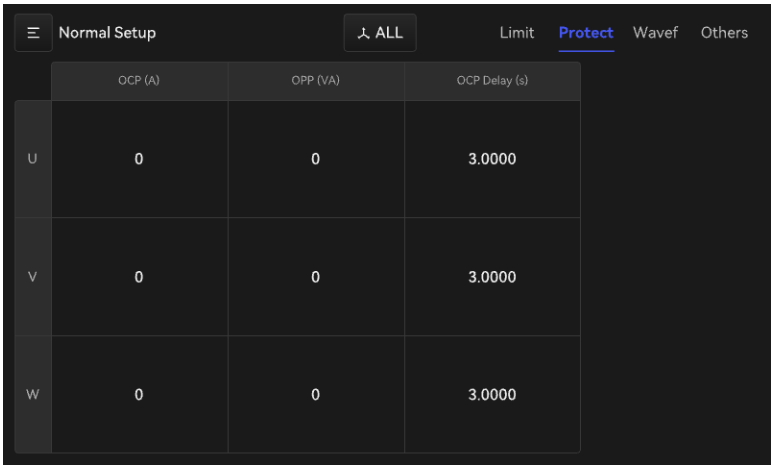
Press ☰ key in the upper left of standby interface to select Common/Programming mode, Common Setting, and System Settings. Select Common Setting to enter Common Setting option, where you can set the parameters for voltage and frequency limits, current and power protection, output Set Waveform, and other settings. The setting of three-phase/single-phase output limit is shown in Figure 5.3.1.



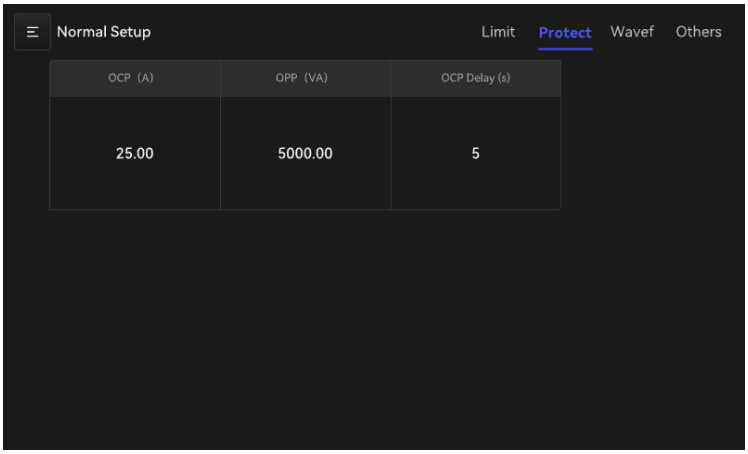
a) Three-phase limit



b) Single-phase limit



c) Three-phase protection value



d) Single-phase protection value

Figure 5.3.1 Three-phase/single-phase output limit and protection settings

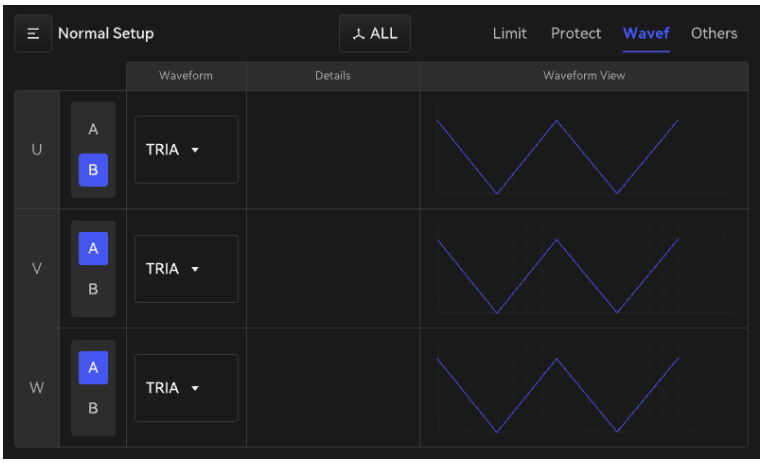
Range of setting of the limit: AC: 0~350V; DC: -494~+494V; frequency: 30~100Hz, same for three-phase/single-phase.

Range of setting of the protection: current: 0~35A; power: 0~6000VA, same for three-phase/single-phase.

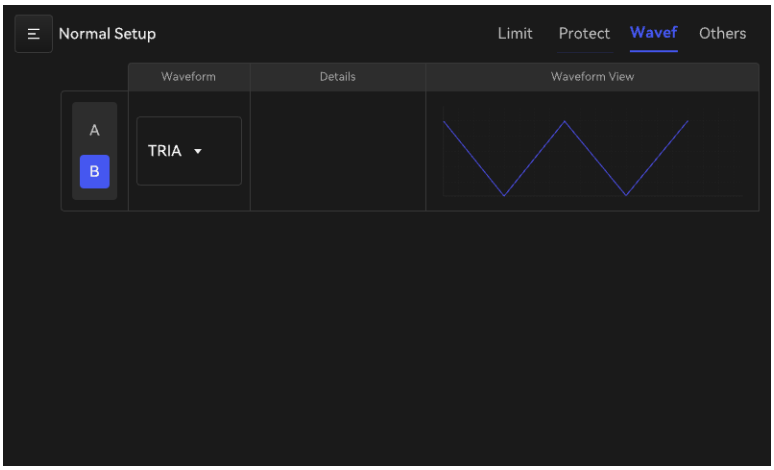
Note: For single-phase output, the output is actually the same voltage of three-phase output simultaneously, and the three-phase is used in parallel. Therefore, when setting limits and protection values for single-phase, the range of setting is the same as for three-phase, but the actual value is the sum of three-phase value. Example: When in single-phase, set a protection current of 35A and a power protection value of 6000VA. The actual output current can reach 105A and the power can reach 15KVA.

5.3.2 Set Waveform

Set the waveform of the output voltage via Set Wavef option, with two options available: A or B. Start the output, the voltage waveform will be output according to the waveform set in "Set Waveform". Waveform A and B can be set in this screen. The final selection is the output waveform in Common Output - Edit Parameter. The three-phase/single-phase setting screen is shown in Figure 5.3.2.



a) Three-phase waveform setting



b) Single-phase waveform setting

Figure 5.3.2 System Settings - Set Waveform

On this screen, various output waveforms can be selected through the dropdown options on the right side of A/B.

5.3.3 Other Settings

In Common Settings screen, Press Others key to display the interface as shown in Figure 5.3.3.

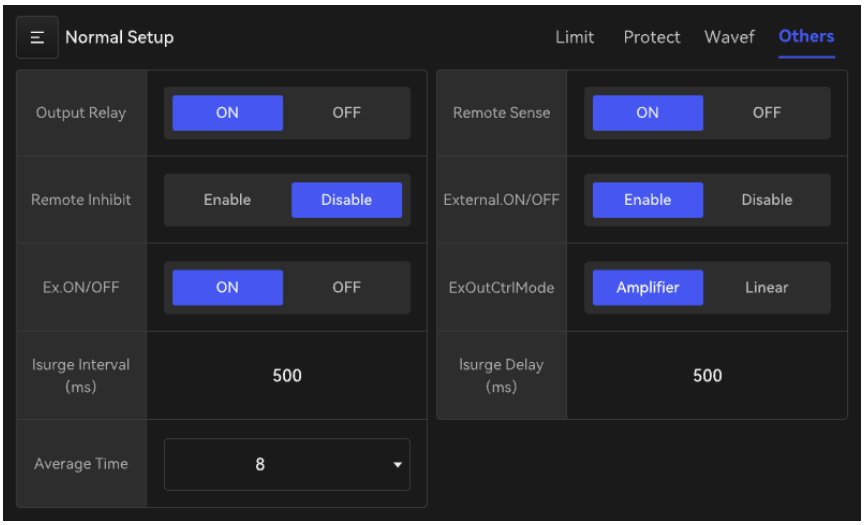


Figure 5.3.3 Common Settings - Others

Available operations in this setting screen:

1) Output relay control: The power supply is connected to the load through output relay. When it is selected as on, it is a normally closed output relay. When it is selected as off, it is connected to the output relay during startup and disconnected during shutdown.

2) Remote measurement setting: When on, enable remote measurement to measure remote voltage. When off, do not measure remote voltage, only measure internal output voltage for output voltage regulation.

3) Remote inhibit output: When the remote control is not disabled, the power supply can receive control signals from the TTL interface on the rear panel. TRIG means that when the TTL signal is at low level, the AC Test Power Supply will turn off its output. If the TTL signal returns to high level and remains in this state, the user shall start the output of the AC Test Power Supply via Start button.

4) Remote control output: When the remote inhibit is not disabled, the power supply can receive control signals from the TTL interface on the rear panel. When the TTL signal is at a low level, the AC Test Power Supply will turn off the output. If the TTL signal returns to high level, the output state will be automatically restored.

5） External input signal control: External input signal control on/off, external setting signals can be received it is on.

6) External input signal control method: In Amplify mode, the external input signal is DC, and the output voltage is only controlled by the external input voltage, and is amplified linearly proportional to the external input DC voltage.

Vout (DC)= Vref (DC) / 10Vdc *494.9V

In the linear setting mode, the external input signal is AC, and the power output voltage is the combination of the voltage setting and the amplified external input voltage.

Vout (AC)= Vref (AC) / 7.072Vac *350V

7) Protection interval: 0.0~999.9ms, indicating the time elapsed from the measurement when Is is turned on to the end of the measurement.

8) Protection delay: 0.0~999.9ms. The Is in the measurement represents the surge current test result, and the protection delay represents the time elapsed from the voltage output to the measurement of Is.

9) Average time: represents the number of sampling the measurement output display. In cases of severe fluctuations in measurement, a high average sampling frequency can be set to improve the accuracy of the measurement. Setting range: 1, 4, 8, 16, 32.

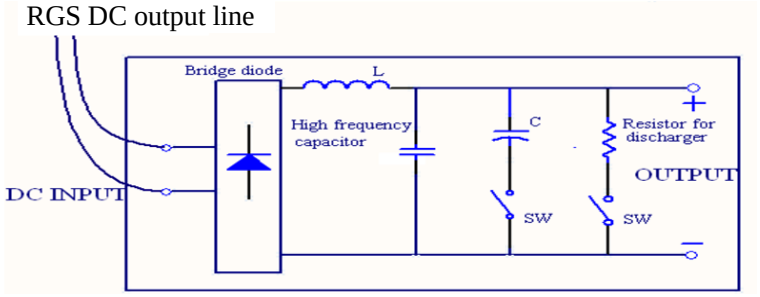
Warning!

The main differences between the ANRGS series AC Test Power Supply when outputting DC voltage and the general DC power supply are as follows:

1. Due to the absence of output filtering capacitor, its output ripple is relatively large.
2. When the output current reaches the limit, the output voltage will immediately be cut off and enter the protection state, which is different from the constant current (CC) mode of general DC power supplies, which only reduces the output voltage.
3. The output end cannot be connected to large capacity electrolytic capacitor (>20uf) to prevent unstable output and damage to the power supply.

To overcome the disadvantage of item 1 and 3 above, it is recommended to add a device at the output terminal. to provide better characteristics and protection.

RGS DC output line



Note:

1. Bridge diode: prevent instable output caused by adding capacitance to the output terminal, and accidentally outputting AC voltage or damaging the tested device due to opposite polarity.
2. L and High frequency capacitor: Combined inductance and capacitance to filter out high-frequency voltage ripple.
3. C and SW: C is high-capacity electrolytic capacitor, which can be added when the tested device end does not contain it. If the tested device end already contains it, it can be turned off via SW (switch).
4. Discharge resistor and SW: The discharge resistor can discharge residual charges from the output terminal or the capacitance of the tested device, avoiding danger. Turn SW (switch) to discharge when needed. Make sure to choose a discharge resistor with sufficient power to achieve this function.

5.4 System Settings

5.4.1 Basic Settings

Press the upper left ≡ to select system settings, and System Settings interface as shown in Figure 5.4.1.

The settings include four options: Basic, Interface, Status, and Message.

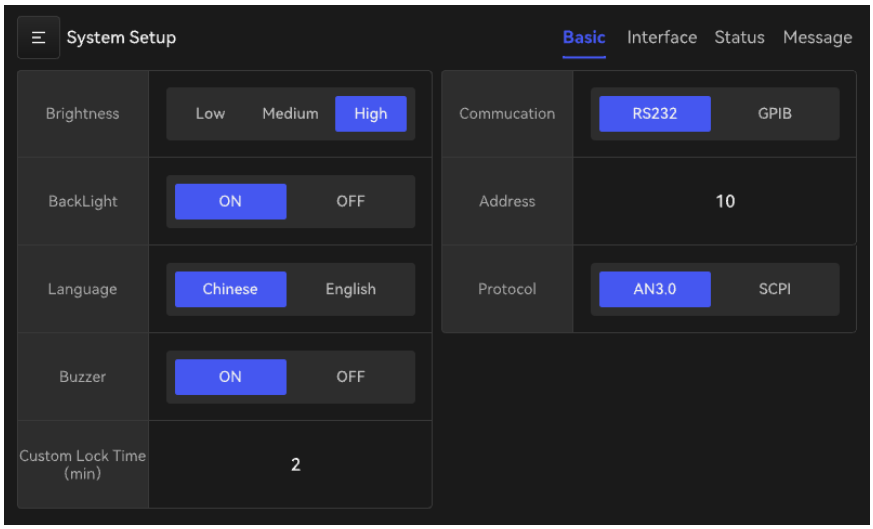


Figure 5.4.1 System Setting

After entering System Settings screen, it enters Basic page by default, where the basic parameters of the power supply are set.

Screen brightness: three levels: low, medium, and high.

Communication methods: standard RS485, RS232 (optional), standard LAN, GPIB (optional).

Backlight: On/off to change the brightness of the screen.

Communication protocols: Ainuo3.0, SCPI, detailed in Appendix I

Language: Chinese, English

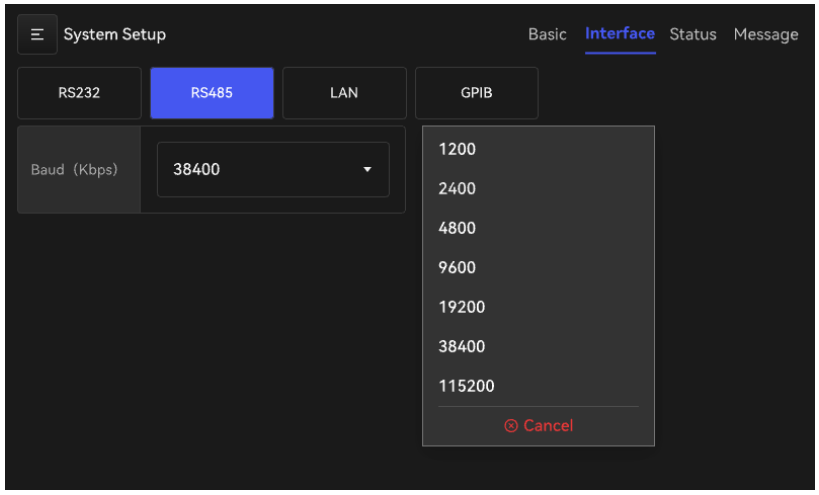
Communication address: 1~255

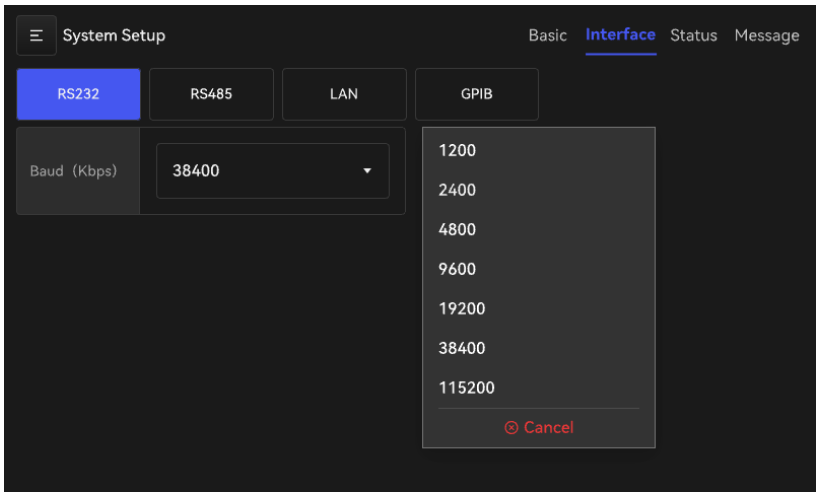
Buzzer: When turned on, clicking on the interface will produce a buzzer sound. When turned off, the interface touch sound will be turned off.

Self-lock interface time: Set the standby interface shutdown time.

5.4.2 Interface Settings

Select Interface page in System Settings, as shown in Figure 5.4.2.





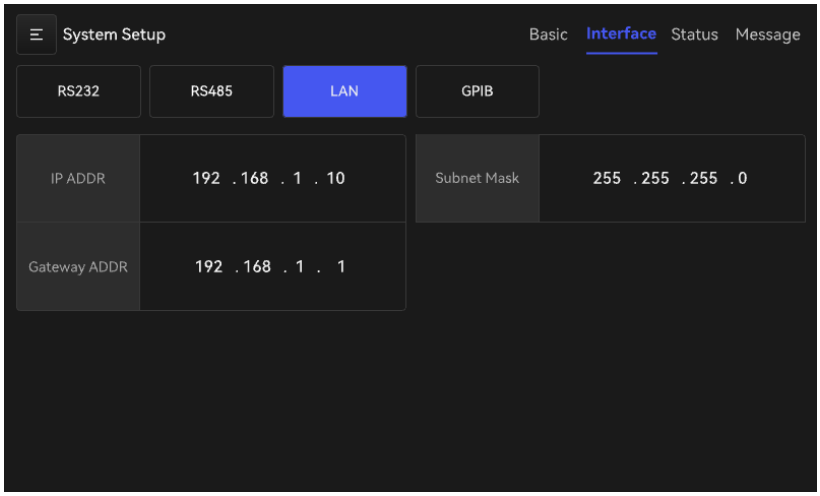


Figure 5.4.2 Interface Settings

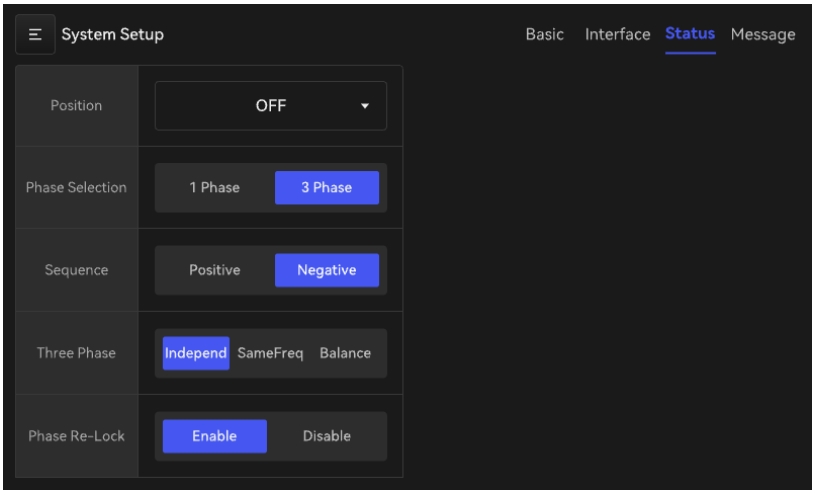
RS485 and RS232 baudrate: 1200, 2400, 4800, 9600, 19200, 38400, 115200.

GPIB: Communication address 1~255.

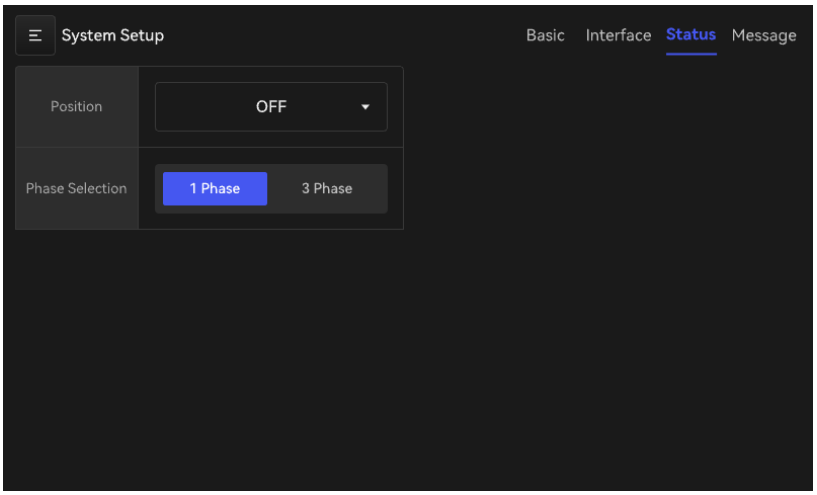
LAN: Gateway address can be changed for communication.

5.4.3 Status Setting

Select Status in System Settings screen, as shown in Figure 5.4.3.



a) Three-phase state setting



b) Single-phase state setting

Figure 5.4.3 State Setting

This is the default screen for three-phase single equipment operation.

Parallel Setting: Choose parallel or not. When select OFF, this power supply is used as

three-phase/single-phase standalone power supply. In the drop-down screen, you can choose whether to use it as master or slave for parallel operation.

Output Mode: Select the power supply for single-phase/three-phase output. For single-phase power supply, short-circuit connect output terminal L1~L3.

Three-phase Output: only available for three-phase power supply and is used for switching the positive phase sequence and negative phase sequence of the output voltage.

Three-phase Relationship: only available for three-phase power supply. Independent: with the highest degree of freedom, the three-phase voltage/frequency can be set separately. Same Frequency: consistent three-phase frequency. Balance: Only AC output mode, and the three-phase voltage/frequency shall be the same.

Phase Repositioning: only available for three-phase power supply, and is phase re-locking. For three-phase output power supply, the voltage/frequency are Independently set, and users can use different frequency outputs. Assuming that the three-phase output frequency is not the same, if Phase Repositioning is not enable, when setting the three-phase output to be consistent, the phase difference the three-phase output will not be restored to the preset value (phase difference is 120 °). When Phase Repositioning is enable, the phase difference the three-phase output will be restored to the preset value (phase difference is 120 °).

Refer to Section 5.10 for parallel operation.

5.4.4 Message screen

Select Message page, as shown in Figure 5.4.4.

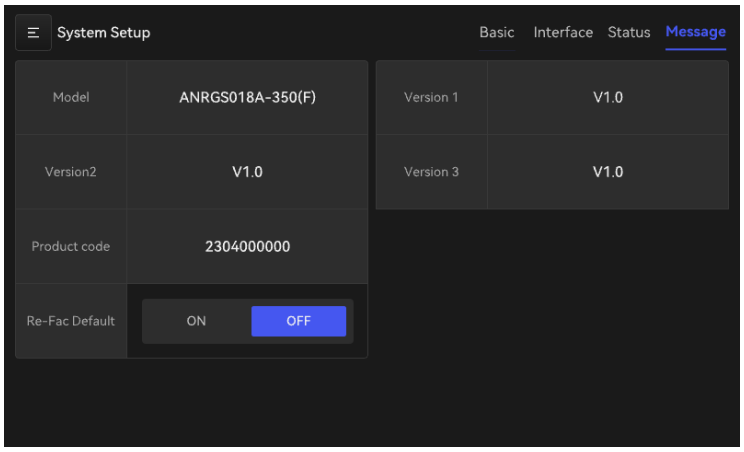


Figure 5.4.4 Information

This interface includes model of power supply, version, code, and other information.

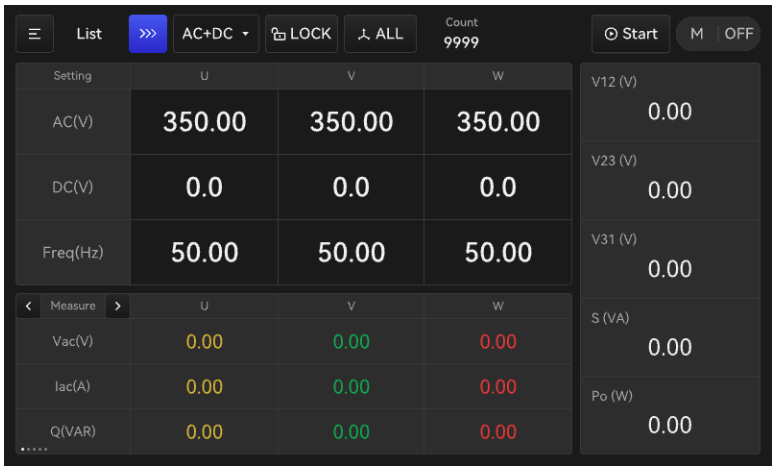
Restore factory setting: Restore the system to default factory setting.

5.5 List Test

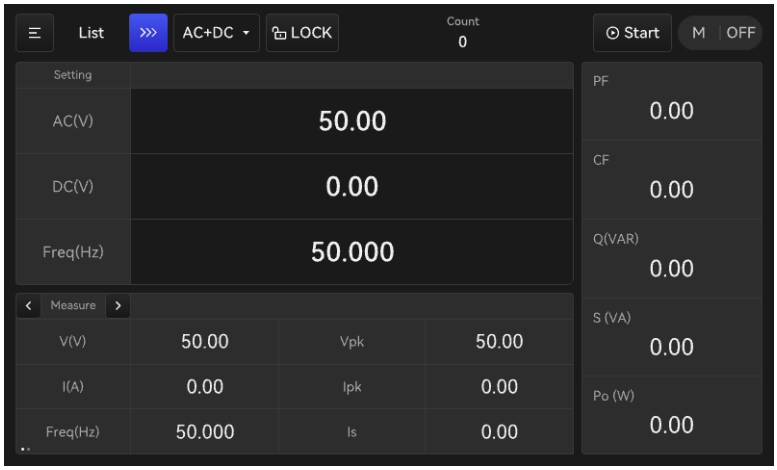
5.5.1 List Test Standby screen

The output waveform in List Test mode is a combination of all List No. configurations. The output waveform will start from List 0, and then be output one by one according to the configuration of the list No., until the running time with list No. is 0, the output will stop. The configuration of subsequent list No. will not be executed. The user can edit the order of the output voltage as required.

Press the upper left ≡ to select List mode, and enter List mode Standby screen. The three-phase/single-phase Standby screen is shown in Figure 5.5.1.



a) Three-phase List mode Standby state



b) Single-phase List mode Standby state

Figure 5.5.1 Three-phase/single-phase List mode Standby

The difference between this interface and the Common Standby interface is that the display title in the upper left is List. Clicking >>> on the right to enter the parameter editing in List mode.

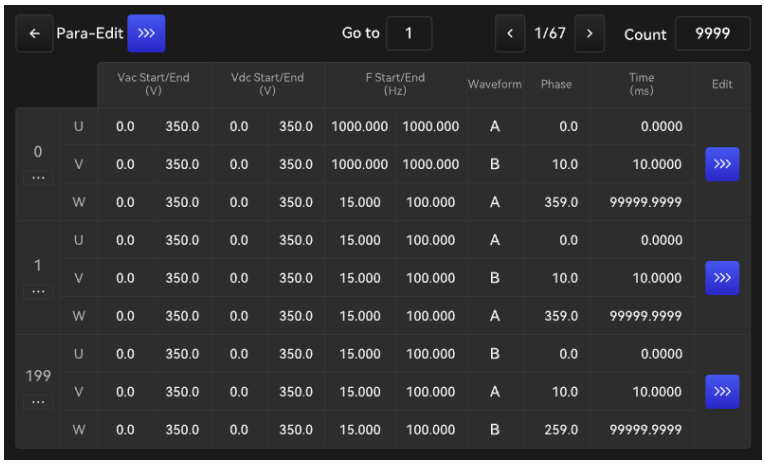
In addition, Start button appears on the left of OF/OFF display in the upper right. Press this button to start the programming mode. After the programming mode is started, Start button changes to Stop button. Click it to turn off the power supply output.

Running Time title: display the number of List test of the current loop (0~9999).

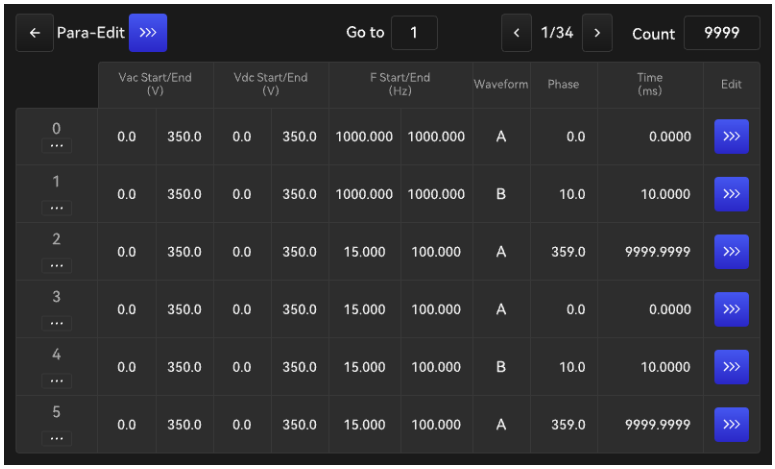
Note: The AC, DC and Frwq set in this interface are all common state parameters and are independent of List Test mode.

5.5.2 List Test Edit Parameters

Click >>> on the right of List title in List Standby interface to enter List Test Edit Parameters screen, as shown in Figure 5.5.2.



a) Edit Parameter of three-phase List mode

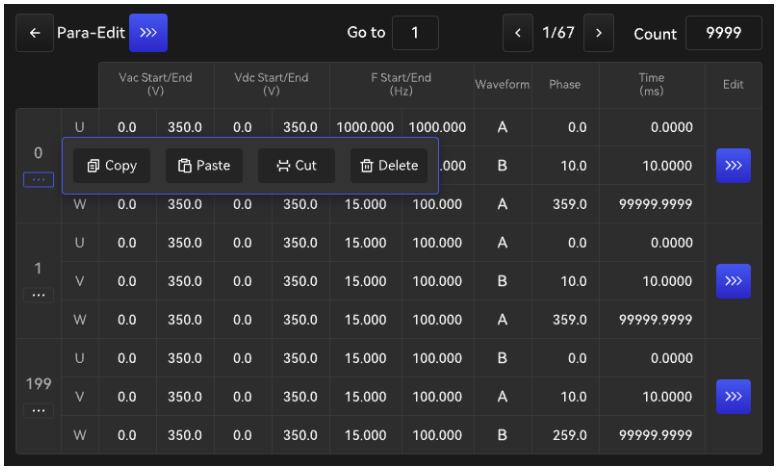


b) Edit Parameter of single-phase List mode

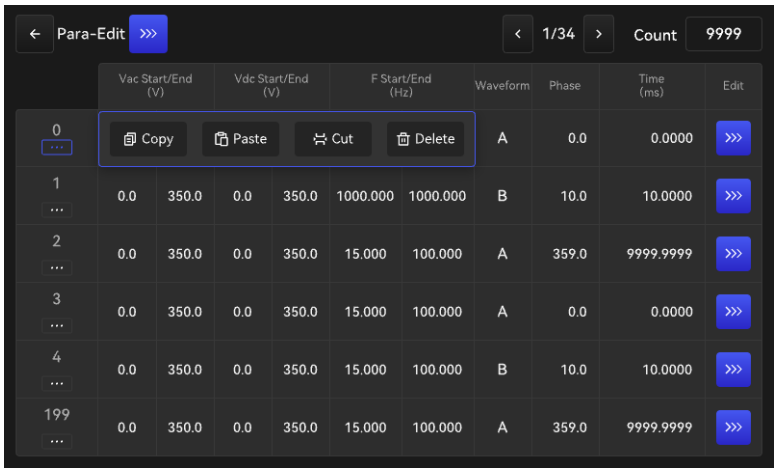
Figure 5.5.2 List Test Edit Parameters

1. List group shortcut

In the interface of Figure 5.5.2, the left 0, 1, 2 ••• are the list group No. Click ••• below the number to perform four operations: copy, paste, insert, and delete, as shown in Figure 5.5.3.



a) Shortcut of three-phase List group



b) Shortcut of single-phase List group

Figure 5.5.3 List group shortcut

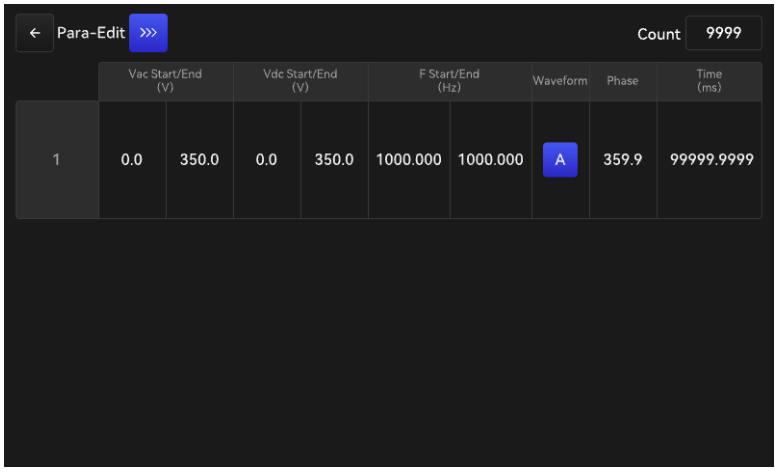
Note: The above four operations are all for all parameters of the list group. When performing the above four operations in three-phase, it is available for U, V and W three-phase simultaneously. When in single-phase, available for a separate List No.

