BriPower
ESA Series User Manual

INFO & CONTACT ADDRESSES

Bridge Technology is a company focusing on business of power supplies and test systems for new energy applications. We are devoted to providing high quality products and solutions for customers.

Bridge Technology has a top-class R&D team in China, workstation on modularization and standardization power supplies and systems. We have sales, technical support, R&D and manufacture in Shanghai, Nanjing, and Chengdu.

Nanjing Bridge New Energy Technology was founded on Jan 12th, 2016, focusing on R&D and manufacturing BriPower brand power systems, including bi-directional AC sources for grid simulation, bi-directional DC sources for battery simulation, and regenerative loads. The BriPower AC&DC power systems are widely used in new energy and related fields.

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The pictures used in this manual do not represent the pictures of the products purchased by the user. The actual products purchased by the user may be customized versions, which may not match the manual in terms of appearance, weight, and technical parameters. For specific understanding of the actual appearance and technical parameters of related products, please contact Bridge Technology.

Software Statement

ESA series provides GUI software, which is installed on the TFT-Touch panel using the Windows OS. Unless interoperability requires by law, it is prohibited to reverse program, disassemble, or decompile the software.

Date and Reversion

Date	Version	Reversion record
Oct, 2020	1.0	Complete the manual
Jan, 2022	2.0	Update the functions
Feb, 2024	3.0	Update the functions and specifications

Safety Requirements

Summary of safety requirements

Please read the manual thoroughly before putting the equipment into operation. Pay regard to the following safety instructions and keep the manual nearby for future purpose to avoid any damage to the equipment. To prevent potential hazards, please follow the instructions in the manual to safely use the instrument. Bridge Technology have no liability for failures caused by violate protective measures or other safety regulations.

- **Unpacking**

  Please make sure that the shipping carton and the packing is without any damage. If any external damage is found, it is important to record the type of damage. Please keep the original packing to ensure the product is adequately protected in case it needs to be transported to the factory or make a claim.

- **Surroundings**

  To avoid electrical hazards or product failure, the equipment should be installed indoor which meets the environment requirements.

- **Operator**

  The equipment operator must follow the warnings, safety instructions and accident prevention measures in the manual.

- **Visual Inspection**

  After unpacking, please immediately check whether there is any defects or damage of the equipment during transportation. If there is obvious physical damage, please do not use the equipment. Please notify the carrier and the agent of Bridge Technology immediately.

- **Power Operation**

  Please confirm the model and voltage / current rating on the nameplate before operating. Damage caused by wrong power supply is not covered by the warranty.

- **Use Suitable Cables**

  Please select the appropriate cable according to the equipment specifications of the local country.

- **Equipment Groundin**

  The equipment is grounded through the protective ground bus. To avoid electrical hazards, connect the ground terminal to the protective ground terminal before connecting any input or output terminals.

- **Appropriate Overvoltage Protection**

  Make sure that there is no overvoltage on the product (such as overvoltage caused by lightning). Otherwise, the operator may be in danger of electrical hazards.

- **Avoid Exposing Circuits or Wires**

  When the module is powered on, do not touch the exposed connectors or components.

Safety Notices and Symbols

Safety Symbols

SHOCK HAZARD	WARNING	PROTECTIVE EARTH TERMAINAL

Other Symbols

IMPORTANT INFORMATION

Safety Information

	WARNING
	If improperly operated, it may cause injury or danger immediately.
	WARNING
	Potentially dangerous situation or practice. If not avoided, it will result in serious injury or death.
	CAUTIOUS
	Potentially dangerous situation or practice. If not avoided, may result in product damage or loss of important data.
	SHOCK HAZARD
	Danger, caution or warning caused by electricity. To avoid the risk of electric shock, the power supply must be firmly connected to the ground wire and other equipment wiring. Within a few seconds after the power supply is off, the high voltage at the output terminal may be maintained. Do not touch the cable or terminal block immediately.
	IMPORTANT INFORMATION
	Important information when operating the equipment/software.

Content

Chapter 1 Equipment Introduction

1.1 System Overview

1.1.1 Overview of ESA series

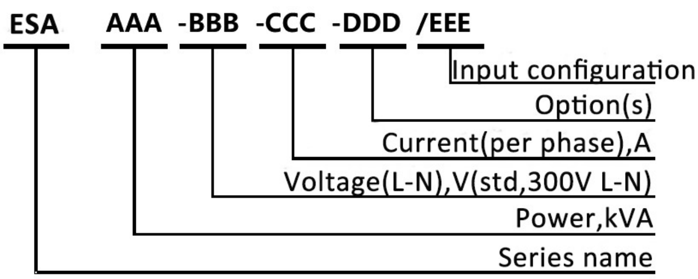
The BriPower ESA series is a high-performance and multi-functional grid simulator, using advanced PWM technology, which contains multi output power levels from 30kVA to 240kVA for single system, and up to 4 individual systems can be paralleled to achieve power levels up to 960KVA and above. Output power level of customized system goes up to 4MW and above.

ESA series uses bi-directional design, which can be used as a grid simulator in varieties of applications such as in Smart Grid, Energy Storage, Solar etc. ESA can also be used as regenerative AC electronic load (- LD option).

ESA series adopts dual DSP+FPGA design, with powerful calculation and control capabilities, and can display and save measured values at 10k/s sampling. The ESA series adopts optical fiber communication and performs multiple monitoring and protection of all main components, communication connections and systems. It is a reliable power supply product.

With touch panel on the front panel, users can control the power source through GUI software. System status indicators and emergency stop button are installed on the front panel. RS485 and LAN standard interface, optional RS232 and analog control interfaces are available for automated test applications.

1.1.2 Model Description



1.1.3 Features and configuration

- Output power: up to more than 4MVA and above
- 4 quadrant operation, regenerative up to 100% of rated output power back to grid (-R option)
- Independent three-phase output
- Up to 50th harmonic waveform generation
- Soft start: effectively restrain the impulse current when power on
- Voltage drop simulation (LVRT test)

- High voltage ride through simulation
- Regenerative AC load function (-LD option)
- Line impedance (RL) simulation (-IMP option)
- Voltage and frequency sequencing programming via GUI, slew rate can be programmed
- ON/ OFF output phase angle can be programmed
- Current limit can be programmed, output can be shorted for short circuit test
- Triger out, TTL signal output for voltage or frequency change
- Extends to DC output (-DC option)
- Adding single phase output (-1P option)
- Using water-cooling (-W option)
- Master-Slave interface (-MS option)
- Change to transformer output topology (-TR option)
- AC output frequency extended to 400Hz (only for CV mode) (-HF400 option)
- TFT-Touch panel operation
- LAN/RS485 interfaces (standard)
- RS232/Analog control interfaces (-ATI/-232 option)
- Mod-bus/SCPI protocols
- Emergency stop button
- Remote sense
- CE conformity
- 13 months warranty

1.1.4 General Specification

Input	
AC input Voltage	3P+N+PE, 380VLL±10% (std)
Frequency	47-63Hz
Efficiency	≥90%
Power Factor	0.95
THDi	≤3%
Output	
Output Modes	AC
Power Level	Single system 30-240KVA, customized up to 4MW and above
Voltage Ranges	0-300V L-N (std), voltage can be customized.

Current Ranges	Please refer to the Standard Models Specification
Frequency range	Standard 30-100Hz
Phase output	Phase B/C relative to phase A, 0.0~360.0°
Voltage Rise Time (10%~90%)	<1ms
Voltage Fall Time (90%~10%)	<1ms
Harmonic Generation	Up to 50th
Load Regulation	0.2%FS
Line Regulation	0.1%FS
Output Voltage THD	<1%FS (Resistive Load, @50/60Hz)
Power Accuracy	0.3%FS
Voltage Accuracy	0.1%FS
Current Accuracy	0.2%FS
Frequency Accuracy	0.01Hz
Phase accuracy	±0.3° @50Hz
Power Resolution	0.1kW
Voltage Resolution	0.01V
Current Resolution	0.1A
Frequency Resolution	0.01Hz
Phase Resolution	0.1°
Measurements	
Power Accuracy	0.3%FS
Voltage Accuracy	0.1%FS
Current Accuracy	0.2%FS
Frequency Accuracy	0.01Hz
Phase accuracy	±0.3° @50Hz
Others	
Standard Interface	LAN/RS485
Optional Interface	ATI/RS232
Protection	OVP, OCP, OPP, OTP
CE Conformity	EN 62040-1, EN 62040-2
Cooling	Forced Air Cooling
Temperature	Operating: 0~40°C Storage: -20~85°C
Operating Humidity	20-90%RH (None Condensing)

1.1.5 Standard Models Specification

Model	Power	Voltage	Current	Dimension (W*D*H mm)	Weight(kg)
ESA 45-300-68-R	45kVA	300V L-N	68A/ph	800*800*2000	720
ESA 60-300-91-R	60kVA	300V L-N	91A/ph	800*800*2100	750
ESA 120-300-181-R	120kVA	300V L-N	181A/ph	1800*900*2200	1300
ESA 150-300-227-R	150kVA	300V L-N	227A/ph	1800*900*2200	1600
ESA 180-300-273-R	180kVA	300V L-N	273A/ph	1800*900*2200	1600
ESA 250-300-378-R	250kVA	300V L-N	378A/ph	1800*900*2200	2000
ESA 300-300-454-R	300kVA	300V L-N	454A/ph	2700*900*2200	2800
ESA 500-300-757-R	500kVA	300V L-N	757A/ph	3600*900*1900	4600

Note: Total weight < 1400KG, the cabinet bottom is wheel structure; otherwise, it is channel steel structure.

1.2 Appearance and structure of Equipment

1.2.1 Appearance and outline

The overall appearance of the ESA (take ESA 30-300-46 as an example) is shown in Figure 1-1. There are lifting rings at the top of the cabinet for lifting operation and moving rollers at the bottom of the cabinet for users to move flexibly. There are TFT-Touch panel displayer (12 inch), status indicator, power knob, emergency stop button and RS232 interface (-232 option) on the front panel, product brand, RS485/LAN interface, TTL interface, ATI interface (-ATI option) which is for automated test applications on the rear panel.

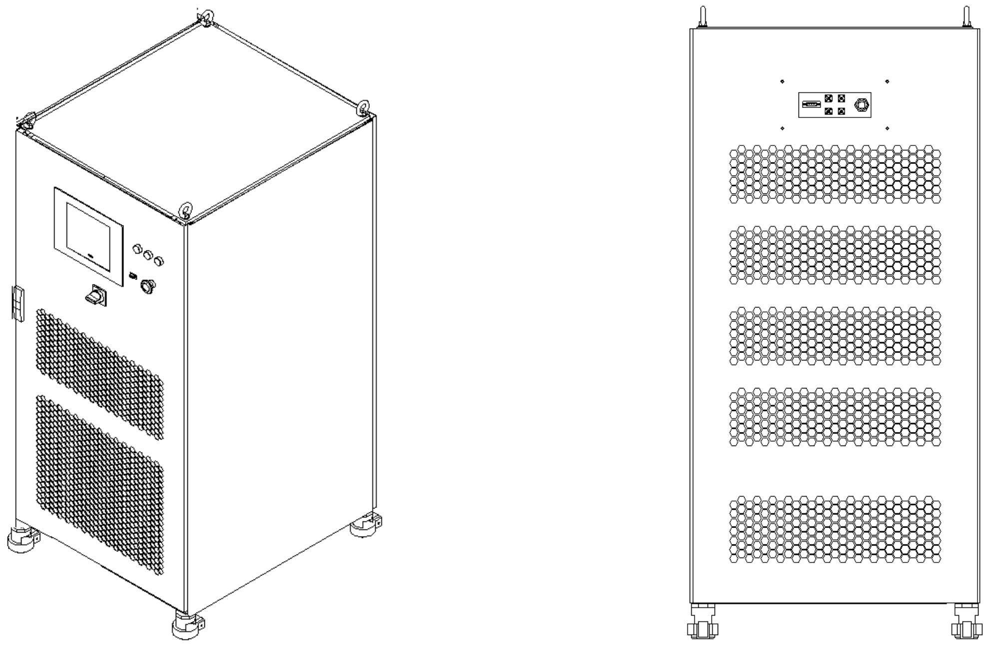


Figure 1-1 Overall appearance

1.2.2 Front Panel

The front panel of ESA series is equipped with a TFT-Touch panel displayer (12 inch), status indicators, power knob, emergency stop button and RS232 interface (-232 option).

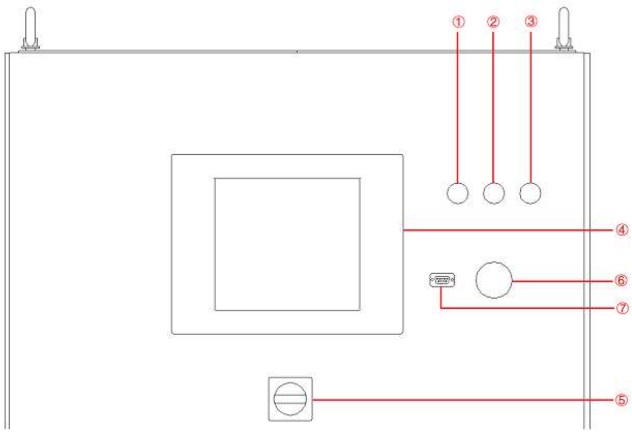


Figure 1-2 Front panel

Table 1-1

No.	Description	Notes
1	**White Light**	The power supply is standby.
2	**Green Light**	The power supply is operating normally.
3	**Red Light**	The power is failure.
4	**TFT-Touch Panel**	TFT touch panel displayer (12 inch), using the Windows OS., provides a GUI software, and has the functions of setting system parameters, output parameters, measurements, capturing and saving Waveform, and displaying faults.
5	**Power Knob**	The User can use power knob to power on/off the unit without opening the cabinet door. Turn clockwise to power on and turn counterclockwise to power off.
6	**Emergency Stop Button**	The emergency stop button is only used in the event of an emergency. Do not press the button under normal working conditions. Turn the emergency stop button clockwise to the right can cancel the emergency braking.
7	**RS232 interface**	Optional, for remote control (-232 option)

1.2.3 Rear panel

The rear panel of ESA series is equipped with RS485/LAN interface (standard), TTL interface(standard) and ATI interface (-ATI option).

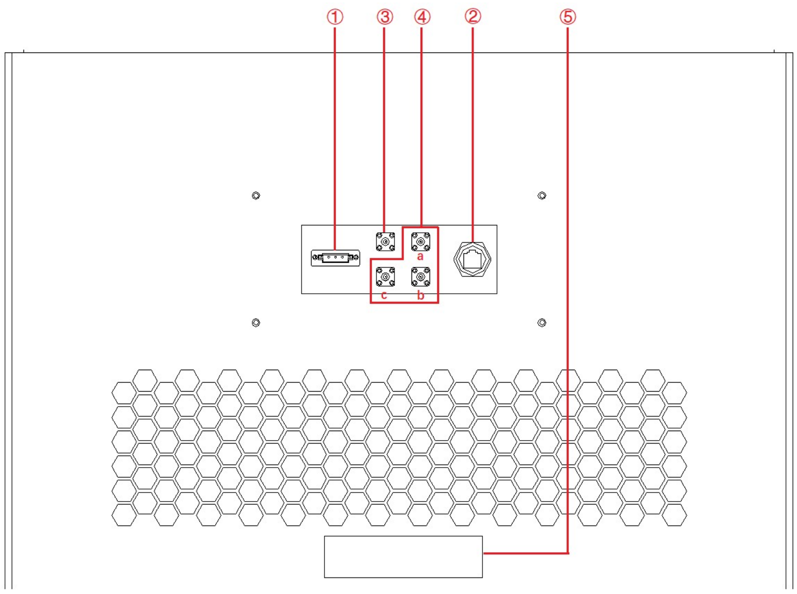


Figure 1-3 Rear panel

Table 1-2

No.	Description	Note
1	**RS485 interface**	Standard, used for remote control.
2	**LAN interface**	Standard, used for remote control.
3	**TTL**	Standard, for users to observe the trigger signal after connecting with the oscilloscope.
4	**ATI interface (-ATI option)**	a. Analog control interface-Phase A b. Analog control interface-Phase B c. Analog control interface-Phase C
5	**Product brand**	The input/output configuration of the product is marked.

1.2.4 Internal structure

As shown in Figure 1-4, take ESA 200-300-300 as an example, from top to bottom, the internal modules of ESA series are: ①Control module, ②Power module, ③Main input/output components, ④Input/Output wiring terminals and other interfaces.

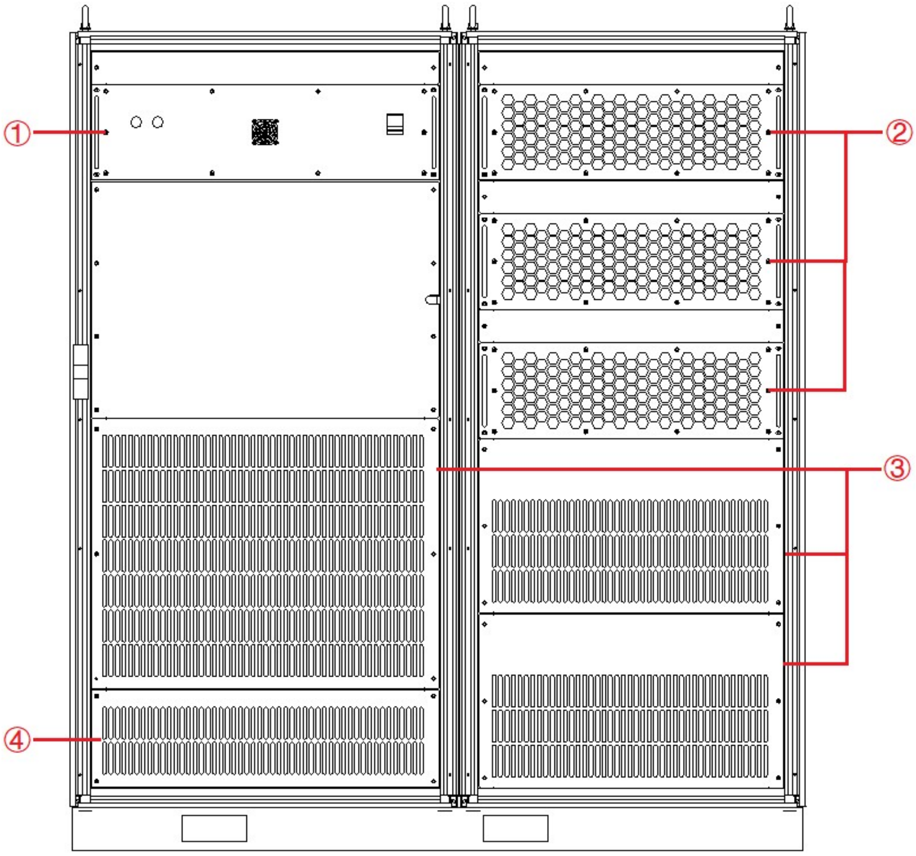


Figure 1-4 Internal structure

1.2.5 Front panel of control module

The front panel of control module is equipped with LAN interface (standard), Master-Slave interface (option), fan, and a power switch.

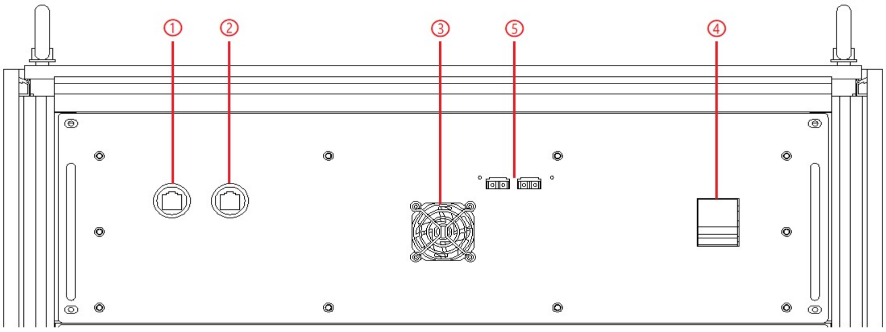


Figure 1-5 Front panel of control module

Table 1-3

No.	Description	Notes
1	**LAN interface**	Standard, for touch screen communication
2	**LAN interface**	Standard, for debugging and firmware update
3	**Fan**	For control module heat dissipation
4	**Power switch**	For the power on / off the control module
5	**Master-Slave interface**	Optional, for communication between power supply when power supplies of the same power are connected in parallel. (Refer to 1.3.8.2 for specific wiring method) (-MS option)

1.2.6 Connection layer and other interface layers

The power input/output wiring copper bar, 220V auxiliary terminal, external emergency stop interface and remote sense interface are shown when remove the bottom baffle, as shown in Figure 1-6.

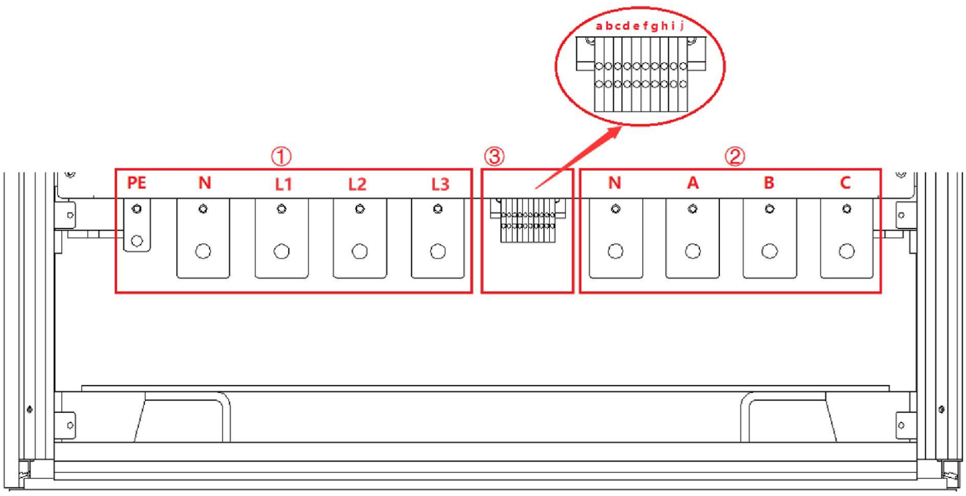


Figure 1-6 connection layer and other interface layers

Table 1-4

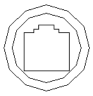
No.	Description	Notes
1	**Input Wiring copper bar**	From left to right: PE, N, L1, L2, L3
2	**Output Wiring copper bar**	From left to right: N, A, B, C
3	**Other terminals**	a + b → Control module 220V auxiliary power terminals (+, -) (No need to wire)
		c + d → External emergency stop interface (+, -)
		e+h →A phase remote sense interface (+， -) f+i →B phase remote sense interface (+， -) g+j →C phase remote sense interface (+， -)

IMPORTANT INFORMATION

Figure 1-6 takes ESA 200-300-300 as an example. Affected by the output voltage/current level, electrical clearance and creepage distance, the position of the output copper bar and other terminals may change. Please refer to the final design of the project.

1.3 Interface Description

1.3.1 LAN interface（standard）



The LAN interface is one of the equipment communication interfaces.

1.3.1.1 Location of LAN interface

The two LAN interfaces on front panel of the control module are used for touch panel communication (Figure 1-7①) and hardware debugging (Figure 1-7②).

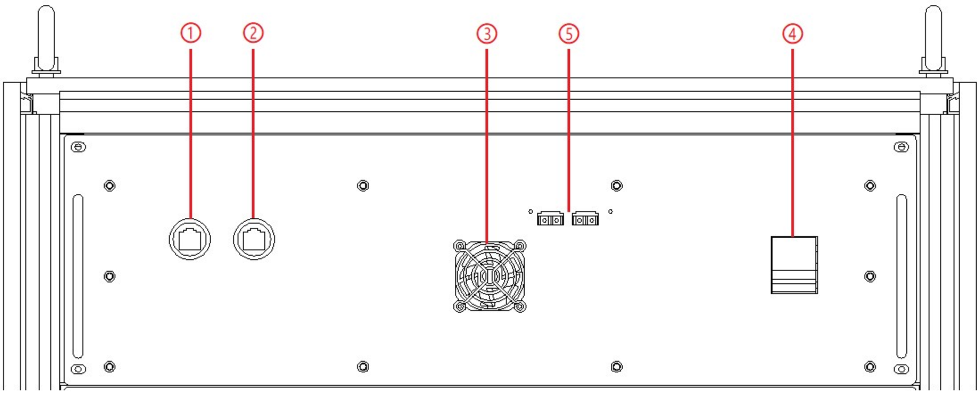


Figure 1-7 front panel of the control module

IMPORTANT INFORMATION

The LAN interface (Figure 1-7①) is connected to the touch panel by default before shipment. Do not remove it without permission.

The interface (Figure 1-7②) is used for debugging before shipment. Do not use it without permission.

The LAN interface located on the rear panel is used for remote control of equipment (Figure 1-8②).

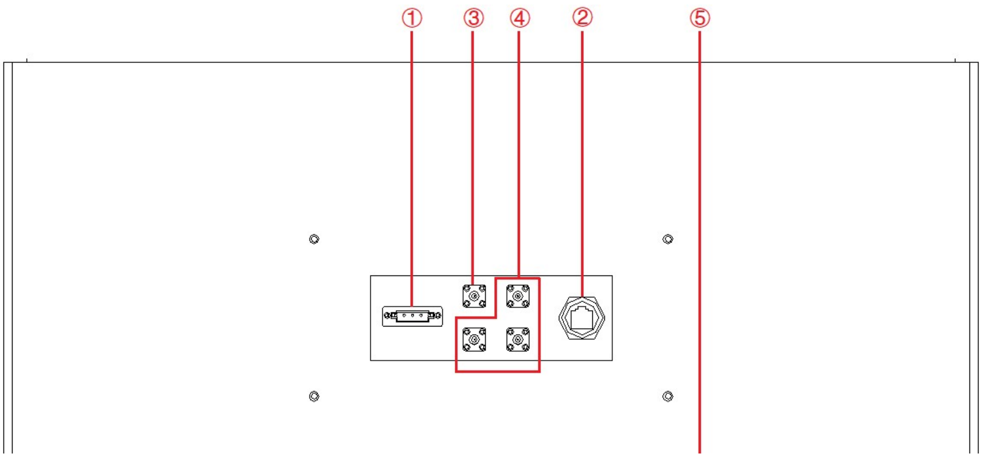


Figure 1-8 Rear panel

1.3.1.2 Connection of LAN interface

Please refer 5.2 for detail connection method.