2. List output edit parameters

Parameters such as AC start/end voltage, DC start/end voltage, frequency start/end value, output waveform format, list phase, and running time can be displayed in the interface shown in Figure 5.5.2.

Press >>> on the right under the edit bar to enter Edit Parameters interface to modify the above parameters, as shown in Figure 5.5.4.

a) Three-phase Edit Parameter



b) Single-phase Edit Parameter

Figure 5.5.4 Edit Parameters

Note: In this screen, for three-phase power supply, if all three-phases are set to the same parameters, you can click ALL button above and edit the parameters of the three-phases at the same time. When the start/end values are the same, you can click the S/E button above to edit the start/end values simultaneously.

In this screen, you can select the waveform in Waveform field. Click the option below the waveform to enter Set Waveform screen in List mode, as shown in Figure 5.5.5.

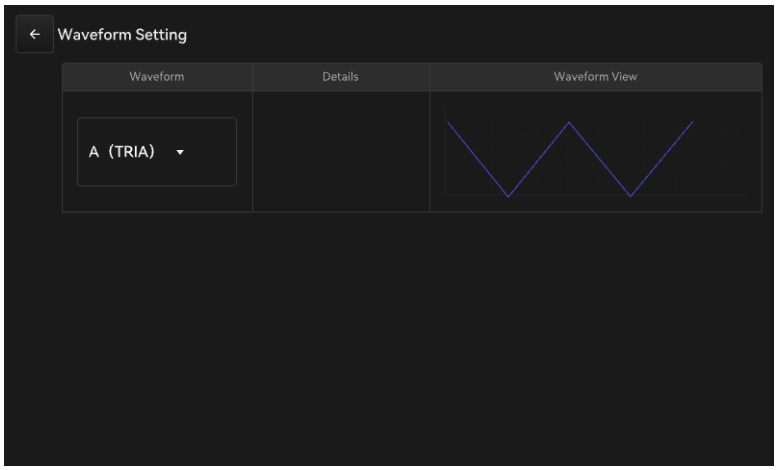


Figure 5.5.5 List Mode - Set Waveform

You can select the output waveforms in this screen, including two types of shortcut waveforms: A and B, and 6 types of output waveforms. After selection, click ← to save and return.

3. More Settings in List mode

In the screen shown in Figure 5.5.2, click >>> on the right of Para-Edit to enter More Settings in List mode, same for single/three-phase, as shown in Figure 5.5.6.

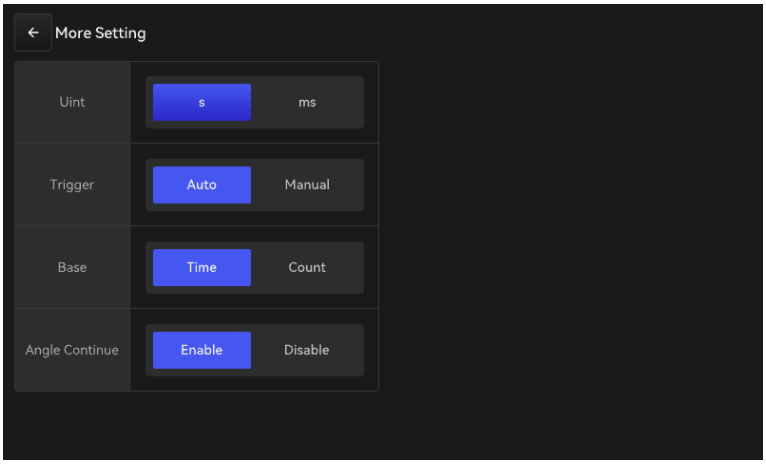


Figure 5.5.6 More Settings in List mode

Time unit: Sec./ms. To modify the time unit of running time in List mode.

Trigger mode: Auto/Manual. In Manual mode, after triggering, only one list waveform is executed, which has the same effect as cycle of 1. In Auto mode, all cycles will be completed after triggering.

Length unit: the measurement method for the running time in the List No. item. "Time": the running time is measured in time, and "Cycle": the running time is measured in the number of cycles of the current waveform.

Stage continue: When it is disabled, the start angle of each list group will be activated according to the set value. When it is enabled, the start angle of each list group will be the end angle of the previous list group.

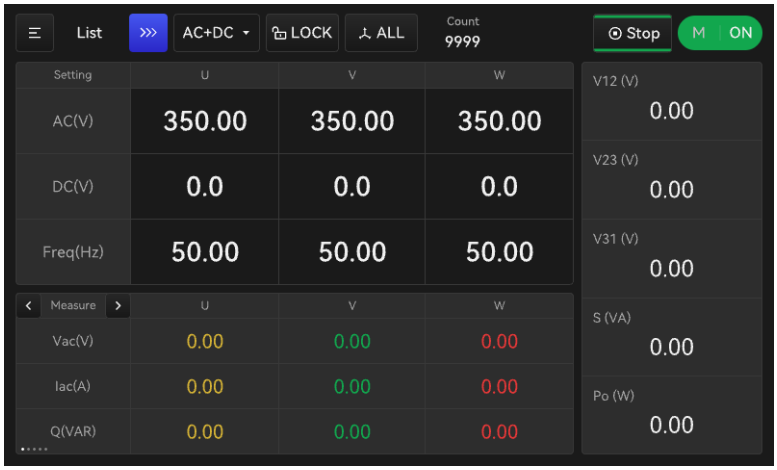
4. Meaning of parameters

- Cycles: 0~9999, 0 represents infinite cycles.
- Trigger mode: Auto/Manual. In Manual mode, after triggering, only one list waveform is executed, which has the same effect as cycle of 1. In Auto mode, all cycles will be completed after triggering.

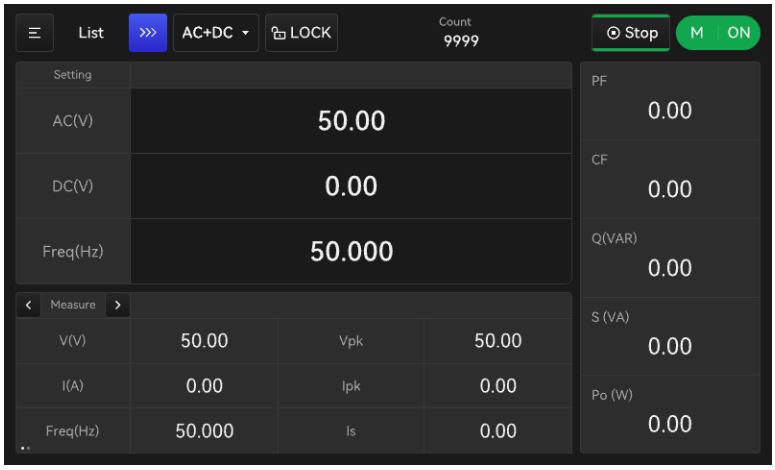
- Length unit: the measurement method for the running time in the List No. item. "Time": the running time is measured in time, and "Cycle": the running time is measured in the number of cycles of the current waveform.
- List No.: 0~99, editing 100 changes; The list group can be jumped through the jump option at the top of the interface in Figure 5.18.
- Running time: 1~9999. If the length unit is "time", the unit is ms or s. If the length unit is "period", the unit is 1 or K. K represents *1000.
- Measurement unit: the unit for running time. If the length unit is "time", ms or s can be selected. If the length unit is "cycle", 1 or K can be selected.
- Initial AC: AC voltage as the current List No. starts, 0.0~350.0V;
- Initial frequency: AC frequency as the current List No. starts, 30~100.0Hz;
- Initial DC: DC voltage as the current List No. starts, -494.9~494.9V;
- End AC: AC voltage as the current List No. ends, 0.0~350.0V;
- End frequency: AC frequency as the current List No. ends, 30~100.0Hz;
- End DC: DC voltage as the current List No. ends, -494.9~494.9V;
- Select waveform: The output waveform of the current List No.; Start the output, the voltage waveform will be output according to the waveform set in "System Settings".
- List phase: The phase angle as the current List No. starts, 0.0~359.9.

5.5.3 List Test Running state

The Standby state in List test is shown in Figure 5.5.1. Click Start button on Standby screen to start it, as shown in Figure 5.5.7 for three-phase/single-phase power supply power supply.



a) Three-phase List mode Running state



b) Single-phase List mode Running state

Figure 5.5.7 Running state in List test

After start the List mode, to turn off the output, press Start button in the upper right of the interface to turn it off, or press ON/OFF on the front panel. The measurement display area is the same as in Common mode.

Note: AC, DC, and Frwq in this interface are all common state parameters. After the List mode is activated, only the parameters set in Edit Parameters in the List mode are output.

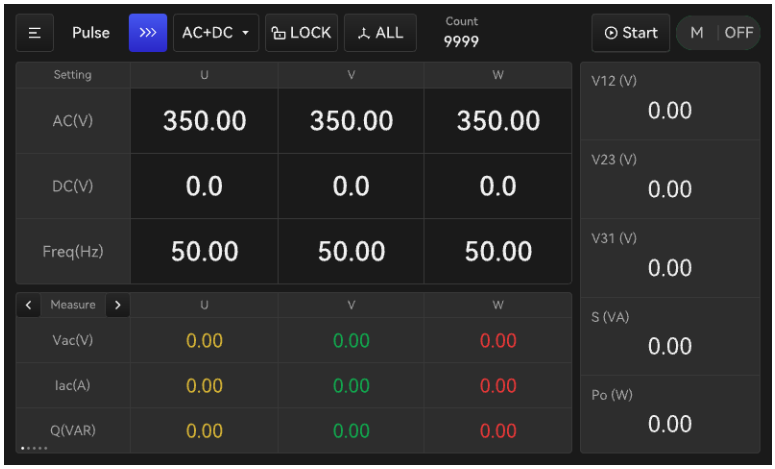
⚠Note: The List mode can only be started via Start button in the upper right. To stop it, press Stop button in the upper right of the interface or ON/OFF on the front panel. If in programming mode, if pressing ON/OFF on the front panel to start the power supply, the output is in Common mode, which is the parameter set on the main screen. At this time, you can click Start button on the interface to start the programming mode.

5.6 Pulse Output

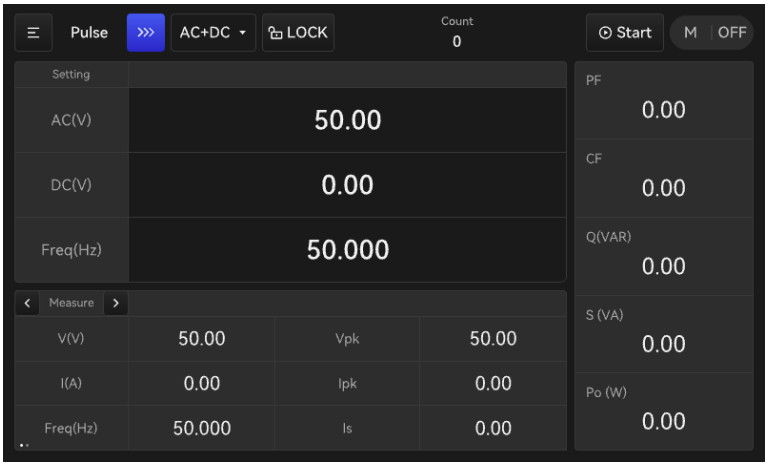
5.6.1 Pulse Output Standby screen

In pulse output mode, the pulse output waveform edited by the users can be provided, to simulate voltage fluctuations and dips in the power grid, and achieve burst and notch output.

Press the ≡ key in the upper left corner of the main interface to select the Pulse mode and enter the standby interface of the intermediate harmonic mode, as shown in Figure 5.6.1.



a) Three-phase Pulse Standby



b) Single-phase Pulse Standby

Figure 5.6.1 Pulse Standby screen

The interface is the same as the List Standby screen, except for the pulse >>> button in the upper left.

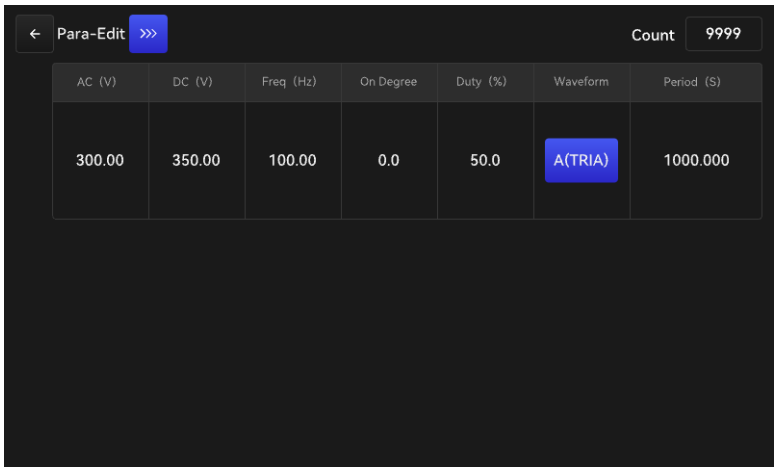
Note: The AC, DC and Frwq set in this interface are all common state parameters and are independent of List Test mode.

5.6.2 Pulse Output Edit Parameters

1. Edit Parameters

Click Pulse >>> button to enter Edit Parameters screen in Pulse output mode. The three-phase/single-phase power supply is shown in Figure 5.6.2.

a) Three-phase Pulse output Edit Parameter



b) Single-phase Pulse output Edit Parameter

Figure 5.6.2 Edit Parameters in Pulse Output mode

This interface is different from the List mode. You shall enter the Edit Parameters interface again to edit. The parameters in pulse output mode can be edited in interface as shown in Figure 5.6.2.

In addition, you can click Select Waveform field to select the waveform. The setting method is the same as Select Waveform in section 5.5.2 of List test.

Click >>> at right of Edit Parameters in the upper left of Figure 5.6.2, to enter More Settings interface for pulse output mode, as shown in Figure 5.6.3.

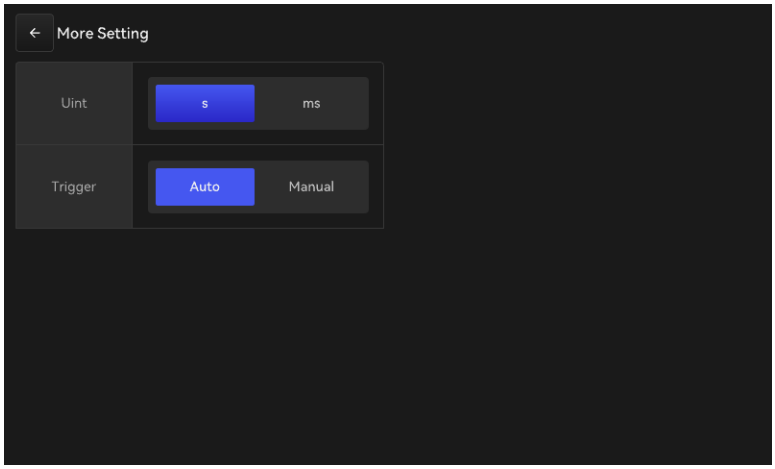


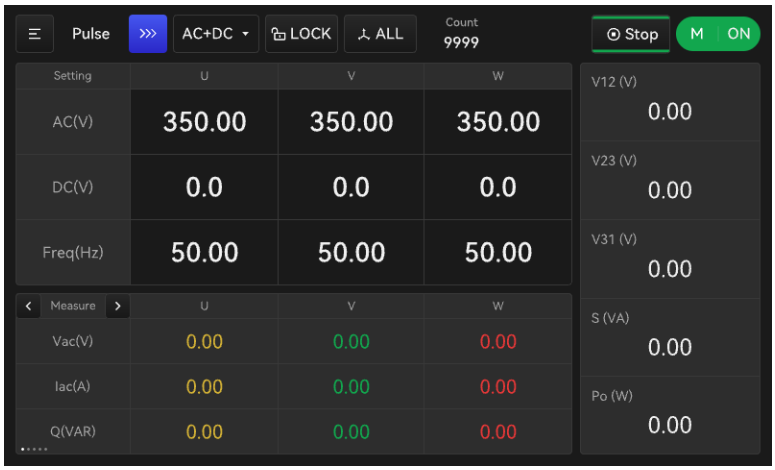
Figure 5.6.3 More Settings for Pulse mode

2. Meaning of parameters

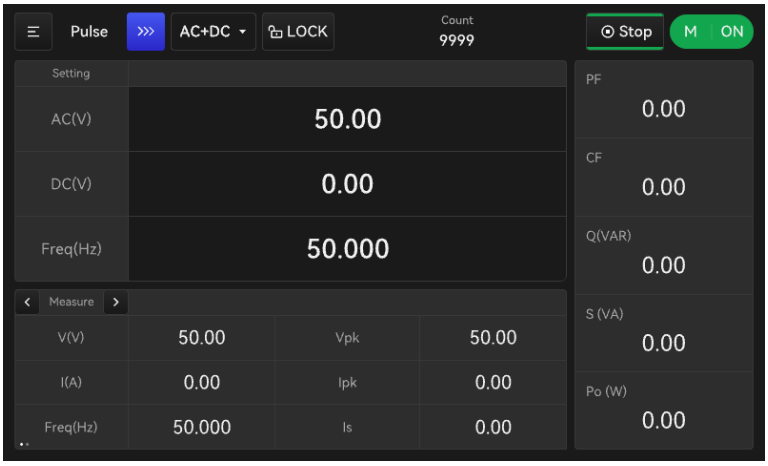
- Running times: The number of repeated pulse cycle outputs, 0~9999, 0 indicates an infinite running times until the output is manually stopped.
- AC: Pulse output AC voltage, 0.0~350.0V
- Frequency: Pulse output frequency, 30~100Hz
- DC voltage: Pulse output DC voltage, -494.9~494.9V
- AC difference: AC voltage difference between adjacent pulses, 0~350.0V
- Frequency difference: Frequency difference between adjacent pulses, 0~100.0Hz
- DC difference: DC voltage difference between adjacent pulses, -494.9~494.9V
- Duty cycle: The duty cycle of the pulse output waveform throughout the cycle, 0~100％
- Represents the percentage of time occupied by the pulse waveform within an output cycle
- Cycle: Output cycle, 1~9999, representing the time of one output cycle, unit: ms, s
- Trigger mode: Manual/Auto. In Manual mode, only one cycle is output and then stop. In Auto mode, the output will be based on the running times set in Running Times until the counting is completed.
- Start angle: The phase angle of the output pulse waveform, 0.0~359.9
- Select waveform: When triggering pulse output, the pulse voltage waveform will be output according to the waveform set in "System Settings".
- Time unit: Output cycle unit: ms, s

5.6.3 Pulse Output Running state

Click Start button on the Standby screen of Pulse output mode to start the Pulse mode output and display the running times in real time. The three-phase/single-phase power supply is shown in Figure 5.6.4.



a) Three-phase Pulse output mode Running state



b) Single-phase Pulse output mode Running state

Figure 5.6.4 Pulse Output mode Running state

After start the Pulse mode, to turn off the output, press Start button in the upper right of the interface to turn it off, or press ON/OFF on the front panel. The measurement display area is the same as in Common mode.

Note: AC, DC, and Frwq in this interface are all common state parameters. After the Pulse mode is activated, only the parameters set Edit Parameters in the Pulse mode are output.

⚠ Note: The Pulse mode can only be started via Start button in the upper right. To stop it, press Stop button in the upper right of the interface or ON/OFF on the front panel. If in programming mode, if pressing ON/OFF on the front panel to start the power supply, the output is in Common mode. At this time, you can click Start button on the interface to start the programming mode.

⚠ Note: In Edit Parameter, when duty cycle × cycle <15ms, due to the screen refresh rate limit, the voltage on the display will not change after running for 20 times, but the actual output is correct.

5.6.4 Example of pulse setting

According to the test standard of the equipment, requiring 220V 50Hz output to start for 9 seconds, stop for 6 seconds, and automatically cycle 50 times. The following parameters can be set:

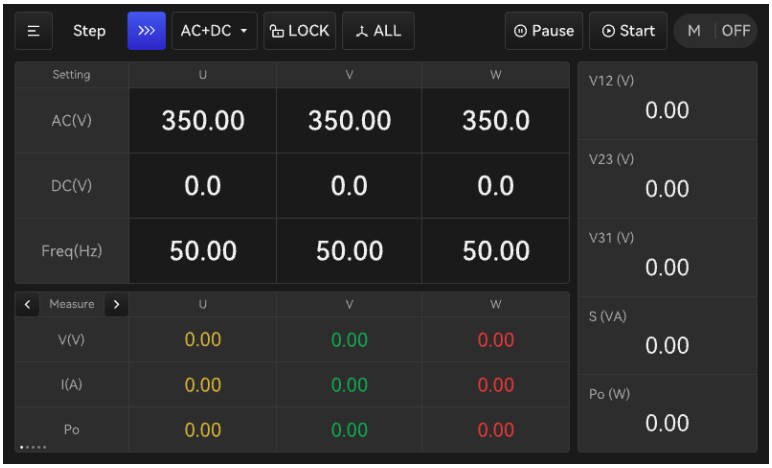
Operating parameters	Main parameter settings
Pulse parameters (Figure 5.23)	AC voltage: 220V, output frequency: 50Hz, duty cycle: 40%, cycle: 15s, time unit: s, running times: 50
Pulse parameters (Figure 5.24)	Time unit: s Trigger mode: Auto

5.7 Step Test

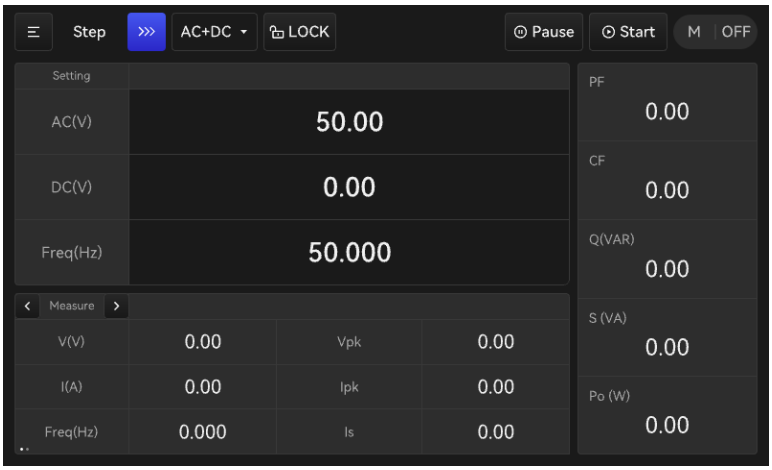
5.7.1 Step Test Standby screen

In Step test mode, the output voltage changes via simple automatic switch in step pattern rather than gradually changing. The start output voltage, number of changes, and duration of stay on each step can be set. After the change is completed, the output voltage will remain the final output voltage.

Press the ☰ key in the upper left corner of the main interface to select step mode and enter the step mode standby interface, as shown in Figure 5.7.1.



a) Three-phase Step Standby



b) Single-phase Step Standby

Figure 5.7.1 Step mode Standby

Compared with the Common Standby screen, this interface has additional Pause and Start buttons, to start Step test and pause after start.

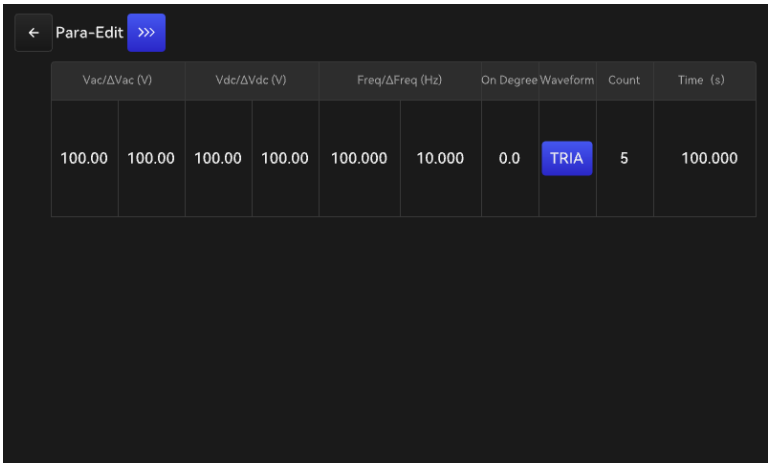
Note: The AC, DC and Frwq set in this interface are all common parameters and are independent of Step test mode.

5.7.2 Step test Edit Parameters

1. Step test Edit Parameters

Click Step >>> button in standby interface shown in Figure 5.7.1 to set the parameters for Step test, as shown in Figure 5.7.2.

a) Three-phase Step test Edit Parameter



b) Single-phase Step test Edit Parameter

Figure 5.7.2 Step Edit Parameters

On this screen, the parameters can be directly modified. The parameters in waveform field can be changed in the same way as select waveform in section 5.5.2 List test.

In the interface of Figure 5.7.2, click Edit Parameters >>> button to enter More Settings interface of Step test, as shown in Figure 5.7.3.

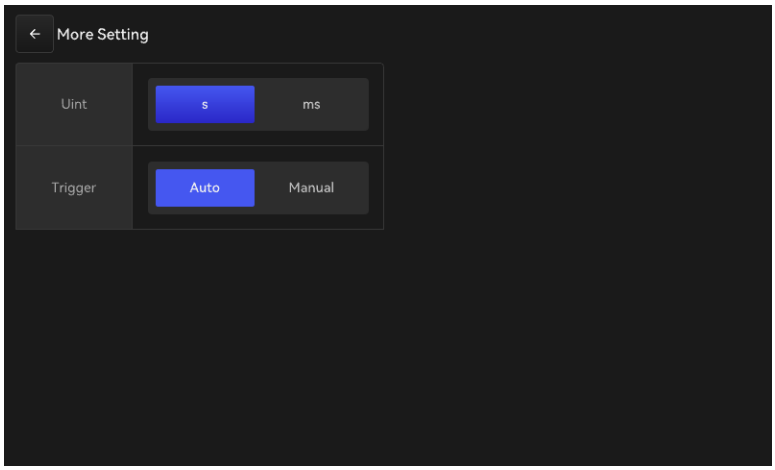


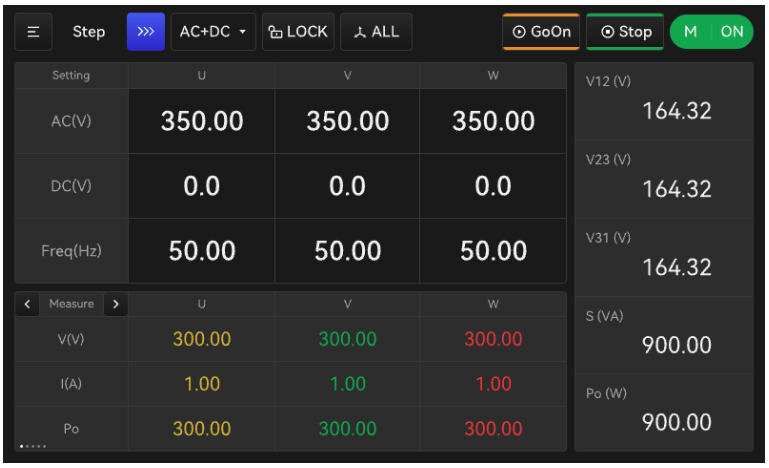
Figure 5.7.3 Step Test More Settings

2. Meaning of parameters:

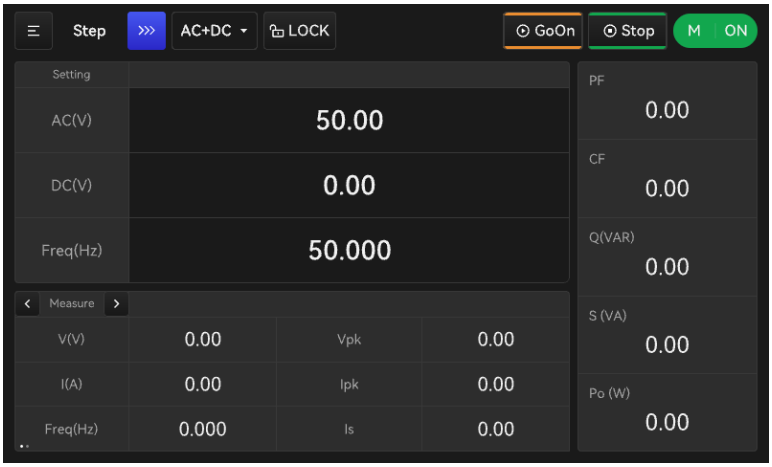
- Running times: Number of times each change is executed, 0~9999;
- Step time: Duration of each step, 1~9999;
- AC: Initial AC voltage when triggering the Step test output, 0.0~350.0V;
- Frequency: Initial frequency when triggering the Step test output, 30~100.0Hz;
- DC: Initial DC voltage when triggering the Step test output, -494.9V~494.9V;
- AC difference: AC voltage difference between adjacent steps, 0~350.0V;
- Frequency difference: Frequency difference between adjacent steps, 0~100.0Hz;
- DC difference: DC voltage difference between adjacent steps, -494.9~494.9;
- Start angle: Output start phase angle of each step, 0.0~359.9;
- Select waveform: Start the output, the voltage wave will be output according to the customized wave type in System Settings.
- Trigger mode: Auto/Manual. After triggering the Step output in Auto mode, it will be executed according to the number of steps. During the triggering process, press Pause button to pause or resume the current changing process. In Manual mode, only one cycle is output and the output is stopped.
- Time unit: ms/s, the unit of step time.

5.7.3 Step Test Running state

Click Start button on the Standby screen of Step test mode to start the Step mode output, as shown in Figure 5.7.4 for three-phase/single-phase power supply.



a) Three-phase Step test Running state



b) Single-phase Step test Running state

Figure 5.7.4 Step Test Running State

After start the Step mode, to turn off the output, press Start button in the upper right of the interface to turn it off, or press ON/OFF on the front panel. The measurement display area is the same as in Common mode.

In addition, you can press the upper right Pause button on the interface to pause/resume the output of Step test.

Note: AC, DC, and Frwq in this interface are all common state parameters. After the Step mode is activated, only the parameters set in Edit Parameters in the Step mode are output.

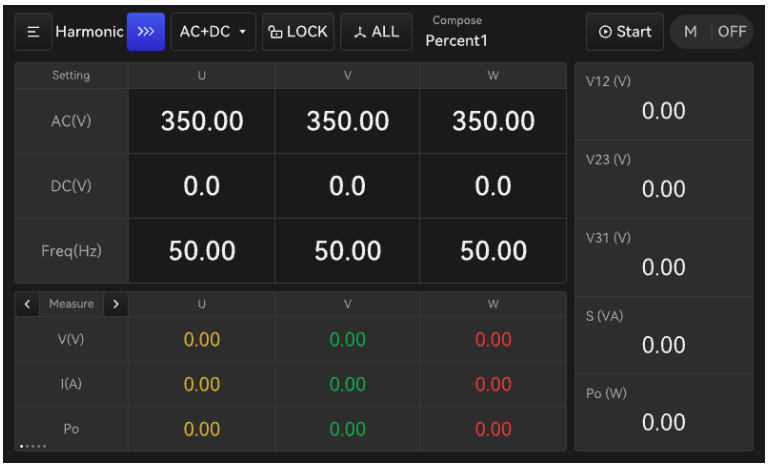
⚠Note: The Step mode can only be started via Start button in the upper right. To stop it, press Stop button in the upper right of the interface or ON/OFF on the front panel. If in programming mode, if pressing ON/OFF on the front panel to start the power supply, the output is in Common mode. At this time, you can click Start button on the interface to start the programming mode.

5.8 Harmonics test

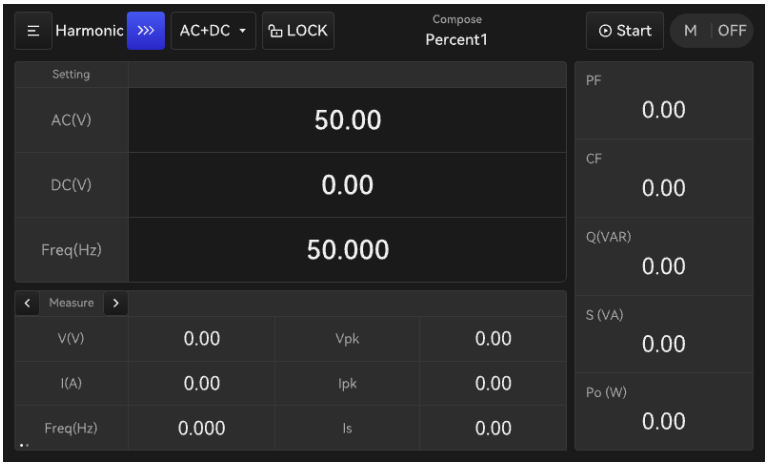
5.8.1 Harmonic Test Standby screen

In Harmonic test, the user can to edit up to 50 harmonic synthesis waveforms, and edit the output phase and harmonic content of each harmonic, to simulate waveform distortion of the output voltage and achieve special waveform output.

Press the ≡ key in the upper left corner of the main interface to select the intermediate harmonic mode and enter the standby interface of the intermediate harmonic mode, as shown in Figure 5.8.1.



a) Three-phase Harmonics test Standby state



b) Single-phase Harmonics test Standby state

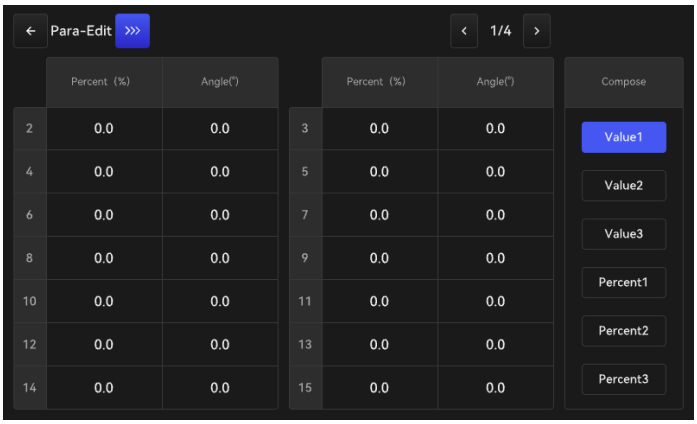
Figure 5.8.1 Harmonic standby screen

The display on this interface is basically the same as the common screen, except for with additional Compose.

5.8.2 Harmonic test Edit Parameters

1. Harmonic test Edit Parameters

Click the harmonic >>> button in the standby interface as shown in Figure 5.8.1 to set the parameters for the harmonic synthesis, as shown in Figure 5.8.2.



a) Three-phase Harmonics test Edit Parameter

b) Single-phase Harmonics test Edit Parameter

Figure 5.8.2 Harmonic Synthesis Edit Parameters

On this screen, the left 2, 3, 4, 5, 6, 7, 8, ... represent the nth harmonic content, and the parameters for the harmonic content can be set in their corresponding rows. Press </> key for Pageup/pagedown, with total 50 harmonics can be set.

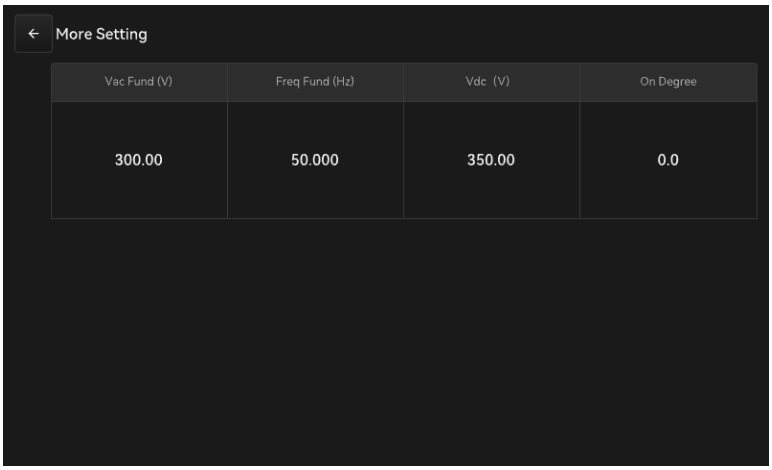
On the right side, there are 6 pre stored harmonic synthesis methods (equivalent to memory shortcuts). After setting them under each synthesis method, they can be saved and used as a shortcut for harmonic synthesis. For Value1 to Value 3, set the amplitude and add a voltage amplitude to the fundamental voltage directly, to achieve waveform distortion. For percent1 to percent1 to percent3, set the percentage and superimpose a harmonic content of fundamental * percentage on the fundamental voltage, to achieve waveform distortion.

Note: The AC, DC and Frwq set in this interface are all common state parameters and are independent of Harmonic test mode.

2. Fundamental wave settings

Click Edit Parameters >>> button in the interface as shown in Figure 5.8.2 to edit parameters such as fundamental voltage, frequency, etc. as shown in Figure 5.8.3.

a) Three-phase fundamental wave setting



b) Single-phase fundamental wave setting

Figure 5.8.3 Fundamental wave settings

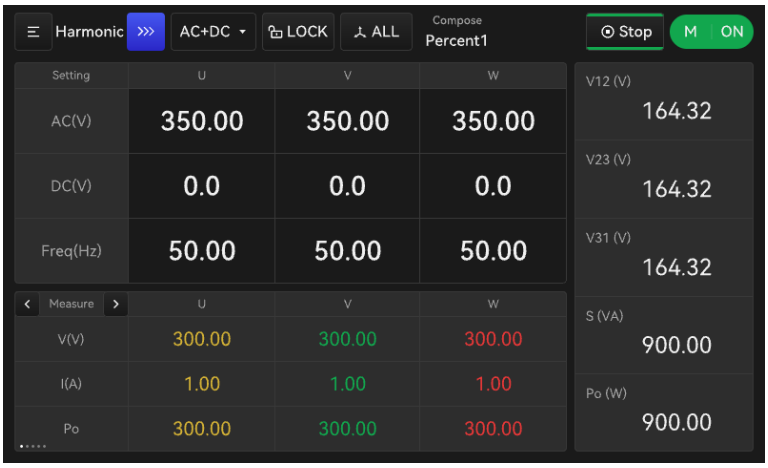
3. Meaning of parameters:

- Synthesis method: waveform synthesis method can be selected (equivalent to 6 memory groups): amplitude or percentage
- Fundamental voltage: fundamental AC voltage, 0~350V
- Fundamental frequency: fundamental output frequency, 50Hz/60Hz
- DC component: Output additional DC voltage, -494.9~494.9V
- Start angle: Start angle of output waveform, 0~359.9 °
- X harmonic amplitude/percentage: The amplitude/percentage of the xth harmonic, which is a composite value or percentage of each order due to practicality and the power limit to protect the AC power supply. 2~50 harmonic amplitude ≤ 90V or percentage ≤ 30%.
- X harmonic angle: start angle of x harmonic, 0~359.9 °

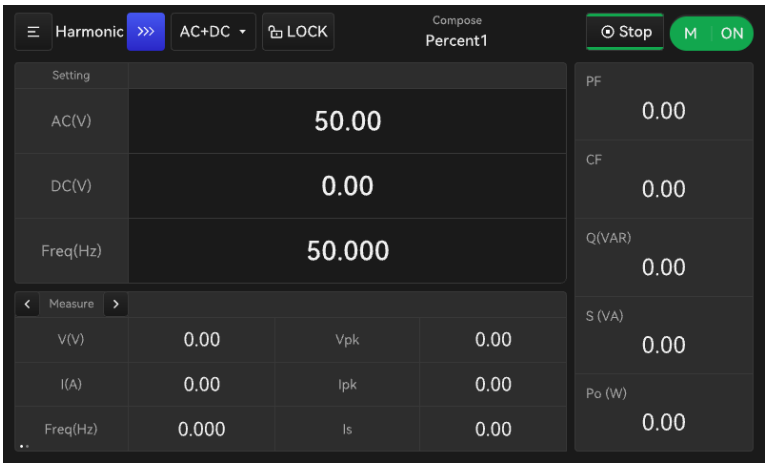
Note: When the setting exceeds the range (such as the common AC+DC parameter exceeding the limit or the harmonic synthesis setting of the fundamental voltage and DC component exceeding the limit), a setting overvoltage alarm will occur. Please set the parameter until it does not exceed the limit before entering.

5.8.3 Harmonic Test Running state

Click Start button on the Standby screen of Step Harmonic mode to start the output of harmonic synthesis mode. The three-phase/single-phase power supply is shown in Figure 5.8.4.



a) Three-phase Harmonics test Running state



b) Single-phase Harmonics test Running state

Figure 5.8.4 Harmonic Test Running state

After start the Harmonic mode, to turn off the output, press Start button in the upper right of the interface to turn it off, or press ON/OFF on the front panel. The measurement display area is the same as in Common mode.

The shortcut number for the synthesis method can be displayed above the screen.

Note: AC, DC and Frwq in this interface are all common state parameters. After the Harmonic mode is activated, only the parameters set in Edit Parameters in Harmonic mode are output. The output is based on fundamental wave parameters and superimposed with harmonic parameters.

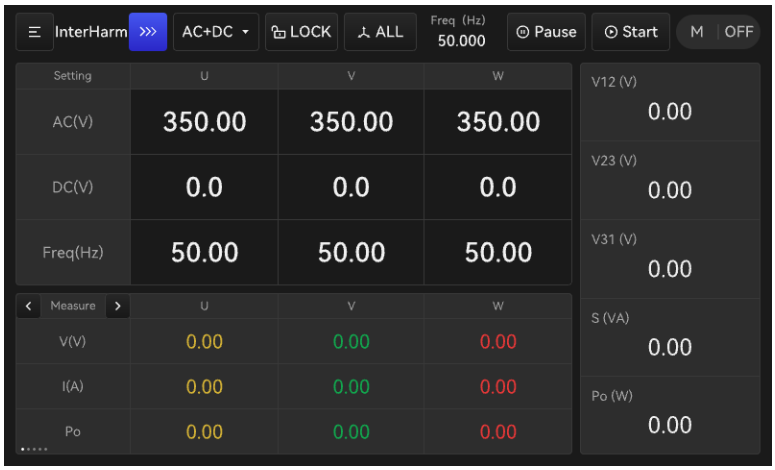
⚠Note: The Harmonic mode can only be started via Start button in the upper right. To stop it, press Stop button in the upper right of the interface or ON/OFF on the front panel. If in programming mode, if pressing ON/OFF on the front panel to start the power supply, the output is in Common mode. At this time, you can click Start button on the interface to start the programming mode.

5.9 Interharmonics test

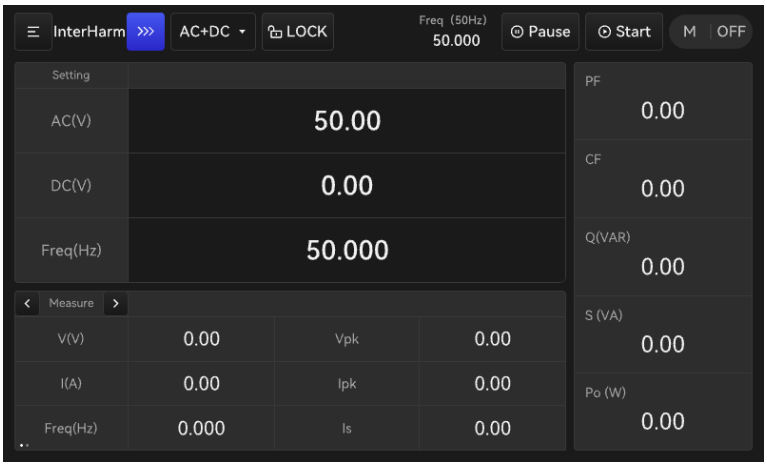
5.9.1 Interharmonics test standby screen

In interharmonics output mode, in addition to providing common voltage output, another frequency adjustable voltage component can be added for certain anti-interference tests.

Press the ☰ key in the upper left corner of the main interface to select the intermediate harmonic mode and enter the standby interface of the intermediate harmonic mode, as shown in Figure 5.9.1.



a) Three-phase Interharmonics test Standby state



b) Single-phase Interharmonics test Standby state

Figure 5.9.1 Interharmonics test standby screen

The Interharmonics standby interface is different from the Common Standby screen, with freq display, Pause button, and Start button added at the upper part.

Frequency display: the current operating frequency, 0.001~1000HZ

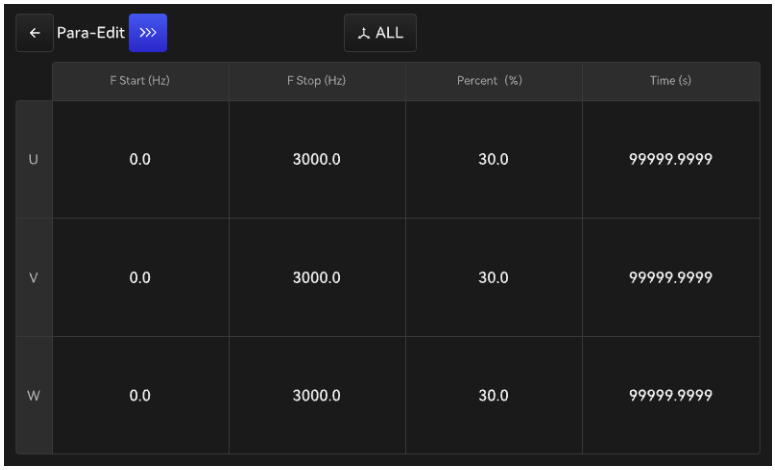
Pause: pause/resume interharmonics output.

Note: The AC, DC and Frwq set in this interface are all common state parameters and are independent of Harmonic test mode.

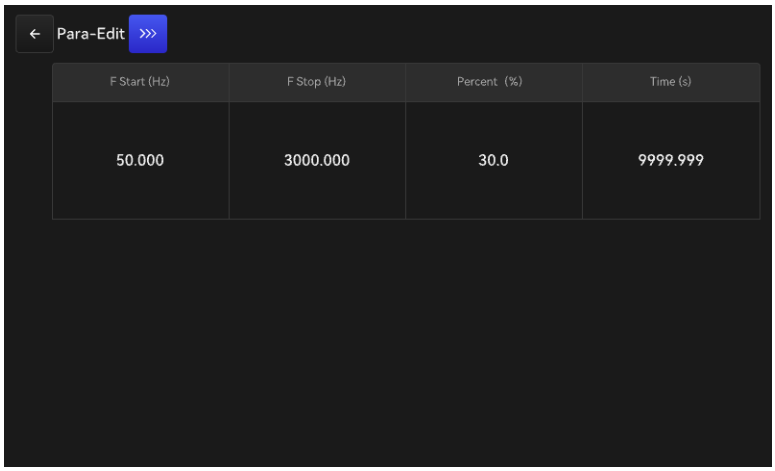
5.9.2 Interharmonics Edit Parameters

1. Interharmonics Edit Parameters

Press Interharmonic >>> button in the interface as shown in Figure 5.9.1 to enter the Interharmonic Edit Parameters screen, as shown in Figure 5.9.2.



a) Three-phase Interharmonics test Edit Parameter



b) Single-phase Interharmonics test Edit Parameter

Figure 5.9.2 Interharmonics Edit Parameters

Press ALL to simultaneously set the start/end frequency to the same value.

Click Edit Parameters >>> button in interface as shown in Figure 5.9.2 to enter Interharmonics More Settings screen, as shown in Figure 5.9.3.

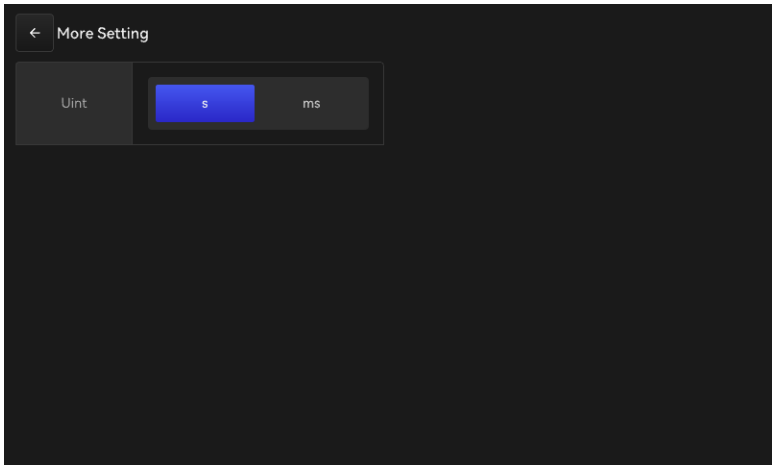


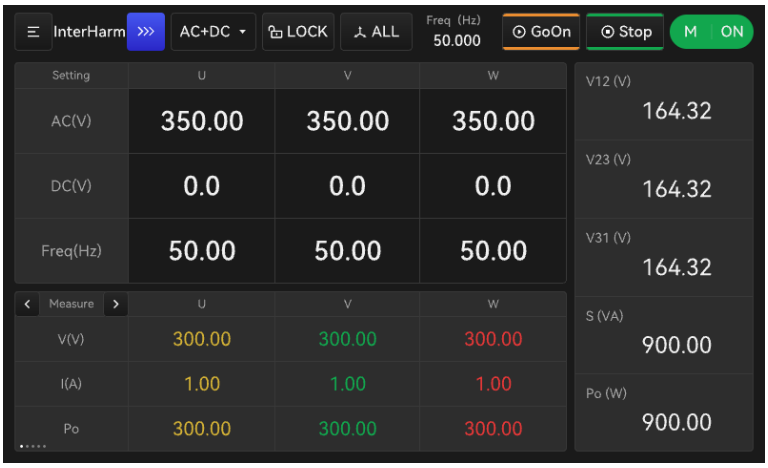
Figure 5.9.3 Interharmonics More Settings

2. Meaning of parameters:

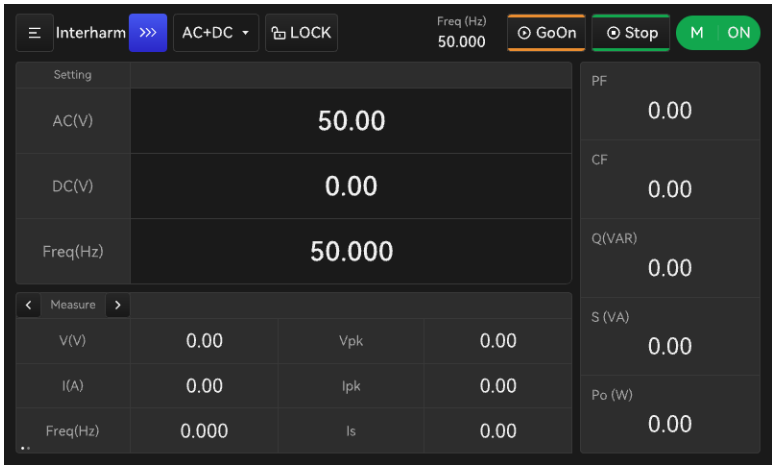
- Start frequency: Start frequency of the scanning wave superimposed on the fundamental wave, 0.1~3000.0Hz;
- End frequency: End frequency of the scanning wave superimposed on the fundamental wave, 0.1~3000.0Hz;
- Percentage: Percentage of harmonics in the fundamental voltage, range: MAX{start frequency, end frequency}<=3000Hz, harmonic content<=30.0%;
- Scanning time: The scanning time from the start frequency to the end frequency: 10ms~9999s;
- Unit: Unit of scanning time, ms/s;

5.9.3 Interharmonics Running state

In Interharmonics Standby mode, click Start button in the upper right corner of the interface to start Interharmonics test. The running interface is shown in Figure 5.9.4.



a) Three-phase Interharmonics test Running state



b) Single-phase Interharmonics test Running state

Figure 5.9.4 Interharmonics Test Running State

This interface can display the running frequency in real time. Press Pause/GoOn to complete the output of Interharmonics.

After start the Interharmonics mode, to turn off the output, press Start button in the upper right of the interface to turn it off, or press ON/OFF on the front panel. The measurement display area is the same as in Common mode.

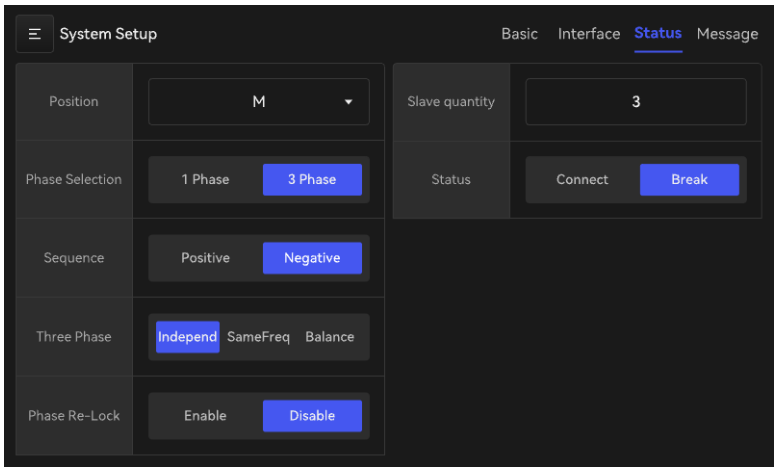
Note: AC, DC and Frwq in this interface are all common state parameters. After the Interharmonics mode is activated, only the parameters set in Edit Parameters in the Interharmonics mode are output. The output is based on fundamental wave parameters and superimposed with harmonic parameters.

⚠Note: The Interharmonics mode can only be started via Start button in the upper right. To stop it, press Stop button in the upper right of the interface or ON/OFF on the front panel. If in programming mode, if pressing ON/OFF on the front panel to start the power supply, the output is in Common mode, which is the parameter set on the main screen. At this time, you can click Start button on the interface to start the programming mode.

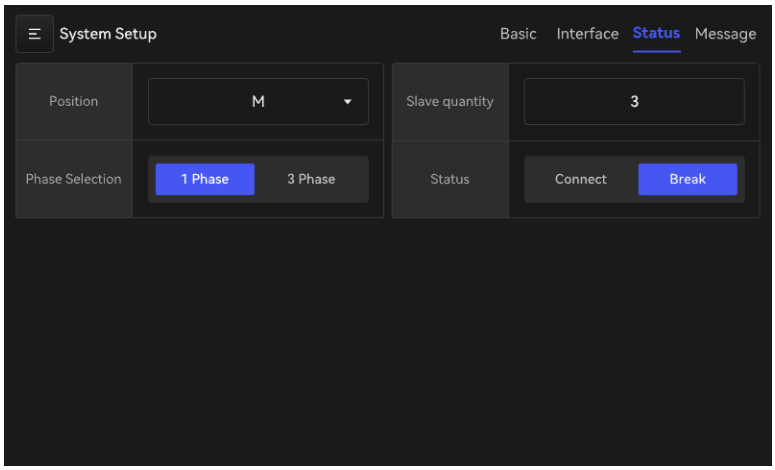
5.10 Parallel operation

1. Parallel Setting - Master

press Status button on the screen shown in Figure 5.4.1 (System Setting) to enter Parallel option screen. The Parallel Setting button on this screen is OFF by default, meaning that the power supply is used as standalone equipment. When Master in Parallel Setting dropdown is chosen, the power supply is used as the master for parallel operation, as shown in Figure 5.10.1 for three-phase/single-phase power supply.



a) Three-phase - Master



b) Single-phase - Slave

Figure 5.10.1 Parallel Setting - Master

The remaining settings are the same, only Number of Slaves (1~8, currently supporting 1~2 slaves) and Connect state appear on the right.

State: Press Connect to connect with the slave. The online handshake screen will appear after clicking it. Press Break to disconnect the slave and restore standalone state.

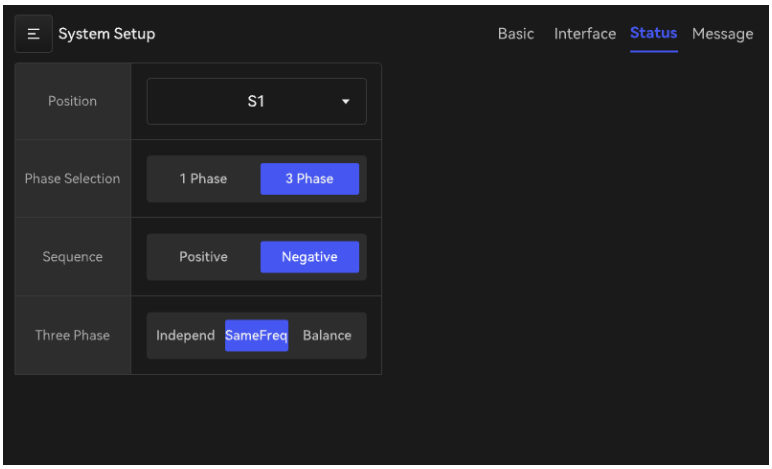
The other functions are the same as section 5.4.3.

Note: 1) When the master is chosen, if it is not connected to the slave, after pressing Connect, "L1 communication exception" will appear on the online handshake after a period, indicating online failure. Click Cancel to switch to standalone mode. Click OK to continue online.

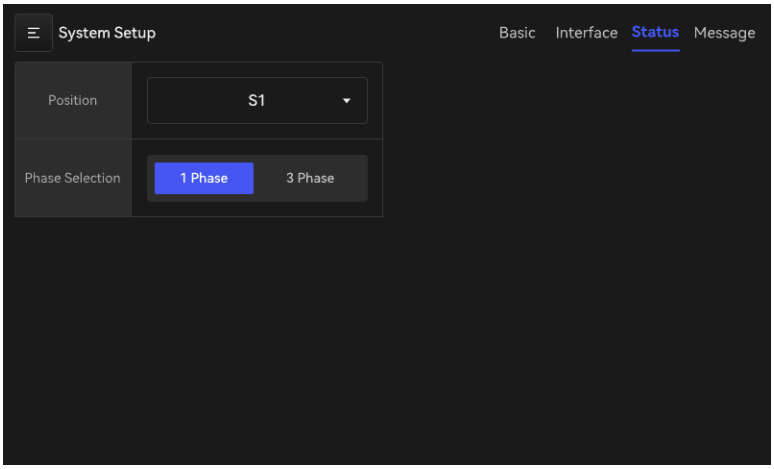
2) When the master is chosen, if it is not connected to the slave, "L1 communication exception" will appear when returning to Common screen from this screen. Click Cancel at this time to switch to standalone state.

2. Parallel Setting - Slave 1/Slave 2

press Status button on the screen shown in Figure 5.13 (System Setting) to enter Parallel option screen. The Parallel Setting button on this screen is OFF by default. When Slave 1/Slave 2 in Parallel Setting dropdown is chosen, the three-phase/single-phase power supply is shown in Figure 5.10.2.



a) Three-phase - Slave



b) Single-phase - Slave

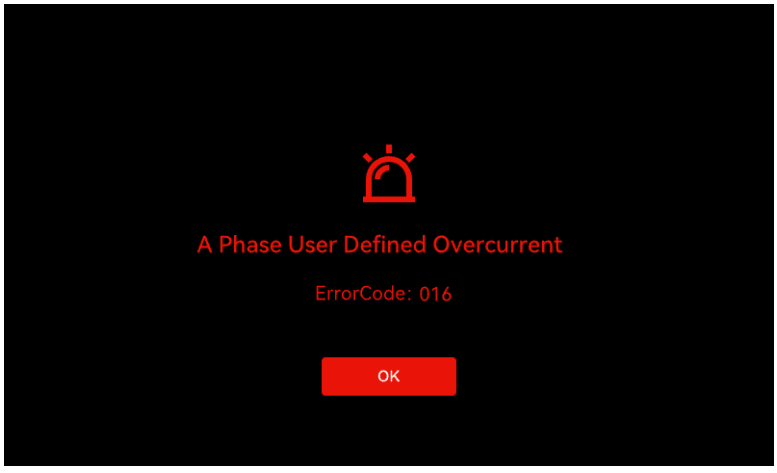
5.10.2 Parallel Setting - Slave

When selecting Slave, there is no output if only the slave power supply is started, for the setting signal output by the slave comes from the master. The other functions are the same as section 5.4.3.

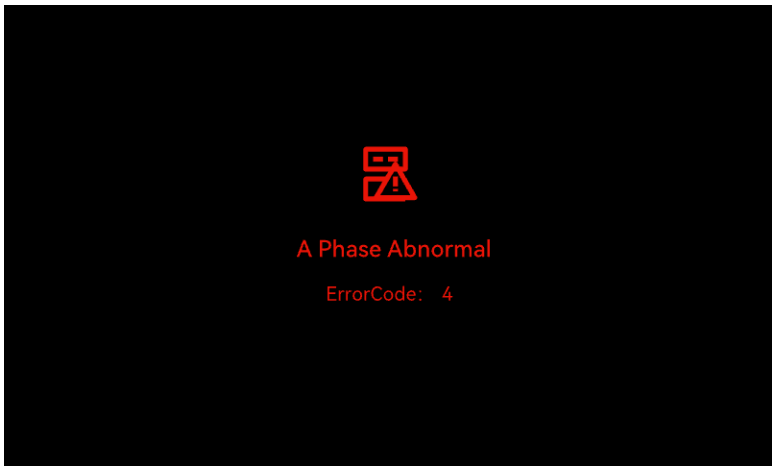
Note: Programming mode cannot be entered in Slave mode.

5.11 Alarm

The AC Test Power Supply can provide comprehensive software/hardware protection. When the protection is triggered, the power supply will stop output and turn off the output relay, and at the same time enter the alarm interface to display the type of protection. The alarm is divided into software alarm and hardware alarm, as shown in Figure 5.11.1.



a. Software alarm



b. Hardware alarm

Figure 5.11.1 Alarm screen

To return to the Common Standby state, remove the load and find out the cause according to the type of protection. For software alarm, there is Confirm option on the alarm screen. Click it cancel the alarm state. When a hardware alarm occurs, the alarm can only be cancelled by restart the power supply.