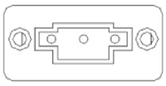
IMPORTANT INFORMATION

The network wire used for LAN connection is Straight-Through Wired Cable.

1.3.1.3 Remote control setting

Please refer 5.2. for detailed remote control setting method.

1.3.2 RS485 interface (standard)



The RS485 interface is one of the equipment communication interfaces. It is used for remote control and can effectively transmit signals under long-distance conditions and in environments with high electronic noise. RS485 interface makes it possible to connect to local networks and configure multi-drop communication link.

1.3.2.1 Location of RS485 interface

The RS485 interface is located on the rear panel of power supply (Figure 1-9①).

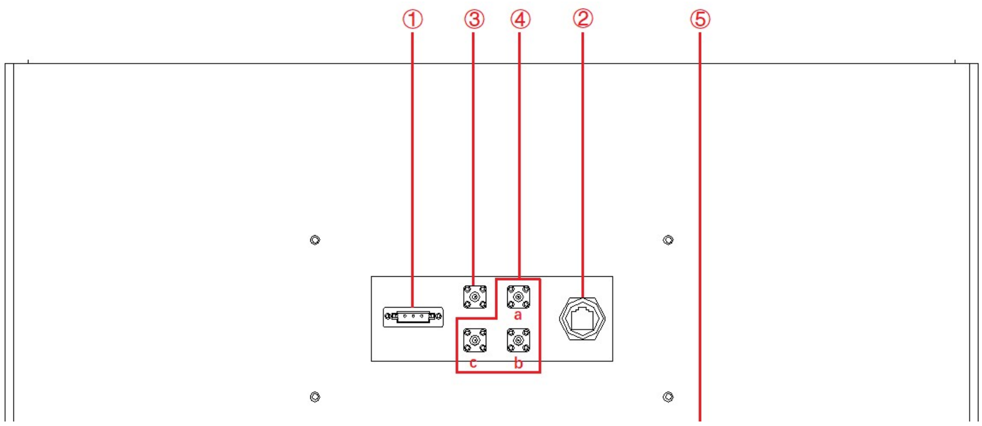


Figure 1-9 Rear panel

1.3.2.2 Connection of RS485 interface

The RS485 interface of ESA series adopts "two-wire + signal ground" wiring. In low-speed, short-distance, non-interference occasions, ordinary twisted-pair wire can be used. Conversely, in high-speed and long-line transmission, RS485 special cable (STP-120Ω 18 AWG) (one pair) with impedance matching (generally 120Ω) must be used. In the environment with severe interference, armored twisted pair shielded cable (ASTP-120Ω 18AWG) (one pair) should also be used. The connection method is shown in Figure 1-10.

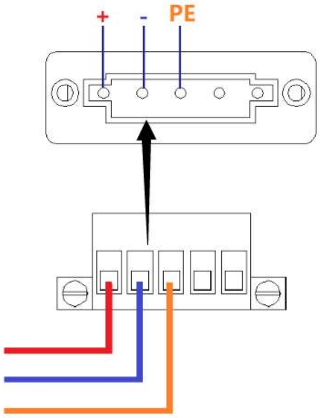
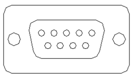


Figure 1-10 Connect RS485

The port setting information:

Port:	COM port on control PC
Baud Rate:	9600
Data Bits:	8
Stop Bits:	1
Parity:	None
Flow control:	None

1.3.3 RS232 interface (-232 option)



RS232 is one of the equipment communication interfaces for remote control. The standard value of RS232 maximum transmission distance is 15 meters, and it can only communicate point to point.

1.3.3.1 Location of RS232

The RS232 interface is located on the front panel of power supply (Figure 1-11⑦).

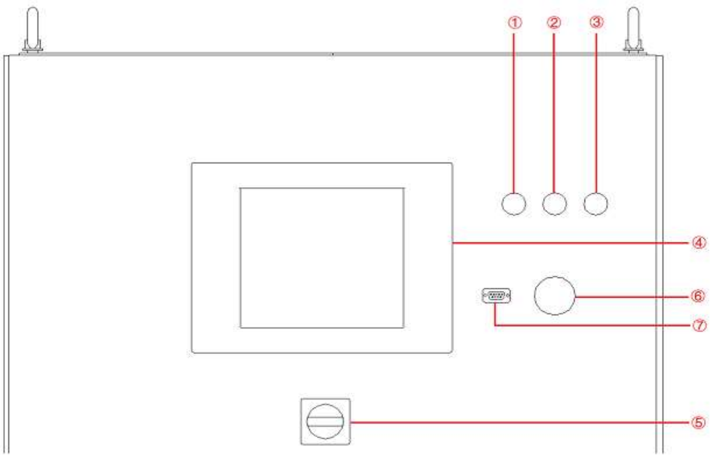


Figure 1-11 Front panel of the power supply

1.3.3.2 Connection of RS232 interface

The RS232 interface usually appears in the form of 9 pins (DB-9). Two RS232 interfaces (one male and one female) can be used by directly plugging in the interconnect normally. The meaning of the pins is as follows. Baud rate is 9600, stop bit is 1.

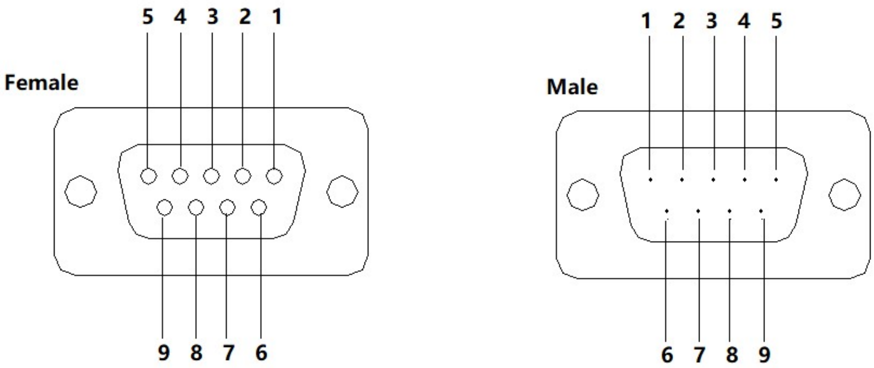


Figure 1-12 RS232 pin

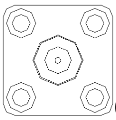
Table 1-5

Pin	Definition	Symbol	Signal transmission direction
1	Data Carrier Detect	DCD (Data Carrier Detect)	←
2	Received Data	RXD (Received Data)	←
3	Transmit Data	TXD (Transmit Data)	→
4	Data Terminal Ready	DTR (Data Terminal Ready)	→
5	Signal Ground	SG (Signal Ground)	-
6	Data Set Ready	DSR (Data Set Ready)	←
7	Request To Send	RTS (Request To Send)	→
8	Clear To Send	CTS (Clear To Send)	←
9	Ring Indicator	RI (Ring Indicator)	←

The port setting information:

Port:	COM port on control PC
Baud Rate:	9600
Data Bits:	8
Stop Bits:	1
Parity:	None
Flow control:	None

1.3.4 TTL interface (standard)

Connect the TTL interface to the oscilloscope. When the voltage/frequency changes, the user can observe the TTL signal level changes through the oscilloscope Waveform.

1.3.4.1 Location of TTL interface

The TTL interface is located on the rear panel of power supply (Figure 1-13③).

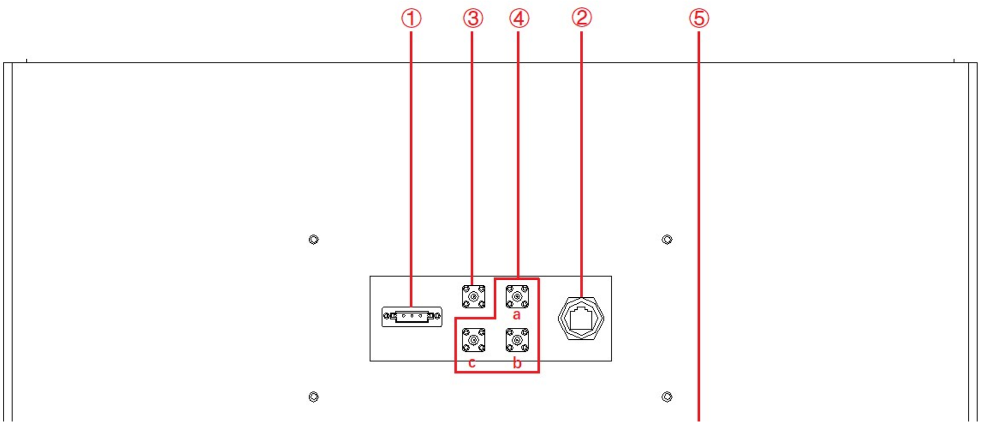


Figure 1-13 Rear panel

1.3.4.2 Connection of TTL interface

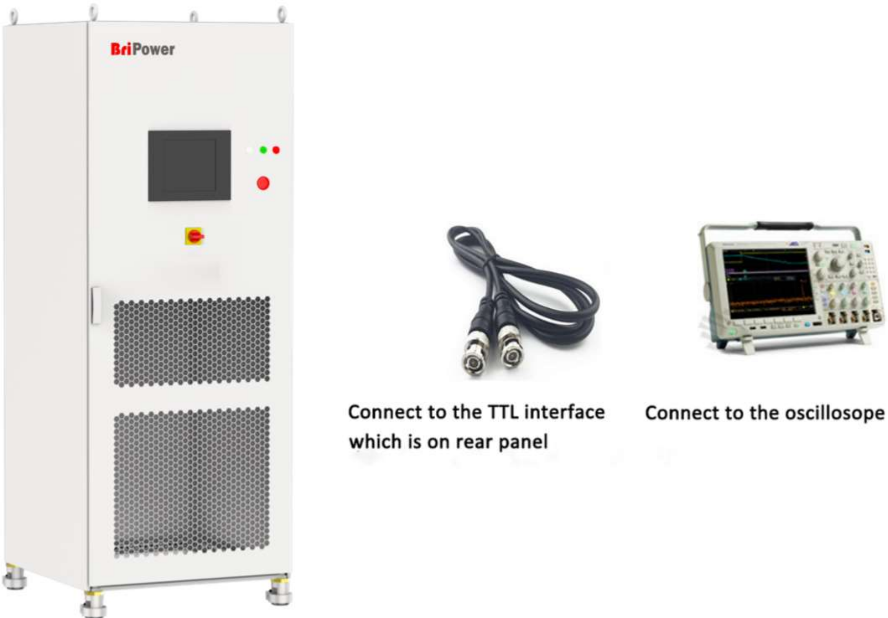
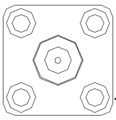


Figure 1-14 TTL interface connection method

1.3.5 ATI Interface (-ATI option)

The output voltage of power supply can be controlled via control signals and by using the analog input (ATI interface). ESA series uses BNC connector for this analog input. The set value is adjusted according to the analog input voltage (0~±5V).

1.3.5.1 Location of ATI interface

The AIT interface is located on the rear panel of power supply (Figure 1-15④).

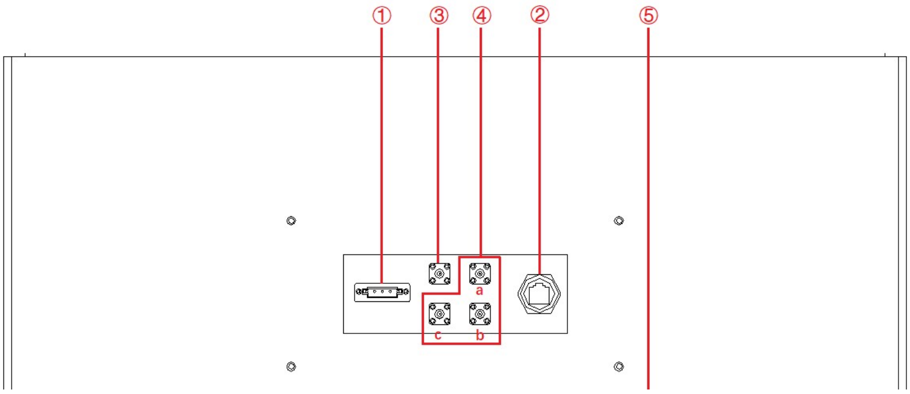


Figure 1-15 Rear panel of power supply

1.3.5.2 Connection of ATI interface

The ATI interface of the ESA series appears as BNC. The connection between the equipment and the signal generator is shown in Figure 1-16.

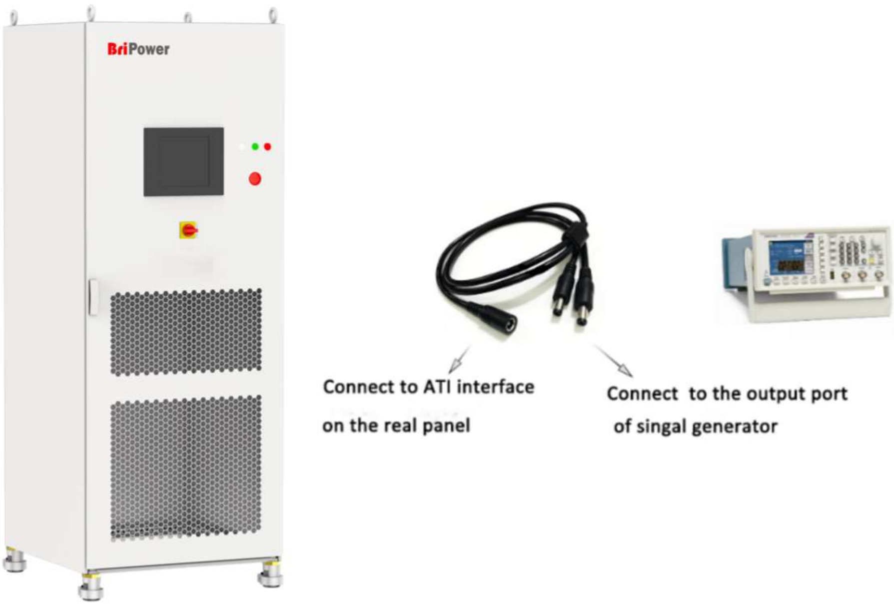


Figure 1-16 ATI interface connection method

1.3.6 External emergency stop interface (standard)

ESA series provides an external emergency stop interface, which can be connected to the user's external emergency stop switch. When an emergency occurs, the user does not need press the emergency button on the front panel of the power supply, which can achieve protection action quickly.

1.3.6.1 Location of emergency stop interface

The External emergency stop interface is located at the internal wiring layer③： c, d（Figure 1-17).

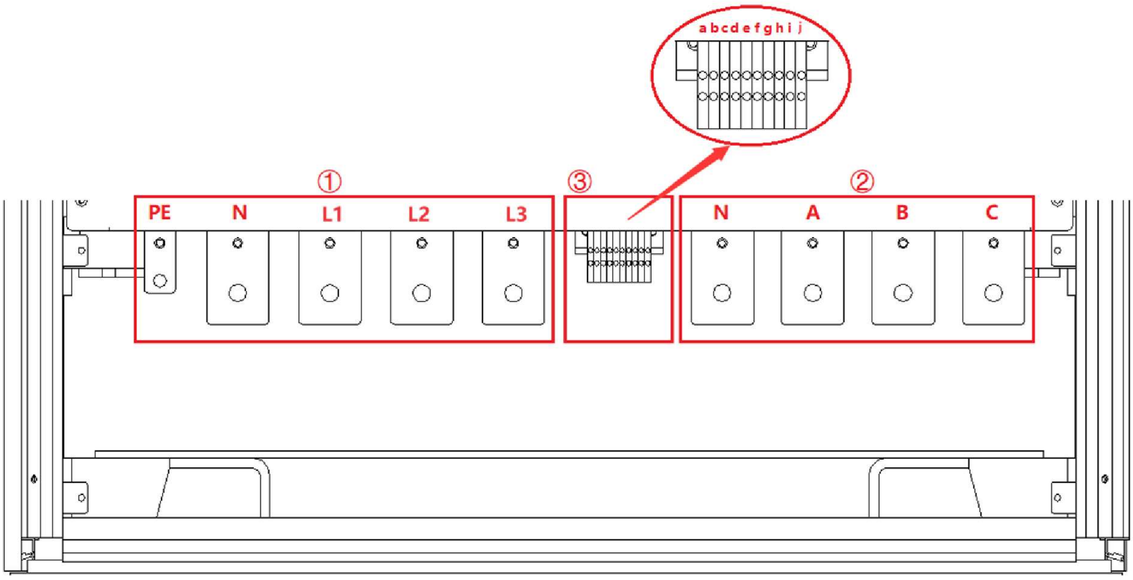


Figure 1-17

1.3.6.2 Connection of emergency stop interface

The wiring method of external emergency stop is shown in Figure 1-18.

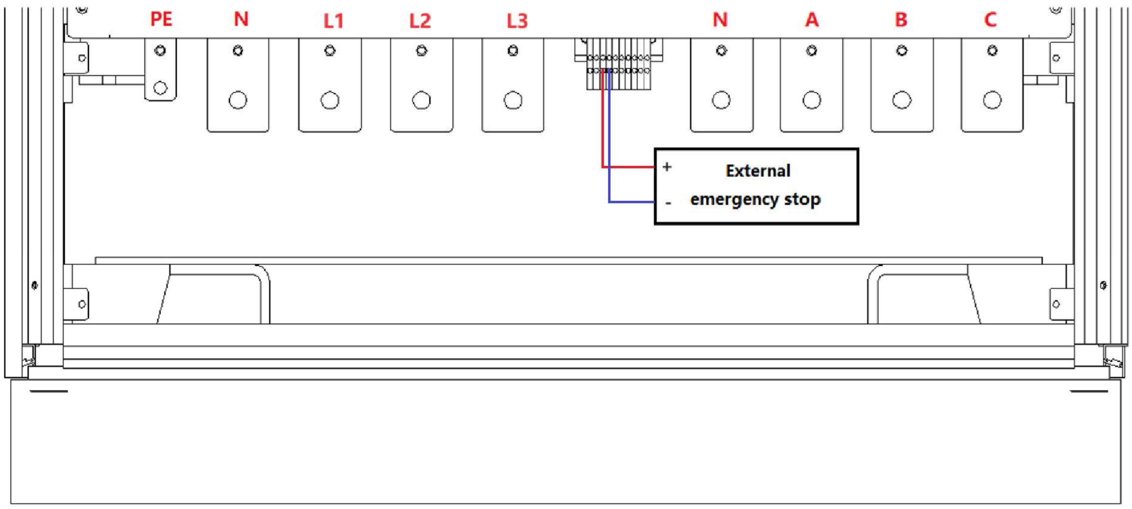


Figure 1-18 Emergency stop interface connection

1.3.7 Remote sense interface (standard)

The remote sense wire is connected to the output terminal of the power supply by the remote sense port. The voltage at the output terminal is fed back to the power supply control loop through the sense wire. The power supply will adjust its output to compensate for the above voltage drop, so that the voltage across the load is equal to the set voltage, so as to achieve the accuracy of the test.

1.3.7.1 Location of remote sense interface

The remote sense interface is located at the internal wiring layer-③: e, f, g, h, i, j (Figure 1-19).

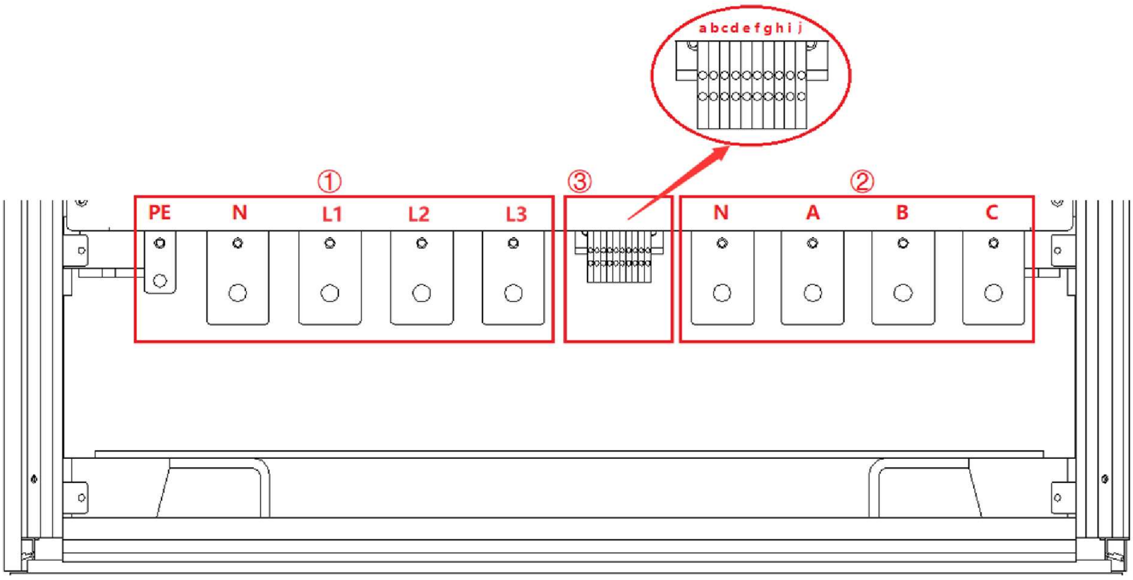


Figure 1-19

1.3.7.2 Connection of remote sense interface

The remote sense interface is connected to the output terminal of the ESA power supply by default before leaving the factory, as shown in Figure 1-20.

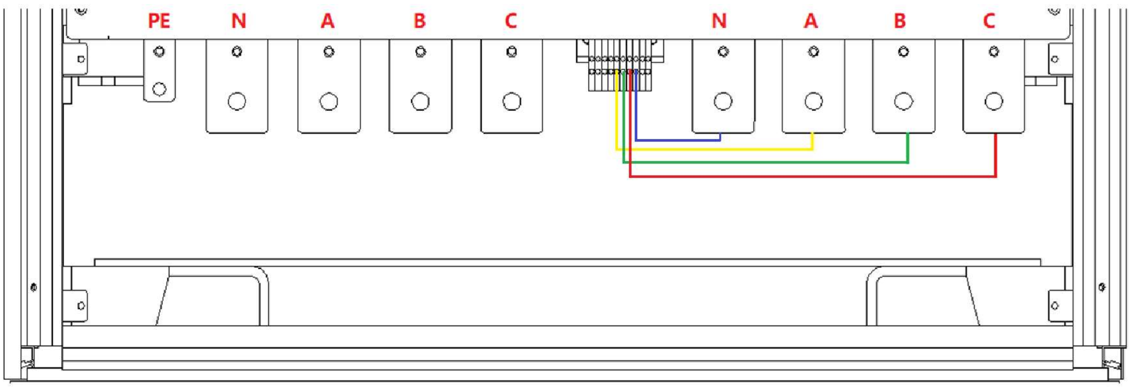


Figure 1-20 Remote sense connection (factory default wiring status)

If the user needs to compensate the input end of the DUT, please remove the default connection cable, and then select a cable with a suitable wire to connect the remote sense terminal to the input end of the DUT, as shown in Figure 1-21.

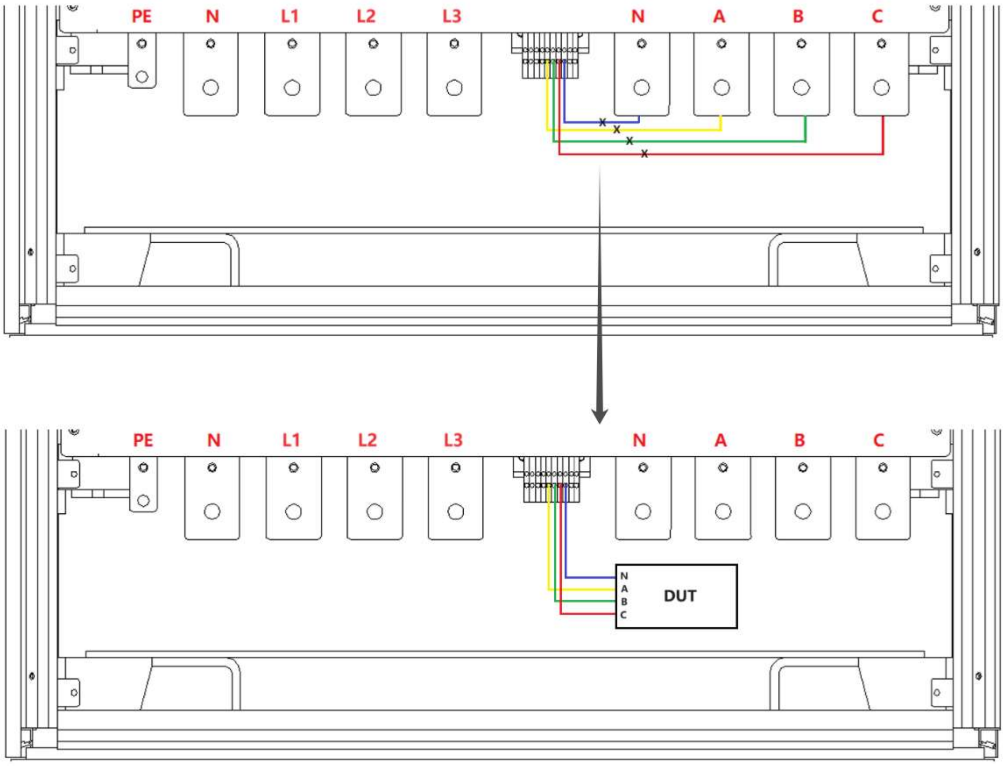


Figure 1-21 Remote sense connection method

1.3.8 Master-slave interface（-MS option）

ESA series support parallel connection of power supply of the same power.

1.3.8.1 Location of master-slave interface

The master-slave interface is located on the front panel of the control module, as shown in Figure 1-22⑤.

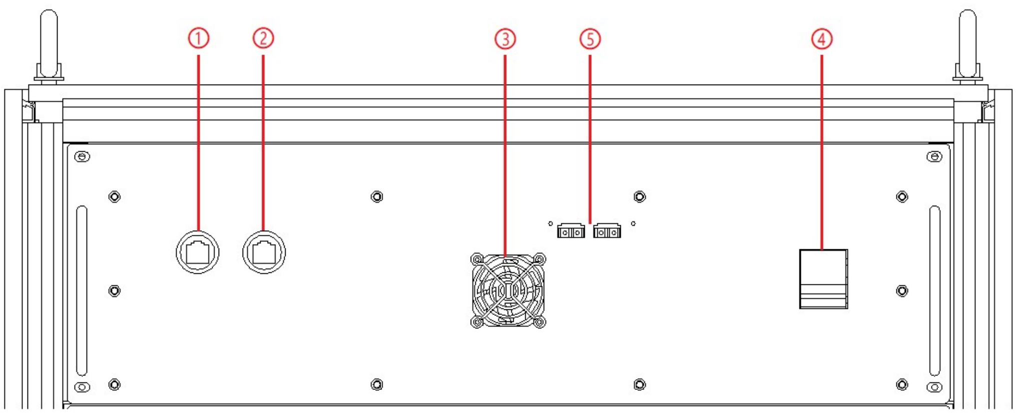


Figure 1-22 Front panel of control module

1.3.8.2 Connection of master -slave interface

When power supplies are connected in parallel, the specific operation steps are as follows.

Step 1:

Pass the fiber optic cable through the cable holes on the top of the cabinet, as shown in Figure 1-23.

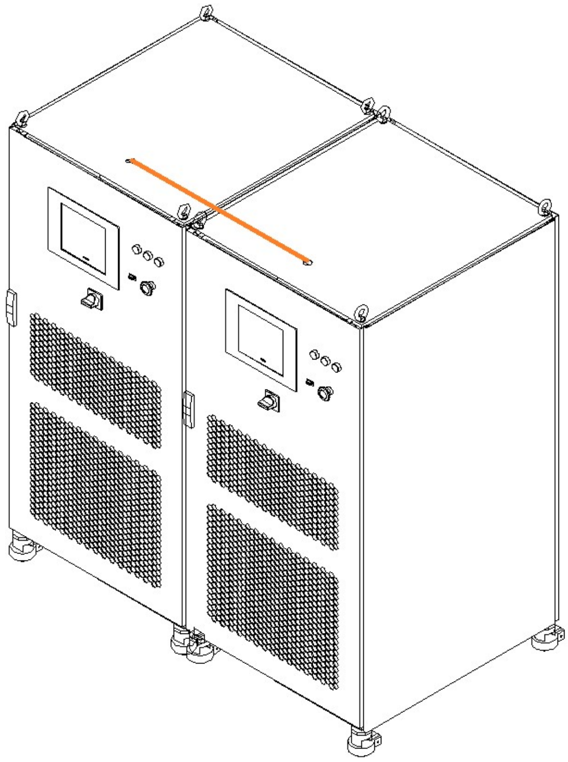


Figure 1-23 Cable hole on the top of the cabinet

Step 2:

As shown in Figure 1-24, connect the fiber optic cables of the two units.

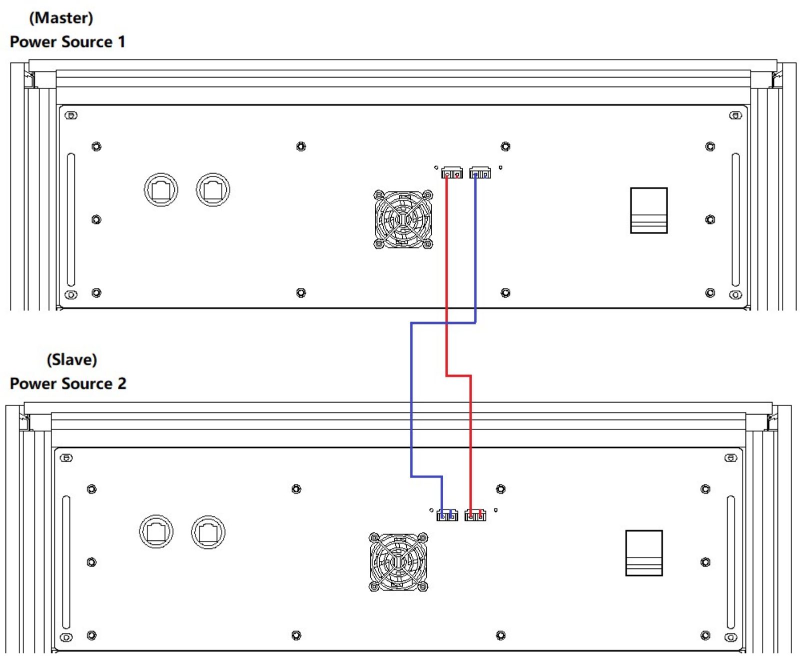


Figure 1-24 Optical fiber cable wiring diagram

IMPORTANT INFORMATION

If the parallel slave is designed without a touch screen, in addition to the optical fiber cable, the parallel communication network cable needs to be inserted through the threading hole on the top of the cabinet, and then connect as shown in Figure 1-25.

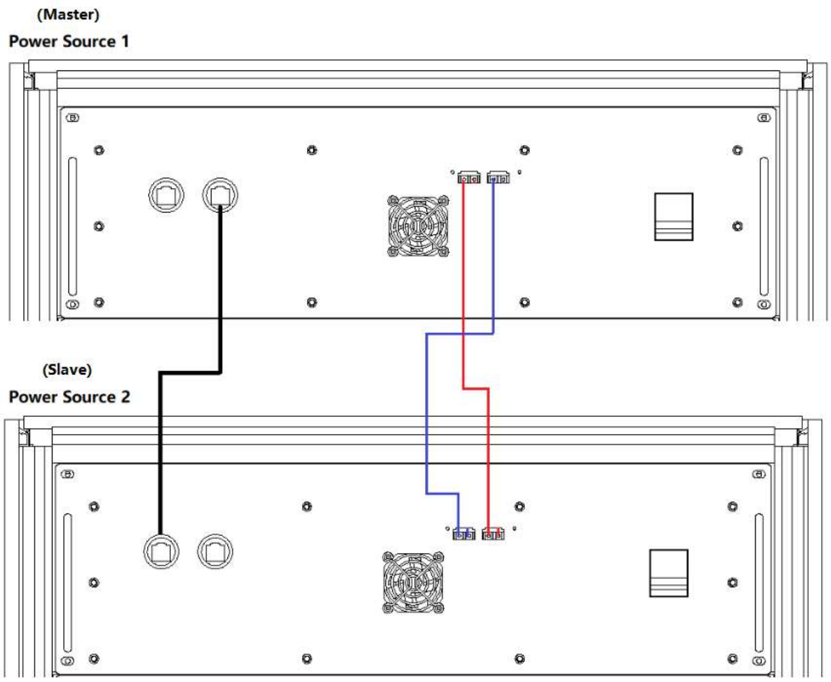


Figure 1-25 Communication Parallel communication fiber

Step 3:

As shown in Figure 1-26, connect the input/output cables of the two equipment in parallel.

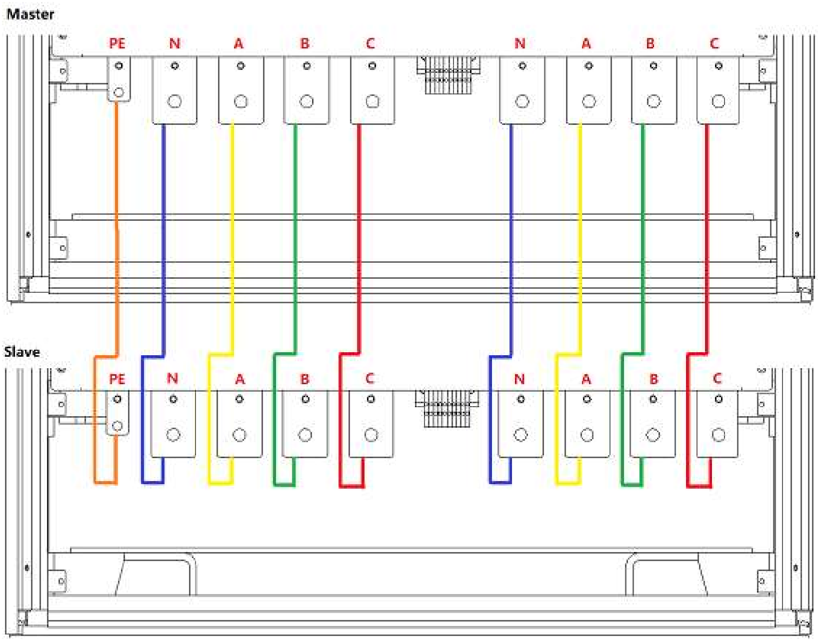


Figure 1-26 Connection of parallel input/output cables

Chapter 2 Equipment Installation

2.1 Check before Installation

2.1.1 Check the packing

When receiving the power supply of ESA series, if the packing is damaged, do not dispose the damaged packing or cushioning materials before checking the integrity of the goods and electrical/mechanical testing. The shipper/carrier should be responsible for product damage caused by the shipment. The factory has no liability for free repair/rework or replacement of products. Please keep the packing box and packing materials and record the type of damage to return the power supply.

2.1.2 Check the equipment

Open the outer packing of the power supply and check with visual inspection or hand feeling when the power supply is in non-working. To ensure:

- There are no serious appearance defects caused by product assembly, and there are no bad phenomena such as assembly seams and breaks that exceed specifications.
- There are no defects that seriously affect the appearance of the product, such as scratches, indentation, color difference, paint drop, etc.

IMPORTANT INFORMATION

If the product has any mechanical damage, missing parts, fails electrical or mechanical tests, please contact the sales of Bridge Technology.

2.2 Equipment Installation

2.2.1 Selection of input/output cables

Before the equipment is installed, the user should confirm the model on the nameplate, select the appropriate specifications of the cable and the cold end according to the equipment input/output voltage level and current of the equipment, and crimp the input cable and the output cable.

Figure 2-1 Cold-pressed terminals

WARNNING

If the equipment is disassembled and installed at a low temperature, water droplets may condense. The cabinet must be dry completely before installing the product, otherwise, there is a risk of electrical hazards and damage to the product.

IMPORTANT INFORMATION

The AC input configuration can be either 3P+N+PE or 3P+PE (please specify in the PO).

2.2.2 Installation steps

Step 1:

Remove the bottom baffle (as shown in Figure 2-2). Lead the input and output cables into the cabinet through the cable entrance holes at the bottom (as shown in Figure 2-3).

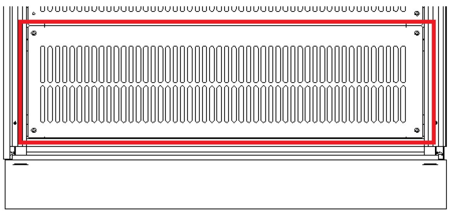


Figure 2-2 Bottom baffle

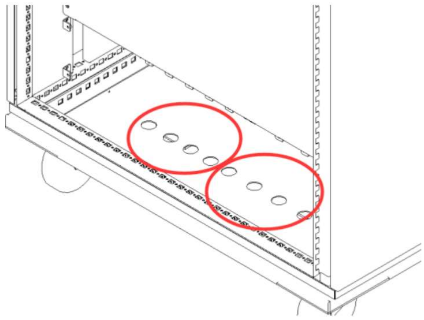


Figure 2-3 Entrance holes

Step 2:

Connect the input cables (PE/N/L1/L2/L3) and output cables (N/A/B/C) to the copper bars. (Figure 2-4)

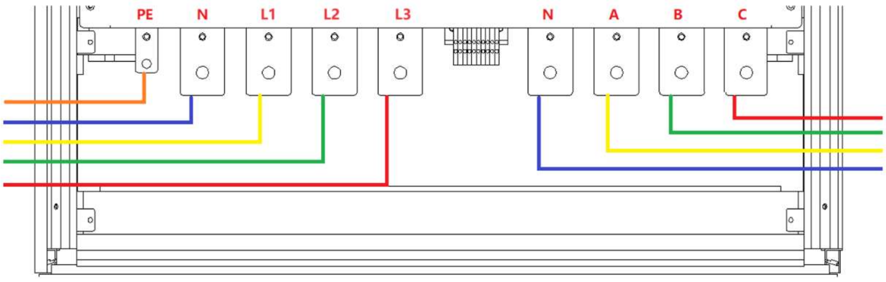


Figure 2-4 Input/Output Copper bars

CAUTIOUS

To avoid electrical hazards, connect the ground terminal to the protective ground terminal before connecting any input or output terminals.

SHOCK HAZARD

Before connecting the cable, make sure that the upper-level switch is off. Do not live working.

Step 3:

Restore the bottom baffle, close the cabinet door, then, the equipment installation is done.

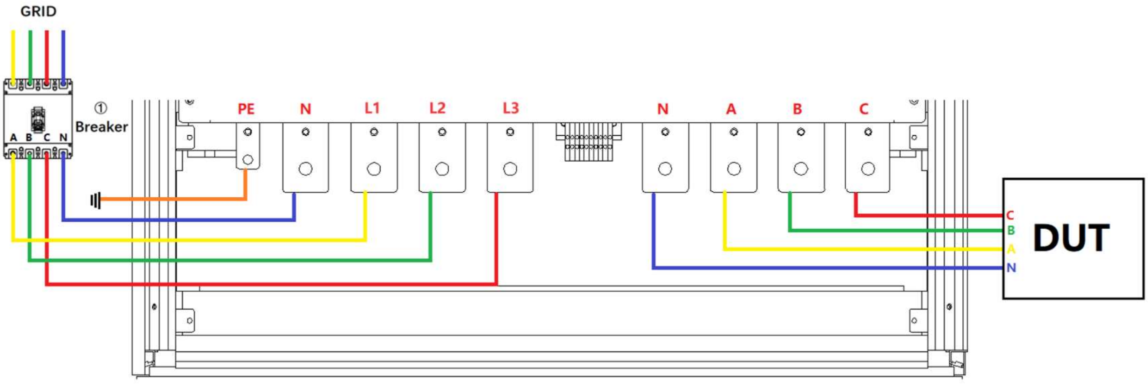


Figure 2-5 Equipment wiring completion status

IMPORTANT INFORMATION

Users can choose whether need remote sense connection. Refer to 1.3.7.2 for specific wiring method.

2.2.3 Add single-phase output (-1P option)

ESA series with the -1P option adds a single-phase output function. By changing the wiring method (parallel three-phase output terminals, as shown in Figure 2-6), the output current can be increased to three times the single-phase current.

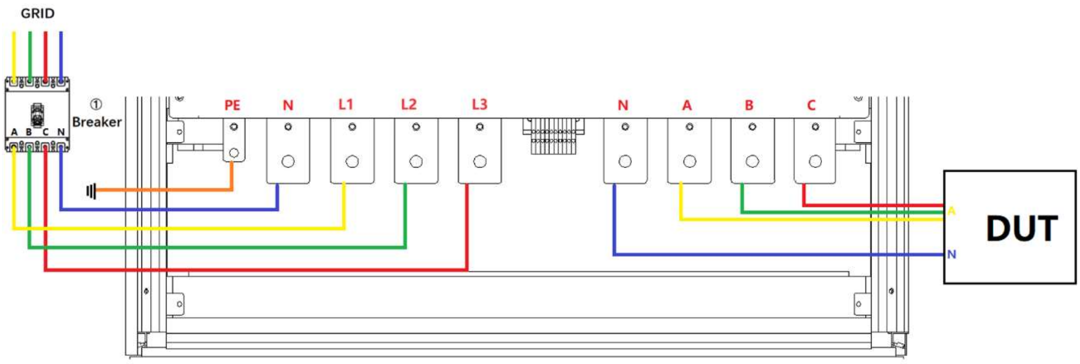


Figure 2-6 Increase single-phase output wiring diagram

IMPORTANT INFORMATION

If the product has any mechanical damage, missing parts, fails electrical or mechanical tests, please contact the sales of Bridge Technology.

2.3 Parallel installation of equipment

ESA series support parallel connection of the same model. The specific operation steps are as follows.

Step 1: Pass the fiber optic cable through the cable hole on the top of the cabinet, as shown in Figure 2-7.

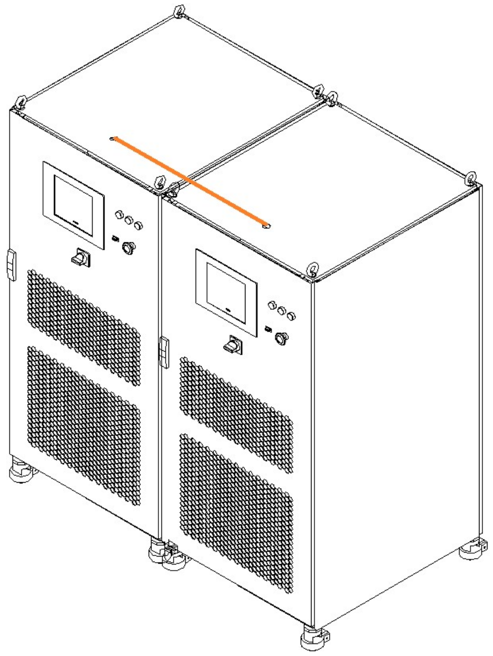


Figure 2-7 Cable hole on the top of the cabinet

Step 2: As shown in Figure 2-8, connect the fiber optic cables of the two equipment.

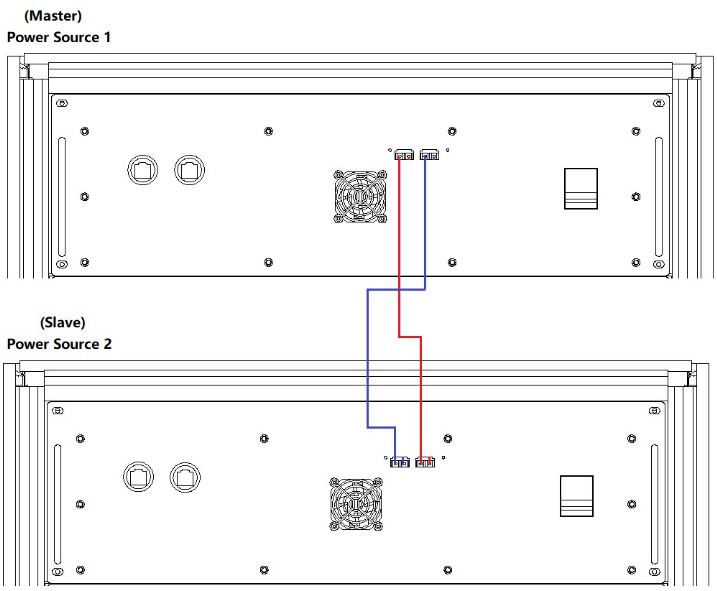


Figure 2-8 Optical fiber cable wiring diagram

IMPORTANT INFORMATION

If the parallel slave is designed without a touch screen, in addition to the optical fiber cable, the parallel communication network cable needs to be inserted through the threading hole on the top of the cabinet, and then connect as shown in Figure 2-9.

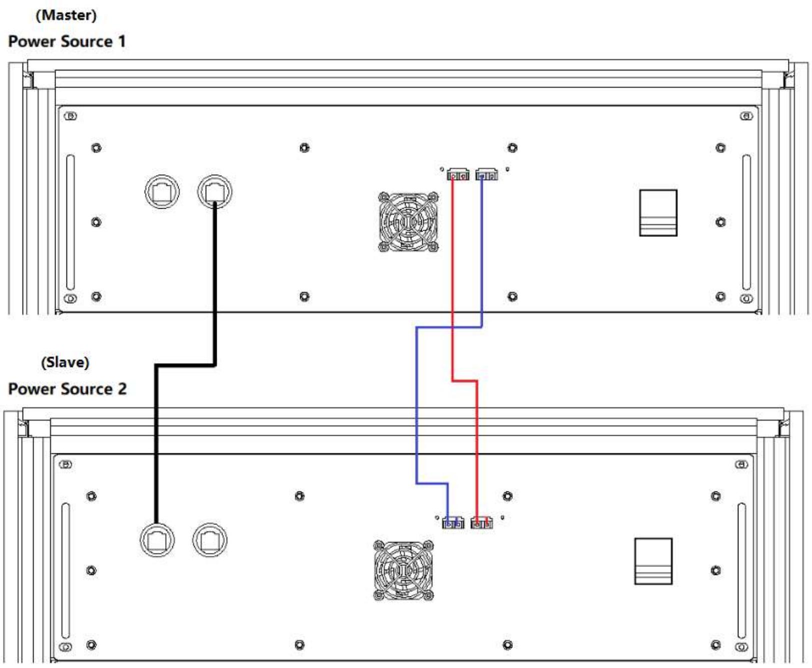


Figure 2-9 Parallel communication cable wiring diagram

Step 3:

As shown in Figure 2-10, connect the input/output cables of the two equipment in parallel.

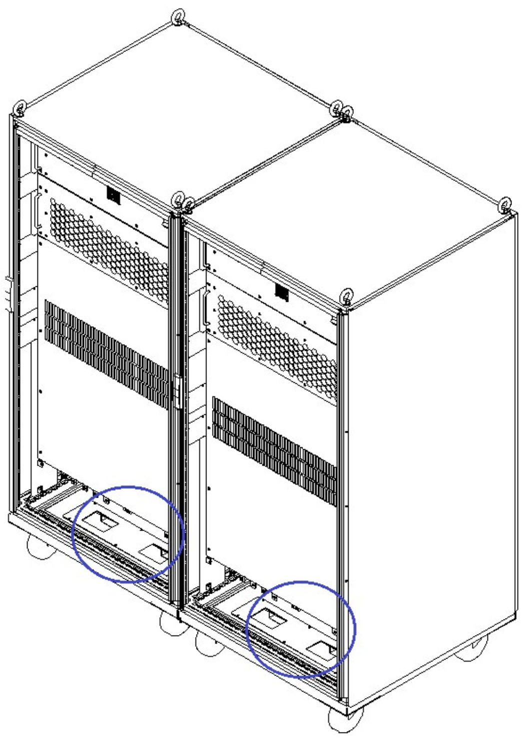


Figure 2-10 Cable holes at the bottom of the cabinet

Step 4:

As shown in Figure 2-11, connect the input and output cables of the two equipment in parallel.

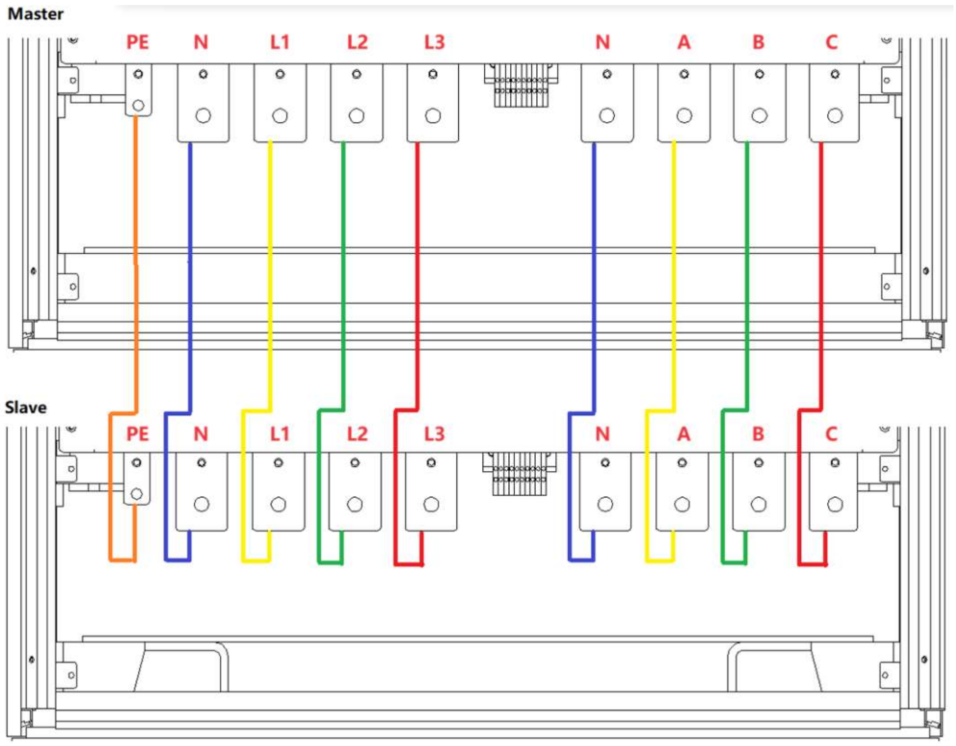


Figure 2-11 Wiring diagram between parallel cabinets

Step 5:

After completing the above parallel work, complete the remaining wiring according to 2.2.2.

Chapter 3 Power On/Off Operation

3.1 Power On Operation

Step 1: Power on the AC input

After completing the installation, close the circuit breaker on the distribution side (Figure 3-1①).