Table 5.11.1 List of alarm codes

Fault code	Type of protection	Cause
E001	Phase-A input abnormal	Phase-A input voltage does not meet the specified value
E002	Phase-A busbar abnormal	Phase-A busbar voltage does not meet the specified value
E003	Phase-A output short circuit	Phase-A output load short circuit, output current exceeding transient impulse limit
E004	Phase-A module overheat	Phase-A module temperature exceeds specification limit
E012	A-phase output overcurrent	Phase-A output current exceeds specification limit
E013	A-phase output overvoltage	Phase-A output voltage exceeds specification limit
E014	A-phase output undervoltage	Phase-A output voltage exceeds specification limit
E015	A-phase output overload	Phase-A output power exceeds specification limit
E016	Phase-A custom overcurrent	Phase-A output current exceeds the set current limit (Manual/Auto mode)
E017	Phase-A custom overload	Phase-A output power exceeds the user's limit
E031	Phase-B input abnormal	Phase-B input voltage does not meet the specified value
E032	Phase-B busbar abnormal	Phase-B busbar voltage does not meet the specified value
E033	Phase-B output short circuit	Phase-B output load short circuit, output current exceeding transient impulse limit
E034	Phase-B module overheat	Phase-B module temperature exceeds specification limit
E042	Phase-B output overcurrent	Phase-B output current exceeds specification limit
E043	Phase-B output overvoltage	Phase-B output voltage exceeds specification limit
E044	Phase-B output undervoltage	Phase-B output voltage exceeds specification limit
E045	Phase-B output overload	Phase-B output power exceeds specification limit
E046	Phase-B custom overcurrent	Phase-B output current exceeds the set current limit (Manual/Auto mode)
E047	Phase-B custom overload	Phase-B output power exceeds the user’s limit
E061	Phase-C input abnormal	Phase-C input voltage does not meet the specified value

E062	Phase-C bus abnormal	Phase-C busbar voltage does not meet the specified value
E063	Phase-C output short circuit	Phase-C output load short circuit, output current exceeding transient impulse limit
E064	Phase-C module overheat	Phase-C module temperature exceeds the specification limit
E072	C-phase output overcurrent	Phase-C output current exceeds specification limit
E073	C-phase output overvoltage	Phase-C output voltage exceeds specification limit
E074	C-phase output undervoltage	Phase-C output voltage exceeds specification limit
E075	C-phase output overload	Phase-C output power exceeds specification limit
E076	Phase-C custom overcurrent	Phase-C output current exceeds the set current limit (Manual/Auto mode)
E077	Phase-C custom overload	Phase-C output power exceeds the user's limit
E100	Software version abnormal	Software version mismatch
E101	Internal software error	Various errors during software running
E102	Set AC voltage exceeding user limit	Set AC voltage exceeding user limit
E103	Set DC voltage exceeding user limit	Set DC voltage exceeding user limit
E104	Setting frequency exceeding user limit	Setting frequency exceeding user limit
E105	Programming mode has running cycle of 0	Programming mode has running cycle of 0
E106	Prompt to restart equipment	Prompt to restart equipment

Section 6 External Interface

6.1 Communication Interface

After receiving the correct communication command, the power supply automatically returns to the Standby screen, as shown in the following figure:

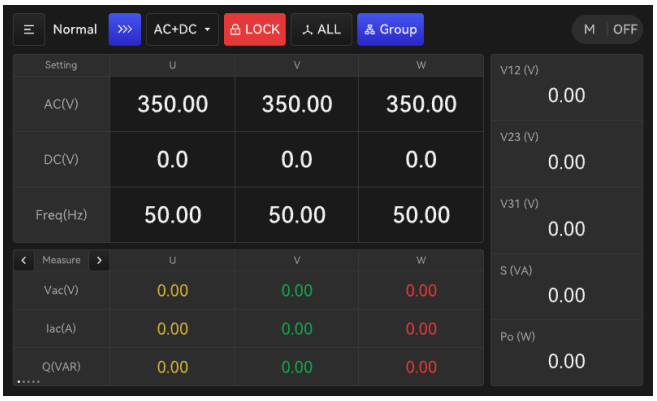


Figure 6.1.1 Standby interface under communication

In remote communication control mode, the Lock Screen button on the screen lights up and is in communication control mode. The communication protocol can be found in the appendix.

6.1.1 RS485 interface (standard)

When RS485 interface is selected, the wiring is as shown in the following figure:

Pin No.	Description
1	A
2	B
3	NC (not connected)
4	NC
5	GND (ground)
6	NC
7	NC
8	NC
9	NC

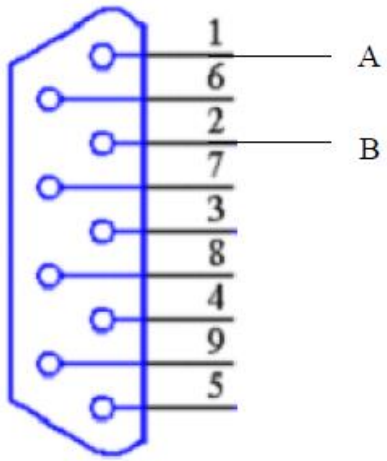


Figure 6.12 RS485 Interface

6.1.2 RS232 interface (optional)

The communication baudrate and address can be set in the System Setting. A 9-pin male serial port is adopted, and the connections are as follows.

Pin No.	Description
1	NC (not connected)
2	RX (Receive)
3	TX (Send)
4	NC
5	GND (ground)
6	NC
7	NC
8	NC
9	NC

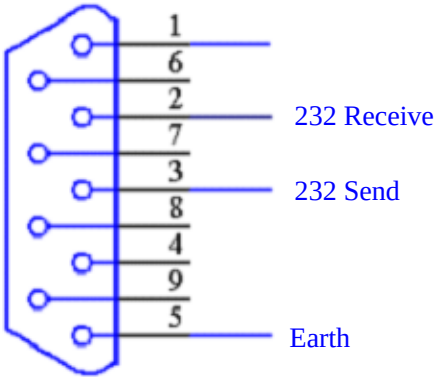


Figure 6.1.3 RS232 interface

Note: When 232 communication is selected, 485 communication is invalid.

6.1.3 LAN port (standard)

When the LAN port is selected for communication, the last page of System Setting screen is as follows:

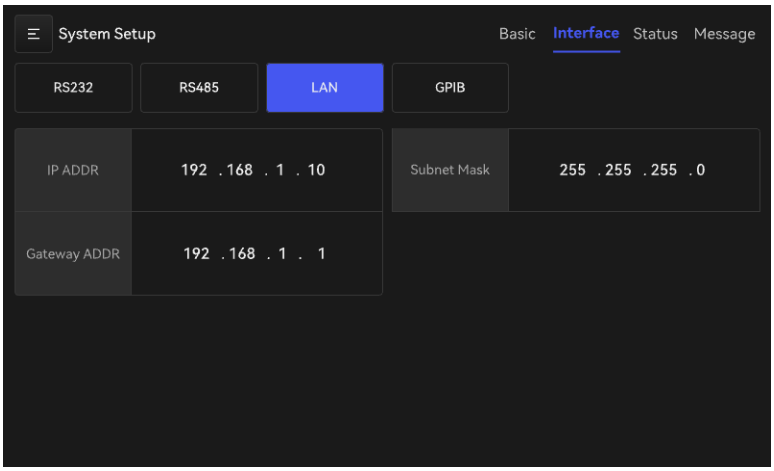


Figure 6.2 Network Port System Setting

The default network parameters are shown in the figure. Change it via the key or knob if necessary. After returning, it will be automatically saved.

6.1.4 GPIB interface (optional)

When GPIB is selected as the communication port, the System Setting screen is as follows:

Figure 6.3 GPIB Interface System Setting

The range of GPIB address setting is 1~255. Change it via the key or knob. After returning, it will be automatically saved.

Note: When GPIB communication is selected, LAN communication are invalid.

6.2 Analog Control Interface

Section 7 Maintenance and Assurance

7.1 Maintenance Guide

For long time stable operation of the power supply, the following should be observed:

1, Operate the unit in clean and dry place. No corrosion is allowed.

2, Check the DC Power and buttons regularly.

3. Check the insulation of the input/output cables and wiring terminals of the power supply for damage regularly. Replace any damaged one timely.

4. Do not place heavy objects, tools etc. on the power cable or the power cover to prevent the insulation of the power cable from being worn out, causing wires to be exposed and conductive, resulting in injury to personnel. Do not place the power cable in areas with frequent human traffic to avoid danger.

5. Do not stack debris around the power supply to avoid blocking the vent. Keep good ventilation when the power supply is operating.

6, The output current should not exceed the maximum output current. No work with overload.

7. Stop the output before shutting down.

8, Do not open the power supply by persons other than professionals, to avoid personal injury or damage to the equipment.

7.2 Troubleshooting

Common faults and solutions are shown in Table 7.1.

Table 7.1 Common Faults and Solutions

Failure	Possible faults and causes	Measures
No display after starting	1) Power supply not connected 2) Abnormal power supply voltage	1) Check the power connection 2) Check the power supply voltage of the instrument
Output undervoltage Output overvoltage	1) The sampling terminal on the rear panel is not connected 2) The output sampling terminal on the rear panel is open circuit	1) Connect the L and N measurement terminals reliably
Over-current protection User defined overcurrent	1) The output current exceeds the specification 2) The output current exceeds the current limit set by the user	1) Reduce load 2) Increase the current limit
Output short circuit	1) Load start current is too large (example: start of inductive load) 2) Output short circuit 3) Short-circuit connect output terminals	1) Reduce the load (for example, the load can be switched in batches), or increase the capacity of power supply 2) Check for short circuit and eliminate
Overload protection	Output power out of specification	1) Reduce load 2) Reduce the output voltage
The voltage cannot rise after start	1) Ramp-up time is too long 2) The screw of the output measurement sampling port on the rear panel is not locked	1) Check the ramp-up time setting 2) Connect the L and N measurement terminals reliably Note: At this time, the output voltage may be very high, do not touch the live part behind to avoid

		injury
Abnormal overheating	1) The ambient temperature is too high 2) The vent is blocked	1) The operating temperature of the machine is 0-40℃ 2) Clear the vent
Input abnormal	Input voltage is higher or lower than specification	Check the input voltage
There is no output after startup.	1) Unreliable connection of input voltage line 2) Internal input wiring loose and detached 3) Internal module damage	1) Check input voltage 2) Call customer service to assist maintenance

Appendix I Communication Protocol

Note: When using this machine to communicate with a PC, ensure that:

1. The address settings of local RS232/RS485 are consistent with the selected address on the master!

2. The baud rate setting of local RS232/RS485 is consistent with the selected baud rate on the master!

3. The master sends commands according to the "download command format"! This machine adopts two types of communication standards, Ainuo3.0 and SCPI, please choose one of them and choose the same protocol option under the System Setting of this machine.

Otherwise the communication will fail!

I.1 Hardware interface standard

1. Configured as RS-485 interface, and RS-485 communication standard applies.
2. When the local interface is RS232/RS485, the baudrate can be manually set to 1200, 2400, 4800, 9600, 19200, 38400, 115200. The default setting is 38400.
3. Data frame format: 1 start bit, 8 data bits, 1 stop bit, total 10 bits.

I.2 Ainuo3.0 communication protocol

I.2.1 Ainuo3.0 Communication Standard

1. The local address can be set manually (1~255).
2. The communication of this tester covers: receiving data and send data. The unified format of the data is as follows:

Frame head	Total number of bytes	Slave address	Command			Check sum	Frame end
			class	Command word	Parameters		
0x**7B**	**XX**	**X**	**X**	**X**	**XXXXX**	**X**	0x**7D**

a) Frame end: 1 byte, fixed at 0x7B, the ASCII code of '{'.
b) Total Bytes: 2-byte, the value is the sum of frame header + total bytes + slave address + type of command + command word + command parameter + checksum + frame tail, with high bytes first and low bytes last.
c) Address: 1-byte, the local communication address. 0x00 is used as a special address for broadcasting, but it can only execute control and set debugging commands except query, but does not respond.
d) Command: The occupied byte length varies, and the length of each command can be found in the "Communication Command Description".
e) Checksum: 1 byte (hexadecimal), the check result of sent data. Adopt level check, that is the sum of bytes + slave address + command. Take the low bytes as the checksum.
f) Frame end: 1 byte, fixed to 0x7D, the ASCII code of '{'.
g) Data format: All data is hexadecimal, high bits first, and then low bits. For example, for 2-byte 350.0V with unit of 0.1V, the actual value is the hexadecimal 0BB8 of 3000 (value divided by the minimum unit); the actual value of -494.9V with unit of 0.1V is hexadecimal EF6E of -4949.

I.2.2 List of Ainuo3.0 Communication Command

Command Class	Command			Functions
	Class	Command word	Parameters	
Control	**0x0 F**	**0x00**	None	Stop
		0xFF	None	Start
		0x08	None	Start pulse output
		0x09	None	Stop pulse output
		0x0A	None	Start harmonic synthesis output
		0x0B	None	Stop harmonic synthesis output
		0x15	None	Start step output
		0x16	None	Stop step output
		0x17	None	Pause step output
		0x18	None	Resume step output
		0x1A	None	Start list output
		0x1B	None	Stop list output
		0x1E	None	Start interharmonics output
		0x1 F	None	Stop interharmonics output
		0x20	None	Pause interharmonics output
		0x21	None	Resume interharmonics output
		0x01	None	Query RMS of current Current -2-byte unit 0.01A
		0x02	None	Query DC voltage DC voltage -2-byte unit 0.1V (signed)
		0x03	None	Query DC current DC current -2-byte unit 0.01A
Settings	**0x5A**	**0x10**	Three-phase / Single-phase: 32-byte/16-byte AC voltage 0.00~350.00V, DC voltage -494.90~494.90V, frequency 15~200Hz	Common settings
		0x11	Three-phase / Single-phase: 43-byte/29-byte Start angle 0~359.9 °, end angle 0~359.9 ° AC conversion rate 0.00~2000.00V, DC conversion rate 0.00~2000.00V, frequency conversion rate 0.000~200.000Hz, end DC conversion rate 0.00~2000.00V, phase difference 0.0~359.9 °, select waveform 0~7, select mode, waveform group No.	Common More Settings
		0x20	Three-phase / Single-phase: 78-byte/32-byte AC start voltage 0.00~350.00V, AC end voltage 0.00~350.00V, DC start voltage -494.90~494.90V, DC end voltage -494.90~494.90V, frequency start 15.000~200.000Hz, frequency end 15.000~200.000Hz, select waveform 0~7, waveform group No., list phase 0.0~360.0 °, running time 0.0~99999	List settings
		0x21	1-byte trigger mode 0: Auto 1: manual	List mode More Settings
		0x30	Three-phase / Single-phase: 59-byte/32-byte AC voltage 0.00~350.00V, DC voltage -494.90~494.90V, frequency 15.000~200.000Hz, start angle 0.0~360.0 °, duty cycle 0.0~100.0%, select waveform 0~7, waveform group No., running time 0.0~99999.	Pulse settings
		0x31	1-byte trigger mode 0: Auto 1: manual	Pulse mode more settings
		0x40	Three-phase / Single-phase: 83-byte/33-byte AC voltage 0.00~350.00V, AC difference 0.00~350.00V, DC difference -494.90~494.90V, frequency 15.000~200.000Hz, start angle 0.0~360.0 °, select waveform 0~7, waveform group	Step settings

			No., running times 0~999, step time 0.0~99999	
		0x41	1-byte trigger mode 0: Auto 1: manual	Step mode more settings
		0x50	Three-phase / Single-phase: 21-byte/13-byte Amplitude/percentage 2~10th 0~90.0V/30.0%; 11~20th 60.0V/30.0%; 21~40th 30.0V/30.0%; 41~50th 15.0V/30.0%, angle 0.0-360.0 °; amplitude/percentage 2~10th 0-90.0V/30.0%; 11~20th 60.0V/30.0%; 21~40th 30.0V/30.0%; 41~50th 15.0V/30.0%, angle 0.0~360.0 °	Harmonic settings
		0x51	Three-phase / Single-phase: 38-byte/18-byte Fundamental voltage 0.00~350.00V, fundamental frequency 15.000~200.000Hz, DC component -494.90~494.90V, start angle 0.0~360.0 °	Harmonics more settings
		0x60	Three-phase / Single-phase: 41 byte/19 byte Start frequency 15.000~3000.000Hz, end frequency 15.000~3000.000Hz, percentage 0.00~30.00, scan time 0.0~99999	Interharmonics settings
		0x70	Three-phase/single-phase: 16-byte/12-byte Analysis source 0: Voltage; 1: Current, fundamental frequency 0: 50.00Hz; 1: 60.00Hz, analysis method 0: amplitude; 1: percentage, display method 0: single time; 1: Continuous	Harmonic analysis settings
		0x80	Three-phase / Single-phase: 41 byte/19 byte AC voltage limit 0.00~350.00V, DC voltage positive limit 0.00~494.90V, DC voltage negative limit -494.90~0.00V, frequency limit 15.000~200.000Hz	Output limit settings
		0x81	Three-phase / Single-phase: 20-byte/12-byte : overcurrent limit 0-35A, overcurrent delay 0-9, overload limit 0~6000VA	Output protection settings
		0x82	Three-phase / Single-phase: 38-byte/18-byte Select waveform 0~5; select mode, valid only when clamped sine wave is selected 0: AMP; 1: THD; Percentage, valid only when clamped sine wave is selected AMP 0.0~100.0, THD 0.0~43.0; Waveform group No., valid only when built-in or custom waveform is selected 1~30	Output waveform settings
		0x83	1-byte output relay, 0: off 1: on	Other output settings
		0x90	Output Mode: 0: Single-phase; 1: Three-phase, Three-phase Output: 0: Positive phase sequence; 1: Negative phase sequence Three-phase Relationship: 0: Independent; 1: Same Frequency; 2: Balance Phase Repositioning, only applicable when Three-phase Relationship is Independent: 0: Disable; 1: Enable Voltage Setting: only applicable when Three-phase Relationship is balance: 0: Phase voltage; 1: Line voltage	System state settings
Query settings:	**0xA5**	**0x10**	None	Query common settings
		0x11	None	Query common more settings
		0x20	None	Query list settings
		0x21	None	Query list more settings
		0x30	None	Query pulse settings
		0x31	None	Query pulse more settings
		0x40	None	Query step settings

		0x41	None	Query step more settings
		0x50	None	Query harmonic settings
		0x51	None	Query harmonic more settings
		0x60	None	Query interharmonics settings
		0x70	None	Query harmonic analysis settings
		0x80	None	Query output limit settings
		0x81	None	Query output protection settings
		0x82	None	Query output waveform settings
		0x83	None	Query other output settings
		0x90	None	Query system state settings

I.2.3 Description of Ainuo3.0 communication command

Command Class	Command			Functions
	Class	Command word	Parameters	
Control	**0x0 F**	**0x00**	None	Stop
		0xFF	None	Start
		0x01	None	Stop trigger
		0xFE	None	Trigger
		0x03	None	Stop alarm
Query	**0xF0**	**0xA4**	None	Query output value
		0xEB	None	Query output Status/alarm code
		0xED	None	Query instrument model
Settings	**0x5A**	**0x16**	None	Set List mode
		0x17	None	Set Pulse mode
		0x18	None	Set harmonic mode
		0x19	None	Set interharmonic mode
		0x1A	None	Set Step Mode
		0x41	Three-phase: 32-byte AC voltage 0.00~300.00V, DC voltage -424.20~424.20V, frequency 30~100Hz Single phase: 16-byte AC voltage 0.00~300.00V, DC voltage -424.20~424.20V, frequency 30~100Hz	Common settings
		0x40	Three-phase: 43-byte Start angle 0~359.9 °, end angle 0~359.9 °, AC conversion rate 0.00~2000.00V, DC conversion rate 0.00~2000.00V, frequency conversion rate 0.000~200.000Hz, end DC conversion rate 0.00~2000.00V, phase difference 0.0~359.9 °, waveform selection 0~7, mode selection 0~1, waveform group No. 1~30 Single phase: 29-byte Start angle 0~359.9 °, end angle 0~359.9 ° AC conversion rate 0.00~2000.00V, DC conversion rate 0.00~2000.00V, frequency conversion rate 0.000~200.000Hz, end DC conversion rate 0.00~2000.00V, phase difference 0.0~359.9 °, select waveform 0~7, select mode, waveform group No.	Common More Settings
		0x51	Three-phase: 78-byte AC start voltage 0.00~300.00V, AC end voltage 0.00~300.00V, DC start voltage -424.20~424.20V, DC end voltage -424.20~424.20V, start frequency 15.000~200.000Hz, end frequency 15.000~200.000Hz, waveform selection 0~7, waveform group No. 1~30, step phase 0.0~360.0 °, running time 0.0~99999 Single phase: 32-byte AC start voltage 0.00~300.00V, AC end voltage 0.00~300.00V, DC start voltage -424.20~424.20V, DC end voltage	List settings

			-424.20~424.20V, start frequency 15.000~200.000Hz, end frequency 15.000~200.000Hz, waveform selection 0~7, waveform group No., step phase 0.0~360.0 °, running time 0.0~99999	
		0x20	Single phase: 1-byte Output mode: 0: AC+DC 1: AC 2: DC	Output mode setting
		0x29	11 byte Trigger mode: 0: Auto; 1: Manual Length unit: 0: Time; 1: Count Stage Continue: 0: Enable; 1: Disable Number of runs: 0-9999	List mode More Settings
		0x2B	Three-phase: 59-byte AC voltage 0.00~300.00V, DC voltage -424.20~424.20V, frequency 15.000~200.000Hz, start angle 0.0~360.0 °, duty cycle 0.0~100.0%, waveform selection 0~7, waveform group No. 1~30, running time 0.0~99999. Single phase: 25-byte AC voltage 0.00~300.00V, DC voltage -424.20~424.20V, frequency 15.000~200.000Hz, start angle 0.0~360.0 °, duty cycle 0.0~100.0%, waveform selection 0~7, waveform group No., running time 0.0~99999.	Pulse settings
		0x2A	Single phase: 9-byte Trigger mode: 0: Auto; 1: Manual Number of runs: 0-9999	Pulse mode more settings
		0x2D	Three-phase: 83-byte AC voltage 0.00~300.00V, AC difference 0.00~300.00V, DC voltage -424.20~424.20V, DC difference -424.20~424.20V, frequency 30.000~100.000Hz, frequency difference 0.000~100.000Hz, start angle 0.0~360.0 °, waveform selection 0~7, waveform group No. 1~30, running times 0~9999, step time 0~99999 Single phase: 33-byte AC voltage 0.00~300.00V, AC difference 0.00~300.00V, DC voltage -424.20~424.20V, DC difference -424.20~424.20V, frequency 15.000~200.000Hz, frequency difference 15.000~200.000Hz, start angle 0.0~360.0 °, waveform selection 0~7, waveform group No. 1~30, running times 0~9999, step time 0.0~99999	Step settings
		0x2C	1-byte trigger mode 0: Auto 1: manual	Step mode more settings
		0x64	Three-phase: 22-byte Group No.: 0~5; Step No.: 2~50 Amplitude/percentage: 2~10th: 0~90.0V/30.0%; 11~20th: 60.0V/30.0%; 21~40th: 30.0V/30.0%; 41~50th~order: 15.0V/30.0%, angle: 0.0~360.0 °, amplitude/percentage 2~10th: 0-90.0V/30.0%; 11~20th: 60.0V/30.0%; 21~40th: 30.0V/30.0%; 41~50th: 15.0V/30.0%, angle: 0.0~360.0 Single phase: 14-byte Group No.: 0~5; Step No.: 2~50 Amplitude/percentage 2~10th 0~90.0V/30.0%; 11~20th 60.0V/30.0%; 21~40th 30.0V/30.0%; 41~50th 15.0V/30.0%, angle 0.0-360.0 °,	Harmonic settings

			amplitude/percentage 2~10th 0-90.0V/30.0%; 11~20th 60.0V/30.0%; 21~40th 30.0V/30.0%; 41~50th 15.0V/30.0%, angle 0.0~360.0 °	
		0x62	Three-phase: 38 byte Fundamental voltage: 0.01~300.00V, fundamental frequency: 50Hz/60Hz, DC component: -424.20~424.20V, start angle: 0.0~360.0 ° Single phase: 18-byte Fundamental voltage: 0.00~300.00V, fundamental frequency: 50Hz/60Hz, DC component: -424.20~424.20V, start angle 0.0~360.0 °	Harmonics more settings
		0x61	9 byte Synthesis method: 1~6	Harmonic synthesis method setting
		0x32	Three-phase: 41 byte Start frequency: 0.1~3000.000Hz, end frequency: 0.1~3000.000Hz, percentage: 0.00~30.00, scanning time: 0.0-99999 Single phase: 19-byte Start frequency: 0.1~3000.000Hz, end frequency: 0.1~3000.000Hz, percentage: 0.00~30.00, scanning time: 0.0-99999	Interharmonics settings
		0x70	Three-phase: 16-byte Analysis source: 0: Voltage; 1: Current; Fundamental frequency: 0 0: 50.00Hz; 1: 60.00Hz; Analysis method: 0: Amplitude; 1: Percentage; Display method: 0: Single; 1: Continuous Single phase: 12-byte Analysis source: 0: Voltage; 1: Current; Fundamental frequency: 0 0: 50.00Hz; 1: 60.00Hz; Analysis method: 0: Amplitude; 1: Percentage; Display method: 0: Single; 1: Continuous	Harmonic analysis settings
		0x80	Three-phase: 41 byte AC voltage limit: 0.00~300.00V; DC voltage positive limit: 0.00~424.20V; DC voltage negative limit: -424.20V~0.00V; Frequency limit: 30.000-100.000Hz Single phase: 19-byte AC voltage limit: 0.00~300.00V; DC voltage positive limit: 0.00~424.20V; DC voltage negative limit: -424.20V~0.00V; Frequency limit: 30.000-100.000Hz	Output limit settings
		0x81	Three-phase: 29-byte Overcurrent limit: 0~25A; Overcurrent delay time: 0~9; Overload limit: 0~18000VA Single phase: 12-byte : overcurrent limit 0-25A, overcurrent delay 0-9, overload limit 0~18000VA	Output protection settings
		0x82	Three-phase: 38 byte Select waveform 0~5; select mode, valid only when clamped sine wave is selected 0: AMP; 1: THD; Percentage, valid only when clamped sine wave is selected AMP 0.0~100.0, THD 0.0~43.0; Waveform group No., valid only when built-in or custom waveform is selected 1~30 Single phase: 18-byte Select waveform 0~5; select mode, valid only when clamped sine wave is selected 0: AMP; 1: THD; Percentage, valid only when clamped sine wave is selected AMP 0.0~100.0, THD 0.0~43.0; Waveform group No., valid only when built-in or	Output waveform settings

			custom waveform is selected 1~30	
		0x83	18 byte Output relay: 0: off 1: on Remote inhibit output 0: Forbidden 1: Enable 远端控制输出 0：关 1：开 Surge duration (ms): 1~999 Remote measurement setting: 0: off 1: on Surge start time (ms): 1~999 External control enable: 0: off 1: on External control mode: 0: Amplify 1: Linear	Other output settings
Query settings:	**0xA5**	**0x41**	None	Query common settings
		0x40	None	Query common more settings
		0x51	X*1 (Step No.)	Query list settings
		0x29	None	Query list more settings
		0x2B	None	Query pulse settings
		0x2A	None	Query pulse more settings
		0x2D	None	Query step settings
		0x2C	None	Query step more settings
		0x61	None	Query harmonic synthesis method
		0x62	None	Query harmonic more settings
		0x64	X*2 (Group No., Step No.) Group No.: 0, 1, 2 Amplitude: 1, 2, 3 3, 4, 5 Percentage: 1, 2, 3 Step No.: 2-50th-order	Query harmonic settings
		0x32	None	Query interharmonics settings
		0x20	None	Query Output Mode settings
		0x80	None	Query output limit settings
		0x81	None	Query output protection settings
		0x82	None	Query output waveform settings
		0x83	None	Query other output settings
		0x90	None	Query System Settings state settings

I.2.3.1 Control Class Command (0x0F)

I.2.3.1 Control Class Command (0x0F)

Command word: 00H
Command function: Stop output/Stop test
Format: 0x7B XX X 0x0F 0x00 X 0x7D (8 bytes)
Example: 7B 00 08 01 0F 00 18 7D
Command word: FFH
Command function: Start output/Start test
Command format: 0x7B XX X **0x0F 0xFF** X 0x7D (8-byte)
Example: 7B 00 08 01 0F FF 17 7D
Command word: 01H
Function: Stop trigger
Command format: 0x7B XX X **0x0F 0x01** X 0x7D (8-byte)
Example: 7B 00 08 01 0F 01 19 7D
Command word: FEH
Function: Trigger
Command format: 0x7B XX X **0x0F 0xFE** X 0x7D (8-byte)
Example: 7B 00 08 01 0F FE 16 7D
Command word: 03H
Command function: Clear alarm
Command format: 0x7B XX X **0x0F 0x03** X 0x7D (8-byte)
Example: 7B 00 08 01 0F 03 1B 7D

I.2.3.2 Query Class Command (0xF0)

Command word: EBH
Function: Query instrument state/alarm code
Command format: 0x7B XX X **0xF0 0xEB** X 0x7D (8-byte)
Example: 7B 00 08 01 F0 EB E4 7D
Answer format: 0x7B XX X **0xF0 0xEB** X XX (1-byte state+2-byte data, see alarm code table) X 0x7D (11-byte)

Command word: EDH
Command function: Query instrument model
Command format: 0x7B XX X **0xF0 0xED** X 0x7D (8-byte)
Example: 7B 00 08 01 F0 ED E6 7D
Answer format: 0x7B XX X **0xF0 0xED** XXXXXXXXXXXXXXXX (16-byte ASCII code, such as " *ANRGS015AG* ") X 0x7D (24-byte)
Command word: A4H
Function: Query output measurements: voltage, current, frequency, power, crest factor, peak current, etc., return all 0 in non-start state
Command format: 0x7B XX X **0xF0 0xA4** X 0x7D (8-byte)
Example: 7B 00 08 01 F0 A4 9D 7D
Answer format: 0x7B XX X **0xF0 0xA4** XX XX XXXX XXX XX XXX XX XX XXX XXX XX XX XX XX XX XX (2-byte mixed voltage, unit 0.01V; 2-byte mixed current, unit 0.1A; 1-byte active power symbol bit, 3-byte active power, unit 0.01W; 3-byte apparent power, unit 0.01VA; 2-byte power factor, unit 0.01%; 3-byte frequency, unit 0.001Hz; 2-byte AC voltage, unit 0.01V; 2-byte AC current, unit 0.01A; 3-byte reactive power, unit 0.01W; 3-byte DC voltage, unit 0.01V; 2-byte DC current, unit 0.01A; 2-byte crest factor, unit 0.01%, 2-byte peak voltage, unit 0.01V; 2-byte peak current, unit: 0.01A; 2-byte surge current, unit 0.01A; 2-byte line voltage, unit 0.01V, the last 2 blocks are the same) XXX XX XXX XXX XXX XX XX XX XXX XX XXX XXX XXX XX XX XX 0x7D (122-byte)

I.2.3.3 Set Class Command (0x5A)