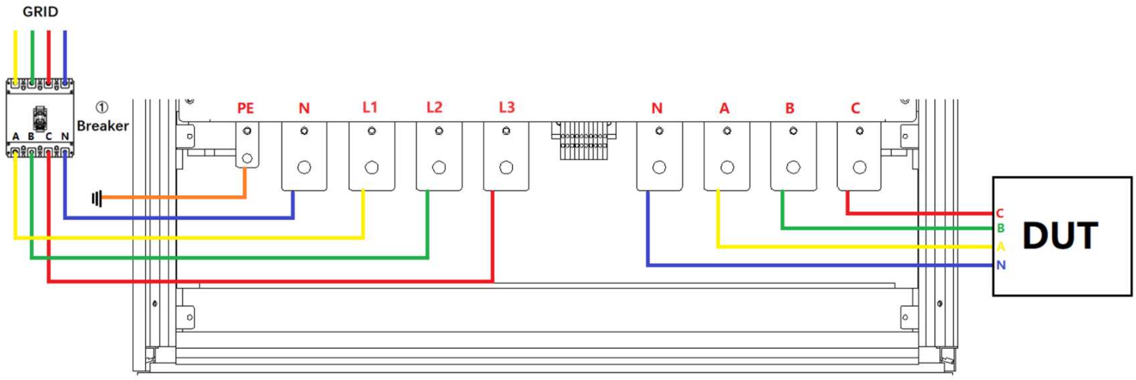


Figure 3-1 Equipment and the circuit breaker

CAUTIOUS

To prevent any damage to the equipment, make sure to confirm the correct wiring sequence.

SHOCK HAZARD

The voltage generated by ESA series equipment may cause personal injury or death. When the power is on, do not touch the exposed connectors and parts.

SHOCK HAZARD

Make sure that there is no overvoltage on the product (such as overvoltage caused by lightning), otherwise there may be a risk of electrical hazards.

Step 2: Power on the control module

After the AC input is powered on, open the cabinet door, close the power switch of the control module (Figure 3-2④), power to the product control module.

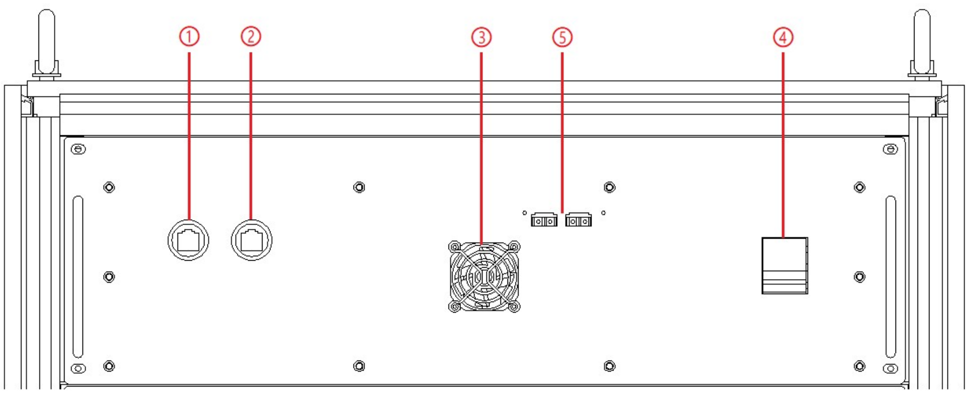


Figure 3-2 Control Modules

Step 3: Turn on power knob

Turn clockwise to close the control switch on front panel (figure 3-3⑤) after closing the cabinet door, the power supply is standby. If the power supply communication connection is normal, the white light is always on (figure 3-3①).

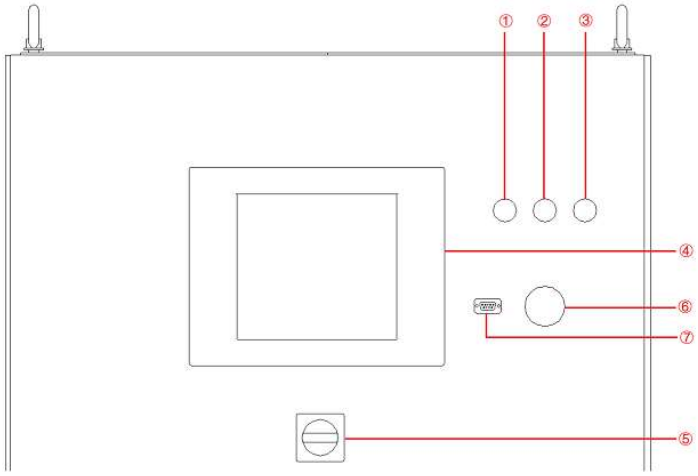


Figure 3-3 Front Panel

3.2 GUI Software Operation (Local Control)

ESA series provide GUI software, it is installed in the touch panel, which uses Windows OS. (the software can also be installed on the control PC connected to the power supply).

A few seconds after the power is initialized, the control unit and touch screen work, the power supply is standby. If the power supply communication is normal, the white light (Figure 3-4①) is always on, and the "Connect" indicator on the TFT touch panel is green (Figure 3-5).

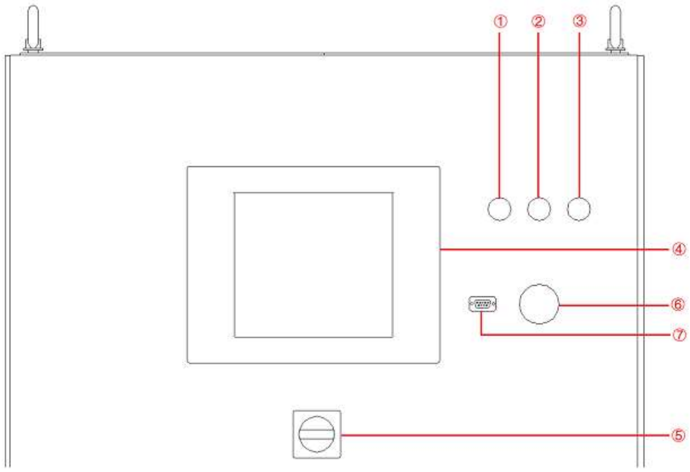


Figure 3-4 Front Panel

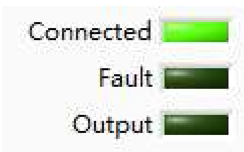


Figure 3-5 Indicators on TFT Touch panel

All functions and parameters can be set and run through the touch screen displayer. The software has the following functions:

- Output settings and limits
- Sequence output settings
- Including working mode, output power, output voltage, output current, duration, switching time settings, storage, and re-import of complex sequences; editing of harmonics and inter-harmonics; on/off phase angle
- Display measurements: voltage, current, power, etc.
- Real-time display of input/output voltage, current, power and IGBT temperature and other parameters
- Capture, display and save output voltage and current Waveforms.
- Display power source faults

The specific functions of the software will be introduced in Part V.

3.3 GUI Software Operation(Remote Control)

ESA series provides GUI software, which can be installed on the control PC connected to the power supply.

The detailed operation information is in Part V.

3.4 Power off Operation

Step 1:

Close the GUI software on the TFT-Touch panel /PC and shut down.

Step 2:

Turn the power knob counterclockwise (Figure 3-9⑤).

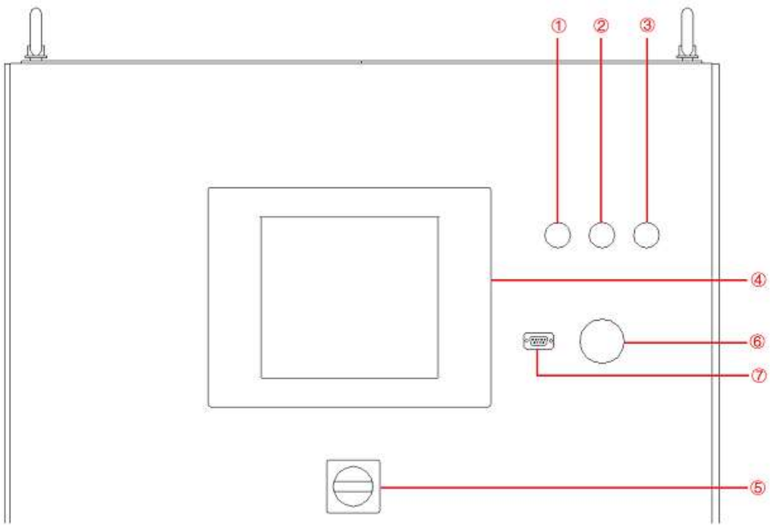


Figure 3-9 Front panel

Step 3:

Open the cabinet door and power off the control unit switch (Figure 3-10④).

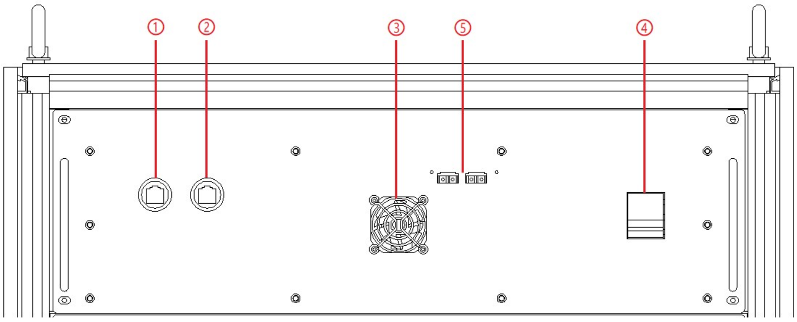


Figure 3-10 Front panel of control module

IMPORTANT INFORMATION

Closing the switch on the front panel of the control module at the first time. Step 3 can be ignored when the power is off, it will always remain closed. when the power supply is on, for easy using, the step 2 of 3.1 can be skipped.

Step 4:

Power off circuit breaker of the AC input side (Figure 3-11①).

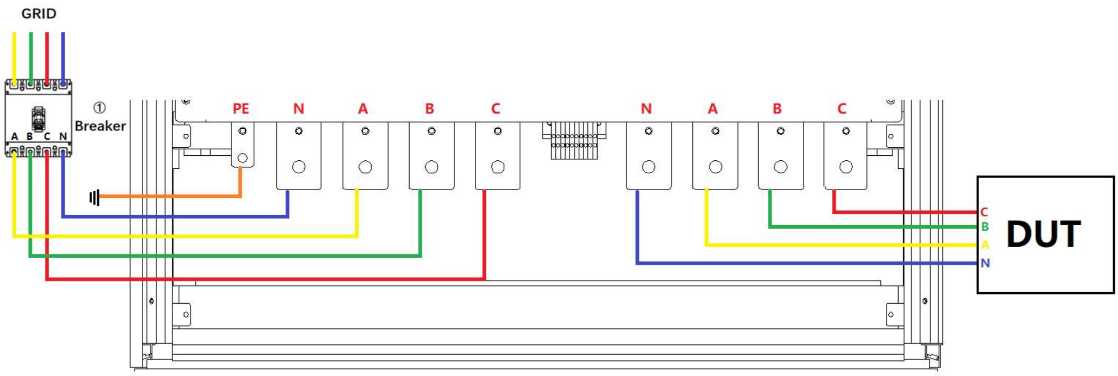


Figure 3-11

Chapter 4 Function and Feature Introduction

4.1 Grid Simulation Function

ESA series can be used as a grid simulator to meet the requirements of grid tied DG regulations testing, such as: grid voltage abnormality test, grid frequency abnormality test, low/zero voltage ride through test, anti-islanding test, etc. ESA series have Various simulation functions, including voltage and frequency fluctuations, voltage sags, low/zero voltage ride through, three-phase unbalance, harmonics and inter-harmonics. ESA series provides standard software that can simulate various real-world power grid operating conditions and supports multiple parameter settings.

Voltage/frequency sequence programming

Voltage and frequency sequence programming via GUI, and the output voltage, frequency, slew rate, ON and OFF output phase angle, dwell time, switching time can be programmed. Three-phase can be independently programmed.

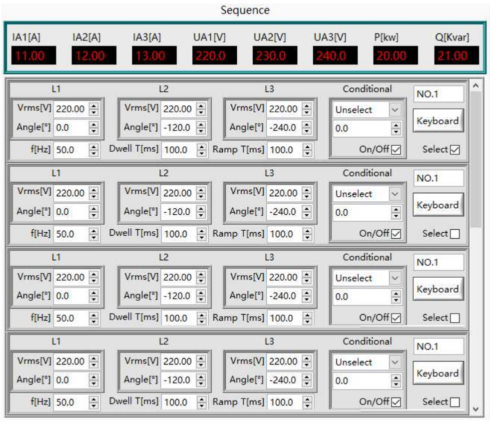


Figure 4-1 Sequence programming

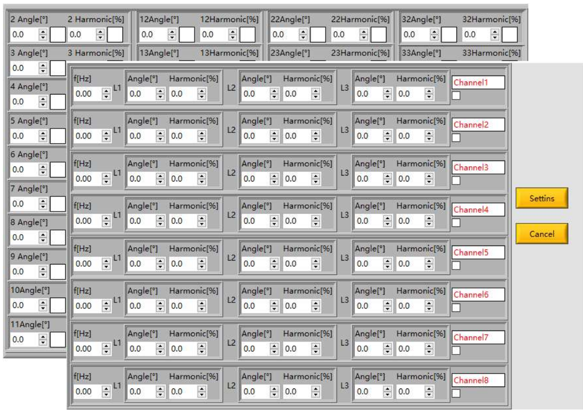


Figure 4-1 Harmonic/Inter-harmonic editing

Harmonic and inter-harmonic waveforms

DSP+FPGA technology are use in ESA series to generate up to 50th harmonic. And ESA supports inter-harmonics editing. User can program the phase angle and amplitude of the harmonic through the GUI, allowing generate three-phase harmonic/inter-harmonic waveforms independently.

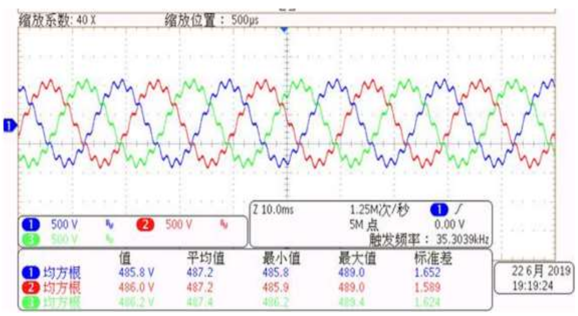


Figure 4-3 Harmonic waveform

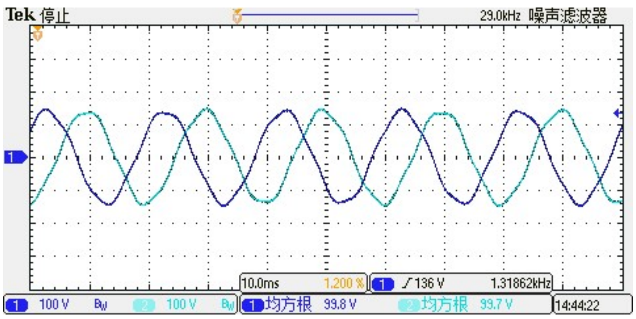


Figure 4-4 Inter-harmonic waveform

Voltage drop simulation (LVRT for inverter test)

ESA series provide firmware and software support for low/zero voltage ride through test for PV inverters. ESA is used to simulate grid voltage/frequency changes, drops and sags to meet the low voltage ride through test requirements of PV inverters.

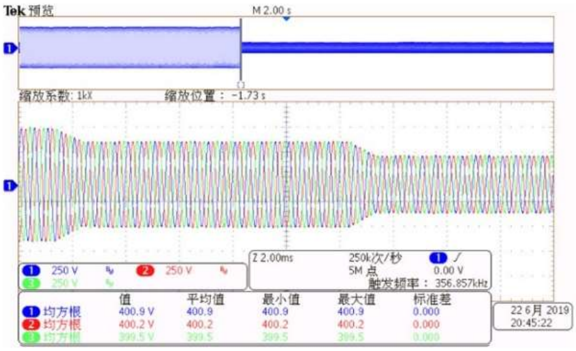


Figure 4-5 Voltage drop

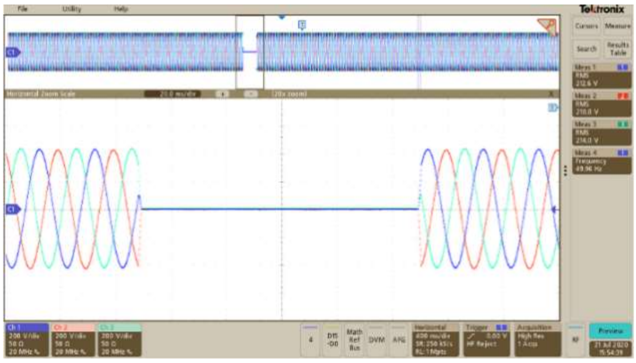


Figure 4-6 Zero voltage ride

In the sequence mode, there is a TTL trigger signal output when voltage or frequency changes.

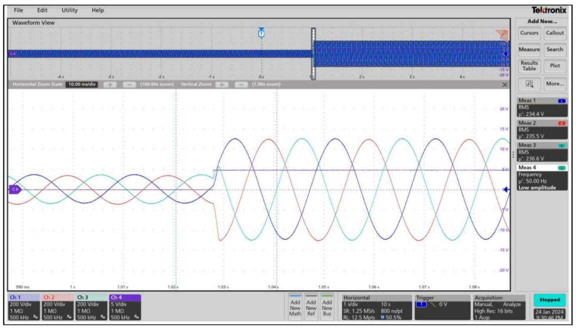
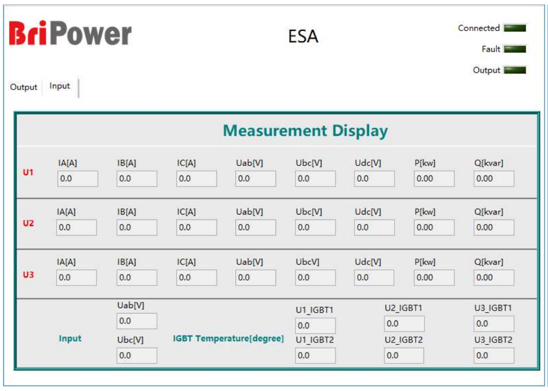


Figure 4-7 TTL trigger signal

During the test, the user can monitor the operating parameters of the power supply in real time on the measurement panel, such as input current/voltage, output current/voltage/power, etc.



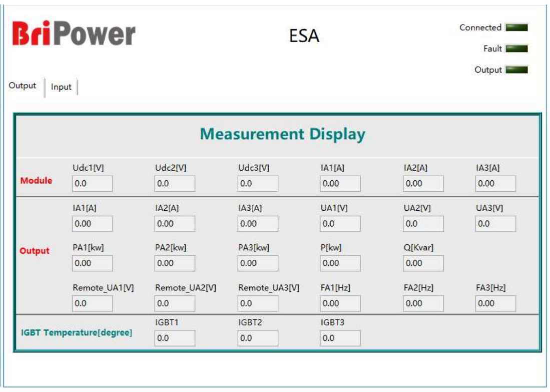


Figure 4-8 Input measurements panel

Figure 4-9 Output measurements panel

ESA series can also capture, display, and save the output voltage and current Waveforms and store them inside the power supply for retrieval and analysis by users.

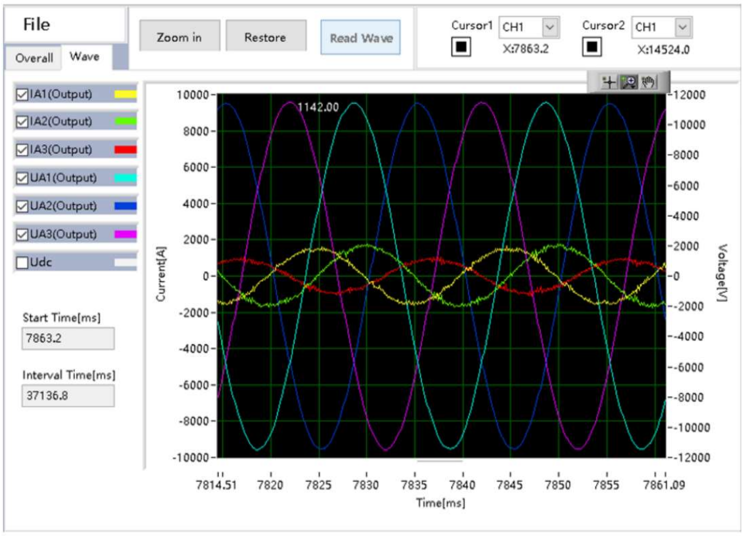


Figure 4-10 Waveform browsing panel

The output terminal of ESA series can be short-circuited and supports short-circuit test. According to the technical specifications of photovoltaic power generation grid-connected inverters, the photovoltaic inverter must have a short-circuit protection function. When a short-circuit condition on the AC output side is detected, the inverter must automatically disconnect from the grid. In the PV inverter test, the short-circuit protection function must be verified to ensure that the photovoltaic inverter can accurately and timely trip protection when a short-circuit condition occurs. ESA series can also provide software and hardware support for the short-circuit test of photovoltaic inverters. Users can set parameters on the GUI software panel according to the standard to simulate various short-circuit faults of the power grid for meeting the short-circuit test requirements of the inverter.

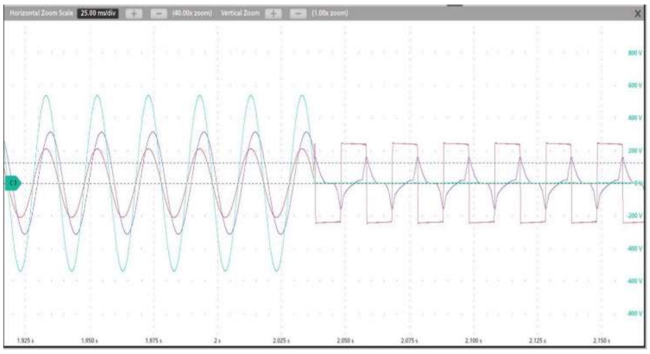


Figure 4-11 phase to phase

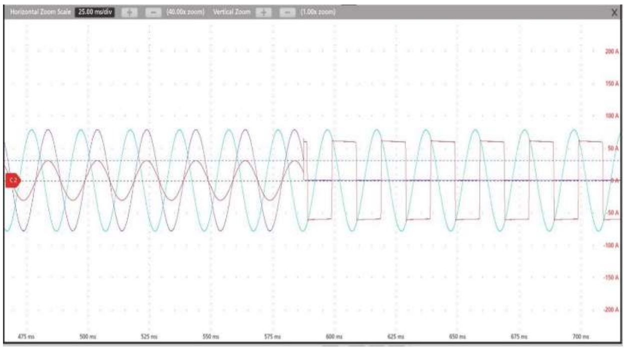


Figure 4-12 phase to N

4.2 Re-generative AC Load (-LD option)[1]

ESA series with -LD option can be used as regenerative AC electronic load. This function consists of CR mode, Rectifier mode, CC/CP phase lead/lag mode. CR mode is used to simulate three-phase resistive loads, the CR mode and three-phase resistance parameters can be set through the panel to simulate the resistance sequence. Rectifier mode can be used to simulate non-linear loads, the CC/CP mode and CF (setting range: 1.414~3) parameters can be set through the panel. CC/CP phase lead/lag mode can simulate sinusoidal current, Constant current CC and constant power CP modes are available to adjust load current or power, phase angle can be set from 90°to -90° simulating the voltage and current conditions under inductive and capacitive loads.

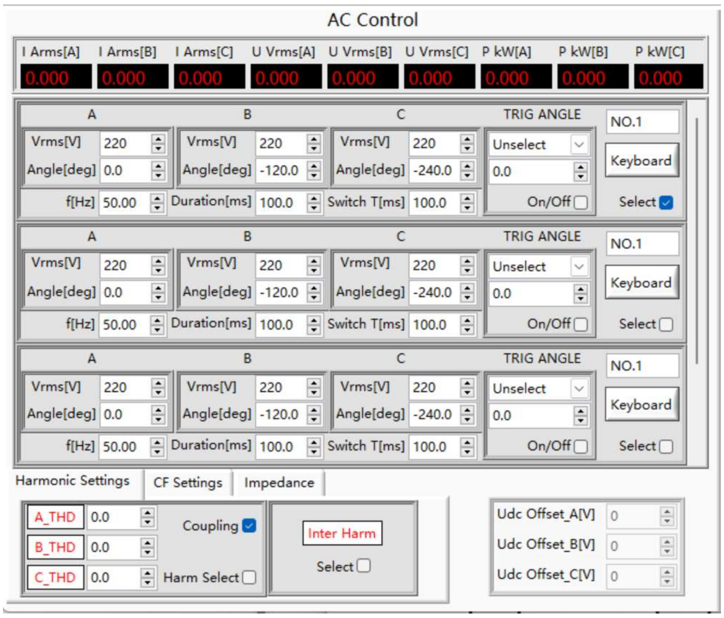
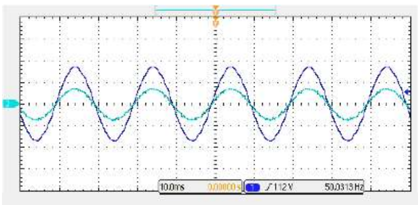
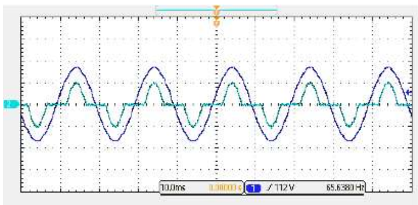


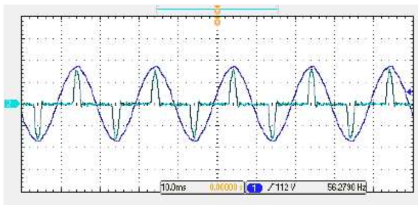
Figure 4-13 Sequence Panel



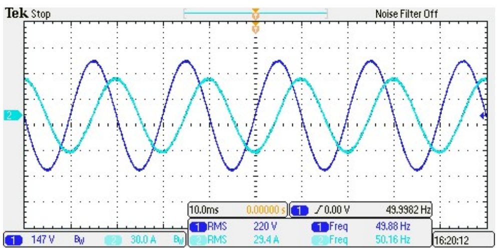
CF=1.414



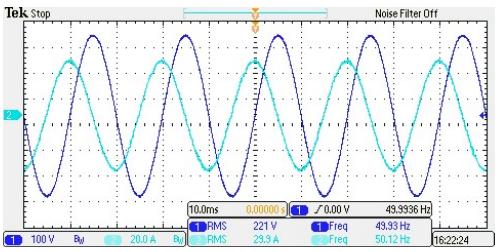
CF=2



CF=3



Angle=+90°



Angle=-90°

Figure 4-14

[1] ESA-LD is suitable for the case where the input voltage is a pure sine wave. If the input voltage is not a pure sine wave, the output current waveform may be affected.

4.3 Extends to DC output (-DC option)

DC output mode is available with the -DC option. The output will be DC and AC 0~100Hz. There is up to 50% output power and current derating below 30Hz.

4.4 Line impedance (RL) Simulation (-IMP option)

ESA series with -IMP option can simulate output line impedance (RL). The impedance range is up to Rated V/Rated I; and the R and L values can be set in GUI software.

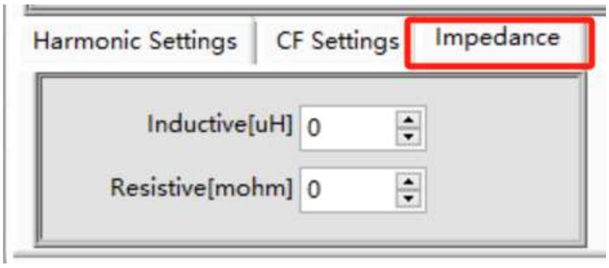


Figure 4-15

4.5 Power supply + Electronic RLC load for anti-islanding test (-62116 option) [2]

The -62116 option of BriPower ESA series provides a perfect solution for anti-islanding test. ESA with -62116 options acts as power supply + electronic RLC load in this application. During the anti-island test, ESA-62116 simulates RLC load, and meets test requirement of IEC62116-2008.

In the test procedure of IEC62116-2008, there is no need to set R, L, C directly, all related settings are to set QL, PAC, QAC by adjusting R, L, C value. In ESA-62116 solution, user can set these parameters directly, and equivalent R, L, C values will be displayed.

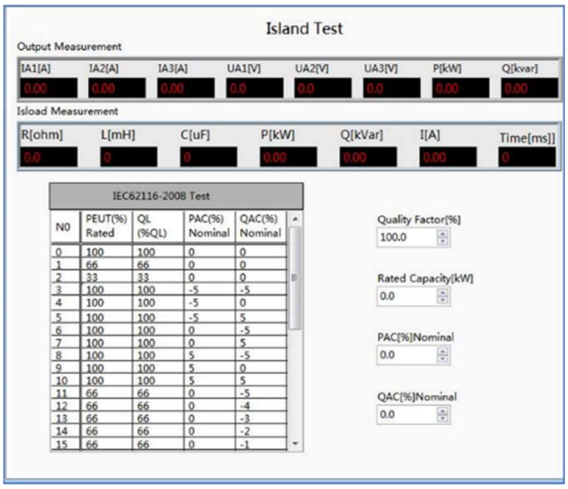


Figure 4-16

[2] ESA-62116 can only simulate RLC load for sine waveform, 50/60Hz input

Chapter 5 Software Interface

5.1 GUI Software Introduction

5.1.1 Operating status

ESA series provides GUI software, which is installed on the front touch screen using the Windows OS. (the software can also be installed on the control PC connected to the power supply). A few seconds after the power supply is initialized, the control unit and touch screen work, the power supply is standby. If the power supply communication is normal, the white light (Figure 3-3①) and the "connected" green light (Figure 5-1①) is always on. All functions and parameters can be accessed through the TFT-Touch panel or GUI software to set up and run.

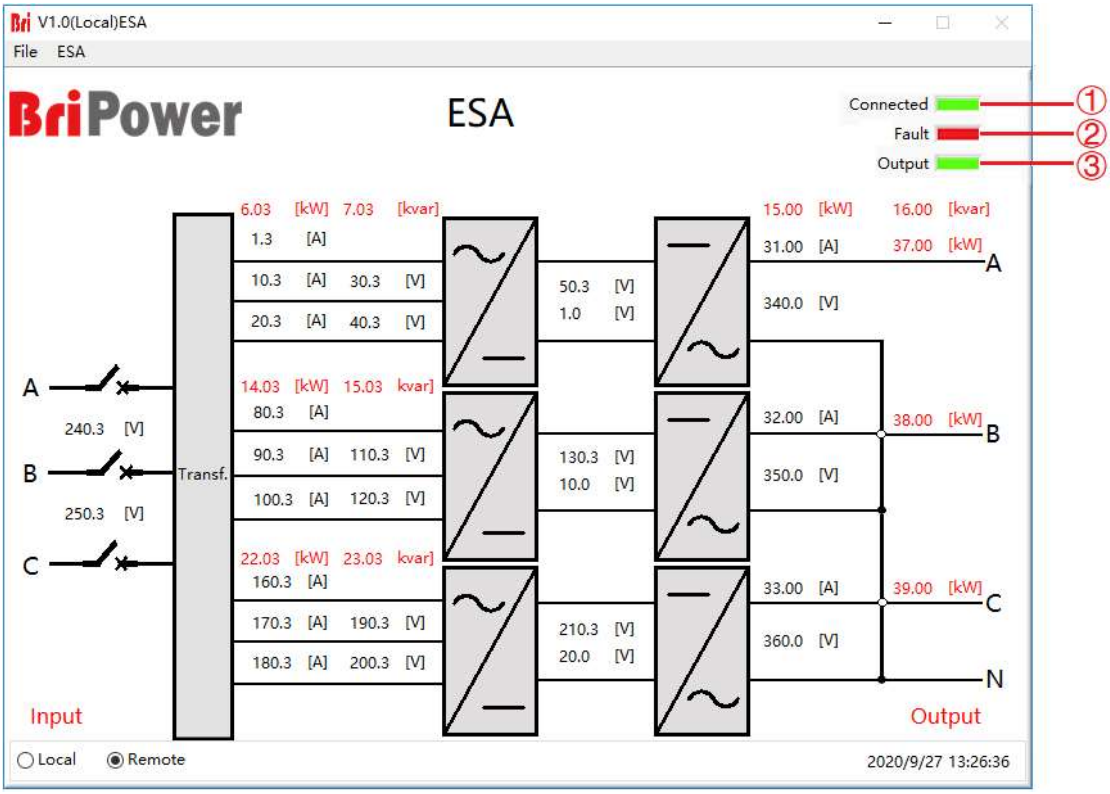


Figure 5-1 Main panel

Table 5-1

No.	Description	Note
1	Connect	A few seconds after the power supply is initialized, the TFT-Touch panel displayer works, the green light is always on when the software and the equipment are connected normally. If the connection fails, please check whether the AC source is normally powered, the communication cable is connected normally, or the IP address of computer is 192.168.1.2.
2	Fault	The red light indicates the equipment automatically stops working when a fault occurs during operation. If the equipment runs in normal, the light is dark green.

3	**Output**	When equipment is operating normally and output AC/DC, the green light is always on. When the equipment has no output, the light is dark green.

5.1.2 Sequence mode

On the right side of the sequence mode Panel, the user can select the power supply operating mode, parameter input mode and output mode according to the test requirements (Figure 5-2①②③).

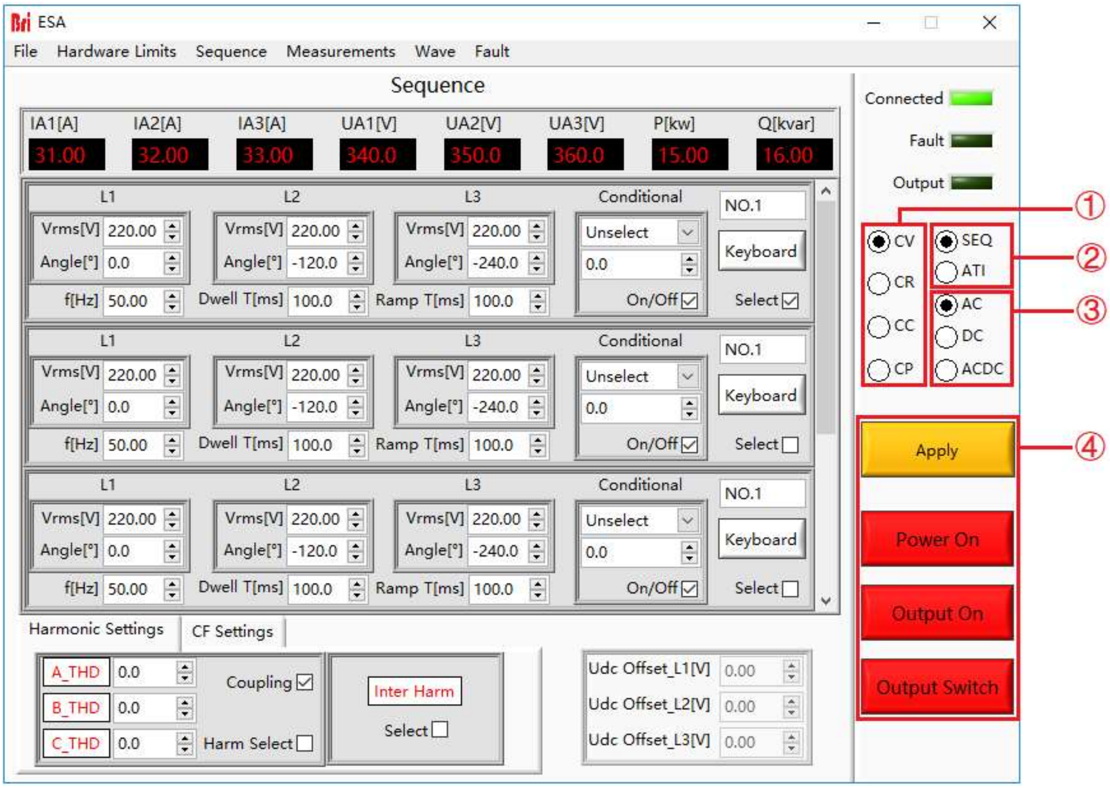


Figure 5-2 Sequence Mode and input/output control

Table 5-2

No.	Description		Note
1	**Operation Status**	CV Mode	CV Mode
		CC Mode	CC Mode
		CP Mode	CP Mode
		CR Mode	CR Mode
2	**Parameter Input Mode**	-SEQ	Manual setting of parameters in sequence mode.
		-ATI	Analog input via ATI interface (-ATI option).
3	**Output Mode**	AC	AC output mode.
		DC	DC output mode.
		AC+DC	AC+DC output mode (-DC option).

IMPORTANT INFORMATION

Output mode-DC mode is only valid after the user selects -DC option, otherwise the setting is invalid.

5.1.3 Input/output controls

There are some important controls on the sequence panel (Figure 5-3). Click “Apply” → “Power On” →“Output On” (→ “Output Switch”), the power supply is on, click (“Output Switch”) → “AC Output” → “Power On”, the power supply is off.

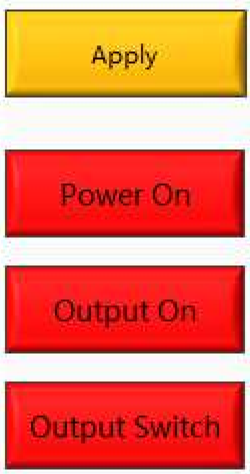


Figure 5-3 Input/output controls

Table 5-3

No.	Description	Note
4	**Apply**	click "Apply" after the parameter setting is completed, the parameter will take effect.
	Power On	It is used for the GRID side on/ off. When the GRID side is on, the button is green, and when the GRID side is off, the button is red.
	Output On	It is used for the output side on/ off, the button is green while outputting, and the green indicator of "Output" is always on (Figure 5-1③). When there is no output, the button becomes red.
	Output Switch	Used to control the AC output contactor, the output terminal of the power supply is live after closing

5.2 Communication Setting

Before establishing a network connection between the power supply and the remote workstation/PC, make sure that the remote workstation/PC and the power supply are on the same network segment. The default network address of the power supply is 192.168.1.2, the port is 502, and the default gateway is 255.255. 255.0. Click “File” → “Communication”, and the power IP address and port are shown in Figure 5-6.

The IP address of the remote workstation /PC should be the different from the IP address of the power supply. If the remote workstation /PC and power supply are in the LAN, ensure the IP addresses do not conflict with other equipment on the network.

In addition, the TFT-touch software and the program-controlled GUI software of the power supply have the same operation method.

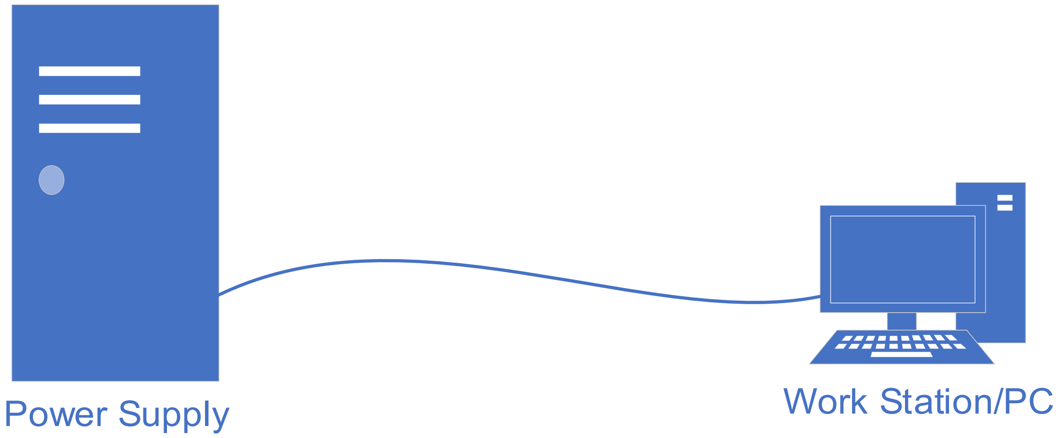


Figure 5-4 Power supply connected to workstation/PC

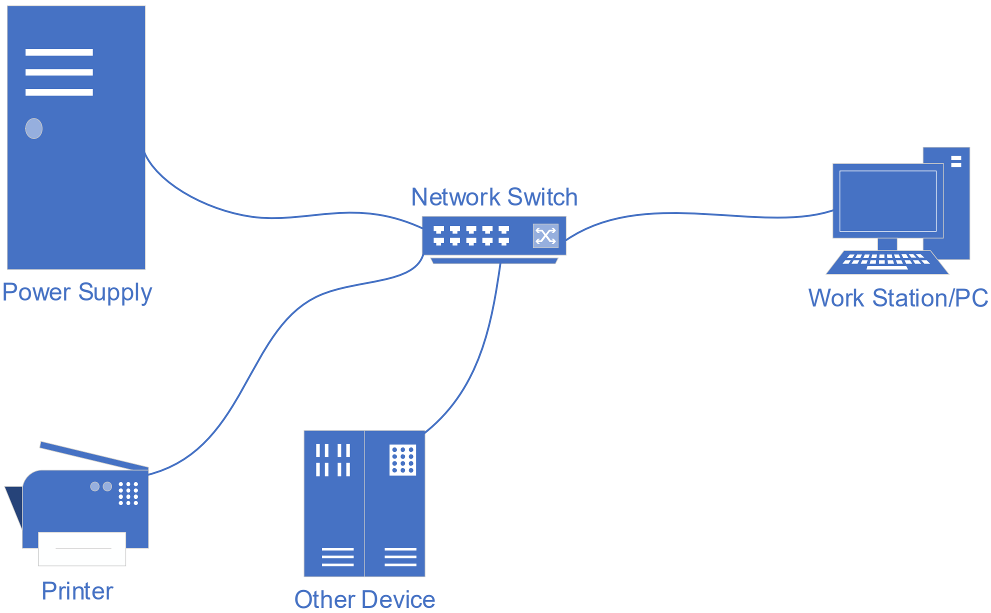


Figure 5-5 LAN connection of power supply and workstation/PC

In general, the hardware of workstation/PC connecting to the power supply must follow the requirements:

- Processor: Intel core 2 duo or above
- RAM：2GB[3] or above
- Operating System：Windows 7 or above
- 10/100/1000 Mbps network port adaptor
- Network Switch (LAN users)
- CAT 5 network cable

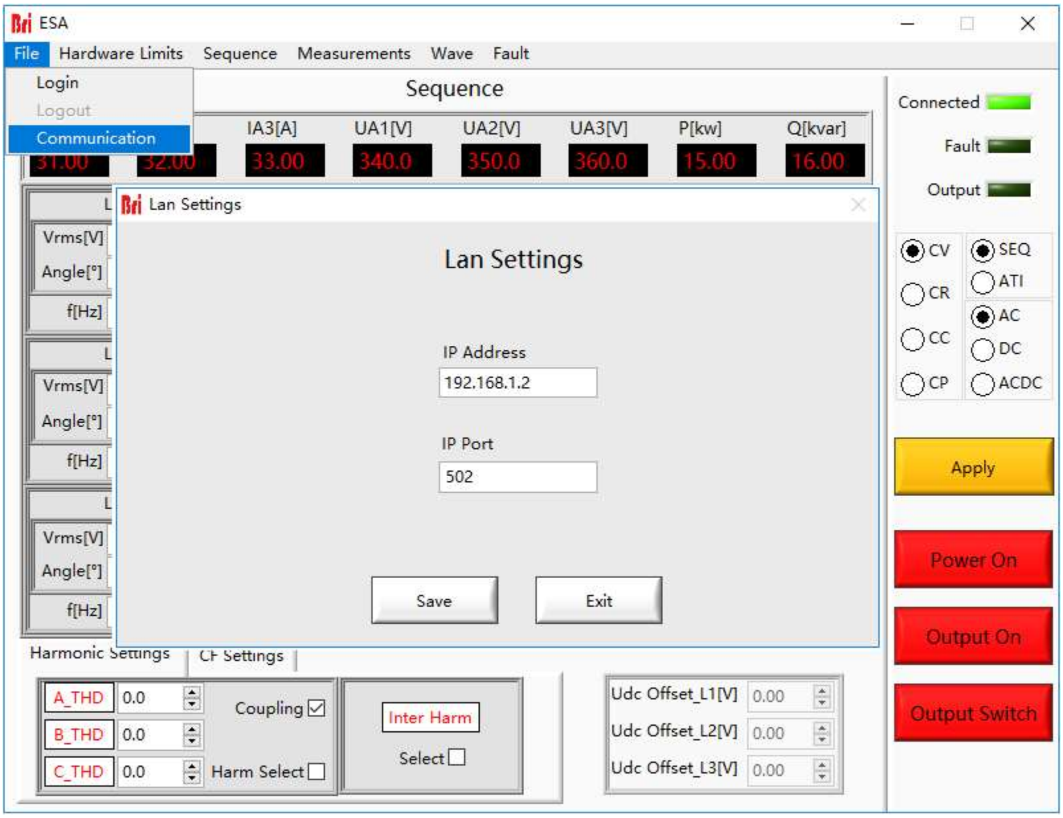


Figure 5-6 Default network address and port of power supply

IMPORTANT INFORMATION

The network cable used for LAN connection is a straight-through cables.

[3] The actual demand for the processor and internal storage also depends on the other software actually running on the work Station/ PC.

5.3 Hardware Limits

To operate safety, please set the relevant protection parameters before the formal test.

Operation steps:

Click "Hardware Limits" to enter the panel (Figure 5-7). After setting the parameters, click "Apply".

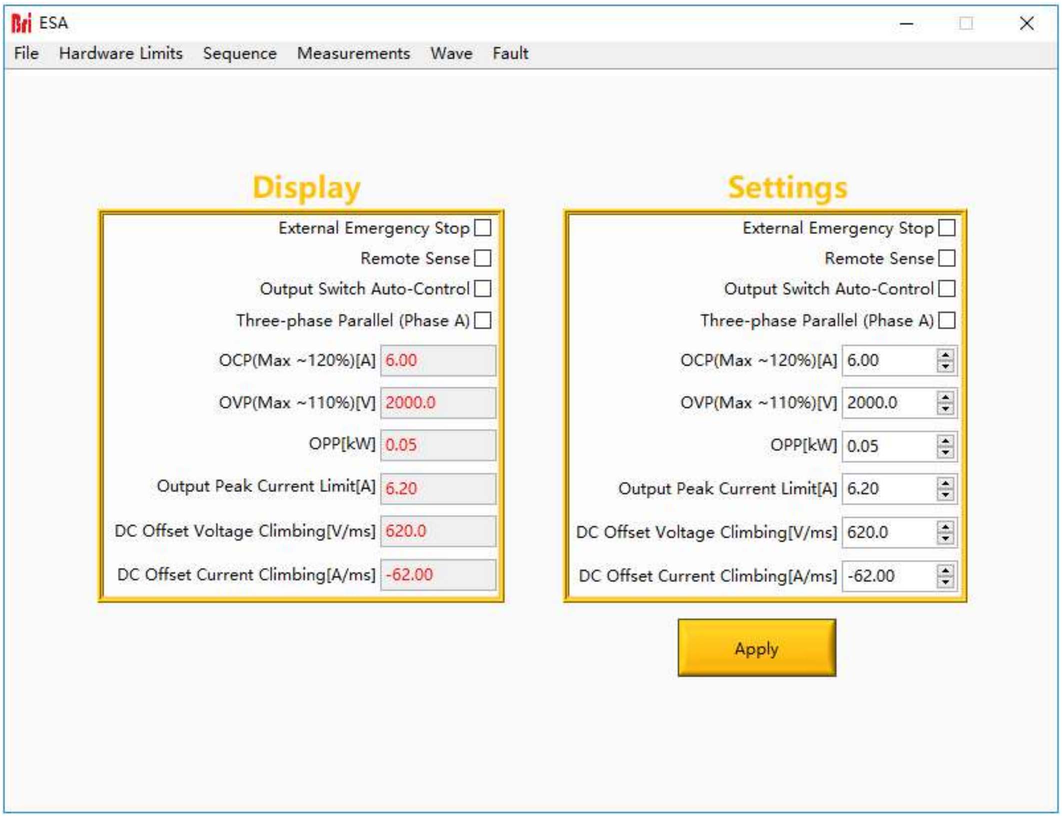


Figure 5-7 Hardware limits panel

Table 5-4

No.	Description	Note
1	**External Emergency Stop**	External emergency stop check box, the external emergency stop is effective when checked.
2	**Remote Sense**	Remote sense check box, the remote compensation will be effective when checked
3	**Output Switch Auto-Control**	The output switch automatic control check box, no need to manually control the "Output Switch" button after it is checked, and the "Output Switch" is disabled, as shown in Figure 5-8 (checked by default)
4	**Three-phase Parallel (Phase A)**	Three-phase parallel output (-1P option), the three-phase parallel output is valid after checking.
5	**OCP (Max~120%)**	Overcurrent protection value, when the output current exceeds the value, the power output will be off.
6	**OVP (Max~110%)**	Overvoltage protection value, when the output current exceeds

		this value, the power output will be off.
7	**OPP [kW]**	Overpower protection value, when the output power exceeds this value, the power output will be off.
8	**Output Peak Current Limit[A]**	Maximum current limit value, when the output current exceeds this value, it will be limited below the current value.
9	**DC Offset Voltage Climbing**	DC voltage climb rate.
10	**DC Offset Current Climbing**	DC current climb rate.

CAUTIOUS

1，2，3，4 is valid after checking, please make sure that the connection of external emergency stop/remote sense/single-phase output cable is completed before checking.

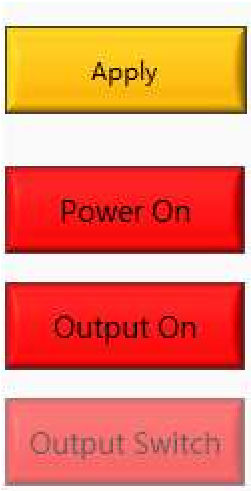


Figure 5-8 "Output Switch" is disabled

5.4 Sequence

The output parameters of ESA series power supply can be controlled through GUI software. The sequence mode interface supports a variety of parameter settings, including output phase voltage/phase current, phase angle, frequency, on/off phase angle, dwell time, and switching time. The output parameters are displayed in real time at the top of the panel, the storage and loading of complex sequences can also be realized.

Test steps:

Click "Sequence" to enter the panel (Figure 5-9). Select the operating mode（-SEQ） on the right side, set the parameters and select the operating sequence. the click "Apply" → "Power On" → " Output On ", the power supply start running in sequence mode.