Command word: 16H
Command function: Set the mode to List, valid for standby/alarm/E-stop state
Command format: 0x7B XX X **0x5A 0x16** X 0x7D (8-byte)
Example: 7B 00 08 01 5A 16 79 7D
Command word: 17H
Command function: Set the mode to Pulse, valid for standby/alarm/E-stop state
Command format: 0x7B XX X **0x5A 0x17** X 0x7D (8-byte)
Example: 7B 00 08 01 5A 17 7A 7D
Command word: 18H
Function: Set the mode to harmonics, valid in state other than running/alarm/emergency stop
Command format: 0x7B XX X **0x5A 0x18** X 0x7D (8-byte)
Example: 7B 00 08 01 5A 18 7B 7D
Command word: 19H
Function: Set the mode to interharmonic, valid in state other than running/alarm/emergency stop
Command format: 0x7B XX X **0x5A 0x19** X 0x7D (8-byte)
Example: 7B 00 08 01 5A 19 7C 7D
Command word: 1AH
Command function: Set the mode to Step, valid for standby/alarm/E-stop state
Command format: 0x7B XX X **0x5A 0x1A** X 0x7D (8-byte)
Example: 7B 00 08 01 5A 1A 7D 7D
Command word: 20H
Command function: Set output mode, effective in standby/alarm/E-stop state
Command format: 0x7B XX X **0x5A 0x20** X (1-byte output mode) X 0x7D (9-byte)
Command example: 7B 00 09 01 5A 20 01 85 7D (set output mode to AC)
Command word: 41H
Command function: Common settings
Three-phase command format: 0x7B XX X **0x5A 0x41** XX XX XX (2-byte*3, AC voltage 0.00~300V) XXX XXX XXX (3-byte*3 DC voltage -424.2~424.2) XXX XXX XXX (3-byte*3, frequency 30~100Hz) X 0x7D (32-byte)
Single-phase command format: 0x7B XX X **0x5A 0x41** XX (2-byte, AC voltage 0.00~300V) XXX (3-byte DC voltage -424.2~424.2) XXX (3-byte, frequency 30~100Hz) X 0x7D (16-byte)

Example of three-phase command: 7B 00 20 01 5A 41 55 F0 55 F0 55 F0 00 00 00 00 00 00 00 00 00 00 C3 50 00 C3 50 00 C3 50 C4 7D (set three-Phase-AC voltage 220.00V, three-phase DC voltage 0.00V, three-phase frequency 50.000Hz)
Example of single-phase command: 7B 00 10 01 5A 41 55F0 000000 00C350 04 7D (set AC voltage 220.00V, DC voltage 0.00V, frequency 50.000Hz)
Command word: 40H
Command function: Common more settings

Three-phase command format: 0x7B XX X **0x5A 0x40** XX (2-byte start angle 0~359.9°, unit 0.1°) XX (2-byte end angle 0~359.9°, unit 0.1°) XXX (3-byte AC conversion rate 0.00~2000.00V, unit 0.01V/ms) XXX (3-byte DC conversion rate 0.00~2000.00V, unit 0.01V/ms) XXX (3-byte frequency conversion rate 0.000~200.000Hz, unit 0.001Hz/ms) XXX (3-byte end DC conversion rate 0.00~2000.00V, unit 0.01V/ms) XX (2-byte phase difference 1_2 0.0~359.9°, unit 0.1°) XX (2-byte phase difference 1_3 0.0~359.9°, unit 0.1°) X X X (1-byte*3: waveform selection 0~7) X X X (1-byte*3: mode selection, valid only when clamped sine wave is selected: 0: AMP; 1: THD) XX XX XX (2-byte*3: percentage, valid only when clamped sine wave is selected: AMP: 0.0~100.0; THD: 0.0~43.0) X X X (1-byte*3: waveform group No., valid only when built-in or custom waveform is selected: 1~30) X 0x7D (43-byte)

Single-phase command format: 0x7B XX X **0x5A 0x40** XX (2-byte start angle 0-359.9°, unit 0.1°) XX (2-byte end angle 0-359.9°, unit 0.1°) XXX (3-byte AC conversion rate 0.00~2000.00V, unit 0.01V/ms) XXX (3-byte DC conversion rate 0.00~2000.00V, unit 0.01V/ms) XXX (3-byte frequency conversion rate 0.000~200.000Hz, unit 0.001Hz/ms) XXX (3-byte end DC conversion rate 0.00~2000.00V, unit 0.01V/ms) X (1-byte waveform selection 0~7) X (1-byte mode selection, valid only when clamped sine wave is selected: 0: AMP; 1: THD) XX (2-byte percentage, valid only when clamped sine wave is selected: AMP: 0.0~100.0; THD: 0.0~43.0) X (1-byte waveform group No., valid only when built-in or custom waveform is selected: 1~30) X 0x7D (29-byte)

Example of three-phase command: 7B 00 2B 01 5A 40 03 84 0A 8C 000064 0003E8 0186A0 0186A0 04 B0 09 60 05 05 06 00 01 00 03 E8 01 AE 00 00 00 00 01 49 7D (Set the start angle 90.0°, end angle 270.0°, AC conversion rate 1.00V/ms, DC conversion rate 10.00V/ms, frequency conversion rate 100.000Hz/ms, end DC conversion rate 1000.00V/ms, phase difference 1_2 120.0°, phase difference 1-3 240.0°, U-phase waveform selection 5, V-phase waveform selection 5, W-phase waveform selection 6, U-phase mode 0, V-phase mode 1, W-phase mode 0, U-phase percentage 100, V-phase percentage 43, W-phase percentage 0, U-phase waveform group No. 0, V-phase waveform Group No. 0, W-phase waveform group No. 1)

Example of single-phase command: 7B 00 1D 01 5A 40 0384 0A8C 000064 0003E8 0186A0 0186A0 00 00 00 00 00 72 7D (set start angle 90.0°, end angle 270.0°, AC conversion rate 1.00V/ms, DC conversion rate 10.00V/ms, frequency conversion rate 100.000Hz/ms, end DC conversion rate 1000.00V/ms, waveform selection 0, mode 0, percentage 0, waveform group No. 0)

Command word: 51H

Command function: List settings

Three-phase command format: 0x7B XX X **0x5A 0x51** X (1-byte Step No.) XX XX XX (2-byte*3: AC start voltage 0.00~300.00V, unit 0.01V) XX XX XX (2-byte*3: AC end voltage 0.00~300.00V, unit 0.01V) XXX XXX XXX (3-byte*3: DC start voltage -424.20~424.20V, unit 0.01V) XXX XXX XXX (3-byte*3: DC end voltage -424.20~424.20V, unit 0.01V) (3-byte*3: start frequency 15.000~200.000Hz, unit 0.001Hz) XXX XXX XXX (3-byte*3: end frequency 15.000~200.000Hz, unit 0.001Hz) X X X (1-byte*3: waveform selection 0~7) X X X (1-byte*3: waveform group No., only applicable when waveform selection is built-in wave or user-defined waveform 1~30) XX XX XX (2-byte*3: step phase 0.0~360.0°, unit 0.1°) XXX XXX XXX (3-byte*3: running time 0.0~99999, unit ms) X 0x7D (78-byte)

Single-phase command format: 0x7B XX X **0x5A 0x51** X (1-byte Step No.) XX (2-byte AC start voltage 0.00~300.00V, unit 0.01V) XX (2-byte AC end voltage 0.00~300.00V, unit 0.01V) XXX (3-byte DC start voltage -424.20~424.20V, unit 0.01V) XXX (3-byte DC end voltage -424.20~424.20V, unit 0.01V) XXX (3-byte start frequency 15.000~200.000Hz, unit 0.001Hz) XXX (3-byte end frequency 15.000~200.000Hz, unit 0.001Hz) X (1-byte waveform selection 0~7) X (1-byte waveform group No., only applicable when selecting built-in and custom waveforms: 1~30) XX (2-byte step phase 0.0~360.0°, unit 0.1°) XXX (3-byte running time 0.0~99999, unit ms) X 0x7D (32-byte)

Example of three-phase command: 7B 00 4E 01 5A 51 01 01F4 01F4 01F4 00C8 00C8 00C8 000000 000000 000000 000000 000000 000000 000000 00C350 00C350 00C350 00C350 00C350 00C350 02 02 02 00 00 00 0000 0000 0000 000064 000064 000064 D6 7D (Set Step 0 three-phase AC start voltage 5.00V, three-phase AC end voltage 2.00V, three-phase DC start voltage 0.00V, three-phase end DC voltage 0.00V, three-phase start frequency 50.000Hz, three-phase end frequency 50.000Hz, three-phase waveform selection No. 2 (sine wave), three-phase waveform group No. is invalid, three-phase start angle 0°, running time 100ms)

Example of single-phase command: 7B 00 20 01 5A 51 01 01F4 00C8 000000 000000 00C350 00C350 02 00 0000 000064 16 7D (Set AC starting voltage 5.00V, AC end voltage to 2.00V, DC start and end voltage 0.00V, start frequency 50.000Hz, end frequency 50.000Hz, three-phase waveform selection No. 2 (sine wave), waveform group No. is invalid, start angle 0°, running time 100ms)

Command word: 29H

Command function: List more settings

Command format: 0x7B XX X **0x5A 0x29** X (1-byte trigger mode 0: Auto 1: manual) X (1-byte length unit 0: time 1: count) X (1-byte stage continue 0: disable 1: enable) XX (2-byte running times) X 0x7D (13-byte)

Command example: 7B 00 0D 01 5A 29 00 00 00 0009 9A 7D (Set trigger mode to Auto, length unit to time,

stage continue to disable, running times to 9)

Command word: 2BH

Command function: Pulse settings

Three-phase command format: 0x7B XX X **0x5A 0x2B** XX XX XX (2-byte*3: AC voltage 0.00~300.00V, unit 0.01V) XXX XXX XXX (3-byte*3: DC voltage -424.20~424.20V, unit 0.01V) XXX XXX XXX (3-byte*3: frequency 15.000~200.000Hz, unit 0.001Hz) XX XX XX (2-byte*3: start angle 0.0~360.0°, unit 0.1°) XX XX XX (2-byte*3: duty cycle 0.0~100.0%, unit 0.1%) X X X (1-byte*3: waveform selection 0~7) X X X (1-byte*3: waveform group No., only applicable when selecting built-in and custom waveforms: 1~30) XXX XXX XXX (3-byte*3: running time 0.0~99999, unit ms) X 0x7D (59-byte)

Single-phase command format: 0x7B XX X **0x5A 0x2B** XX (2-byte AC voltage 0.00~300.00V, unit 0.01V) XXX (3-byte DC voltage -424.20~424.20V, unit 0.01V) XXX (3-byte frequency 15.000~200.000Hz, unit 0.001Hz) XX (2-byte start angle 0.0~360.0°, unit 0.1°) XX (2-byte duty cycle 0.0~100.0%, unit 0.1%) X (1-byte waveform selection 0~7) X (1-byte waveform group No., only applicable when selecting built-in and custom waveforms: 1~30) XXX (3-byte running time 0.0~99999, unit ms) X 0x7D (25-byte)

Example of three-phase command: 7B 00 3B 01 5A 2B 55 F0 55 F0 55 F0 00 55 F0 00 55 F0 00 55 F0 00 C3 50 00 C3 50 00 C3 50 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 03 E8 00 03 E8 00 03 E8 59 7D (set three-phase AC voltage 220.00V, three-phase DC voltage 220.00V, three-phase frequency 50.000Hz, three-phase start angle 0.0°, three-phase duty cycle 0.0%, three-phase waveform selection 0, three-phase waveform group No. 0, three-phase cycle 1000ms)

Example of single-phase command: 7B 00 19 01 5A 2B 55F0 0055F0 00C350 0000 0000 00 00 0003E8 27 7D (set AC voltage 220.00V, DC voltage 220.00V, frequency 50.000Hz, start angle 0.0°, duty cycle 0.0%, waveform selection 0, waveform group No. 0, cycle 1000ms)

Command word: 2AH

Command function: Pulse more settings

Command format: 0x7B XX X **0x5A 0x2A** X (1-byte trigger mode 0: Auto 1: manual) XX (2-byte running times) X 0x7D (11-byte)

Command example: 7B 00 0B 01 5A 2A 00 0001 91 7D (set trigger mode to Auto, running times to 1)

Command word: 2DH

Command function: Step settings

Three-phase command format: 0x7B XX X **0x5A 0x2D** XX XX XX (2-byte*3: AC voltage 0.00~300.00V, unit 0.01V) XX XX XX (2-byte*3: AC voltage difference 0.00~300.00V, unit 0.01V) XXX XXX XXX (3-byte*3: DC voltage -424.20~424.20V, unit 0.01V) XXX XXX XXX (3-byte*3: DC voltage difference -424.20~424.20V, unit 0.01V) XXX XXX XXX XXX (3-byte*3: frequency 15.000~200.000Hz, unit 0.001Hz) (3-byte*3: frequency difference 15.000~200.000Hz, unit: 0.001Hz) XXX XXX XXX (2-byte*3: start angle 0.0~360.0°, unit: 0.1°) X X X (1-byte*3: waveform selection 0~7) X X X (1-byte*3: waveform group No., only used when selecting built-in and custom waveforms 1~30) XX XX XX (2-byte*3: running times 0~999) XXX XXX XXX (3-byte*3: step time 0.0~99999, unit: ms) X 0x7D (83-byte)

Single-phase command format: 0x7B XX X **0x5A 0x2D** XX (2-byte AC voltage 0.00~300.00V, unit 0.01V) XX (2-byte AC voltage difference 0.00~300.00V, unit 0.01V) XXX (3-byte DC voltage -424.20~424.20V, unit 0.01V) XXX (3-byte DC voltage difference -424.20~424.20V, unit 0.01V) XXX (3-byte frequency difference 15.000~200.000Hz, unit 0.001Hz) XXX (3-byte frequency difference 15.000~20.000Hz, unit 0.001Hz) XX (2-byte start angle 0.0~360.0°, unit 0.1°) X (1-byte waveform selection 0~7) X (1-byte waveform group No., only applicable when selecting built-in and custom waveforms: 1~30) XX (2-byte running times 0-999) XXX (3-byte step time 0.0-99999, unit ms) X 0x7D (33-byte)

Example of three-phase command: 7B 00 53 01 5A 2D 0000 0000 0000 00C8 00C8 00C8 000000 000000 000000 000000 000000 000000 00C350 00C350 00C350 000000 000000 000000 0000 0000 0000 02 02 02 00 00 00 0002 0002 0002 000064 000064 000064 A4 7D (set three-phase AC start voltage 0.00V, AC voltage difference 2.00V, DC start voltage 0.00V, DC voltage difference 0.00V, start frequency 50.000Hz, frequency difference 0.000Hz, waveform selection No. 2 (sine wave), waveform selection Group No. 0, running times 2, running time 100ms)

Example of single-phase command: 7B 00 21 01 5A 2D 0000 00C8 000000 000000 00C350 000000 0000 02 00 0002 000064 EC 7D (Set AC start voltage 0.00V, AC voltage difference 2.00V, DC start voltage 0.00V, DC voltage difference 0.00V, start frequency 50.000Hz, frequency difference 0.000Hz, waveform selection No. 2 is sine wave, waveform selection Group No. 0, running times 2, running time 100ms)

Command word: 2CH

Command function: Step more settings

Command format: 0x7B XX X **0x5A 0x2C** X (1-byte trigger mode 0: Auto 1: manual) X 0x7D (9-byte)

Command example: 7B 00 09 01 5A 2C 00 90 7D (set trigger mode to Auto)

Command word: 61H

Command function: Set harmonic synthesis method
Single-phase command format: 0x7B XX X **0x5A 0x61** X (1-byte synthesis method) X 0x7D (9-byte)
Example of single-phase command: 7B 00 09 01 5A 61 01 C6 7D (set synthesis method 0)

Command word: 64H

Command function: Harmonic settings
Three-phase command format: 0x7B XX X **0x5A 0x64** X (1-byte Group No.) X (1-byte Step No.) XX XX XX (2-byte*3: amplitude/percentage 2~10th: 0-90.0V/30.0%; 11~20th: 60.0V/30.0%; 21~40th: 30.0V/30.0%; 41~50th: 15.0V/30.0%, unit 0.1V/0.1%) XX XX XX (2-byte*3: angle 0.0~360.0 °, unit 0.1 °) X 0x7D (22-byte)
Single-phase command format: 0x7B XX X **0x5A 64** X (1-byte Group No.) X (1-byte Step No.) XX (2-byte amplitude/percentage 2~10th: 0-90.0V/30.0%; 11~20th: 60.0V/30.0%; 21~40th: 30.0V/30.0%; 41~50th: 15.0V/30.0%, unit 0.1V/0.1%) XX (2-byte angle 0.0~360.0 °, unit 0.1 °) X 0x7D (14-byte)
Example of three-phase command: 7B 00 16 01 5A 64 00 02 012C 012C 012C 0384 0384 0384 F3 7D (set Group No. 0, Step No. 2, three-phase amplitude 30.0V, three-phase angle 90.0 °)
Example of single-phase command: 7B 00 0E 01 5A 64 00 02 01 2C 03 84 83 7D (set Group No. 0, Step No. 2, amplitude 30.0V, angle 90.0 °)

Command word: 62H

Command function: Harmonics more settings
Three-phase command format: 0x7B XX X **0x5A 0x62** XX XX XX (2-byte*3: fundamental voltage 0.00~300.00V, unit 0.01V) XXX XXX XXX (3-byte*3: fundamental frequency 15.000~200.000Hz, unit 0.001Hz) XXX XXX XXX (3-byte*3: DC component -424.20~424.20V, unit 0.01V) XX XX XX (2-byte*3: start angle 0.0~360.0 °, unit 0.1 °) X 0x7D (38-byte)
Single-phase command format: 0x7B XX X **0x5A 0x62** XX (2-byte fundamental voltage 0.00~300.00V, unit 0.01V) XXX (3-byte fundamental frequency 15.000~200.000Hz, unit 0.001Hz) XXX (3-byte DC component -424.20~424.20V, unit 0.01V) XX (2-byte start angle 0.0~360.0 °, unit 0.1 °) X 0x7D (18-byte)
Example of three-phase command: 7B 00 26 01 5A 62 55 F0 55 F0 55 F0 00 C3 50 00 C3 50 00 C3 50 00 03 E8 00 03 E8 00 03 E8 03 84 03 84 03 84 41 7D (set three-phase fundamental voltage 220.00V, three-phase frequency 50.000Hz, three-phase DC component 10.00V, three-phase start angle 90.0 °)
Example of single-phase command: 7B 00 12 01 5A 62 55 F0 00 C3 50 00 03 E8 03 84 99 7D (set fundamental voltage 220.00V, frequency 50.000Hz, DC component 10.00V, start angle 90.0 °)

Command word: 32H

Command function: Interharmonics settings
Three-phase command format: 0x7B XX X **0x5A 0x32** XXX XXX XXX (3-byte*3: start frequency 15.000~3000.000Hz, unit 0.001Hz) XXX XXX XXX (3-byte*3: end frequency 15.000~3000.000Hz, unit 0.001Hz) XX XX XX (2-byte*3: percentage 0.00~30.00, unit 0.01%) XXX XXX XXX (3-byte*3: scanning time 0.0-99999, unit ms) X 0x7D (41-byte)
Single-phase command format: 0x7B XX X **0x5A 0x32** XXX (3-byte start frequency 15.000~3000.000Hz, unit 0.001Hz) XXX (3-byte end frequency 15.000~3000.000Hz, unit 0.001Hz) XX (2-byte percentage 0.00~30.00, unit 0.01%) XXX (3-byte scanning time 0.0~99999, unit ms) X 0x7D (19-byte)
Example of three-phase command: 7B 00 29 01 5A 32 00 EA 60 00 EA 60 00 EA 60 2D C6 C0 2D C6 C0 2D C6 C0 0B B8 0B B8 0B B8 00 03 E8 00 03 E8 00 03 E8 B7 7D (set the three-phase start frequency 60.000Hz, three-phase end frequency 3000.000Hz, three-phase percentage 30.00%, three-phase scanning time 1000ms)
Example of single-phase command: 7B 00 13 01 5A 60 00 EA 60 2D C6 C0 0B B8 00 03 E8 79 7D (set start frequency 60.000Hz, end frequency 3000.000Hz, percentage 30.00%, scanning time 1000ms)

Command word: 70H

Command function: Harmonic analysis settings
Three-phase command format: 0x7B XX X **0x5A 0x70** X X X (1-byte*3: analysis source 0: voltage; 1: current) X X X (1-byte*3: fundamental frequency 0: 50.00Hz; 1: 60.00Hz) X (1-byte analysis method 0: amplitude; 1: percentage) X (1-byte display method 0: single; 1: continuous) X 0x7D (16-byte)
Single-phase command format: 0x7B XX X **0x5A 0x70** X (1-byte analysis source 0: voltage; 1: current) X (1-byte fundamental frequency 0: 50.00Hz; 1: 60.00Hz) X (1-byte analysis method 0: amplitude; 1: percentage) X (1-byte display method 0: single; 1: continuous) X 0x7D (12-byte)
Example of three-phase command: 7B 00 10 01 5A 70 01 01 01 01 01 01 01 01 E3 7D (Set the three-phase analysis source to current, three-phase fundamental frequency 60.00Hz, the analysis method to percentage 1, and display method to continuous)
Example of single-phase command: 7B 00 0C 01 5A 70 01 01 01 01 DB 7D (Set the analysis source to current, fundamental frequency 60.00Hz, analysis method to percentage 1, and display method to continuous)

Command word: 80H

Command function: Output limit setting
Three-phase command format: 0x7B XX X **0x5A 0x80** XX XX XX (2-byte*3: AC voltage limit 0.00~300.00V,

unit 0.01V) XXX XXX XXX (3-byte*3: DC voltage positive limit 0.00~424.20V, unit 0.01V) XXX XXX XXX XXX (3-byte*3: DC voltage negative limit -424.20~0.00V, unit 0.01V) XXX XXX XXX (3-byte*3: frequency limit 15.000~20.000Hz, unit 0.001Hz) X 0x7D (41-byte)
Single-phase command format: 0x7B XX X **0x5A 0x80** XX (2-byte AC voltage limit 0.00~300.00V, unit 0.01V) XXX (3-byte DC voltage positive limit 0.00~424.20V, unit 0.01V) XXX (3-byte DC voltage negative limit -424.20~0.00V, unit 0.01V) XXX (3-byte frequency limit 15.000~200.000Hz, unit 0.001Hz) X 0x7D (19-byte)
Example of three-phase command: 7B 00 29 01 5A 80 7530 7530 7530 00A5A0 00A5A0 00A5A0 000000 000000 000000 0186A0 0186A0 0186A0 37 7D (set three-phase AC voltage limit 300.00V, three-phase DC voltage positive limit 424.00V, three-phase DC negative limit 0.00V, three-phase frequency limit 200.000Hz)
Example of single-phase command: 7B 00 13 01 5A 80 75 30 00 A5 A0 00 00 00 03 0D 40 28 7D (set AC voltage limit 300.00V, DC voltage positive limit 424.00V, DC negative limit 0.00V, frequency limit 200.000Hz)

Command word: 81H

Command function: Output protection settings
Three-phase command format: 0x7B XX X **0x5A 0x81** XX XX XX (2-byte*3: overcurrent limit 0-25V, unit A) X X X (1-byte*3: overcurrent delay time 0~9, unit S) XXXX XXXX XXXX (4-byte*3: overload limit 0~6000VA, unit VA) X 0x7D (29-byte)
Single-phase command format: 0x7B XX X **0x5A 0x81** XX (1-byte overcurrent limit 0~25V, unit A) X (1-byte overcurrent delay time 0~9, unit S) XXXX (2-byte overload limit 0-6000VA, unit VA) X 0x7D (15-byte)
Example of three-phase command: 7B 00 1D 01 5A 81 0019 0019 0019 09 09 09 00001388 00001388 00001388 30 7D (set three-phase overcurrent limit 0.25A, three-phase overcurrent delay time 9S, three-phase overload limit 50.00VA)
Example of single-phase command: 7B 00 0F 01 5A 81 0019 09 00001388 A8 7D (set overcurrent limit 0.25A, overcurrent delay time of 9S, overload limit 50.00VA)

Command word: 82H

Command function: Output waveform settings
Three-phase command format: 0x7B XX X **0x5A 0x82** X (U-Phase A waveform selection 0~5) X (U-Phase B waveform selection 0~5) X X X X (1-byte*4: V, W waveform selection and so on) X X X X X X (1-byte*6: mode selection, valid only when clamped sine wave is selected: 0: AMP; 1: THD) XX XX XX XX XX XX (2-byte*6: percentage, valid only when clamped sine wave is selected: AMP: 0.0~100.0, THD: 0.0~43.0) X X X X X X (1-byte*6: waveform group No., only applicable when selecting built-in and custom waveforms: 1~30) X 0x7D (38-byte)
Single-phase command format: 0x7B XX X **0x5A 0x82** X (A waveform selection 0~5) X X (B waveform selection 0~5) X (1-byte*2: mode selection, valid only when clamped sine wave is selected: 0: AMP; 1: THD) XX XX (2-byte*2: percentage, valid only when clamped sine wave is selected: AMP: 0.0~100.0; THD: 0.0~43.0) X X (1-byte*2: waveform group No., only applicable when selecting built-in and custom waveforms: 1~30) X 0x7D (18-byte)
Example of three-phase command: 7B 00 26 01 5A 82 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 03 7D
Example of single-phase command: 7B 00 12 01 5A 82 00 00 00 00 00 00 00 00 00 00 EF 7D

Command word: 83H

Command function: Output other settings
Command format: 0x7B XX X **0x5A 0x83** X (1-byte output relay 0: Off 1: On) X (Remote suppression 0: Off 1: On) X (Remote control 0: Off 1: On) XX (Surge duration in ms, 0~999) X (Remote measurement 0: Off 1: On) XX (Surge start time in ms, 0~999), X (External control switch 0: Off 1: On), X (External control mode 0: Amplify 1: Linear:) X 0x7D (18-byte)
Example of command: 7B 00 12 01 5A 83 01 00 00 0000 00 0000 00 00 F1 7D (output relay on, remote suppression off, remote control off, surge duration 0, remote measurement off, surge start time 0, external control off, external control mode Amplify)

Command word: 90H

Command function: System state setting
Command format: 0x7B XX X **0x5A 0x90** X (1-byte output mode: 0: single-phase, 1: three-phase) X (1-byte three-phase output: 0: positive phase sequence, 1: negative phase sequence) X (1-byte Three-phase Relationship: 0: Independent, 1: Same Frequency, 2: Balance) X (1-byte Phase Repositioning, only applicable when Three-phase Relationship is Independent: 0: disable, 1: enable) X (1-byte voltage setting, only applicable when Three-phase Relationship is Balance: 0: phase voltage 1: line voltage) X 0x7D (13-byte)
Example of command: 7B 00 0D 01 5A 90 01 00 00 00 00 F9 7D (Output mode: three-phase, three-phase output: positive phase sequence, Three-phase Relationship: Independent, Phase Repositioning: disable, voltage setting: phase voltage)

I.2.3.4 Query Settings Class Command (0xA5)

Command word: 41H
Command function: Query common settings
Command format: 0x7B XX X **0xA5 0x41** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 41 EF 7D
Three-phase answer format: 0x7B XX X **0xA5 0x41** XX XX XX (2-byte*3: AC voltage, unit 0.01V) XXX XXX XXX (3-byte*3: DC voltage, unit 0.01V) XXX XXX XXX (3-byte*3: frequency, unit 0.001Hz) X 0x7D (32-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x41** XX (2-byte AC voltage, unit 0.01V) XXX (3-byte DC voltage, unit 0.01V) XXX (3-byte frequency, unit 0.001Hz) X 0x7D (16-byte)
Command word: 40H
Command function: Query common more settings
Command format: 0x7B XX X **0xA5 0x40** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 40 EE 7D
Three-phase answer format: 0x7B XX X **0xA5 0x40** XX (2-byte start angle, unit 0.1 °) XX (2-byte end angle, unit 0.1 °) XXX (3-byte AC conversion rate, unit 0.01V/ms) XXX (3-byte DC conversion rate, unit 0.01V/ms) XXX (3-byte frequency conversion rate, unit 0.001Hz/ms) XXX (3-byte end DC conversion rate, unit 0.01V/ms) XX (2-byte phase difference 1_2, unit 0.1 °) XX (2-byte phase difference 1_3, unit 0.1 °) X X X (1-byte*3: waveform selection) X X X (1-byte*3: mode selection, 0: AMP; 1: THD) XX XX XX (2-byte*3: percentage) X X X (1-byte*3: waveform group No.) X 0x7D (43-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x40** XX (2-byte start angle, unit 0.1 °) XX (2-byte end angle, unit 0.1 °) XXX (3-byte AC conversion rate, unit 0.01V/ms) XXX (3-byte DC conversion rate, unit 0.01V/ms) XXX (3-byte frequency conversion rate, unit 0.001 Hz/ms) XXX (3-byte end DC conversion rate, unit 0.01 V/ms) X (1-byte waveform selection) X (1-byte mode selection, 0: AMP; 1: THD) XX (2-byte percentage) X (1-byte waveform group No.) X 0x7D (29-byte)
Command word: 51H
Command function: Query list settings
Command format: 0x7B XX X **0xA5 0x51** X (1-byte step No.) X 0x7D (9-byte)
Example: 7B 00 09 01 A5 51 00 00 7D
Three-phase answer format: 0x7B XX X **0xA5 0x51** X (1-byte Step No.) XX XX XX (2-byte*3: AC start voltage, unit 0.01V) XX XX XX (2-byte *3: AC end voltage 0.00~300.00V, unit 0.01V) XXX XXX XXX (3-byte*3: DC start voltage, unit 0.01V) XXX XXX XXX (3-byte*3: DC end voltage, unit 0.01V) XXX XXX XXX (3-byte*3: start frequency, unit 0.001Hz) XXX XXX XXX (3-byte*3: end frequency, unit 0.001Hz) X X X (1-byte*3: waveform selection 0~7) X X X (1-byte*3: waveform group No.) XX XX XX (2-byte*3: step phase, unit 0.1 °) XXX XXX XXX (3-byte*3: running time, unit ms) X 0x7D (78-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x51** X (1-byte Step No.) XX (2-byte AC start voltage, unit 0.01V) XX (2-byte AC end voltage, unit 0.01V) XXX (3-byte DC start voltage, unit 0.01V) XXX (3-byte DC end voltage, unit 0.01V) XXX (3-byte start frequency, unit 0.001Hz) XXX (3-byte end frequency, unit 0.001Hz) X (1-byte waveform selection) X (1-byte waveform group No.) XX (2-byte step phase, unit 0.1 °) XXX (3-byte running time, unit ms) X 0x7D (32-byte)
Command word: 29H
Command function: Query list more settings
Command format: 0x7B XX X **0xA5 0x29** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 29 D7 7D
Answer format: 0x7B XX X **0xA5 0x29** X (1-byte trigger mode 0: Auto 1: manual) X (1-byte length unit 0: time 1: count) X (1-byte stage continue 0: disable 1: enable) XX (2-byte running times) X 0x7D (13-byte)
Command word: 2BH
Command function: Query pulse settings
Command format: 0x7B XX X **0xA5 0x2B** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 2B D9 7D
Three-phase answer format: 0x7B XX X **0xA5 0x2B** XX XX XX (2-byte*3: AC voltage, unit 0.01V) XXX XXX XXX (3-byte*3: DC voltage, unit 0.01V) XXX XXX XXX (3-byte*3: frequency, unit 0.001Hz) XX XX XX (2-byte*3: start angle, unit 0.1 °) XX XX XX (2-byte*3: duty cycle, unit 0.1%) X X X (1-byte*3: waveform selection) X X X (1-byte*3: waveform group No.) XXX XXX XXX (3-byte*3: running time, unit ms) X 0x7D (59-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x2B** XX (2-byte AC voltage, unit 0.01V) XXX (3-byte DC voltage, unit 0.01V) XXX (3-byte frequency, unit 0.001Hz) XX (2-byte start angle, unit 0.1 °) XX (2-byte duty cycle, unit 0.1%) X (1-byte waveform selection) X (1-byte waveform group No.) XXX (3-byte running time, unit ms) X 0x7D (32-byte)
Command word: 2AH
Command function: Query pulse more settings

Command format: 0x7B XX X **0xA5 0x2A** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 2A D8 7D
Answer format: 0x7B XX X **0xA5 0x31** X (1-byte trigger mode 0: Auto 1: manual) XX (2-byte running times) X 0x7D (11-byte)