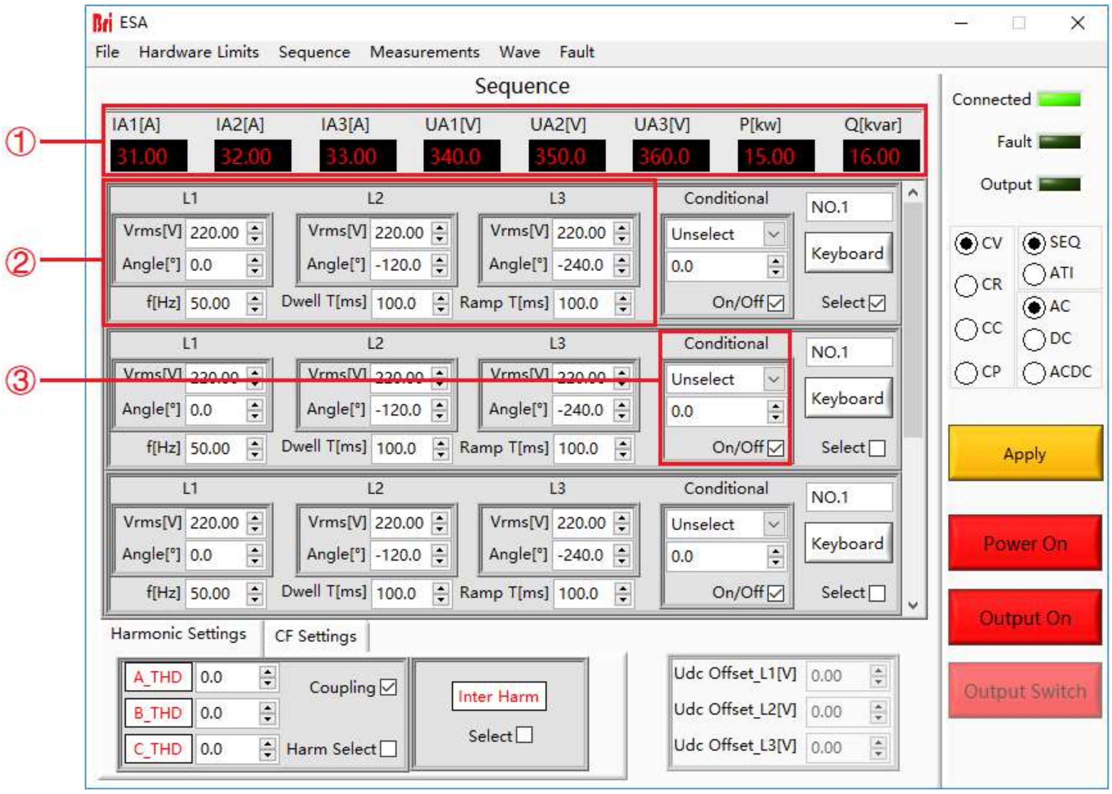


Figure 5-9 Sequence panel

Table 5-5

No.	Description	Note
1	**Real-time parameters**	The current output voltage, current and power of the power supply displays in Real time.
2	**Parameter setting 1**	The user can set the output phase voltage/phase current, phase angle, frequency, dwell time and switching time of each step. The right side of each step is the serial number and valid check box.
3	**Parameter setting 2**	The user can set the on/off phase angle of a phase of each step. The power system refers to the dwell time firstly by default, and then refers to the on/off phase angle.

IMPORTANT INFORMATION

When the power supply is working, if the parameters need to be modified, please directly click the Keyboard button to modify the parameters, and finally click Apply (no need to turn off the power).

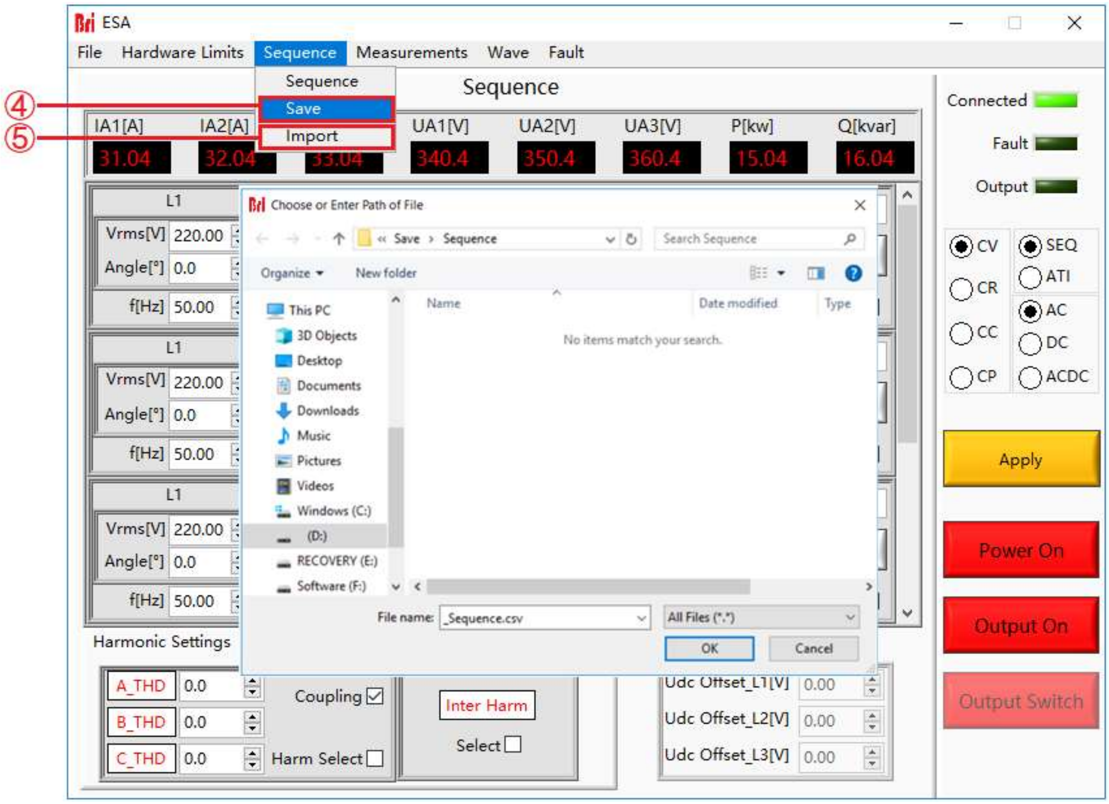


Figure 5-10 Sequence save/Import

Table 5-6

No.	Description	Note
4	**Sequence Save Button**	Click "Save", the user can save the parameters set as a .csv file during the testing. When more complicated parameters need to be set, saving the parameter data file for future use (Figure 5-10).
5	**Sequence Import Button**	Click "Import", the user can reload the sequence parameter file of historical test settings.

5.5 Analog Input

The output voltage of ESA series can be controlled by control signal and using analog input (ATI interface). The ATI interface is located on the rear panel of power supply, please refer to 1.3.5 for specific connection. The BNC connectors for analog input is used in ESA series. The set value will be adjusted according to the AC/DC voltage (0-5 V) of the analog input.

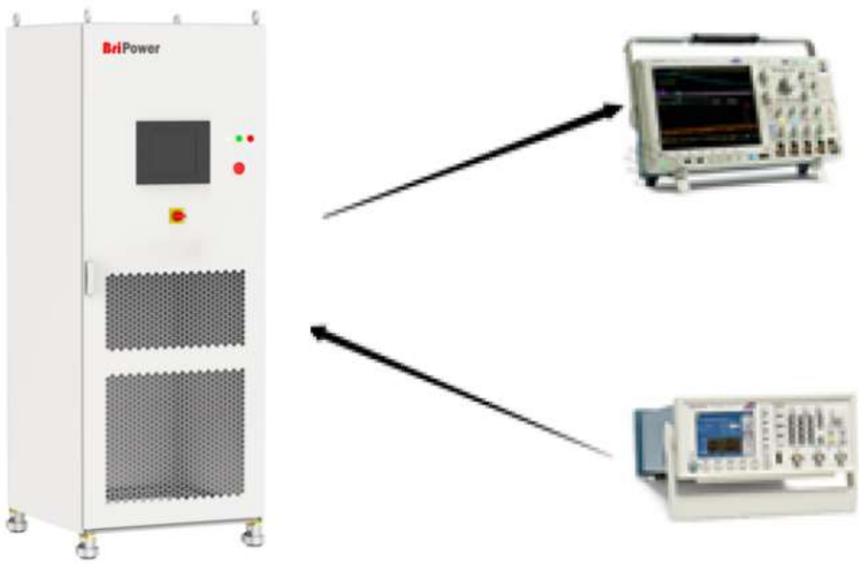


Figure 5-11 Analog input

Test steps:

Select the analog input operating mode (-ATI) on the right side of the panel (as shown in Figure 5-12), set the analog input on the signal generator, after the parameter setting is complete, click "Power On" → "Output On", the power supply is on . Users can observe and record the output voltage/current through the software Waveform panel or the oscilloscope recording panel.

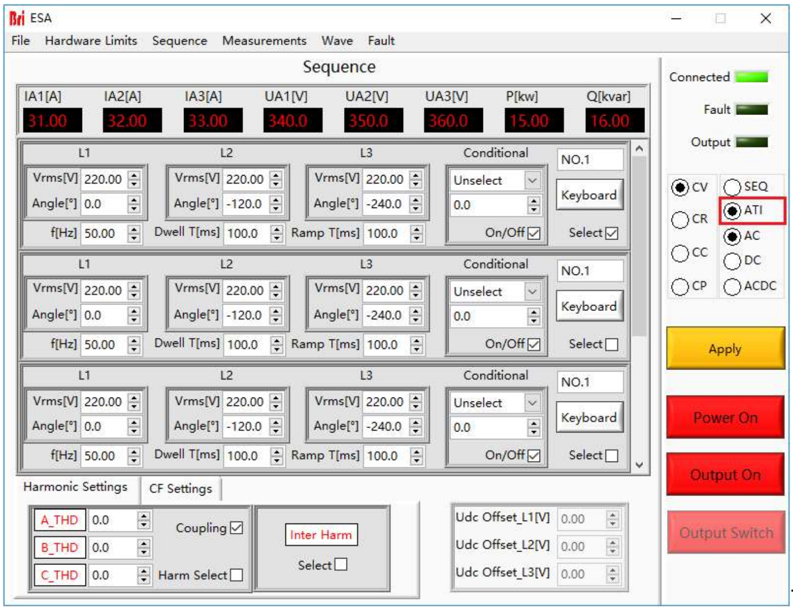


Figure 5-12 Analog input mode

5.6 AC/AC+DC/DC

ESA series adopts bidirectional design and can be used as AC/DC power supply for DUT. The output modes include: AC, DC, AC+DC.

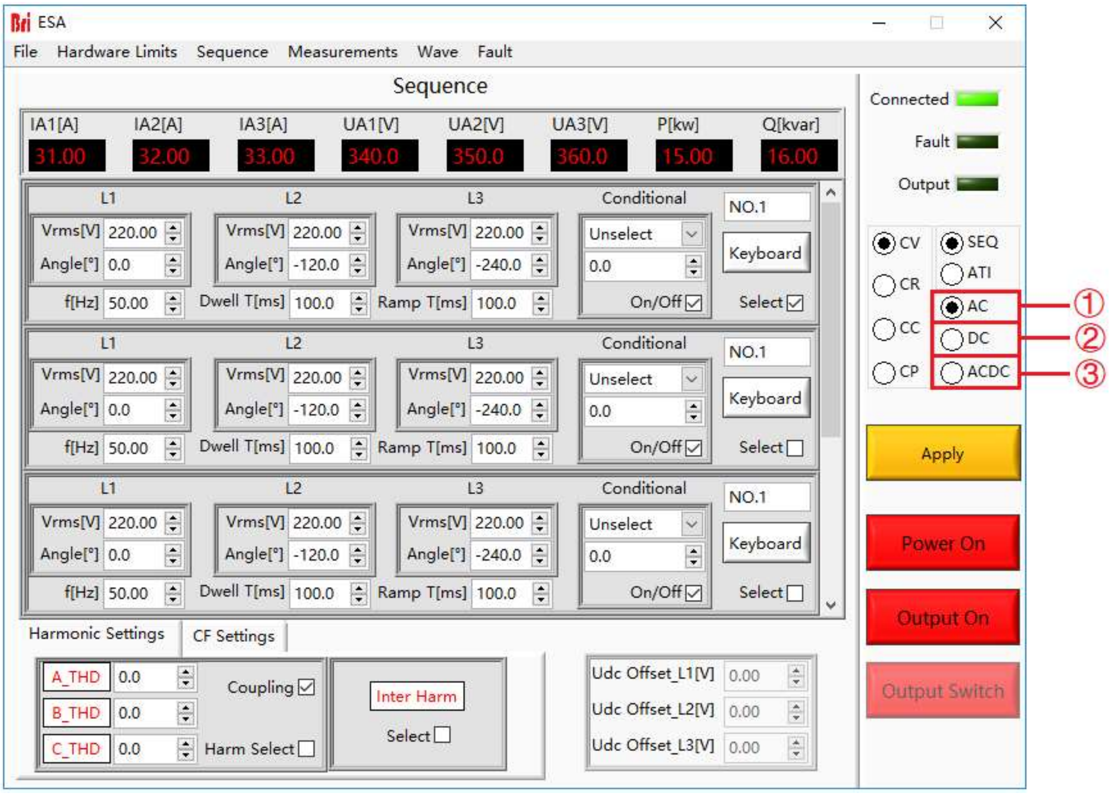


Figure 5-13 Output mode

5.6.1 AC

The ESA series allows the generation of AC voltage, current which can simulate the real AC circuit conditions. Three-phase independent programmable control and have high accuracy.

Test steps:

Click "Sequence Mode" to enter the panel, select AC output mode (AC) on the right side of the panel (Figure 5-13①), the user can select different operating modes (CV/CC/CP) according to the test requirements, and set the AC voltage/current/power. After setting the parameters, click "Apply"→"Power On"→"Output On", the power supply is on and output.

IMPORTANT INFORMATION

In AC output mode, the three phases are independently programmable. If the -1P option is added, the output AC current range will be expanded. For example, inESA 30-300-46, the standard output AC current is 46A/phase. If the -1P option is added (Add single phase output function), after changing the corresponding wiring, the maximum single-phase AC current can be output 138A.

(when related to wiring issues, please combine 2.2.2 and 2.2.3)

5.6.2 AC+DC

The ESA series support AC+DC output mode.

Test steps:

Click "Sequence" to enter the panel, select AC+DC output mode (AC+DC) on the right side (Figure 5-13③), the user can choose different operating modes (CV/CC) according to the test requirements, and set the AC voltage/current and DC offset voltage/current (Figure 5-14). After setting the parameters, click "Apply"→"Power On"→"Output On" in turn, and the power supply is on.

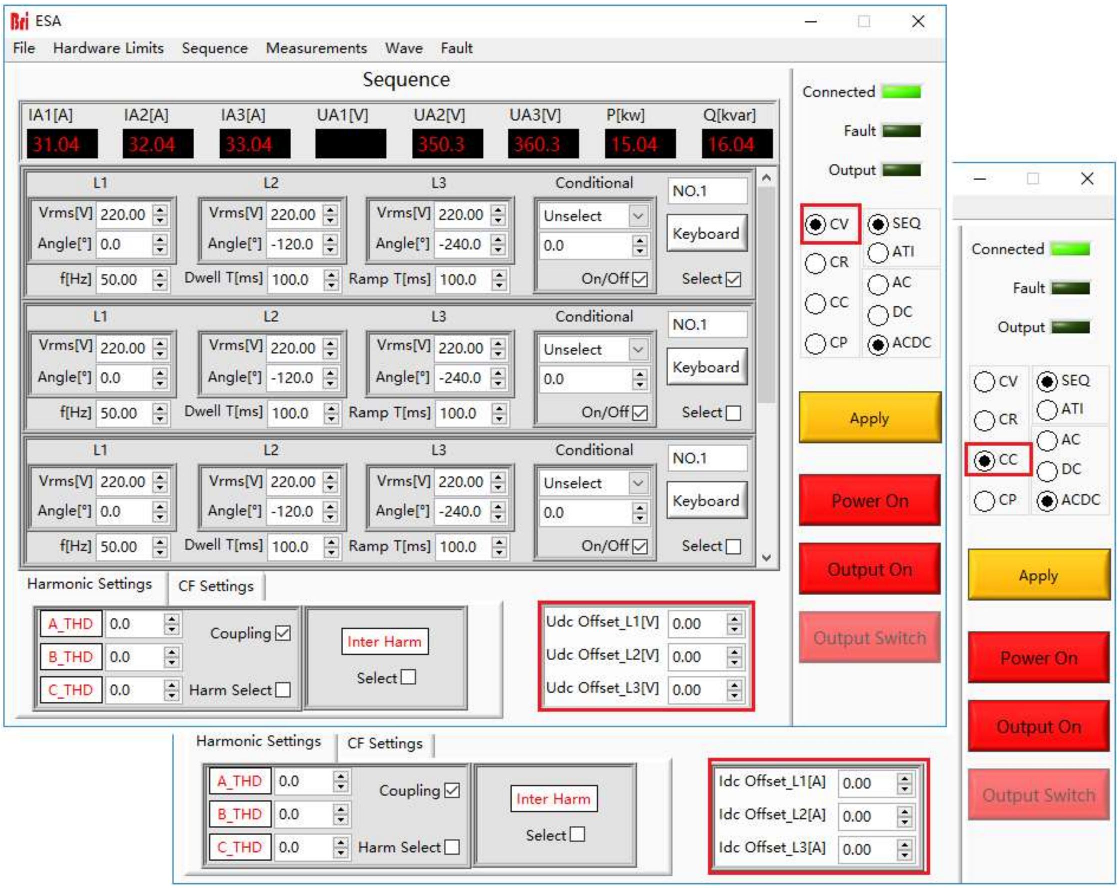


Figure 5-14 DC offset voltage/Current

IMPORTANT INFORMATION

When the CV mode is selected, the parameters that can be set to AC voltage and DC offset voltage.

when the CC mode is selected, the parameters can be set to AC current and DC offset current.

5.6.3 DC (-DC option)

In source and sink mode, ESA can also be designed as a DC output, allowing DC voltage and current to be generated. The output frequency range is extended to DC~100Hz. The DC voltage range is 420V (standard), and the accuracy is 0.2% FS.

Test steps:

Click "Sequence Mode" to enter panel, select the DC output mode (DC) on the right side(Figure 5-13②), the user can select different operating modes (CV/CC/CP) according to the test requirements, and set the DC voltage/ Current. When the parameter setting is completed, click "Apply"→"Power On"→"Output On", the power supply is on and outputs DC voltage/current/Power.

IMPORTANT INFORMATION

In the DC output mode, only need to set the voltage/current of a certain phase, and it will be the output DC voltage/current. If -1P option is added, the three-phase parameters (L1, L2, L3) need to be set at the same time. For example, in ESA 30-300-46, the standard output DC current is 23A/phase, if -1P option is added (add single phase output), after changing the corresponding wiring, the maximum output DC current will be 69A.

(when related to wiring issues, please combine 2.2.2 and 2.2.3)

5.7 Harmonic and inter-harmonic simulation

5.7.1 Harmonic simulation

ESA series provides GUI software, which can edit up to the 50th harmonic.

Test steps:

Click "Sequence Mode" to enter the panel, firstly set the operating parameters (such as output voltage, frequency). Click "Apply"→"Power On"→"Output On", the power supply is on. Check the harmonic selection box (Figure 5-15①), click the A/B/C phase harmonic simulation button (Figure 5-15③), the harmonic setting panel of each order will automatically pop up, then the user can set the harmonic angle, content and other parameters. After setting the parameters, check the corresponding boxes and click "Setting" → "Apply" in turn.

To cancel the harmonic simulation, click the A/B/C phase harmonic simulation button (Figure 5-15③), click "Clear" on the pop-up panel to clear all parameters, and then click "Setting" → "Apply". Finally, uncheck the harmonic selection box.

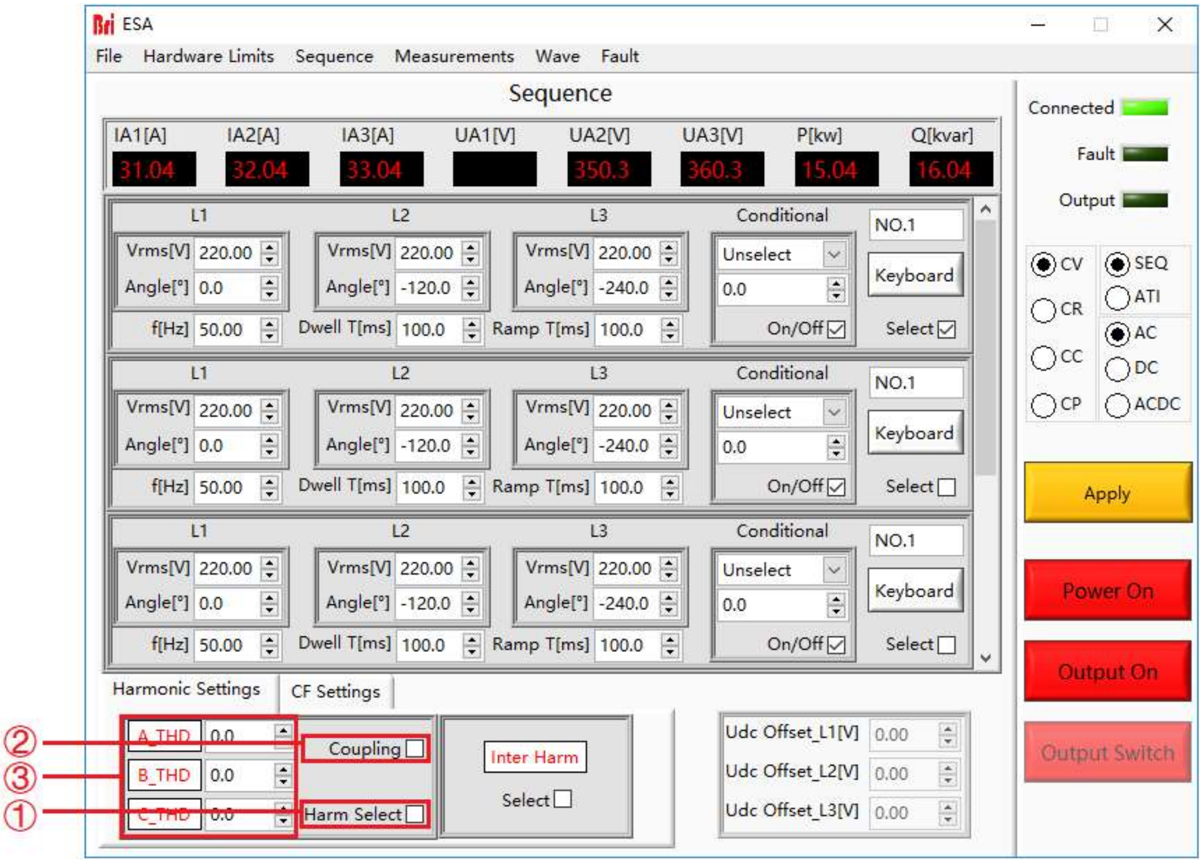


Figure 5-15 Harmonic Simulation-1

Table 5-7

No.	Description	Note
1	**Harmonic selection box**	After checking, the harmonic setting is valid.
2	**Coupling box**	After checking, the three-phase harmonics can be set at the same time. If unchecked, three-phase harmonics can be set independently.

3	**A/B/C phase harmonic setting**	Three-phase harmonic setting button, the panel is shown in Figure 5-16 will automatically pop up after clicking it. The user can check and set various harmonic parameters on this panel, such as angle, content, and other parameters.

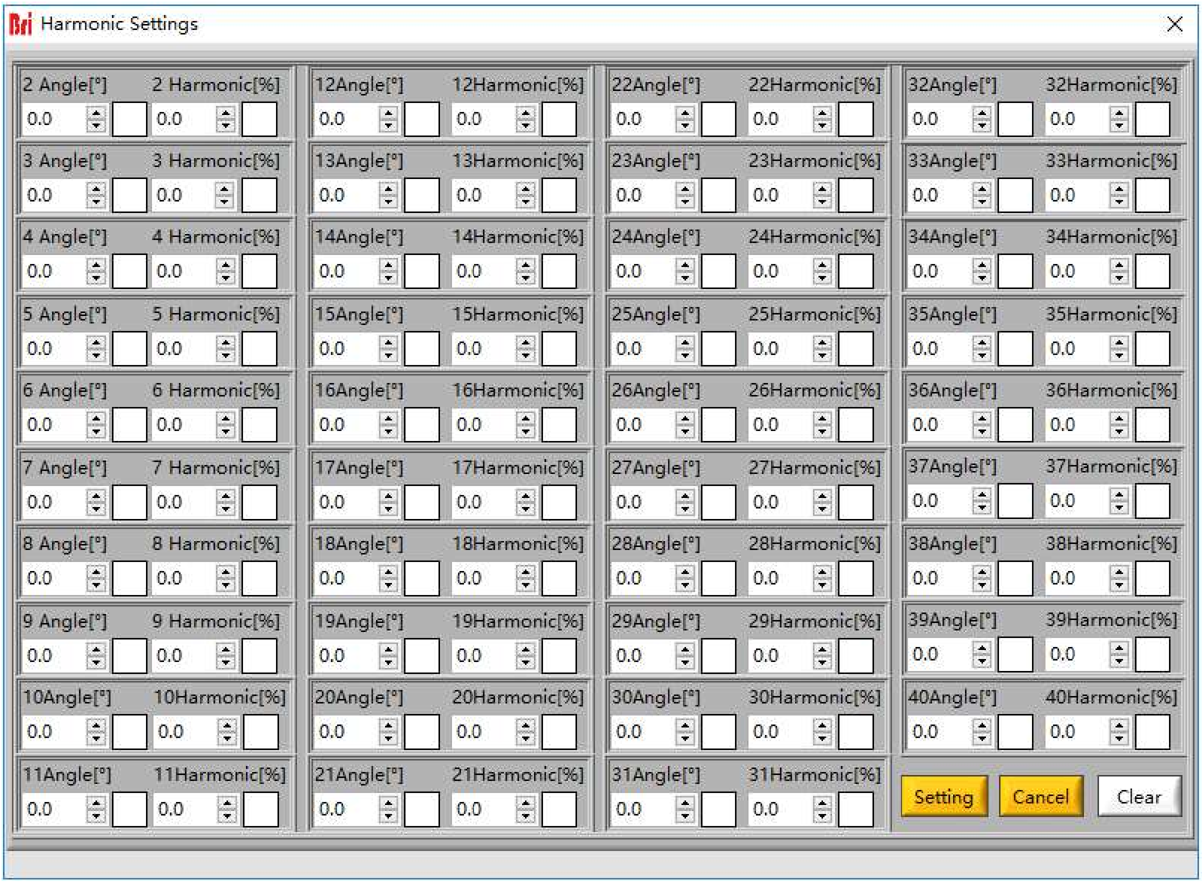


Figure 5-16 Harmonic Simulation-2

5.7.2 Inter-harmonic simulation

ESA series power supply provides GUI software, which can edit inter-harmonic.

Test steps:

Click "Sequence Mode" to enter the panel, firstly set the operating parameters (such as output voltage, frequency, etc.). Click "Apply"→"Power On"→"Output On", the power supply is on. Check the inter-harmonic selection box (Figure 5-17①), click the inter-harmonic simulation button (Figure 5-17②), the inter-harmonic setting panel will automatically pop up (Figure 5-18). The user can set the inter-harmonic frequency, angle, content, and other parameters on this panel. After the parameter setting is completed, check the corresponding box, and click "Setting" → "Apply".

To cancel the inter-harmonic simulation, click the inter-harmonic setting button at the bottom of the page (Figure 5-17②), click "Clear" in the pop-up panel to clear all parameters, click "Setting" → "Apply" in turn, and finally cancel the harmonics by checking the box.

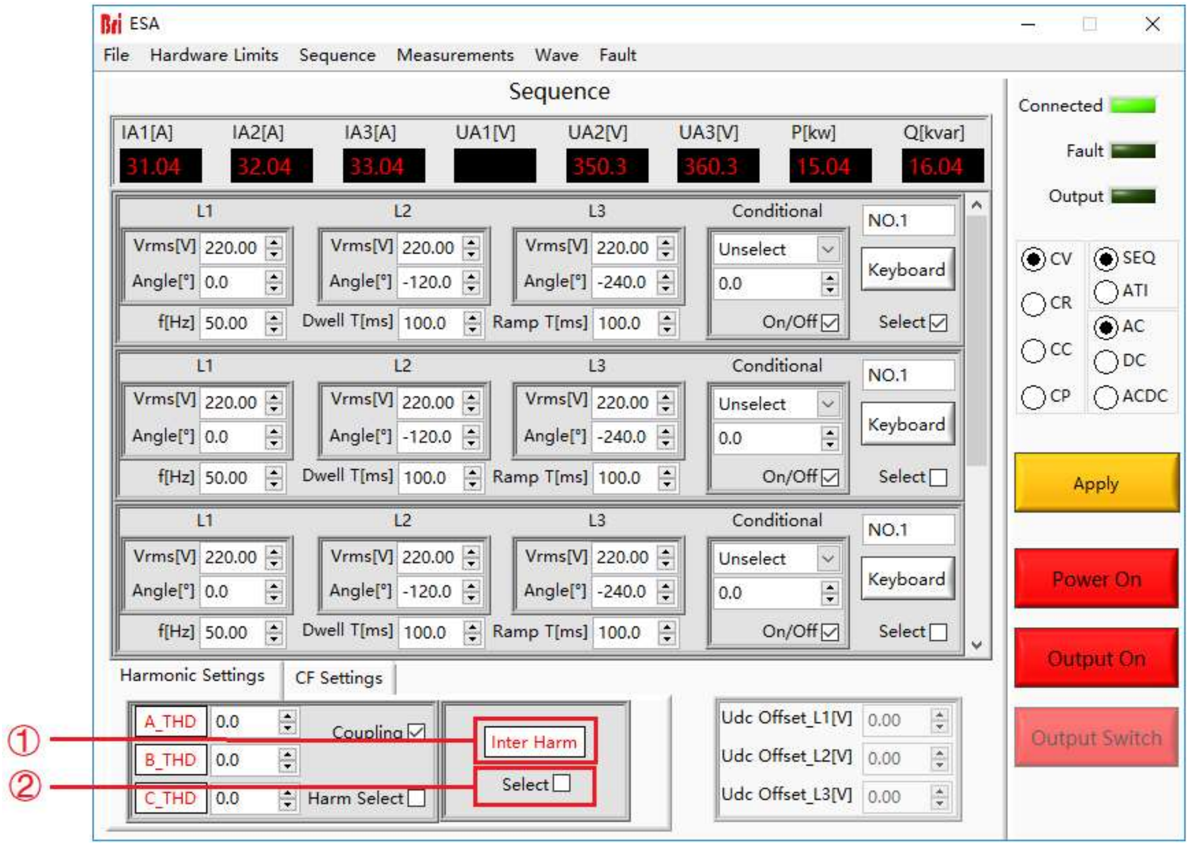


Figure 5-17 Inter-harmonic Simulation -1

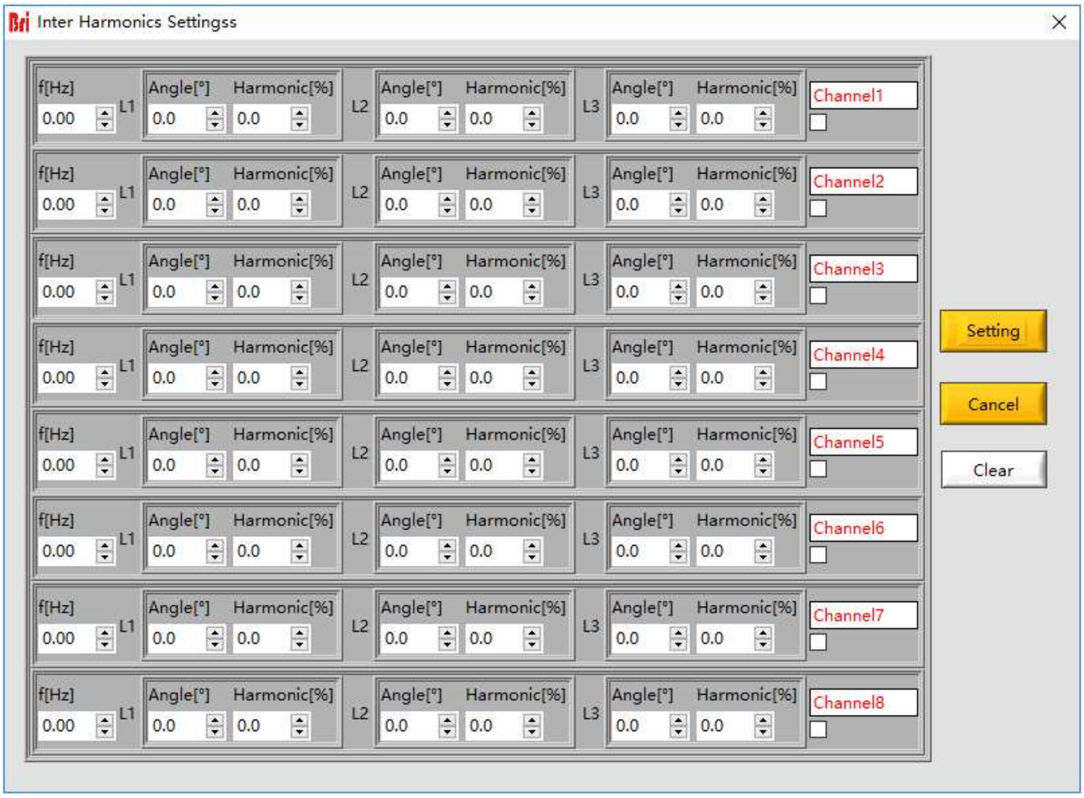


Figure 5-18 Inter-harmonic Simulation -2

5.8 Simulation of Re-generative AC Load

ESA series with -LD option can be used as regenerative AC electronic load. This function consists of CR mode, Rectifier mode, CC/CP phase lead/lag mode.

5.8.1 CR mode

CR mode is used to simulate three-phase resistive loads, the CR mode and three-phase resistance parameters can be set through the panel.

Test steps:

Click "Sequence" to enter the interface, select CR mode on the right side of the panel and set the three-phase resistance parameters (Figure 5-19), click "Apply" → "Power On" → "Output On", the device starts to run and Simulate three-phase resistive load.

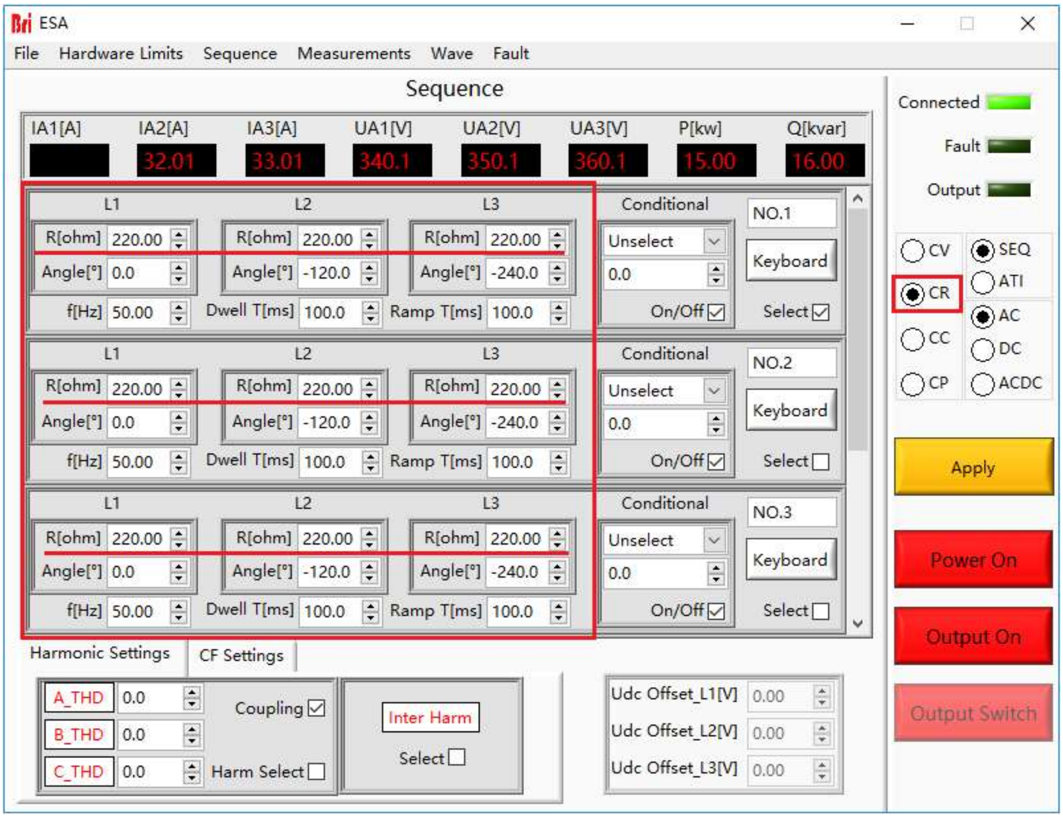


Figure 5-19 CR mode

5.8.2 Rectifier mode

Rectifier mode is mainly used to simulate nonlinear Rectifier load testing. Users can set parameters such as CC/CR mode, load current/power value and CF value (setting range 1.414~3) through the panel.

Test steps:

Click "Sequence" to enter the panel, select the CC/CP mode on the right side of the panel and set the three-phase current/power parameters and CF parameter values (Figure 5-20), then click "Apply"→"Power On"→" Output On", the power supply starts to run and simulates a three-phase rectifier load.

Figure 5-20 Rectifier mode

5.8.3 CC/CP phase lead/lag mode

When the CC/CP phase lead/lag mode simulates sinusoidal current, the user can set the CC/CP mode through the panel to adjust the load current or power, and the phase angle range can be adjusted from 90° to -90°, which simulates inductive and capacitive loads Voltage and current conditions.

Test steps:

Click "Sequence" to enter the spanel, select the CC/CP mode on the right side of the panel and set the three-phase current/power parameters and phase angle (Figure 5-21), then click "Apply" → "Power On" → "Output" On", the power supply starts to run and simulates the sinusoidal current in phase lead/lag mode.

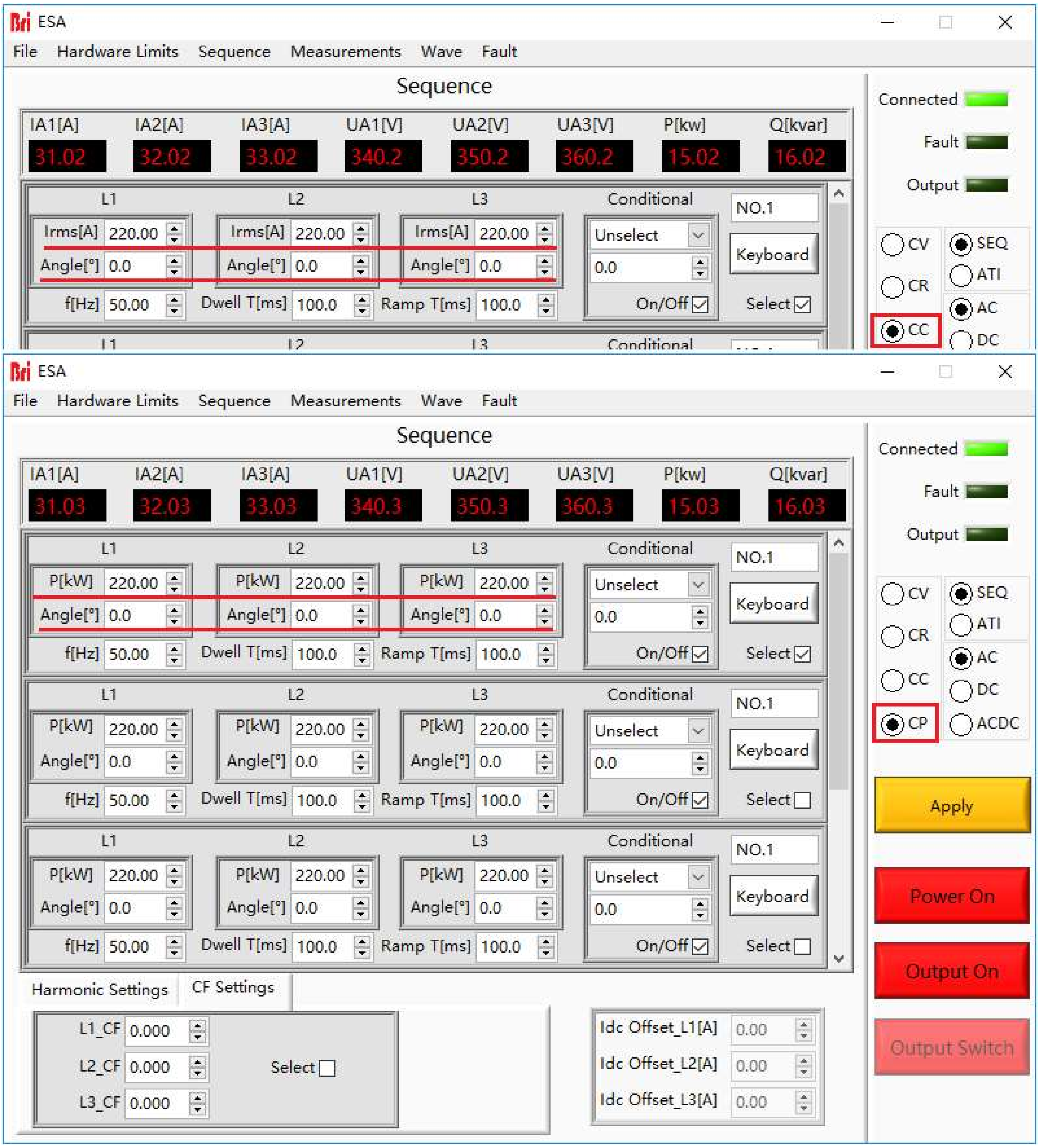


Figure 5-21 the CC/CP phase lead/lag mode

5.9 Measurements

The GUI software of ESA series can monitor the input/output status of the equipment in real time. Click "Measurement" to enter the panel. The user can monitor real-time Input current/voltage/power (Figure 5-22), output current/voltage/power, output frequency and other parameters on this panel (Figure 5-23).

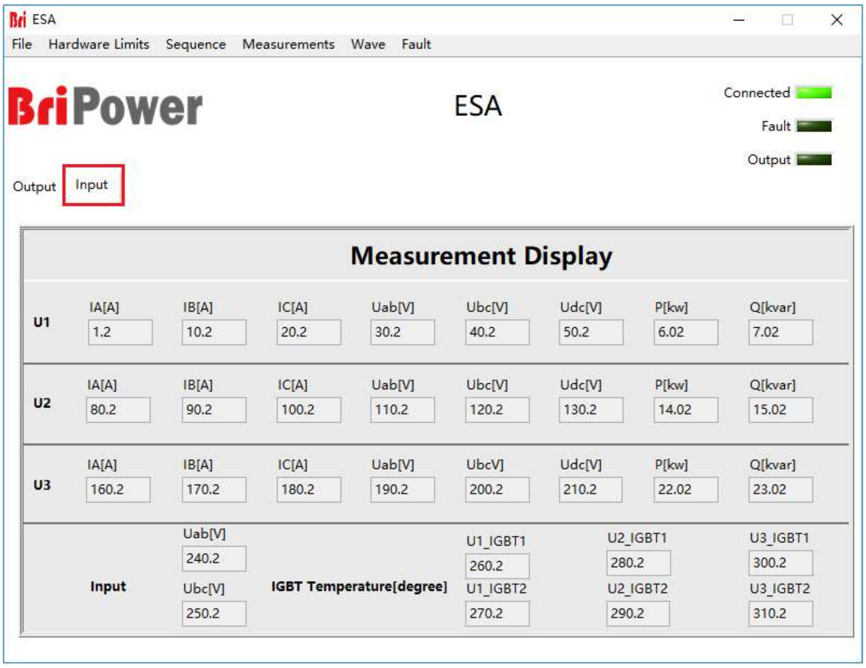


Figure 5-22 Measurements panel-Input

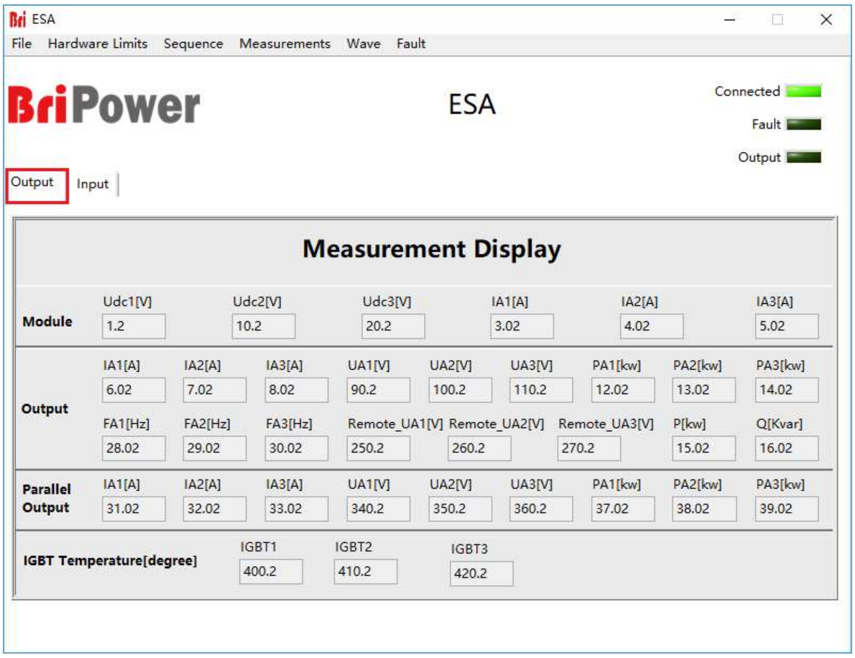


Figure 5-23 Measurements panel-Output

5.10 Waveform

5.10.1 Real-time waveform browsing

The GUI software of ESA Series can record the waveform of output voltage and current, and store in the TFT touch panel/workstation, for the user to retrieve browsing and analysis in future.

Steps:

Click "waveform" to enter the panel (Figure 5-24). In the window of waveform browsing, the user can individually or simultaneously select the data of output voltage or output current (Figure 5-24⑦) and browse the waveform. In addition, the user can also set the window display time of the waveform data points, and observe the sampling time interval, start time, saved time and other parameters (Figure 5-24⑧).

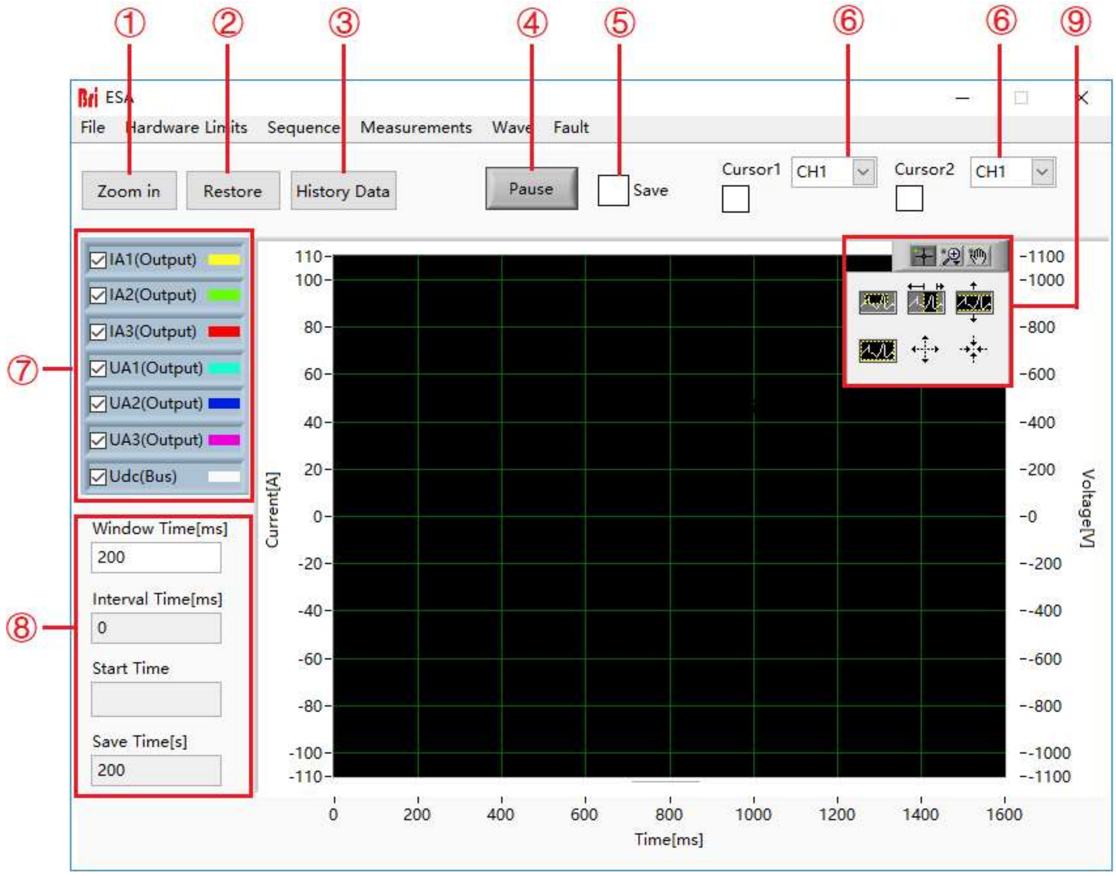


Figure 5-24 Waveform Panel

Table 5-8

No.	Description	Note
1	**Zoom In**	Click “Zoom in” control to zoom in waveform.
2	**Restore**	Click “Restore” control to restore the enlarged waveform to the default scale for browsing.
3	**Historical Data**	Retrieve the historical Waveform data, click it to pop up the historical waveform browsing window as shown in Figure 5-19.
4	**Pause**	Click pause control, the waveform will stop updating and stay on the captured.

5	**Save**	Check “Save”, the data in the waveform browsing window will be saved.
6	**Cursor1**	Cursor 1, the amplitude and time of a point on the waveform, often cooperate with cursor 2 to measure the time interval.
	Cursor2	Cursor 2, the amplitude and time of a point on the waveform, often cooperate with Cursor 1 to measure the time interval.
7	**Waveform Selection**	The output voltage or output current data can be set individually or at the same time and browse its waveform.
8	**Parameter Setting**	The window display time, sampling time interval and other parameters of the waveform data points can be set.
9	**Control button**	The user can zoom in horizontally/vertically, zoom in/out as a whole, zoom in partly, restore the original state, and drag the waveform though clicking different buttons.

5.10.2 Historical waveform browsing

The GUI software of ESA series can record the waveform of output voltage and current, and store it in the TFT touch panel/workstation, for users to retrieve browsing and analysis in future

Operation Steps:

Click "Historical Data" to enter the panel (Figure 5-251). The historical waveforms are arranged in the window on the left in order of recording time. After selecting a waveform, click "Read waveform " to browse the historical Waveforms (the operation steps are similar to 5.9.1).

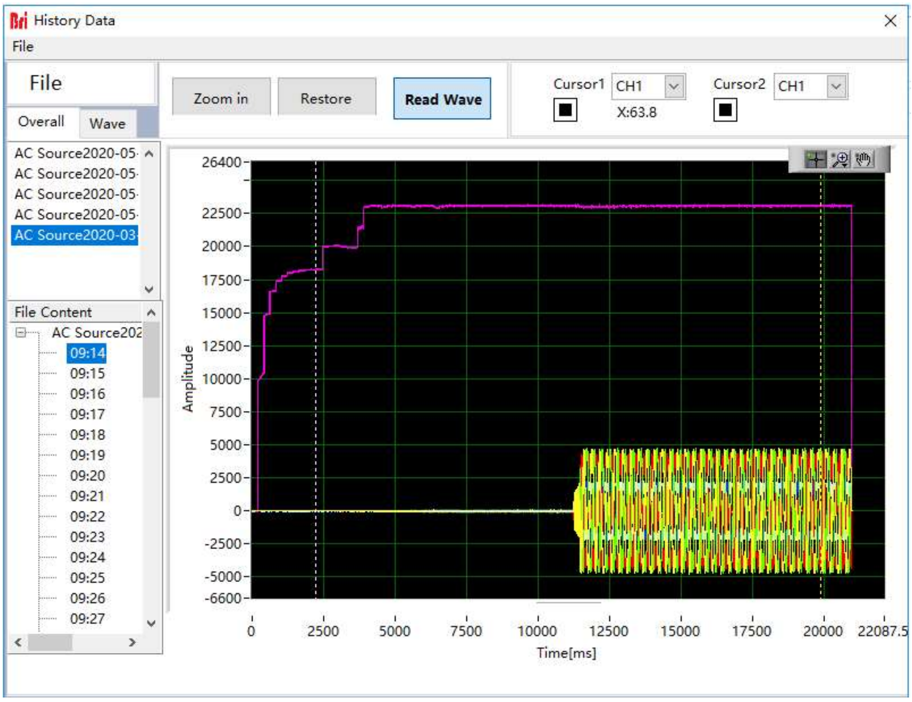


Figure 5-25 Historical waveform panel

5.11 System Status

The user can browse the status of each part of the system during the testing through the GUI software.