Command word: 2DH

Command function: Query step settings
Command format: 0x7B XX X **0xA5 0x2D** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 2D DB 7D
Three-phase answer format: 0x7B XX X **0xA5 0x2D** XX XX XX (2-byte*3: AC voltage, unit 0.01V) XX XX XX (2-byte*3: AC difference, unit 0.01V) XX XX XX (3-byte*3: DC voltage, unit 0.01V) XX XX XX (3-byte*3: DC difference, unit 0.01V) XX XX XX (3-byte*3: frequency, unit 0.001Hz) XX XX XX (3-byte*3: frequency difference, unit 0.001Hz) XX XX XX (2-byte*3: start angle, unit 0.1 °) X X X (1-byte*3: waveform selection) X X X (1-byte*3: waveform group No.) XX XX XX (2-byte*3: running times 0~999) XXX XXX XXX (3-byte*3: step time, unit ms) X 0x7D (83-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x2D** XX (2-byte AC voltage, unit 0.01V) XX (2-byte AC difference, unit 0.01V) XXX (3-byte DC voltage, unit 0.01V) XXX (3-byte DC difference, unit 0.01V) XXX (3-byte frequency, unit 0.001Hz) XXX (3-byte frequency difference, unit 0.001Hz) XX (2-byte start angle, unit 0.1 °) X (1-byte waveform selection) X (1-byte waveform group No.) XX (2-byte running times) XXX (3-byte step time, unit ms) X 0x7D (33-byte)

Command word: 2CH

Command function: Query step more settings
Command format: 0x7B XX X **0xA5 0x2C** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 2C DA 7D
Answer format: 0x7B XX X **0xA5 0x2C** X (1-byte trigger mode 0: Auto 1: manual) XX (2-byte running times) X 0x7D (11-byte)

Command word: 61H

Command function: Query harmonic synthesis method
Command format: 0x7B XX X **0xA5 0x61** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 61 0F 7D
Answer format: 0x7B XX X **0XA5 0x61** X (1-byte synthesis method) X 0x7D (9-byte)

Command word: 64H

Command function: Query harmonic settings
Command format: 0x7B XX X **0xA5 0x64** X 0x7D (8-byte)
Example: 7B 00 0A 01 A5 64 01 00 15 7D
Three-phase answer format: 0x7B XX X **0xA5 0x64** X (1-byte Group No.) X (1-byte Step No.) XX XX XX (2-byte*3: amplitude/percentage unit 0.1V/0.1%) XX XX XX (2-byte*3: angle, unit 0.1 °) X 0x7D (22-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x64** X (1-byte Group No.) X (1-byte Step No.) XX (2-byte amplitude/percentage, unit 0.1V/0.1%) XX (2-byte angle, unit 0.1 °) X 0x7D (14-byte)

Command word: 62H

Command function: Query harmonics more settings
Command format: 0x7B XX X **0xA5 0x62** X 0x7D (8-byte)
Example: 7B 00 0A 01 A5 64 01 00 15 7D
Answer format: 0x7B XX X **0xA5 0x62** XX XX XX (2-byte*3: fundamental voltage 0.00~300.00V, unit 0.01V) XXX XXX XXX (3-byte*3: fundamental frequency 15.000~200.000V, unit 0.001Hz) XXX XXX XXX (3-byte*3: DC component -424.20~424.20V, unit 0.01V) XX XX XX (2-byte*3: start angle 0.0~360.0 °, unit 0.1 °) X 0x7D (38-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x62** XX (2-byte fundamental voltage, unit 0.01V) XXX (3-byte fundamental frequency, unit 0.001Hz) XXX (3-byte DC component, unit 0.01V) XX (2-byte start angle, unit 0.1 °) X 0x7D (18-byte)

Command word: 32H

Command function: Query interharmonics settings
Command format: 0x7B XX X **0xA5 0x32** X 0x7D (8-byte)
Example: 0x7B XX X **0xA5 0x32** X 0x7D (8-byte)
Three-phase answer format: 0x7B XX X **0xA5 0x32** XXX XXX XXX (3-byte*3: start frequency, unit: 0.001Hz) XXX XXX XXX (3-byte*3: end frequency, unit: 0.001Hz) XX XX XX (2-byte*3: percentage, unit: 0.01%) XXX XXX XXX (3-byte*3: scanning time, unit: ms) X X 0x7D (41-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x32** XXX (3-byte start frequency, unit 0.001Hz) XXX (3-byte end frequency, unit 0.001Hz) XX (2-byte percentage, unit 0.01%) XXX (3-byte scanning time, unit ms) X 0x7D (19-byte)

Command word: 70H
Command function: Query harmonic analysis settings
Command format: 0x7B XX X **0xA5 0x70** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 70 1E 7D
Three-phase answer format: 0x7B XX X **0xA5 0x70** X X X (1-byte*3: analysis source: 0: voltage; 1: current) X X X (1-byte*3: fundamental frequency: 0: 50.00Hz; 1: 60.00Hz) X (1-byte analysis method: 0: amplitude; 1: percentage) X (1-byte display method: 0: single; 1: continuous) X 0x7D (16-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x70** X (1-byte analysis source: 0: voltage; 1: current) X (1-byte fundamental frequency: 0: 50.00Hz; 1: 60.00Hz) X (1-byte analysis method: 0: amplitude; 1: percentage) X (1-byte display method: 0: single; 1: continuous) X 0x7D (12-byte)
Command word: 80H
Command function: Query output limit settings
Command format: 0x7B XX X **0xA5 0x80** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 80 2E 7D
Three-phase answer format: 0x7B XX X **0xA5 0x80** XX XX XX (2-byte*3: AC voltage limit, unit 0.01V) XXX XXX XXX (3-byte*3: DC voltage positive limit, unit 0.01V) XXX XXX XXX (3-byte*3: DC voltage negative limit, unit 0.01V) XXX XXX XXX (3-byte*3: frequency limit, unit 0.01V) X 0x7D (41-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x80** XX (2-byte AC voltage limit, unit 0.01V) XXX (3-byte DC voltage positive limit, unit 0.01V) XXX (3-byte DC voltage negative limit, unit 0.01V) XXX (3-byte frequency limit, unit 0.001Hz) X 0x7D (19-byte)
Command word: 81H
Command function: Query output protection settings
Command format: 0x7B XX X **0xA5 0x81** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 81 2F 7D
Three-phase answer format: 0x7B XX X **0xA5 0x81** X X X (1-byte*3: overcurrent limit, unit A) X X X (1-byte*3: overcurrent delay time, unit s) XX XX XX (2-byte*3: overload limit, unit VA) X 0x7D (20-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x81** X (1-byte overcurrent limit, unit A) X (1-byte overcurrent delay time, unit S) XX (2-byte overload limit, unit VA) X 0x7D (12-byte)
Command word: 82H
Command function: Query output waveform settings
Command format: 0x7B XX X **0xA5 0x82** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 82 30 7D
Three-phase answer format: 0x7B XX X **0xA5 0x82** X (U-Phase A waveform selection) X (U-Phase B waveform selection) X X X X (1-byte*4: V, W waveform selection, etc.) X X X X X X (1-byte*6: mode selection 0: AMP; 1: THD) XX XX XX XX XX XX (2-byte*6: percentage) X X X X X X (1-byte*6: waveform group No.) X 0x7D (38-byte)
Single-phase answer format: 0x7B XX X **0xA5 0x82** X (A waveform selection 0~5) X (B waveform selection 0~5) X X (1-byte*2: mode selection 0: AMP; 1: THD) XX XX (2-byte*2: percentage) X (1-byte*2: waveform group No.) X 0x7D (18-byte)
Command word: 83H
Command function: Query other output settings
Command format: 0x7B XX X **0xA5 0x83** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 83 31 7D
Answer format: 0x7B XX X **0xA5 0x83** X (1-byte output relay 0: off 1: on) X (1-byte output inhibit 0: off 1: on) X (remote control 0: off 1: on) XX (surge duration in ms 0~999) X (remote measurement 0: off 1: on) XX (surge start time in ms 0~999) X (external control 0: off 1: on) X (external control mode 0: amplification 1: linear) X 0x7D (18-byte)
Command word: 90H
Command function: Query system state settings
Command format: 0x7B XX X **0xA5 0x90** X 0x7D (8-byte)
Example: 7B 00 08 01 A5 90 3E 7D
Answer format: 0x7B XX X **0xA5 0x90** X (1-byte output mode 0: single-phase 1: three-phase) X (1-byte three-phase output 0: positive phase sequence 1: negative phase sequence) X (1-byte Three-phase Relationship 0: Independent 1: Same Frequency 2: Balance) X (1-byte Phase Repositioning, only applicable when Three-phase Relationship is Independent: 0: disable 1: enable) X (1-byte voltage setting, only applicable when Three-phase Relationship is Balance: 0: phase voltage 1: line voltage) X 0x7D (13-byte)
Command word: 20H
Command function: Query output mode
Command format: 0x7B XX X **0XA5 0x20** X 0x7D (8-byte)

Example: 7B 00 08 01 A5 20 83 7D
Answer format: 0x7B XX X **0xA5 0x83** X (1-byte output mode 0: AC+DC 1: AC 2: DC) X 0x7D (9-byte)

I.2.4 Ainuo3.0 answer command

When the host command is received, a corresponding response is given to reflect whether the command is received correctly. Its format is as follows:

Frame head	Total number of bytes	Slave address	Command			Check sum	Frame end
			Class of command	Command word	Parameters		
0x**7B**	**XX**	**X**	**X**	**X**	**XXXXX**	**X**	0x**7D**

If the command (excluding the query command) is received correctly and executed, the corresponding execution command will be returned, and the returned argument is 0x00. If the command is received incorrectly, the command type 0x99 and the received command word and corresponding error code will be returned. The types of error code are as follows:

Error code	Error message	Remarks
0x01	Check sum error	
0x02	Command class error	Command class not in the range
0x03	Command word error	Command word not in the range
0x04	Improper state	The received command can't be executed in current state, answer this error code.
0x05	Parameter error	Parameter invalid or number error
0x06	Protection alarm	For example, in case of overvoltage protection, as the master sends command to set output voltage, the DC Power shall answer this error code.
0x07	Over range	The argument is out of the current range

I.3 SCPI Communication Protocol

I.3.1 SCPI Communication Standard

I.3.1.1 Common Symbols

Angle bracket < >: Angle bracket contains parameter abbreviations (see Section I.3.1.2)
Separator|: Choose one of the two parameters separated by the separator
Square bracket [ ]: The content of square bracket is optional. For example, OUTP [: STATe] means : STATe can be omitted or not written.
Brace { }: Brace indicates that an argument can be repeated. <A>{<,B>} means that parameter A must be entered, while parameter B can be omitted or entered one or more times

I.3.1.2 Data Format

All data formats (including send and return data) are ASCII. Data can be numbers or strings.

Symbol	Description	Example
<NR1>	Integer (no decimal point)	123
<NR2>	Numbers with decimals	12.3
<NR3>	Numbers with decimals and exponents	1.23E+2
<Boolean>	Bool, only ON|OFF	ON|OFF
<CRD>	Byte format, the longest string is 12-byte	
<SRD>	String format	

I.3.1.3 Definitions

Instruction tree:
The local instructions are based on a hierarchical structure, also known as a tree system. Instructions on all tree nodes must be written.
Program header:
Program headers are keywords that identify instructions. The machine can receive upper/lower case letters,

including common instruction header and instrument control header.

Common instructions and query headers:

The syntax and query headers of common instructions are described in detail in IEEE488.2. Commands preceded by "*" are common instructions.

Instrument control header:

The instrument control header of master, and each header has two formats: long and short. The header short format is represented by uppercase letters, and the remaining headers are represented by lowercase letters.

Separator:

When the instruction has more than one header, they need to be separated by colon (:).

A space ( ) is required to separate the header and arguments.

When multi instructions are in the same command, they need to be separated by semicolon (;).

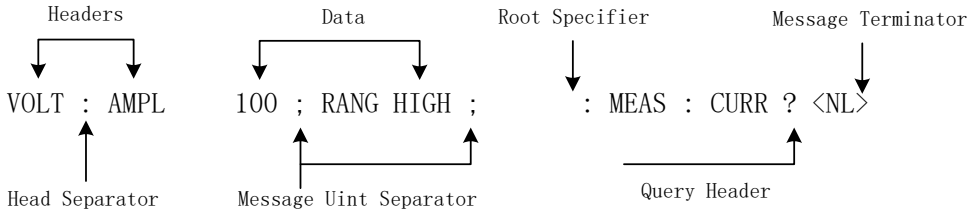
There are three types of terminators (<PMT>):

(1) <END>: end or confirm (EOI)

(2)<NL>: ASCII character 0x0A (hexadecimal of 10)

(3)<NL><END>: end or confirm (EOI) plus 0x0A

Note: EOI is for GPIB interface, and <NL> is used for RS232 interface.



Program message:

Program messages contain zero sequence or program message components, separated by the separator of program message components.

Program message components:

The program message component represents single instruction, programming data, or query.

For example: FREQ? , OUTPut ON

I.3.1.4 Description of tree command

Multi communication instructions can be sent in one command. The first instruction usually refers to the root node. Subsequent instructions refer to the same tree level as the previous instruction in the command. Before the colon communication instruction, it indicates that the header path is the root layer. For example:

OUTPut : PROTection : CLEar All colons are command separators

OUTPut : PROTection : CLEar Only the first colon is the specified root node

OUTPut : PROTection : CLEar; : VOLT: AC 100 Only the third colon is the specified root node

I.3.2 List of SCPI Communication Commands

I.3.2.1 Common instructions

*CLS: clear state
*ESR? Query read
*IDN? Query company name, machine model, master version, display version
*RST Restore the AC power to the initial state, and needs to wait 2~3 seconds before other operations

I.3.2.2 Instrument instructions

FETCh|MEASure
[: SCALar]
: CURRent
: AC?
: DC?
: AMPLitude: MAXimum?
: CREStfactor
: INRush

```
            : FREQuency?
            : POWer
                : AC
                    [: REAL]?
                    : APParent?
                    : REACtive?
                    : PFACtor?
            : VOLTage
                : ACDC?
                : DC?
        : INTerharmonics
            : FREQuency?

OUTPut
        [: STATe]
        : RELay
        : SLEW
            : VOLTage
                : AC
                : DC
            FREQuency
        : COUPling
        : IMPedance
            : STATe
            : RESistor
            INDuction
        : MODE
        : PROTection
            : CLEar

[SOURce: ]
        CURRent
            : LIMit
            : DELay
            : INRush
                : STARt
                : INTerval
        FREQuency
        FUNCtion
            : SHAPe
            : SHAPe
                : A
                : A
                    : MODE
                    : THD
                    : AMP
                : B
                : B
                    : MODE
                    : THD
                    : AMP
        VOLTage
            [: LEVel][: IMMediate][: AMPLitude]
                : AC
                : DC
            : LIMit
                : AC
                : DC
                    : PLUS
```

```
                    : MINus
        : RANGe
    LIST
        : POINts?
        : COUNt
        : DWELl
        : SHAPe
        : BASE
        : VOLTage
            : AC
                : STARt
                : END
            : DC
                : STARt
                : END
        : FREQuency
            : STARt
            : END
        : DEGRee
    PULSe
        : VOLTage
            : AC
            : DC
        : FREQuency
        : SHAPe
        : SPHase
        : COUNt
        : DCYCle
        : PERiod
    STEP
        : VOLTage
            : AC
            : DC
        : FREQuency
        : SHAPe
        : SPHase
        : DVOLtage
            : AC
            : DC
        : DFRequency
        : DWELL
        : COUNt
    SYNThesis
        : COMPose
        : AMPLitude
        : PHASe
        : FUNDamental
        : DC
        : FREQuency
        : SPHase
    : INTerharmonics
        : FREQuency
            : STARt
            : END
        : LEVEl
        : DWELl

[SOURce:]
    PHASe
```

: ON
: OFF

[SOURce:]
CONFigure
: INHibit
: EXTernal
: COUPling
SYSTem
: ERRor?
: VERSion?
TRIG
TRIG: STATE?

I.3.3 Explanation of SCPI Communication Commands

I.3.3.1 Common instructions

The common instruction starts with "*" and contains three letters and/or one "?". Common instructions and queries are listed in alphabetical order。

*CLS: clear state

This instruction clears the following register

Standard Event Status Event

*ESR? Query the standard events of the read register and clear.

Standard Event State Enable register

Bit	7	6	5	4	3	2	1	0
Name	PON	---	CME	EXE	DDE	QYE	---	OPC

CME = Command Error
EXE = Execution Error
PON = Power On
DDE = Device Dependent Error
OPC = Operation Complete
QYE = Query Error

*IDN? Query company name, machine model, master version, display version
*RST Restore the AC power to the initial state, and needs to wait 2~3 seconds before other operations

I.3.3.2 FETCh & MEASure subsystem

FETCh|MEASure
[: SCALar]
: CURRent
: AC? Query RMS of current
: DC? Query DC current
: ACDC? Query AC+DC current
: AMPLitude: MAXimum? Query peak current
: CRESTfactor? Query current crest factor
: INRush? Query surge current
: FREQuency? Query frequency
: POWer
: AC
[: REAL]? Query active power
: APParent? Query apparent power
: Reactive? Query reactive power
: PFActor? Query power factor
: TOTal? Query total power
: TOTal: APParent? Query total apparent power

: VOLTage

: ACDC? Query AC+DC RMS of voltage

: DC? Query DC voltage

: AC? Query AC voltage

: AMPNumber: MAXinum Query peak voltage

: LINE

:V12? Query the voltage difference between phase 1 and phase 2

:V23? Query the voltage difference between phase 2 and phase 3

: V31? Query the voltage difference between phase 3 and phase 1

FETCh [: SCALar]: CURRent: AC?
MEASure [: SCALar]: CURRent: AC?

Remark : Query RMS of current

Syntax of query : FETCh: CURRent: AC?,MEASure: CURRent: AC?

Query returned parameters : <NR2>

FETCh [: SCALar]: CURRent: DC?
MEASure [: SCALar]: CURRent: DC?

Remark : Query DC current

Syntax of query : FETCh: CURRent: DC?,MEASure: CURRent: DC?

Query returned parameters : <NR2>

FETCh [: SCALar]: CURRent: ACDC?
MEASure [: SCALar]: CURRent: ACDC?

Remark : Query AC+DC current

Syntax of query : FETCh: CURRent: ACDC?,MEASure: CURRent: ACDC?

Query returned parameters : <NR2>

FETCh[: SCALar]: CURRent: AMPLitude: MAXimum?
MEASure[: SCALar]: CURRent: AMPLitude: MAXimum?

Remark : Query absolute peak current

Syntax of query : FETCh: CURRent: AMPLitude: MAXimum?, MEASure: CURRent: AMPLitude: MAXimum?

Query returned parameters : <NR2>

FETCh [: SCALar]: CURRent: CREStfactor?
MEASure [: SCALar]: CURRent: CREStfactor?

Remark : Query current crest factor

Syntax of query : FETCh: CURRent: CREStfactor?,MEASure: CURRent: CREStfactor?

Query returned parameters : <NR2>

FETCh [: SCALar]: CURRent: INRush?
MEASure [: SCALar]: CURRent: INRush?

Remark : Query surge current

Syntax of query : FETCh: CURRent: INRush?,MEASure: CURRent: INRush?

Query returned parameters : <NR2>

FETCh [: SCALar]: FREQuency?
MEASure [: SCALar]: FREQuency?

Remark : Query frequency, unit Hz

Syntax of query : FETCh: FREQuency?,MEASure: FREQuency?

Query returned parameters : <NR2>

FETCh [: SCALar]: POWer: AC[: REAL]?
MEASure [: SCALar]: POWer: AC[: REAL]?

Remark : Query power, unit W

Syntax of query : FETCh: POWer: AC[: REAL]?,MEASure: POWer: AC[: REAL]?

Query returned parameters : <NR2>

FETCh [: SCALar]: POWer: AC: APParent?
MEASure [: SCALar]: POWer: AC: APParent?

Remark : Query apparent power, unit VA

Syntax of query : FETCh: POWer: AC: APParent?,MEASure: POWer: AC: APParent?

Query returned parameters : <NR2>

FETCh [: SCALar]: POWer: AC: REACtive?
MEASure [: SCALar]: POWer: AC: REACtive?

Remark : Query reactive power

Syntax of query : FETCh: POWer: AC: REACtive ?,MEASure: POWer: AC: REACtive?

Query returned parameters : <NR2>

FETCh [: SCALar]: POWer: AC: PFACtor?
MEASure [: SCALar]: POWer: AC: PFACtor?CC

Remark : Query power factor

Syntax of query : FETCh: POWer: AC: PFACtor?,MEASure: POWer: AC: PFACtor?

Query returned parameters : <NR2>

FETCh [: SCALar]: POWer: AC: TOTal?
MEASure [: SCALar]: POWer: AC: TOTal?

Remark : Query total power

Syntax of query : FETCh: POWer: AC: TOTal?,MEASure: POWer: AC: TOATal?

Query returned parameters : <NR2>

FETCh [: SCALar]: POWer: AC: TOTal: APParent?
MEASure [: SCALar]: POWer: AC: TOTal: APParent?

Remark : Query total apparent power

Syntax of query : FETCh: POWer: AC: TOTal: APParent?,MEASure: POWer: AC: TOATal: APParent?

Query returned parameters : <NR2>

FETCh [: SCALar]: VOLTage: ACDC?
MEASure [: SCALar]: VOLTage: ACDC?

Remark : Query voltage RMS

Syntax of query : FETCh: VOLTage: ACDC?,MEASure: VOLTage: ACDC?

Query returned parameters : <NR2>

FETCh [: SCALar]: VOLTage: DC?
MEASure [: SCALar]: VOLTage: DC?

Remark : Query DC voltage

Syntax of query : FETCh: VOLTage: DC?,MEASure: VOLTage: DC?

Query returned parameters : <NR2>

FETCh [: SCALar]: VOLTage: AC?
MEASure [: SCALar]: VOLTage: AC?

Remark : Query AC voltage

Syntax of query : FETCh: VOLTage: AC?,MEASure: VOLTage: AC?

Query returned parameters : <NR2>

FETCh [: SCALar]: VOLTage: AMPLitude: MAXinum?
MEASure [: SCALar]: VOLTage: AMPLitude: MAXinum?

Remark : Query peak voltage

Syntax of query : FETCh: VOLTage: AMPLitude: MAXinum?,MEASure: VOLTage: AMPLitude: MAXinum?

Query returned parameters : <NR2>

FETCh [: SCALar]: LINE: V12?
MEASure [: SCALar]: LINE: V12?

Remark : Query the voltage difference between phases 1 and 2

Syntax of query : FETCh[: SCALar]: LINE: V12?,MEASure[: SCALar]: LINE: V12?

Query returned parameters : <NR2>

FETCh [: SCALar]: LINE: V23?
MEASure [: SCALar]: LINE: V23?

Remark : Query the voltage difference between phases 2 and 3

Syntax of query : FETCh[: SCALar]: LINE: V23?,MEASure[: SCALar]: LINE: V23?

Query returned parameters : <NR2>

FETCh [: SCALar]: LINE: V31?
MEASure [: SCALar]: LINE: V31?

Remark : Query the voltage difference between phases 3 and 1

Syntax of query : FETCh[: SCALar]: LINE: V31?,MEASure[: SCALar]: LINE: V31?

Query returned parameters : <NR2>

I.3.3.3 OUTPUT subsystem

OUTPut
[: STATe]
: RELay
: SLEW
: VOLTage
: AC
: DC
FREQuency
: OFF
: VOLTage
: DC
: COUPling
: MODE
: PROTection
: CLEar
: STATe?

OUTPut [: STATe]

Remark : Start/stop the power supply

Parameters : OFF|ON

Syntax of query : OUTPut[: STATe]?

Query returned parameters : OFF|ON

OUTPut: RELay

Remark : Set output relay ON/OFF

Parameters : OFF|ON

Syntax of query : OUTPut: RELay?

Query returned parameters : OFF|ON

OUTPut: SLEW: VOLTage: AC

Remark : Set AC Ramp, V/ms

Parameters : <NR2>, range: 0.00V/ms~2000.00V/ms
Syntax of query : OUTPut: SLEW: VOLTage: AC?
Query returned parameters : <NR2>

OUTPut: SLEW: VOLTage: DC
Remark : Set DC Ramp, V/ms
Parameters : <NR2>, range: 0.00V/ms~2000.00V/ms
Syntax of query : OUTPut: SLEW: VOLTage: DC?
Query returned parameters : <NR2>

OUTPut: SLEW: FREQuency
Remark : Set frequency Ramp, Hz/ms
Parameters : <NR2>, range: 0.000Hz/ms~2000.000Hz/ms
Syntax of query : OUTPut: SLEW: FREQuency?
Query returned parameters : <NR2>

OUTPut: SLEW: OFF: VOLTage: DC
Remark : This command sets the reversal rate when the DC output voltage is turned off
Parameters : <NR2>, range: 0.00V/ms~2000.00V/ms
Syntax of query : OUTPut: SLEW: OFF: VOLTage: DC?
Query returned parameters : <NR2>

OUTPut: COUPling
Remark : Set output method
Parameters : AC|DC|ACDC
Syntax of query : OUTPut: COUPling?
Query returns Parameters : AC|DC|ACDC

OUTPut: MODE
Remark : Set the output mode, FIXED in general
Parameters : FIXED|LIST|PULSE|STEP|SYNTH|INTERHAR
Syntax of query : OUTPut: MODE
Inquiry returned parameters : FIXED|LIST|PULSE|STEP|SYNTH|INTERHAR. Note: If not returned, it indicates that the power supply is in the initial setting state and cannot be directly started/stopped

OUTPut: PROTection : CLEar
Remark : Clear alarm state (note: Abnormal alarm faults need to be eliminated)
Parameter : None
Syntax of query : 无
Query returned parameters : None

I.3.3.4 SOURCE subsystem

[SOURce:]
CURRent
: LIMit
: DELay
: INRush
: STARt
: INTerval
FREQuency
[: {CW|IMMediate}]
: LIMit
VOLTage
[: LEVel][: IMMediate][: AMPLitude]
: AC

: DC
: LIMit
: AC
: DC
: PLUS
: MINus
FUNCtion
: SHAPe
: SHAPe
: A
: A
: MODE
: THD
: AMP
: B
: B
: MODE
: THD
: AMP

[SOURce:]CURRent: LIMit

Remark	: Set the current limit in A
Parameters	: <NR2>, range: 0.0A~-25.00A
Syntax of query	: [SOURce:]CURRent: LIMit?
Query returned parameters	: <NR2>

[SOURce:]CURRent: DELay

Remark	: Set current protection delay in s
Parameters	: <NR2>, range: 1S~-9S
Syntax of query	: [SOURce:]CURRent: DELay?
Query returned parameters	: <NR2>

[SOURce:]CURRent: INRush: STARt

Remark	: Set surge current measurement start time in ms
Parameters	: <NR2>, range: 0.0S~-999.9ms
Syntax of query	: [SOURce:]CURRent: INRush: STARt?
Query returned parameters	: <NR2>

[SOURce:]CURRent: INRush: INTerval

Remark	: Set surge current measurement duration in ms
Parameters	: <NR2>, range: 0.0S~-999.9ms
Syntax of query	: [SOURce:]CURRent: INRush: INTerval?
Query returned parameters	: <NR2>

[SOURce:]FREQuency[: CW|IMMEdiate}]

Remark	: Set the output waveform frequency the power supply in Hz
Parameters	: <NR2>, range: 30.00Hz~-100.00Hz
Syntax of query	: [SOURce:]FREQuency[: CW|IMMEdiate}]?
Query returned parameters	: <NR2>

[SOURce:]FREQuency: LIMit

Remark	: Set the output frequency limit to limit the frequency setting
Parameters	: <NR2>, range: 30.00Hz~-100.00Hz
Syntax of query	: [SOURce:]FREQuency: LIMit?
Query returned parameters	: <NR2>

[SOURce:]VOLTage[: LEVel][: IMMediate][: AMPLitude]: AC

Remark	: Set AC voltage in V

Parameters : <NR2>, range: 0.00~350.00
Syntax of query : [SOURce:]VOLTage[: LEVel][: IMMediate][: AMPLitude]: AC?
Query returned parameters : <NR2>

[SOURce:]VOLTage[: LEVel][: IMMediate][: AMPLitude]: DC
Remark : Set DC voltage in V
Parameters : <NR2>, range: - 494.90~494.90
Syntax of query : [SOURce:]VOLTage[: LEVel][: IMMediate][: AMPLitude]: DC?
Query returned parameters : <NR2>

[SOURce:]VOLTage: LIMit: AC
Remark : Set Vac LIMIT in V
Parameters : <NR2>, range: 0~350.00
Syntax of query : [SOURce:]VOLTage: LIMit: AC?
Query returned parameters : <NR2>

[SOURce:]VOLTage: LIMit: DC: PLUS
Remark : Set Vac LIMIT (+) in V
Parameters : <NR2>, range: 0~494.90
Syntax of query : [SOURce:]VOLTage: LIMit: DC: PLUS?
Query returned parameters : <NR2>

[SOURce:]VOLTage: LIMit: DC: MINus
Remark : Set Vac LIMIT (-) in V
Parameters : <NR2>, range: -494.90~0
Syntax of query : [SOURce:]VOLTage: LIMit: DC: MINus?
Query returned parameters : <NR2>

[SOURce:]FUNCtion: SHAPe
Remark : Set waveform
Parameters : A|B
Syntax of query : [SOURce:]FUNCtion: SHAPe?
Query returns Parameters : A|B|SINE|SQUA|CSIN|DST<01..30>|USR<01..30>

[SOURce:]FUNCtion: SHAPe: A
Remark : Set the waveform corresponding to waveform A
Parameters : SINE|SQUA|CSIN|DST<01..30>|USR<01.. 30>
Syntax of query : [SOURce:]FUNCtion: SHAPe: A?
Query returns Parameters : SINE|SQUA|CSIN|DST<01..30>|USR<01.. 30>

[SOURce:]FUNCtion: SHAPe: A: MODE
Remark : Set CSIN waveform mode corresponding to waveform A
Parameters : AMP|THD
Syntax of query : [SOURce:]FUNCtion: SHAPe: A: MODE?
Query returned parameters : AMP|THD

[SOURce:]FUNCtion: SHAPe: A: THD
Remark : Set the total harmonic percentage in CSIN waveform THD mode corresponding to waveform A
Parameters : <NR2>, range: 0.0~43.0%
Query syntax : [SOURce:]FUNCtion: SHAPe: A: THD?
Query returned parameters : <NR2>

[SOURce:]FUNCtion: SHAPe: A: AMP
Remark : Set the clipping peaks percentage in CSIN waveform AMP mode corresponding to waveform A
Parameters : <NR2>, range: 0.0~100.0%

Query syntax : [SOURce:]FUNCtion: SHAPe: A: AMP?
Query returned parameters : <NR2>

[SOURce:]FUNCtion: SHAPe: B
Remark : Set the waveform corresponding to waveform B
Parameters : SINE|SQUA|CSIN|DST<01..30>|USR<01..06>
Syntax of query : [SOURce:]FUNCtion: SHAPe: B?
Query returns Parameters : SINE|SQUA|CSIN|DST<01..30>|USR<01..06>

[SOURce:]FUNCtion: SHAPe: B: MODE
Remark : Set CSIN waveform mode corresponding to waveform B
Parameters : AMP|THD
Syntax of query : [SOURce:]FUNCtion: SHAPe: B: MODE?
Query returned parameters : AMP|THD

[SOURce:]FUNCtion: SHAPe: B: THD
Remark : Set the total harmonic percentage in CSIN waveform THD mode corresponding to waveform A
Parameters : <NR2>, range: 0.0~43.0%
Query syntax : [SOURce:]FUNCtion: SHAPe: A: THD?
Query returned parameters : <NR2>

[SOURce:]FUNCtion: SHAPe: B: AMP
Remark : Set the clipping peaks percentage in CSIN waveform AMP mode corresponding to waveform A
Parameters : <NR2>, range: 0.0~100.0%
Query syntax : [SOURce:]FUNCtion: SHAPe: A: AMP?
Query returned parameters : <NR2>

I.3.3.5 CONFIGURE subsystem

[SOURce:]
CONFigure
: INHibit
: EXTernal
: COUPling
: EXTON
: VOLTage
: SENSe

[SOURce:]CONFigure: INHibit
Remark : Set remote control
Parameters : OFF|LIVE|TRIG|EXCITE
Syntax of query : [SOURce:]CONFigure: INHibit?
Query returns Parameters : OFF|LIVE|TRIG|EXCITE

[SOURce:]CONFigure: EXTernal
Remark : Set external control signal On/OFF
Parameters : OFF|ON
Syntax of query : [SOURce:]CONFigure: EXTernal?
Query returned parameters : OFF|ON

[SOURce:]CONFigure: COUPling
Remark : Set working mode of external control signal
Parameters : AC|DC
Syntax of query : [SOURce:]CONFigure: COUPling?
Query returns Parameters : AC|DC

[SOURce:]CONFigure: EXTON
Remark : Set External ON/OFF control
Parameters : DISABLE|ENABLE
Syntax of query : [SOURce:]CONFigure: EXTON?
Query returns Parameters : DISABLE|ENABLE
[SOURce:]CONFigure: VOLTage: SENSe
Remark : Set the measurement position for output voltage
Parameters : LOCAL|REMOTE
Syntax of query : [SOURce:]CONFigure: VOLTage: SENSe?
Query returns Parameters : LOCAL|REMOTE

I.3.3.6 PHASE subsystem

[SOURce:]
PHASe
: ON
: OFF
: P12
: P13
: SEQuence
: THREE
: BALanced
: RELOCK
: BALanced
[SOURce:]PHASe: ON
Remark : Set the start angle
Parameters : <NR2>, range: 0.0~359.9 °
Syntax of query : [SOURce:]PHASe: ON?
Query returned parameters : <NR2>
[SOURce:]PHASe: OFF
Remark : Set the end angle
Parameter : <NR2>, range: 0.0~360.0 °, 360.0 °represents IMMED
Syntax of query : [SOURce:]PHASe: OFF?
Query returned parameters : <NR2>
[SOURce:]PHASe: P12
Remark : Set the phase difference between phase 1 and 2
Parameters : <NR2>, range: 0.0~359.9
Syntax of query : [SOURce:]PHASe: P12?
Query returned parameters : <NR2>
[SOURce:]PHASe: P13
Remark : Set the phase difference between phase 1 and 3
Parameters : <NR2>, range: 0.0~359.9
Syntax of query : [SOURce:]PHASe: P13?
Query returned parameters : <NR2>
[SOURce:]PHASe: SEQuence
Remark : Set phase sequence in three-phase mode
Parameters : POS|NEG
Syntax of query : [SOURce:]PHASe: SEQuence?
Query returns Parameters : POSITIVE|NEGATIVE
[SOURce:]PHASe: RELOCK
Remark : Set Phase Repositioning in three-phase mode
Parameters : ENABLE|DISABLE

Syntax of query : [SOURce:]PHASe: RELOCK?

Query returns Parameters : ENABLE|DISABLE

[SOURce:]PHASe: THREE

Remark : Set the operating mode in three-phase mode

Parameters : INDEPEND|SAMEFREQ|BALANCE

Syntax of query : [SOURce:]PHASe: THREE?

Query returns Parameters : INDEPEND|SAMEFREQ|BALANCE

[SOURce:]PHASe: THREE: BALanced

Remark : Set the operating mode in three-phase mode

Parameters : PHASE|LINE

Syntax of query : [SOURce:]PHASe: THREE: BAL?

I.3.3.8 LIST subsystem

[SOURce:]
- LIST
- : COUPing
- : TRIG
  - : POINts?
  - : COUNt
  - : DWELl
  - : SHAPe
  - : BASE
  - : VOLTage
    - : AC
      - : STARt
      - : END
    - : DC
      - : STARt
      - : END
  - : FREQuency
    - : STARt
    - : END
  - : DEGRee

TRIG

TRIG: STATE?

[SOURce:]LIST: COUPing?

Remark : Set the mode of List test

Parameters : ALL|NONE

Syntax of query : [SOURce:]LIST: COUPing?

Query returns Parameters : ALL|NONE

[SOURce:]LIST: TRIG?

Remark : Set the triggering mode of List test

Parameter : AUTO|MANUAL|EXCITE

Syntax of query : [SOURce:]LIST: TRIG?

Query returned parameters : AUTO|MANUAL|EXCITE

[SOURce:]LIST: POINts?

Remark : Set Step No. of the list

Parameters : <NR1>, range: 0~99

Syntax of query : [SOURce:]LIST: POINts?

Query returned parameters : <NR1>, 0~99

[SOURce:]LIST: COUNt

Remark : Set cycles of list

Parameters : <NR1>, range: 0~9999
Syntax of query : [SOURce:]LIST: COUNt?
Query returned parameters : <NR1>

[SOURce:]LIST: DWELl
Remark : Set list running time
Parameters : <NR2>, 1~9999999.9ms
Syntax of query : [SOURce:]LIST: DWELl?
Query returned parameters : <NR2>

[SOURce:]LIST: SHAPe
Remark : Set List waveform
Parameters : A|B
Syntax of query : [SOURce:]LIST: SHAPe?
Query returned parameters : A|B

[SOURce:]LIST: BASE
Remark : Set the unit of List running time
Parameters : TIME|CYCLE
Syntax of query : [SOURce:]LIST: BASE?
Query returns Parameters : TIME|CYCLE

[SOURce:]LIST: VOLTage: AC: STARt
Remark : Set the list start AC voltage in V
Parameters : <NR2>, range: 0.0~350.0V
Syntax of query : [SOURce:]LIST: VOLTage: AC: STARt?
Query returned parameters : <NR2>

[SOURce:]LIST: VOLTage: AC: END
Remark : Set the list end AC voltage in V
Parameters : <NR2>, range: 0.0~350.0V
Syntax of query : [SOURce:]LIST: VOLTage: AC: END?
Query returned parameters : <NR2>

[SOURce:]LIST: VOLTage: DC: STARt
Remark : Set the list start DC voltage in V
Parameters : <NR2>, range: -494.9~494.9V
Syntax of query : [SOURce:]LIST: VOLTage: DC: STARt?
Query returned parameters : <NR2>

[SOURce:]LIST: VOLTage: DC: END
Remark : Set the list end DC voltage in V
Parameters : <NR2>, range: -494.9~494.9V
Syntax of query : [SOURce:]LIST: VOLTage: DC: END?
Query returned parameters : <NR2>

[SOURce:]LIST: FREQuency: STARt
Remark : Set the list start frequency in Hz
Parameters : <NR2>, range: 15.0Hz~-1000.0Hz
Syntax of query : [SOURce:]LIST: FREQuency: STARt?
Query returned parameters : <NR2>

[SOURce:]LIST: FREQuency: END
Remark : Set the list end frequency in Hz
Parameters : <NR2>, range: 15.0Hz~-1000.0Hz
Syntax of query : [SOURce:]LIST: FREQuency: END?
Query returned parameters : <NR2>

[SOURce:]LIST: DEGRee

Remark : Set the list angle
Parameters : <NR2>, range: 0.0~359.9 °
Syntax of query : [SOURce:]LIST: DEGRee?
Query returned parameters : <NR2>

OUTPut: MODE
Remark : Set operation mode
Parameters : FIXED|LKST|PULSE|STEP|SYNTH|INYERHAR
Syntax of query : OUTPut: MODE?
Query returned parameters : FIXED|LKST|PULSE|STEP|SYNTH|INYERHAR

TRIG
Remark : After setting OUTput: : MODE LIST, this instruction activates the list mode in OFF/ON state. To change the parameter, set OUTput: MODE FIXED after TRIG OFF. Then set OUTPUT: MODE LIST again and execute TRIG ON.
Parameters : OFF|ON
Syntax of query : TRIG: STATE?
Query returned parameters : OFF|RUNNING

I.3.3.9 PULSE subsystem

[SOURce:]
PULSe
: VOLTage
: AC
: DC
: FREQuency
: SHAPe
: SPHase
: COUNt
: DCYCle
: PERiod
: TRIG
OUTPut
: MODE
TRIG
TRIG: STATE?

[SOURce:]PULSe: VOLTage: AC
Remark : Set pulse AC voltage in V
Parameters : <NR2>, range: 0.0~350.0
Syntax of query : [SOURce:]PULSe: VOLTage: AC?
Query returned parameters : <NR2>

[SOURce:]PULSe: VOLTage: DC
Remark : Set pulse DC voltage in V
Parameters : <NR2>, range: -494.9~494.9
Syntax of query : [SOURce:]PULSe: VOLTage: DC?
Query returned parameters : <NR2>

[SOURce:]PULSe: FREQuency
Remark : Set pulse frequency in Hz
Parameters : <NR2>, range: 15.0Hz~-1000.0Hz
Syntax of query : [SOURce:]PULSe: FREQuency?
Query returned parameters : <NR2>

[SOURce:]PULSe: SHAPe

Remark : Set pulse waveform
Parameters : A|B
Syntax of query : [SOURce:]PULSe: SHAPe?
Query returned parameters : A|B

[SOURce:]PULSe: SPHase
Remark : Set pulse angle
Parameters : <NR2>, range: 0.0~359.9 °
Syntax of query : [SOURce:]PULSe: DEGRee?
Query returned parameters : <NR2>

[SOURce:]PULSe: COUNt
Remark : Set the number of pulses
Parameters : <NR1>，0~9999
Syntax of query : [SOURce:]PULSe: COUNt?
Query returned parameters : <NR1>

[SOURce:]PULSe: DCYCle
Remark : Set pulse duty cycle
Parameters : <NR1>，0%~100%
Syntax of query : [SOURce:]PULSe: DCYCle?
Query returned parameters : <NR1>

[SOURce:]PULSe: PERiod
Remark : Set pulse period
Parameters : <NR2>, 1~9999999.9ms
Syntax of query : [SOURce:]PULSe: PERiod?
Query returned parameters : <NR2>

[SOURce:]PULSe: TRIG
Remark : Set the trigger mode of PULSE mode
Parameters : AUTO|MANUAL|EXCITE
Syntax of query : [SOURce:]PULSe: TRIG?
Query returned parameters : AUTO|MANUAL|EXCITE

OUTPut: MODE
Remark : Set operation mode
Parameters : FIXED|LKST|PULSE|STEP|SYNTH|INYERHAR
Syntax of query : OUTPut: MODE?
Query returned parameters : FIXED|LKST|PULSE|STEP|SYNTH|INYERHAR

TRIG
Remark : After setting OUTput: : MODE PULSE, this instruction activates the PULSE mode in OFF/ON state. To change the parameter, set OUTput: MODE FIXED after TRIG OFF. Then set OUTPUT: MODE PULSE again and execute TRIG ON.
Parameters : OFF|ON
Syntax of query : TRIG: STATE?
Query returned parameters : OFF|RUNNING

I.3.3.10 STEP subsystem

[SOURce:]
STEP
: VOLTage
: AC

: DC
: FREQuency
: SHAPe
: SPHase
: DVOLtage
: AC
: DC
: DFRequency
: DWELl
: COUNt
: TRIG
OUTPut
: MODE
TRIG
TRIG: STATE?

[SOURce:]STEP: VOLTage: AC
Remark : Set initial AC voltage in STEP mode in V
Parameters : <NR2>, range: 0.0~350.0V
Syntax of query : [SOURce:]STEP: VOLTage: AC?
Query returned parameters : <NR2>
[SOURce:]STEP: VOLTage: DC
Remark : Set initial DC voltage in STEP mode in V
Parameters : <NR2>, range: -494.9~494.9V
Syntax of query : [SOURce:]STEP: VOLTage: DC?
Query returned parameters : <NR2>
[SOURce:]STEP: FREQuency
Remark : Set initial frequency in STEP mode in Hz
Parameters : <NR2>, range: 15.0Hz~-1000.0Hz
Query syntax : [SOURce:]STEP: FREQuency?
Query returned parameters : <NR2>
[SOURce:]STEP: SHAPe
Remark : Set waveform in STEP mode
Parameters : A|B
Syntax of query : [SOURce:]STEP: SHAPe?
Query returned parameters : A|B
[SOURce:]STEP: SPHase
Remark : Set angle in STEP mode
Parameters : <NR2>, range: 0.0~359.9 °
Syntax of query : [SOURce:]STEP: DEGRee?
Query returned parameters : <NR2>
[SOURce:]STEP: DVOLtage: AC
Remark : Set step AC voltage in STEP mode in V
Parameters : <NR2>, range: -350.0V~350.0V
Syntax of query : [SOURce:]STEP: DVOLTage: AC?
Query returned parameters : <NR2>
[SOURce:]STEP: DVOLtage: DC
Remark : Set step DC voltage in STEP mode in V
Parameters : <NR2>, range: -494.9V~494.9V
Syntax of query : [SOURce:]STEP: DVOLTage: DC?
Query returned parameters : <NR2>
[SOURce:]STEP: DFRequency

Remark : Set step frequency in STEP mode in Hz
Parameters : <NR2>, range: -1000.0Hz~1000.0Hz
Query syntax : [SOURce:]STEP: FREQuency?
Query returned parameters : <NR2>

[SOURce:]STEP: DWELl
Remark : Set step time in STEP mode
Parameters : <NR2>, 1~9999999.9ms
Syntax of query : [SOURce:]STEP: DWELl?
Query returned parameters : <NR2>

[SOURce:]STEP: COUNt
Remark : Set the number of steps in STEP mode
Parameters : <NR1>，0~9999
Syntax of query : [SOURce:]STEP: COUNt?
Query returned parameters : <NR1>

[SOURce:]STEP: TRIG
Remark : Set the trigger mode in STEP mode
Parameters : AUTO|MANUAL|EXCITE
Syntax of query : [SOURce:]STEP: TRIG?
Query returned parameters : AUTO|MANUAL|EXCITE

OUTPut: MODE
Remark : Set operation mode
Parameters : FIXED|LKST|PULSE|STEP|SYNTH|INYERHAR
Syntax of query : OUTPut: MODE？
Query returned parameters : FIXED|LKST|PULSE|STEP|SYNTH|INYERHAR

TRIG
Remark : After setting OUTput: MODE STEP, this instruction activates STEP mode in OFF/ON states. To change the parameter, set OUTput: MODE FIXED after TRIG OFF. Then set OUTPUT: MODE STEP again and execute TRIG ON.
Parameters : OFF|ON
Syntax of query : TRIG: STATE?
Query returned parameters : OFF|RUNNING

I.3.3.12 SYNTHESIS subsystem

[SOURce:]

SYNThesis
: COMPose
: AMPLitude
: PHASe
: FUNDamental
: DC
: FREQuency
: SPHase

OUTPut
: MODE

TRIG
TRIG: STATE?

[SOURce:]SYNThesis: COMPose
Remark : Set the harmonic synthesis method
Parameters : VALUE1|VALUE2|VALUE3|PERCENT1|PERCENT2|PERCENT3

Syntax of query : SYNThesis: COMPose?

Query returns Parameters : VALUE1|VALUE2|VALUE3|PERCENT1|PERCENT2|PERCENT3

[SOURce:]SYNThesis: AMPLitude

Remark : Set the amplitude/percentage of each harmonic in harmonic synthesis

Parameters : <NR2>,...,<NR2> The effective range is the same as the operating instructions

Query syntax : [SOURce:]SYNThesis: FUNDamental?

Query returned parameters : <NR2>,…,<NR2>

Order of harmonic	数值 Numerical value	Percentage
2~10	0~90.0	0~30.0
11~20	0~60.0	0~30.0
21~30	0~30.0	0~30.0
31~40	0~30.0	0~30.0
41~50	0~15.0	0~30.0

[SOURce:]SYNThesis: PHASe

Remark : Set the angle of each harmonic in harmonic synthesis

Parameters : <NR2>,…,<NR2>, range: 0.0~359.9 °

Query syntax : [SOURce:]SYNThesis: SPHase?

Query returned parameters : <NR2>,…,<NR2>

[SOURce:]SYNThesis: FUNDamental

Remark : Set the harmonic synthesis AC voltage in V

Parameters : <NR2>, range: 0.00~350.00V

Query syntax : [SOURce:]SYNThesis: FUNDamental?

Query returned parameters : <NR2>

[SOURce:]SYNThesis: DC

Remark : Set the harmonic synthesis DC voltage in V

Parameters : <NR2>, range: -494.90V~494.90V

Syntax of query : [SOURce:] SYNThesis: DC?

Query returned parameters : <NR2>

[SOURce:]SYNThesis: FREQuency

Remark : Set the fundamental frequency in harmonic synthesis

Parameters : 50Hz|60Hz

Syntax of query : [SOURce:]SYNThesis: FREQuency?

Query returns Parameters : 50Hz|60Hz

[SOURce:]SYNThesis: SPHase

Remark : Set the fundamental angle of harmonic synthesis

Parameters : <NR2>, range: 0.0~359.9 °

Query syntax : [SOURce:]SYNThesis: SPHase?

Query returned parameters : <NR2>

OUTPut: MODE

Remark : Set operating mode

Parameters : FIXED|LKST|PULSE|STEP|SYNTH|INYERHAR

Syntax of query : OUTPut: MODE？

Query returned parameters : FIXED|LKST|PULSE|STEP|SYNTH|INYERHAR

TRIG

Remark : After setting OUTput: MODE SYNTH, this instruction

activates SYNTH mode in OFF/ON state. To change the parameter, set OUTput: MODE FIXED after TRIG OFF. Then set OUTPUT: MODE SYNTH again and execute TRIG ON.

Parameters : OFF|ON

Syntax of query : TRIG: STATE?

Query returned parameters : OFF|RUNNING

I.3.3.13 INTERHARMONICS subsystem

```
[SOURce: ]
    : INTerharmonics
        : FREQuency
            : STARt
            : END
        : LEVel
        : DWELl
OUTPut
    : MODE
TRIG
TRIG: STATE?
FRTCh|MEASure
    : INTerharmonics
        : FREQuency?
```

[SOURce:]: INTerharmonics: FREQuency: STARt

Remark :Set the start scanning frequency in Interharmonics mode in Hz

Parameters : <NR2>, range: 0.1Hz~-2400.0Hz

Syntax of query : [SOURce:]: INTerharmonics: FREQuency: STARt?

Query returned parameters : <NR2>

[SOURce:]: INTerharmonics: FREQuency: END

Remark : Set the end scanning frequency in Interharmonics mode in Hz

Parameters : <NR2>, range: 0.1Hz~-2400.0Hz

Syntax of query : [SOURce:]: INTerharmonics: FREQuency: END?

Query returned parameters : <NR2>

[SOURce:]: INTerharmonics: LEVEl

Remark : Set the RMS of interharmonics as a percentage the fundamental frequency

Parameter : <NR2>, valid range as described in the operating instructions

Syntax of query : [SOURce:]: INTerharmonics: LEVEl?

Query returned parameters : <NR2>

[SOURce:]: INTerharmonics: DWELl

Remark : Set the interharmonics scanning time

Parameters : <NR2>，0.010~9999.999s

Syntax of query : [SOURce:]: INTerharmonics: DWELl?

Query returned parameters : <NR2>

FRTCh|MEASure: INTerharmonics: FREQuency?

Remark : Query the interharmonics scanning frequency in Hz

Syntax of query : FETCh: INTerharmonics: FREQuency?,
MEASure: INTerharmonics: FREQuency?

Query returned parameters :<NR2>

OUTPut: MODE

Remark : Set operating mode

Parameters : FIXED|LKST|PULSE|STEP|SYNTH|INYERHAR

Syntax of query : OUTPut: MODE?

Query returned parameters : FIXED|LKST|PULSE|STEP|SYNTH|INYERHAR

TRIG

Remark : After setting OUTput: MODE INTERHAR, this instruction activates INTERHAR mode in OFF, ON, PAUSE, or CONTANUE state. To change the parameter, set OUTput: MODE FIXED after TRIG OFF. Then set OUTPUT: MODE INTERHAR again and execute TRIG ON.

Parameters : OFF|ON|PAUSE|CONTINUE

Syntax of query : TRIG: STATE?

Query returns Parameters : OFF|RUNNING|COMPLETE

TETCh[: SCALar]: INTERHARmonics: FREQuency?
MEASure[: SCALar]: INTERHARmonics: FREQuency?

Remark : Return the scanning frequency superposed on the reference voltage

Syntax of query : TETCh[: SCALar]: INTERHARmonics: FREQuency?
MEASure[: SCALar]: INTERHARmonics: FREQuency?

Query returned parameters : <NR2>

I.3.3.15 SYSTEM subsystem

SYSTem
: ERRor?
: VERSion?

SYSTem: ERRor?

Remark :Query cause for communication command error

Parameter :None

Syntax of query : SYSTem: ERRor?

Query returns Parameters : NONE |FORMAT |RANGE (Radius |EXCEED (overmuch)|EXE

SYSTem: VERSion?

Remark :Query software version.

Parameter :None

Syntax of query : SYSTem: VERSion?

Query returns Parameters : V2.00,V2.00 (Control and display version numbers)

I.3.3.16 INSTRUMENT subsystem

INSTrument
: EDIT
: couple
: NSELect
: SElect
: PHASe

INSTrument: EDIT

Remark :In a multiphase power supply, the INST: EDIT ALL command will set all phases; INST: EDIT EACH will cancel the INST: EDIT ALL command.

Parameters : EACH|ALL

Syntax of query : INSTrument: EDIT?

Query returned parameters : None

INSTrument: COUPle

Remark :In a multiphase power supply, the INST: COUP ALL command will set to return all phases; INST: COUP NONE will cancel the INST: COUP ALL command.

Parameters : NONE|ALL

Syntax of query : INSTrument: COUPle?

Query returned parameters : None

INSTrument: NSElect

Remark : Set individual outputs for commands in a multiphase power supply. If EAST: COUP NONE is programmed, the phase selection command will be sent to the special output phase set by EAST: NSElect; INST: EDIT EACH will cancel the INST: EDIT ALL command. INST: COUP ALL will set all output phases. INST: NSEL selects the phase based on the number.

Parameters : 1|2|3

Syntax of query : INSTrument: NSElect?

Query returned parameters : 1|2|3

INSTrument: SElect

Remark :Set individual returns for queries in a multi-phase power supply. If INST:COUP NONE is programmed, the phase selection command is sent to the special phase backpass set by INSTrument:NSElect; INST:EDIT EACH cancels the INST:EDIT ALL command. INST:COUP ALL sets all phase returns. INST:SELect Selects the phase based on the number.

Parameters : POUTPUT1| POUTPUT12| POUTPUT13

Syntax of query : INSTrument: SElect?

Query returned parameters : 1|2|3

INSTrument: PHASe

Remark : This command sets switching of single-phase/three-phase mode.

Parameters : THREE|SINGLE|

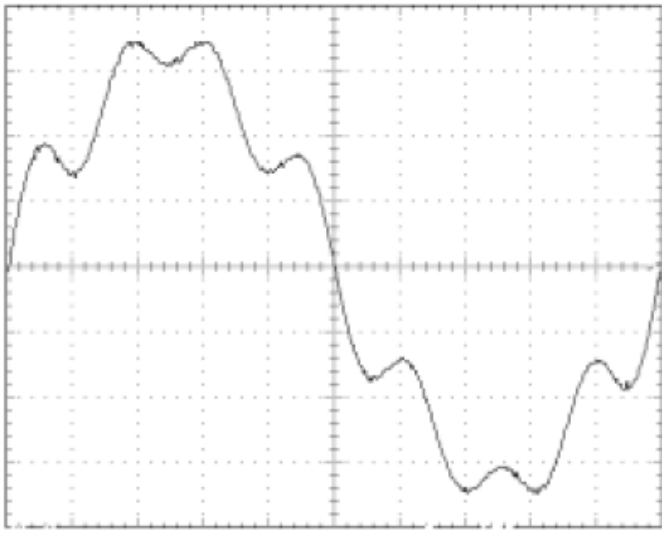
Syntax of query : INSTrument: PHASe?

Query returns Parameters: THREE|SINGLE|

Appendix II Built in Waveform

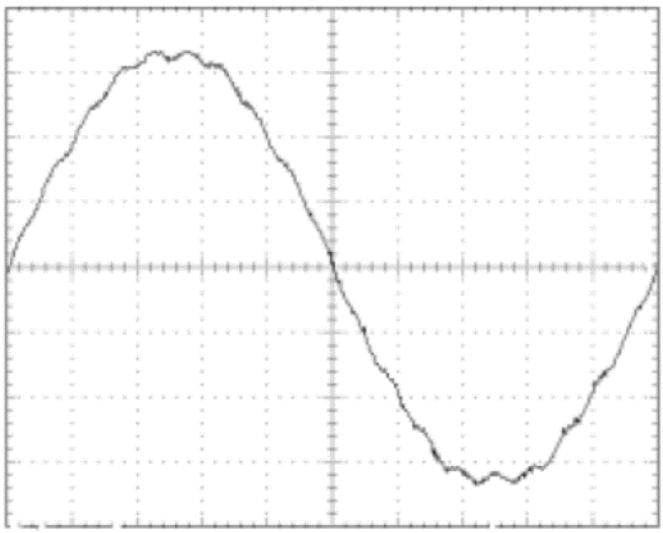
DST01:

Harmonic order	Percentage	Phase
5	9.80	0
7	15.80	0
8	2.16	0



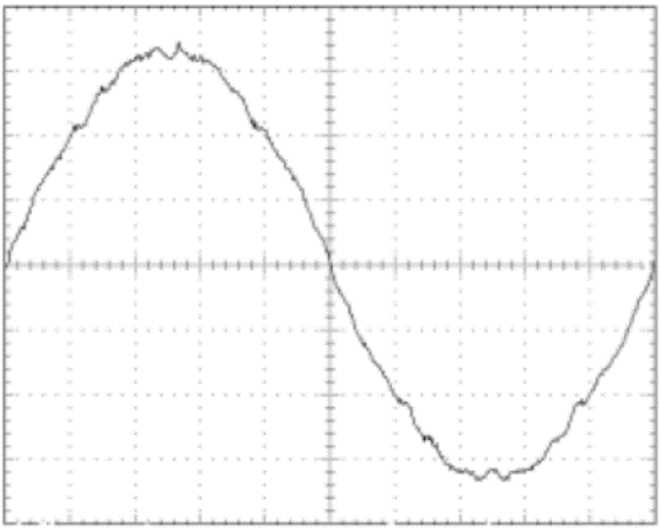
DST02:

Harmonic order	Percentage	Phase
3	1.44	0
7	1.47	0
19	1.95	0



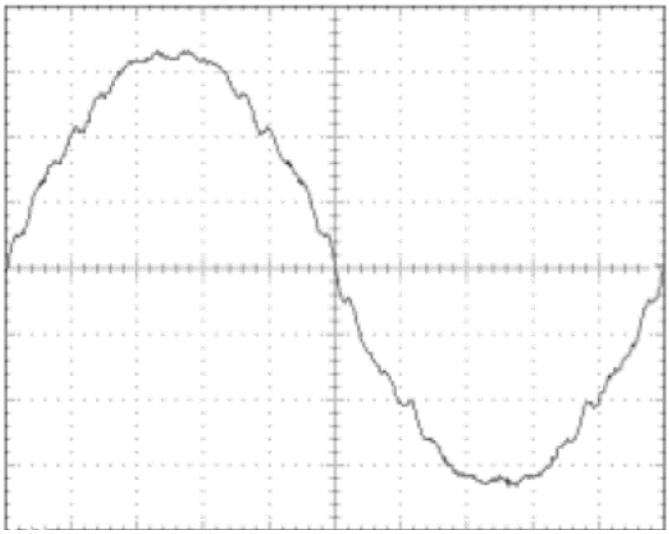
DST03:

Harmonic order	Percentage	Phase
3	1.96	0
5	1.37	0
7	1.98	0
23	1.42	0
31	1.00	0



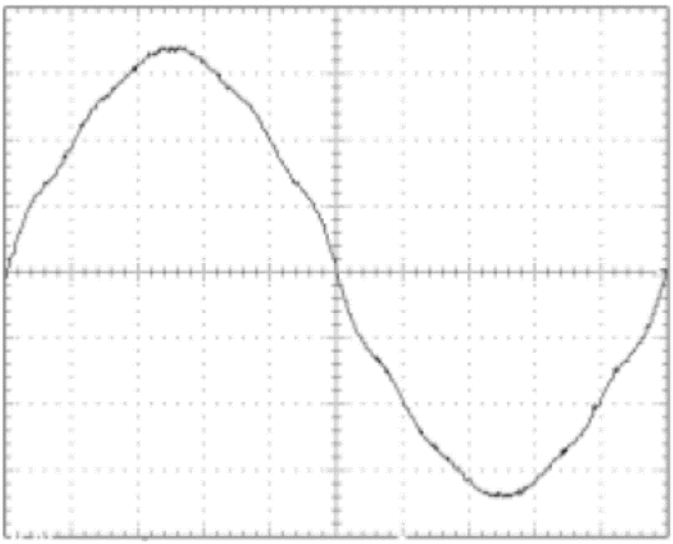
DST04:

Harmonic order	Percentage	Phase
3	2.45	0
5	1.88	0
7	2.46	0
23	1.95	0
25	1.09	0
31	1.52	0
33	1.09	0



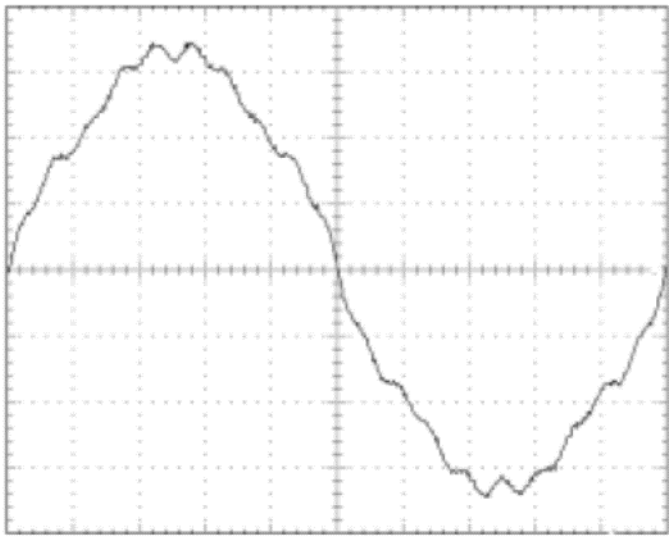
DST05:

Harmonic order	Percentage	Phase
3	1.10	0
5	2.80	0
7	1.40	0
9	2.30	0
11	1.50	0



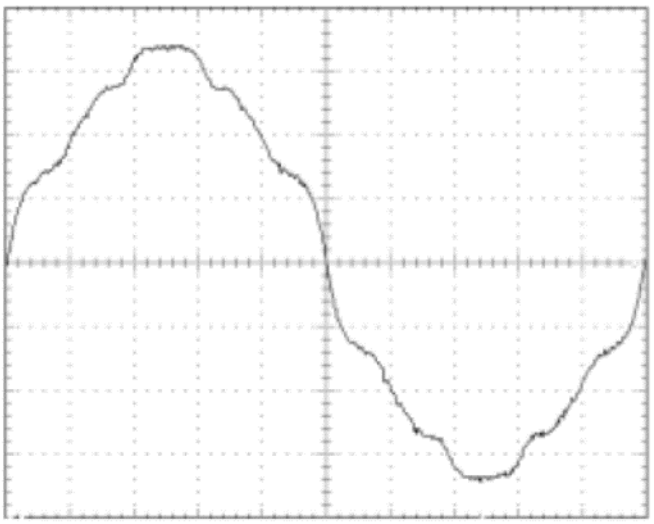
DST06:

Harmonic order	Percentage	Phase
3	1.60	0
5	4.17	0
7	3.40	0
15	1.02	0
19	2.92	0



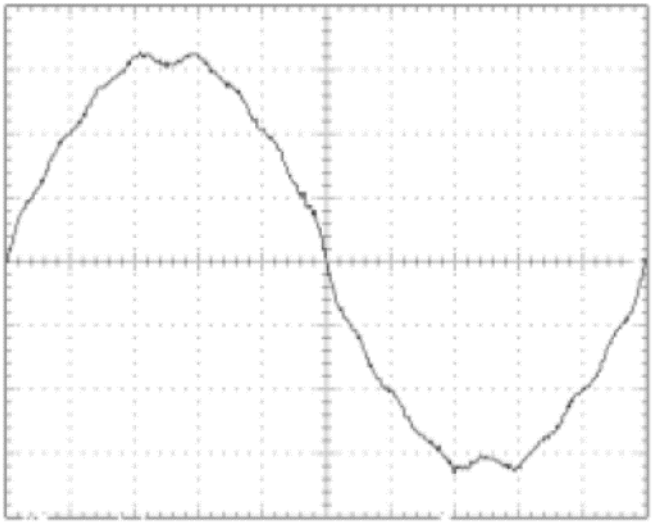
DST07:

Harmonic order	Percentage	Phase
3	2.17	0
5	5.59	0
7	2.79	0
9	4.56	0
11	2.92	0
15	1.35	0
21	0.99	0



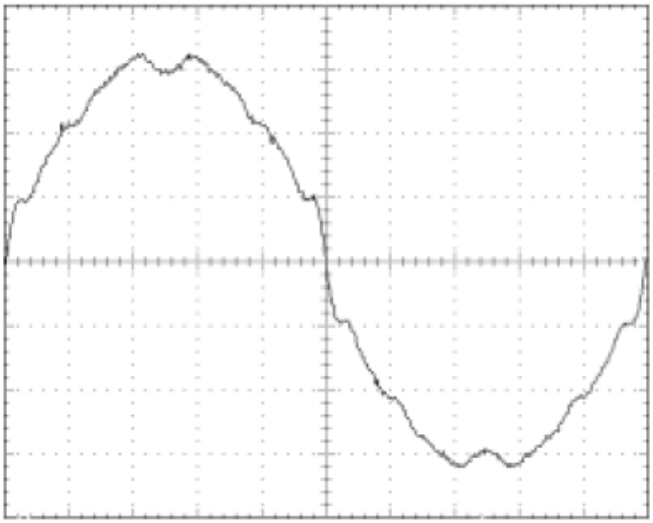
DST08:

Harmonic order	Percentage	Phase
3	4.86	0
5	1.58	0
7	2.64	0
11	1.37	0
15	1.95	0
17	1.06	0



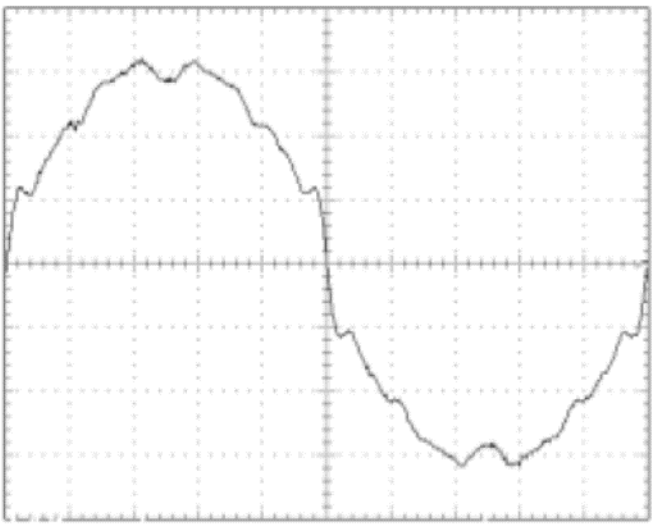
DST09:

Harmonic order	Percentage	Phase
3	7.72	0
5	2.39	0
7	4.01	0
11	2.07	0
13	1.03	0
15	2.94	0
17	1.59	0
19	1.00	0
21	1.04	0
23	1.19	0
25	1.03	0



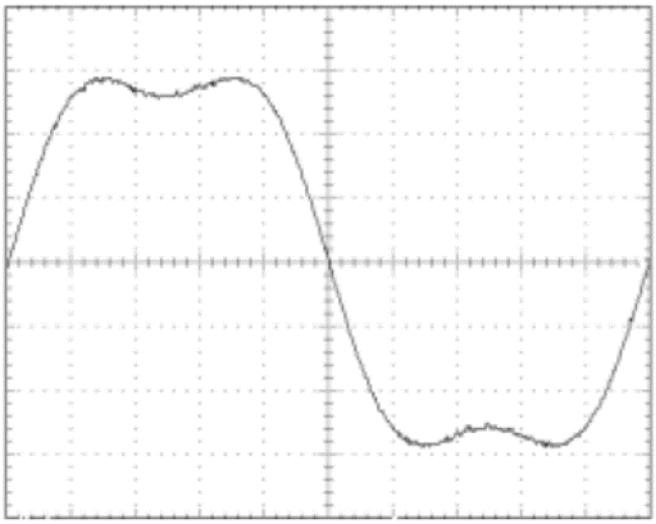
DST10:

Harmonic order	Percentage	Phase
3	9.78	0
5	3.19	0
7	5.37	0
9	1.17	0
11	2.76	0
13	1.37	0
15	3.92	0
17	2.13	0
19	1.34	0
21	1.39	0
23	1.59	0
25	1.36	0



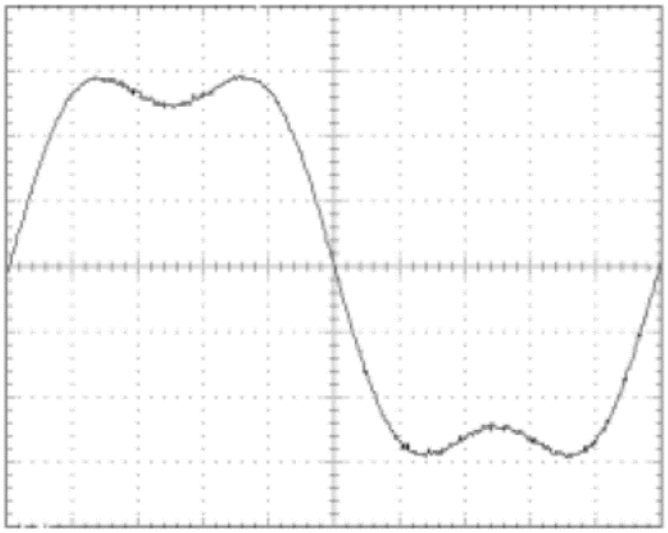
DST11:

Harmonic order	Percentage	Phase
3	17.72	0



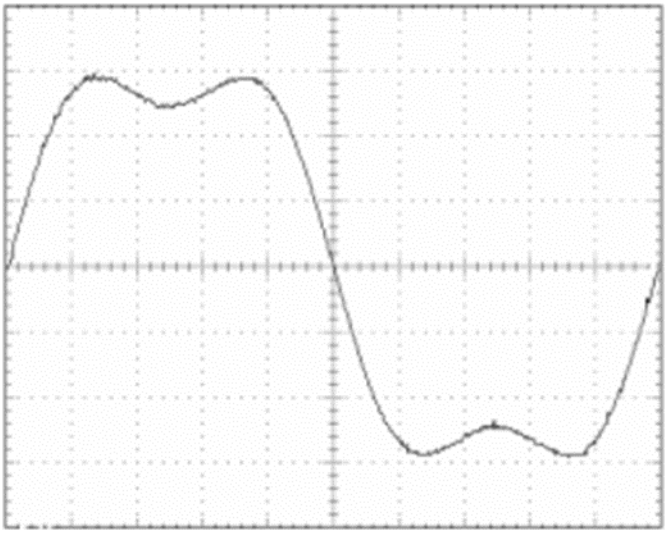
DST12:

Harmonic order	Percentage	Phase
3	21.21	0



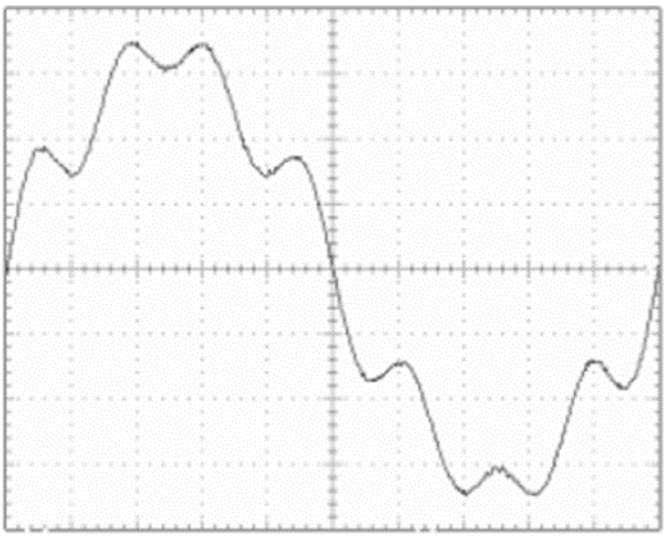
DST13:

Harmonic order	Percentage	Phase
3	24.48	0



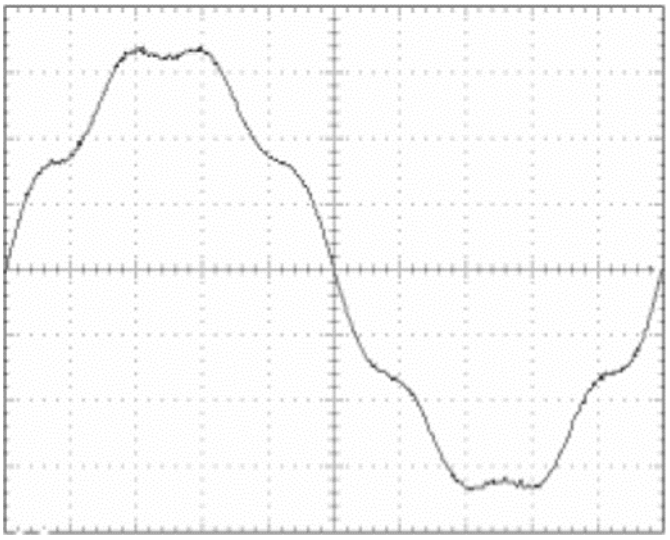
DST14:

Harmonic order	Percentage	Phase
2	2.19	0
5	9.83	0
7	15.76	0
8	2.34	0



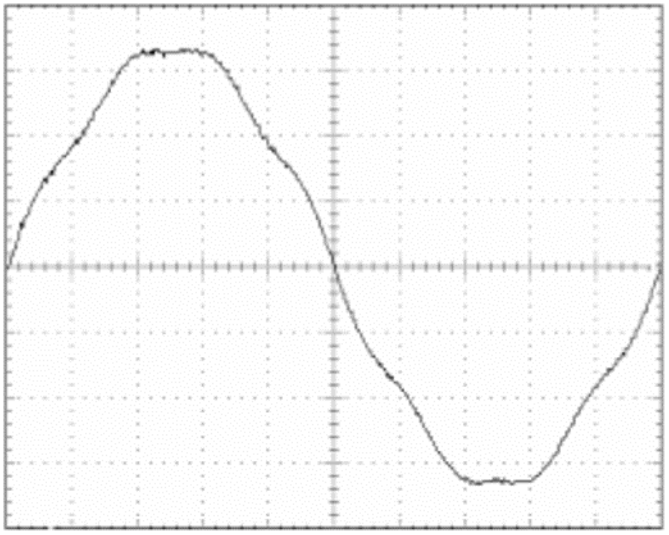
DST15:

Harmonic order	Percentage	Phase
2	1.04	0
5	4.90	0
7	7.86	0
8	1.14	0



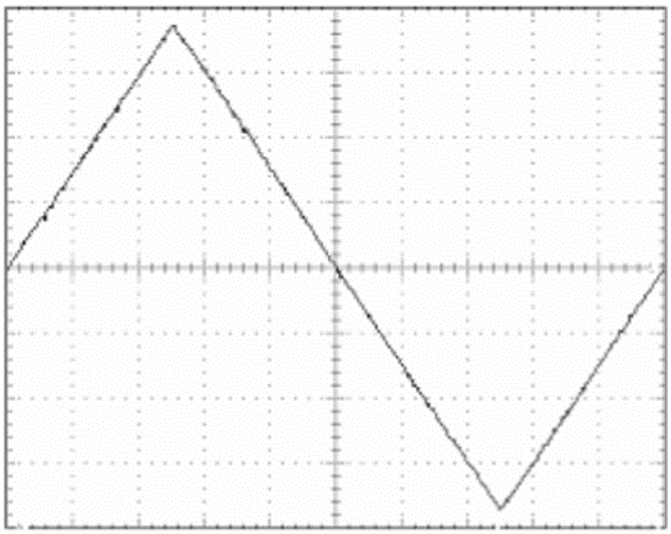
DST16:

Harmonic order	Percentage	Phase
5	2.42	0
7	3.91	0



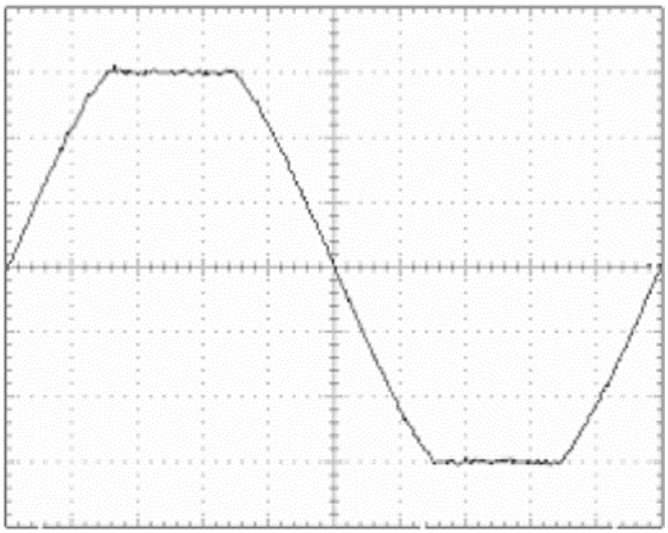
DST17:

Harmonic order	Percentage	Phase
3	11.08	180
5	4.05	0
7	2.03	180
9	1.27	0



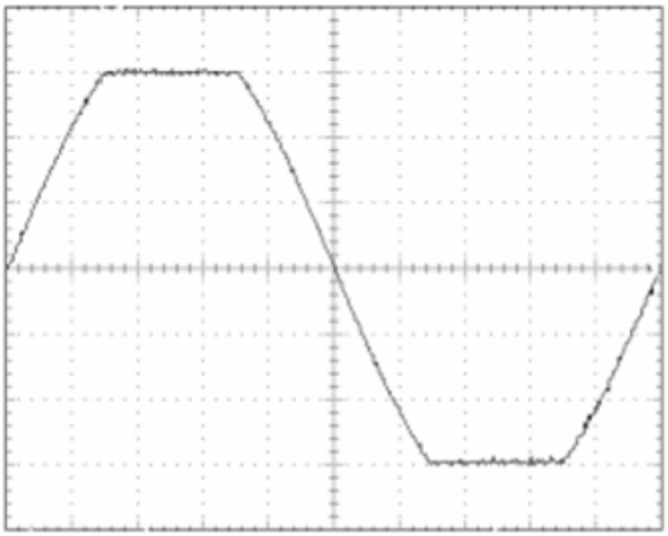
DST18:

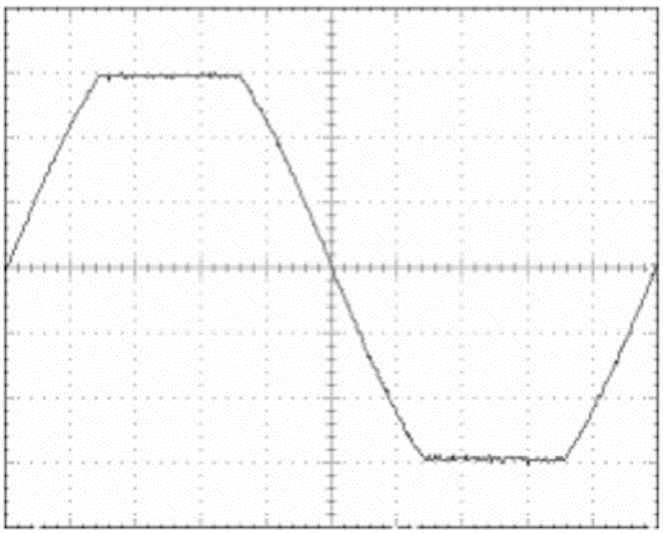
Harmonic order	Percentage	Phase
3	7.16	0
5	3.46	180



DST19:

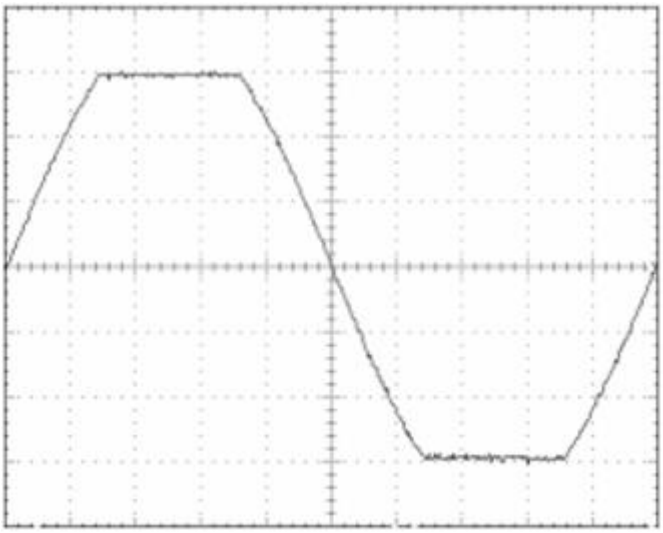
Harmonic order	Percentage	Phase
3	8.07	0
5	3.55	180
9	0.96	0
13	0.92	180





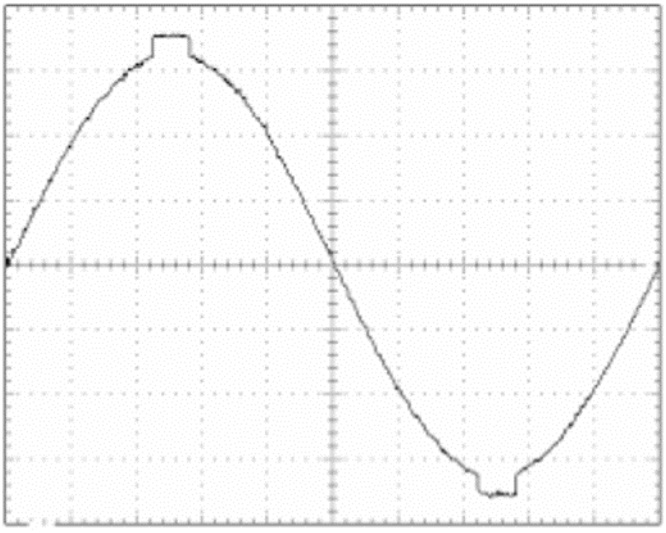
DST20:

Harmonic order	Percentage	Phase
3	9.38	0
5	3.44	180
9	1.12	0
13	0.50	180



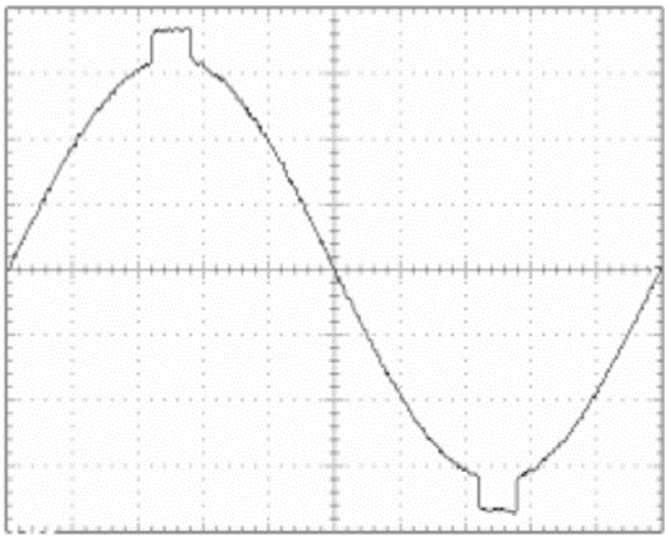
DST21:

Harmonic order	Percentage	Phase
3	2.06	180
5	1.77	0
7	1.62	180
9	1.23	0
11	0.91	180
13	0.54	0
23	0.51	0
25	0.53	180



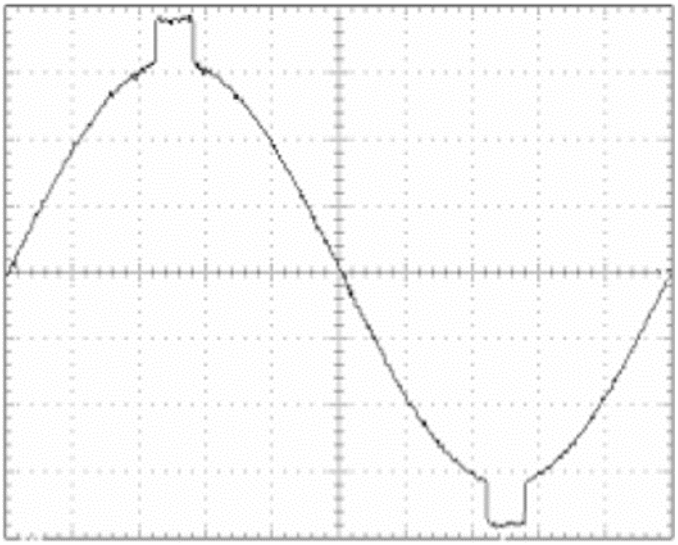
DST22:

Harmonic order	Percentage	Phase
3	3.08	180
5	2.72	0
7	2.43	180
9	1.97	0
11	1.41	180
13	0.86	0
21	0.62	180
23	0.73	0
25	0.77	180
27	0.69	0
29	0.56	180



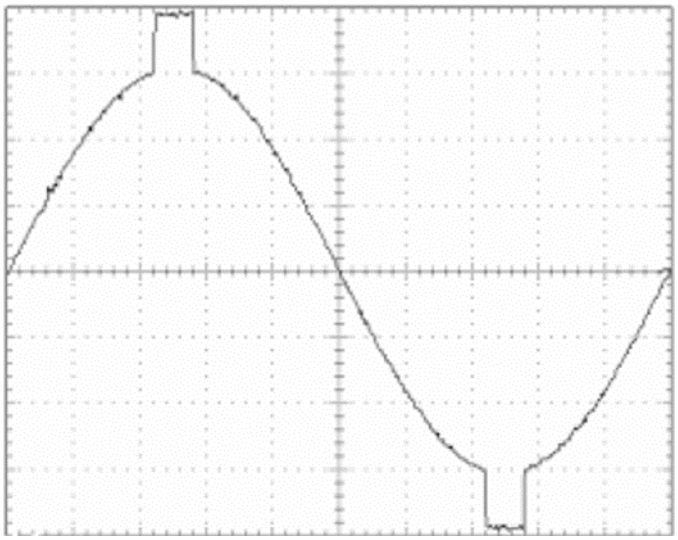
DST23:

Harmonic order	Percentage	Phase
2	0.13	180
3	4.28	180
5	3.77	0
7	3.27	180
9	2.57	0
11	1.93	180
13	1.22	0
15	0.55	180
19	0.46	0
21	0.83	180
23	0.97	0
25	1.04	180
29	0.75	180



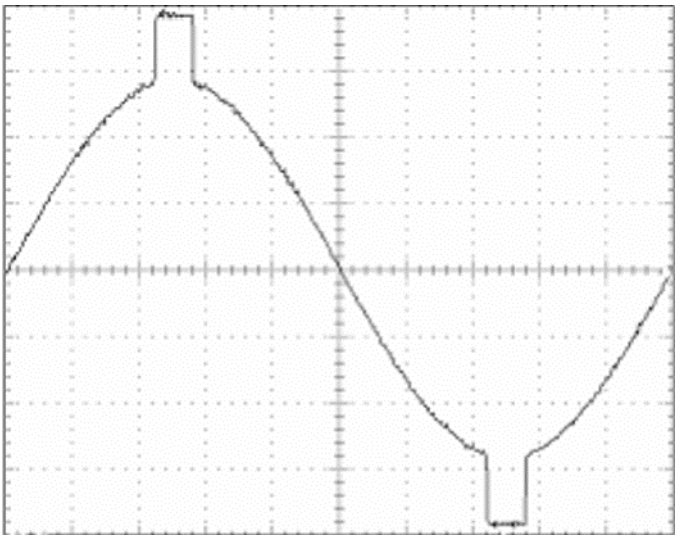
DST24:

Harmonic order	Percentage	Phase
3	5.74	180
5	5.11	0
7	4.44	180
9	3.52	0
11	2.63	180
13	1.65	0
15	0.80	180
19	0.61	0
21	1.07	180
23	1.28	0
25	1.35	180
27	1.22	0
29	0.98	180



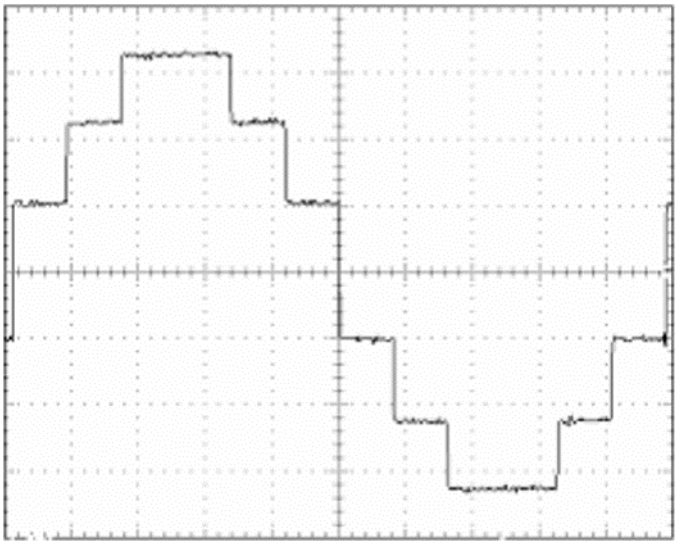
DST25:

Harmonic order	Percentage	Phase
3	7.35	180
5	6.60	0
7	5.74	180
9	4.57	0
11	3.41	180
13	2.16	0
15	1.04	180
19	0.74	0
21	1.35	180
23	1.64	0
25	1.73	180
27	1.56	0
29	1.24	180



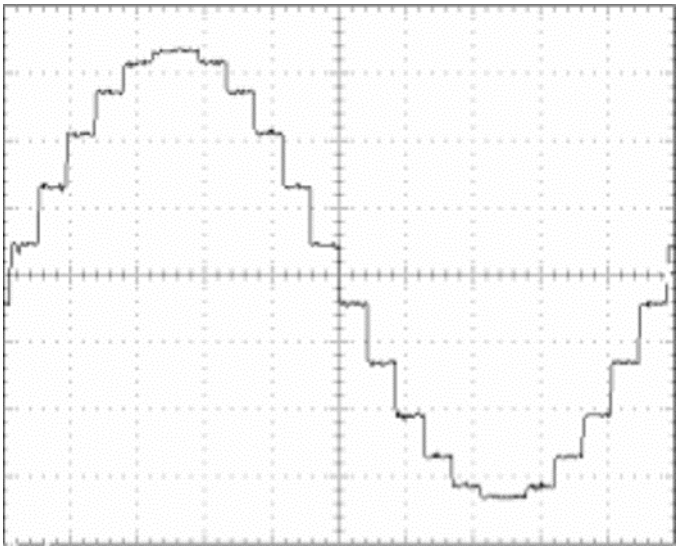
DST26:

Harmonic order	Percentage	Phase
5	3.41	0
7	2.55	0
11	9.22	0
13	7.68	0
17	0.90	0
19	0.90	0
23	3.88	0
25	3.56	0
31	0.50	0
35	2.34	0
37	2.21	0



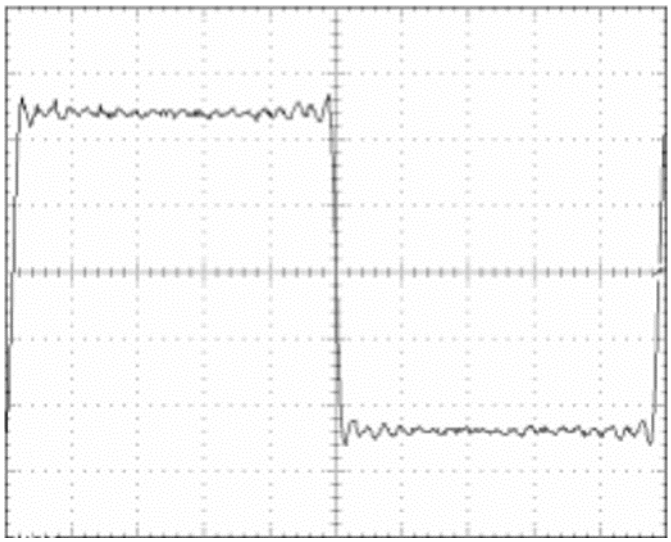
DST27:

Harmonic order	Percentage	Phase
21	1.24	0
23	4.91	0
25	2.21	0



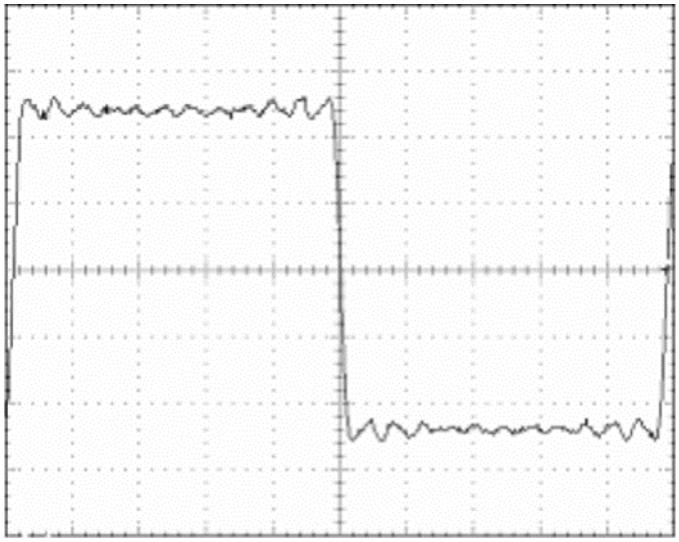
DST28:

Harmonic order	Percentage	Phase
3	33.39	0
5	20.01	0
7	13.76	0
9	10.70	0
11	8.39	0
13	7.06	0
15	5.86	0
17	4.86	0
19	4.86	0
21	4.52	0
23	4.00	0
25	3.49	0
27	2.91	0
29	2.45	0
31	1.94	0
33	1.95	0
35	1.91	0
37	1.89	0
39	1.83	0



DST29:

Harmonic order	Percentage	Phase
3	33.39	0
5	20.01	0
7	13.75	0
9	10.71	0
11	8.37	0
13	7.05	0
15	5.84	0
17	4.84	0
19	4.83	0
21	4.48	0
23	3.93	0
25	0.89	0
27	0.92	0
29	0.94	0
31	0.94	0
33	0.94	0
35	0.93	0
37	0.92	0
39	0.91	0



DST30:

Harmonic order	Percentage	Phase
3	33.39	0
5	20.01	0
7	13.74	0
9	10.67	0
11	8.33	0
13	6.99	0
15	5.26	0