Operation steps:

Click "System Status" to enter the panel, users can browse equipment faults and status (Figure 5-26), software faults and status (Figure 5-27). Green light means no fault, and red light means fault occurs. After troubleshooting, the user can click "Reset" to reset the power supply.

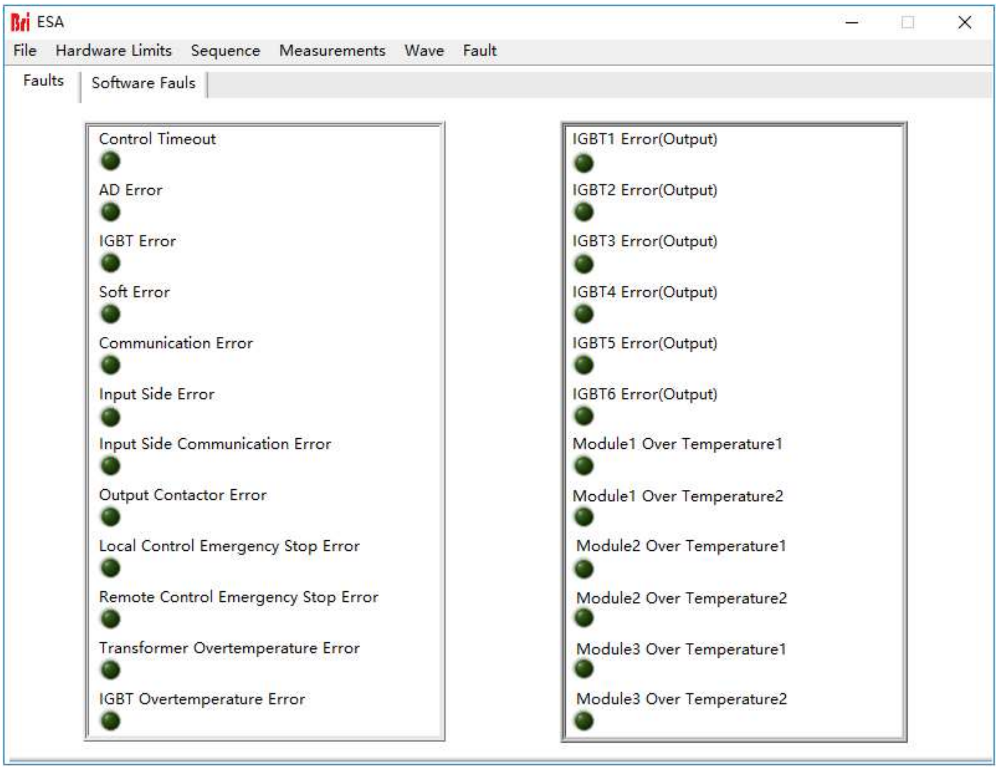


Figure 5-26 Faults and system status

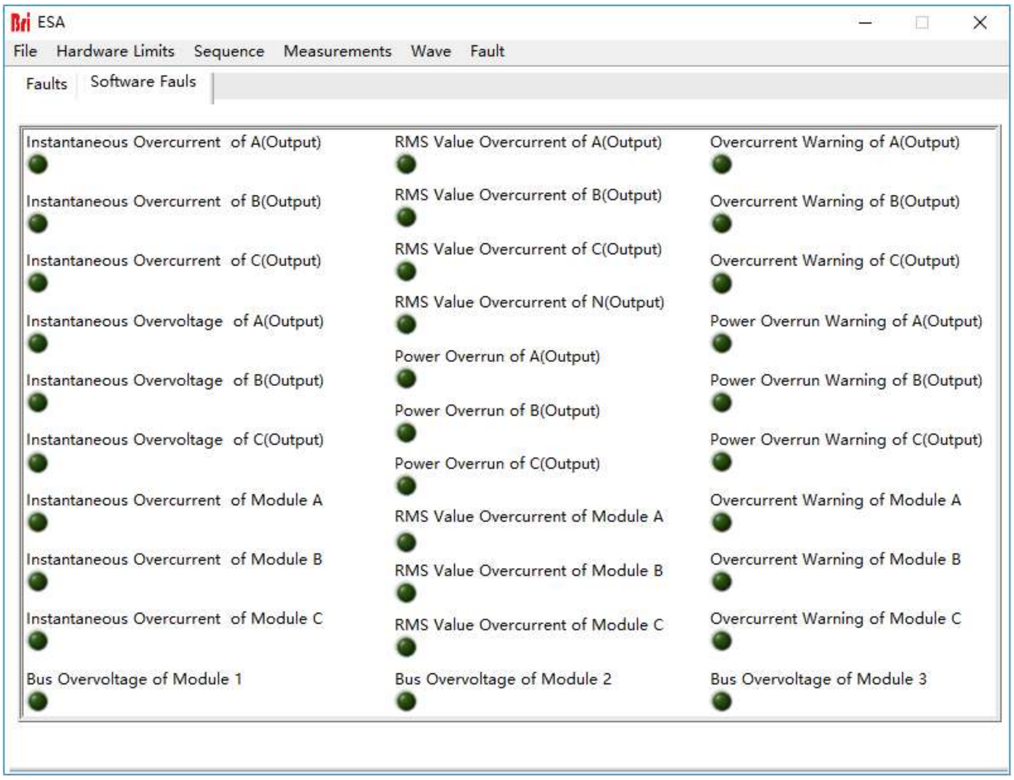


Figure 5-27 Software fault and status

5.12 Administrator Account

After entering the administrator account, the internal parameters can be set. It is not recommended that the user enter the account to avoid accidental settings causing equipment failure or loss of accuracy. The default login account is a guest account, and all functions of the power supply are open and can be used normally.

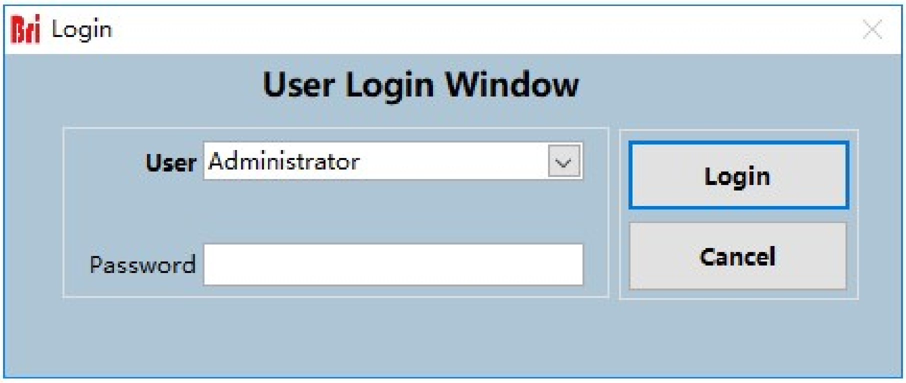


Figure 5-28 System status panel

5.13 Line impedance (RL) Simulation (-IMP option)

ESA series with -IMP option can simulate output line impedance (RL). The impedance range is up to Rated V/Rated I; and the R and L values can be set in GUI software.

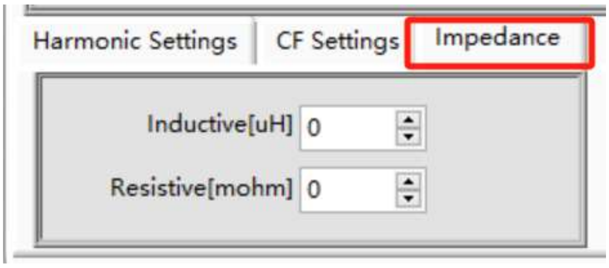


Figure 5-29

5.14 Power supply + Electronic RLC load for anti-islanding test (-62116 option)

The -62116 option of BriPower ESA series provides an alternative solution for anti-islanding test.

In IEC62116-2008, R, L, C load should be adjusted according following steps to have Qf = 1,0 ± 0,053.

1) Determine the amount of inductive reactance required in the resonant RLC circuit using the relation QL = Qf × PEUT= 1,0 × PEUT.

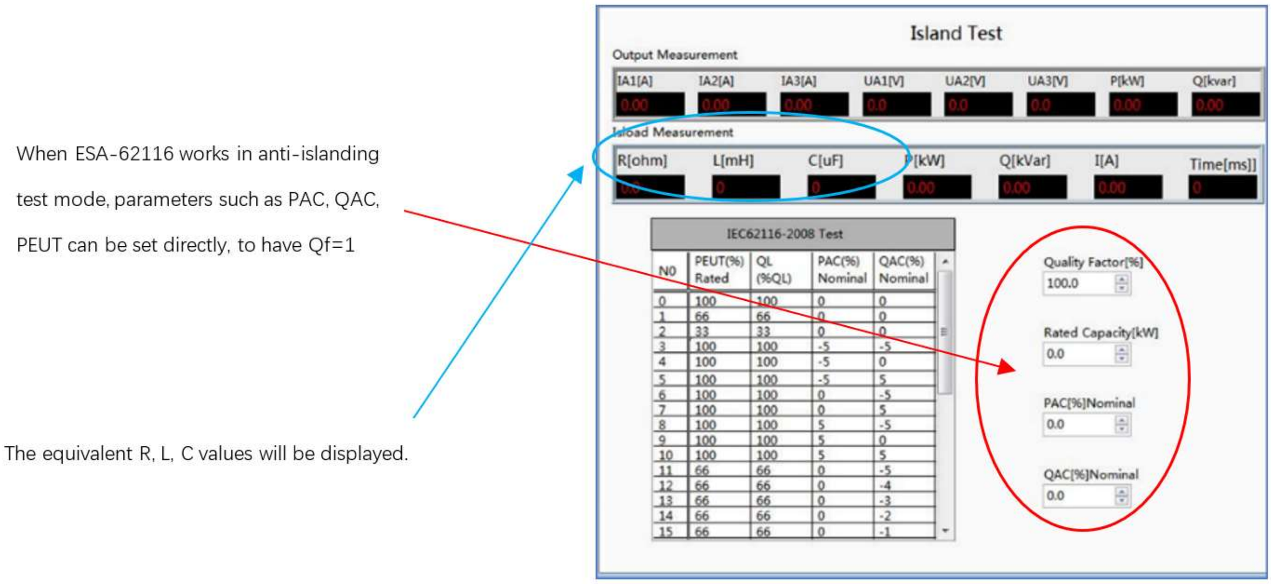
2) Connect an inductor as the first element of the RLC circuit. Adjust the inductance to QL.

3) Connect a capacitor in parallel with the inductor. Adjust the capacitive reactance so that QC + QL = – QEUT.

4) Connect a resistor that results in the power consumed by the RLC circuit equaling PEUT.

While using ESA with -62116 option, working in anti-islanding test mode, parameters such as PAC, QAC, PEUT, will be set directly. During the test, ESA will calculate the equivalent R, L, C values to have Qf = 1.0 ± 0.053, and simulate RLC load in real time. And the R, L, C values will be displayed.

In this way, the R, L, C load adjusting steps are not the same as what is suggested in the test standard, but it meets the requirements of the test standard, and provides a more convenient testing method.



ESA Operation Panel

Figure 5-30

IMPORTANT INFORMATION

ESA-62116 can only simulate RLC load for sine waveform, 50/60Hz input.

Chapter 6 Equipment verification and calibration

6.1 Performance Verification

6.1.1 Verity equipment and settings

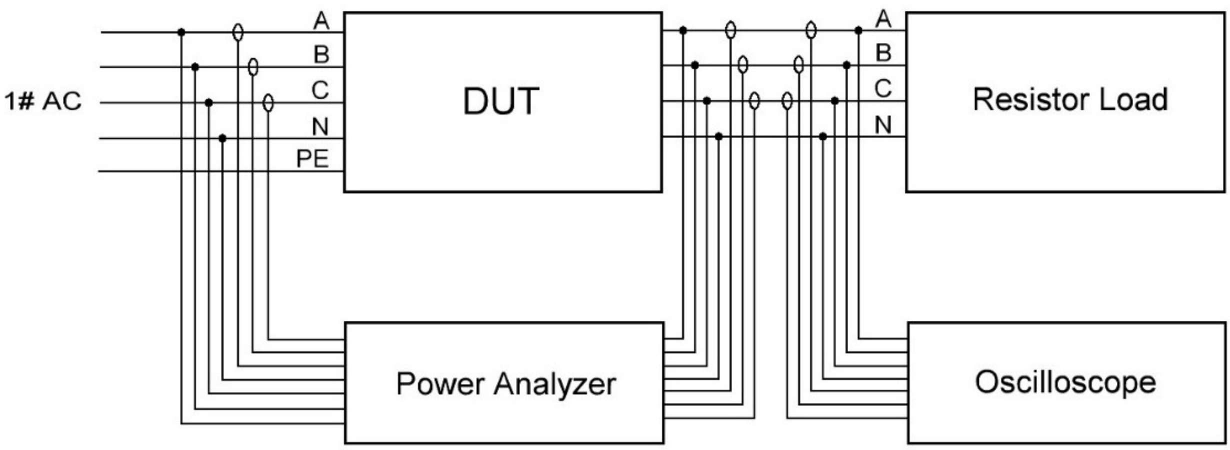


Figure 6-1 Three-phase output test with resistive load

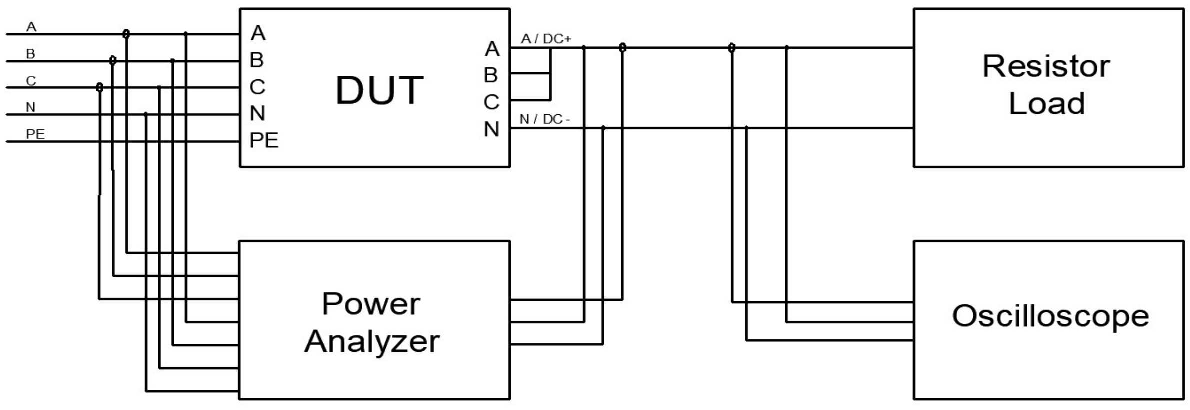


Figure 6-2 Single-phase output test with resistive load

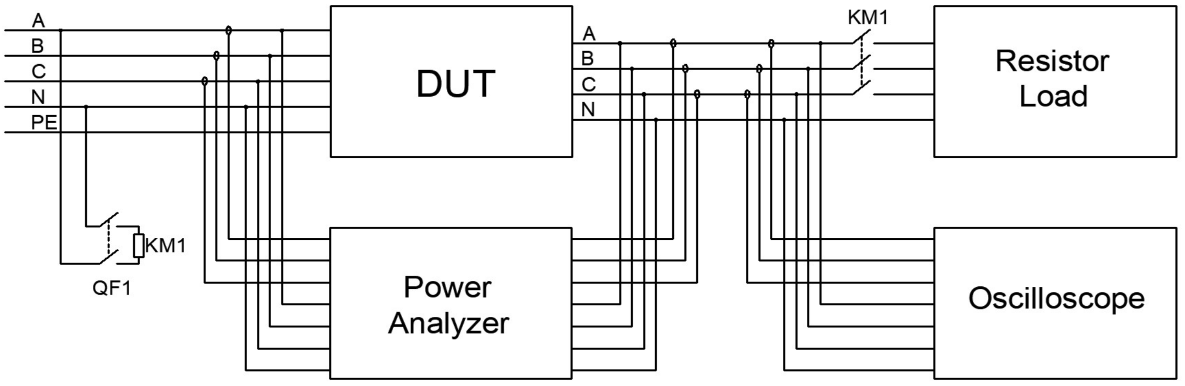


Figure 6-3 Load step change test

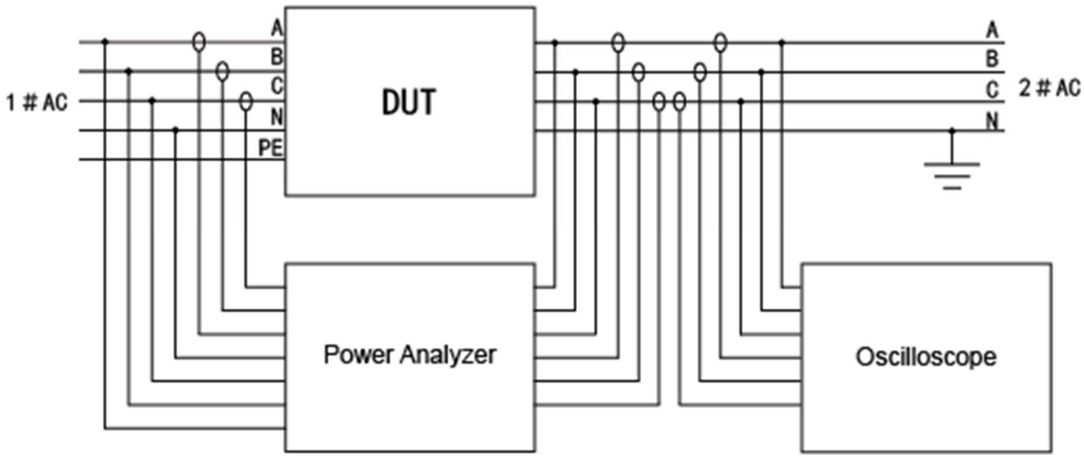


Figure 6-4 Recycling electronic load test

Table 6-1

No.	Instruments	Model
1	Power analyzer	ZIMMER LMG670
2	Oscilloscope	Tektronix DPO2002B/ DS4000E
3	Voltage Probe	RIGOL RP1050D
4	Current Probe	CAT III 600V/1000A
5	Noise Detector	SOUND LEVEL METER
6	Temperature Scanner	FLUKE MT4 MAX
7	Breaker	Schneider C4A
8	AC contactor	CHNT NC2-150

CAUTIOUS

To achieve the best performance, all verification and calibration procedures should follow the recommendations:
The ambient temperature remains constant and is between 25±5℃.
The relative humidity of the environment is below 90%.
Keep the cable length as short as possible, and use twisted or shielded cables to reduce noise.

SHOCK HAZARD

Danger of electric shock, the voltage generated by ESA series equipment may be lethal! Make sure that all equipment and load wiring are connected reliably.
When connecting / disconnecting any equipment which connected to the power supply or changing the wiring, turn off the power supply, and do not live working.

6.1.2 Verity content

Voltage Range

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Adjust the output voltage value within the rated voltage range, read and record the measured value on the power analyzer.

Current Range

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Adjust the output voltage value within the rated voltage range to make the output current reach the rated current value of the power supply, read, and record the measured value on the power analyzer.

Frequency Range

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply. After setting the voltage value, change the frequency setting of the power supply, read, and record the measured value on the power analyzer.

Voltage Accuracy

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Set the output voltage value to make the power supply work within the rated output voltage range, read and record the output voltage measurement value on the power analyzer and the power supply, and take the largest error for calculation.

The voltage accuracy is obtained by the following formula:

$$\delta_U = \frac{|U_0 - U_1|}{U_N} \times 100\%$$

And:

δ_U——VoltageAccuracy;

U_1——Voltage value measured via power analyzer, V;

U_0——Voltage value displayed on power supply, V;

U_N——Rated Voltage, V;

Current Accuracy

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Set the output voltage value to make the power supply work within the rated output current range, read and record the output current measurement value on the power analyzer and the power supply, and take the largest error for calculation.

The current accuracy is obtained by the following formula:

$$\delta_I = \frac{|I_0 - I_1|}{I_N} \times 100\%$$

And:

δ_I——Current Accuracy;

I_1——Current value measured via power analyzer, A;

I_0——Current value displayed on power supply, A;

I_N——Rated Current, A;

Frequency Accuracy

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply. After setting the voltage value, change the frequency setting value of the power supply, read and record the output frequency measurement value of the power analyzer and the power supply, and take the one with the largest error for calculation. The frequency accuracy is obtained by the following formula:

$$\delta_f = \frac{|f_0 - f_1|}{f_N} \times 100\%$$

And：

δ_f——Power accuracy;

f_1——Frequency value measured via power analyzer, Hz；

f_0——Frequency value displayed on power supply, Hz；

f_N——Rated Frequency， Hz；

Power Accuracy

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Set the output voltage value to make the power supply work within the rated output power range, read and record the output power measurement value on the power analyzer and the power supply, and take the largest error for calculation. The power accuracy is obtained by the following formula:

$$\delta_P = \frac{|P_0 - P_1|}{P_N} \times 100\%$$

And:

δ_P——Power Accuracy;

P_1——Power value measured via power analyzer, kW;

P_0——Power value displayed on power supply, kW;

P_N——Rated Power, kW;

Output Characteristics

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Set the output voltage value to make the power supply work within the rated output voltage range, read and record the output measurement value, efficiency, and PF value on the power analyzer.

Load Regulation

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Set the output voltage value to make the power supply work within the rated output voltage range, read and record the output voltage measurement value on the power analyzer when there is no-load and On-load, the load adjustment rate is obtained by the following formula:

$$L = \frac{|U_0 - U_1|}{U_1} \times 100\%$$

And:

L——Voltage Accuracy;

U_1——On-load voltage, V;

U_0——No-load voltage, V;

Un——Rated voltage, V;

Voltage THD

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Set the output voltage value to make the power supply work within the rated output voltage range, read and record the output voltage measurement value on the power analyzer when there is no-load and On-load, and set the frequency value as:50Hz/1000Hz/2000Hz. Read and record the various voltage THD on the power analysis.

Ripple Test

The ripple voltage is the superposition of all AC voltage components at the output of the power supply. When the power supply is DC output, the output is connected to a pure resistive load, so that the output voltage and output current reach the maximum value specified by the product, read and record the AC voltage indication value, and take the maximum value in the test.

The ripple coefficient is obtained by the following formula:

$$Y = \frac{U_{rms}}{U_N} \times 100\%$$

And:

Y ——Ripple coefficient;

U_{mrs}——RMS of voltage ripple, V;

U_N ——Rated Voltage, V;

Harmonic Test

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Set the output voltage value to make the power supply work within the rated output voltage range, and enable the harmonic editing function, set the superimposition value of each harmonic, read and record the measured value of the harmonic component on the power analysis, record the oscilloscope waveform.

Inter-harmonic Test

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output side is connected to a pure resistive load. Set the output voltage value to make the power supply work within the rated output voltage range, and enable the inter-harmonic editing function, set the frequency and harmonic superimposition value, read and record the inter-harmonic component measurement value and THD on the power analysis, record Oscilloscope waveform.

Regenerative AC load test

Connect the input and output of the ESA to the grid so that the input/output voltage is within the operating voltage range of the power supply. The AC load function consists of CC&CP Rectifier mode, CC&CP lead/lag mode, and CR mode. Set parameter values such as CC/CP mode, CF and phase angle on the panel (the phase angle setting range is 90°~-90°, the CF parameter setting range is 1.414~3), read and record the oscilloscope waveform.

Voltage Drop Change

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. In the sequence mode, set the output voltage value, duration and change rate of each step, read, and record the oscilloscope waveform.

Three-phase Unbalanced Output

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Set the output voltage value to make the power supply work within the rated output voltage range and set the phase angle value, read and record the waveform data on the oscilloscope and power analyzer.

Step Load Change

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load through an AC contactor. When the AC power is output to 200V, control the AC contactor to on/off, and record the oscilloscope waveform.

The output power calculation is obtained by the following formula:

$$P = \frac{(U_N)2}{R} \times 3 = \frac{40000}{5.2} \times 3 = 23.08KW$$

And:

P ——Total output power at 200V,，kW；

U_N——Set voltage value，V；

R ——Resistance value，Ω；

Voltage Offset Test

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply, and the output is connected to a pure resistive load. Set the output voltage/current offset to make the power supply work within the rated output voltage range, read and record the offset measurement values on the power analyzer and the power supply.

TTL Signal Trigger

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply. Set the output voltage, phase angle and frequency to make the power supply operating within the rated output voltage range, read and record the oscilloscope Waveform.

Waveform Injection

Connect the input of the ESA to the power grid, so that the input voltage is within the operating voltage range of the power supply. Within the rated voltage range, use the panel or signal generator to set the

Input inrush current

Connect the input of the ESA to the grid so that the input voltage is within the operating voltage range of the power supply. Input start, read and record the oscilloscope waveform of input start.

• Protective Function

1. Adjust the output voltage above the rated voltage specified by the power supply, and the voltage output will be limited by power supply.
2. Adjust the input voltage above the rated voltage specified by the power supply, and the power supply will immediately cut off the output and give an alarm.

3. Adjust the load or output voltage so that the output current is greater than 1.2 times the rated value. The power supply will immediately start the protection function and cut off the output.

4. Adjust the temperature setting value of the software program. When the current measured temperature is greater than 10% of the software setting temperature, the power supply will immediately cut off the output and give an alarm.

Log Function

The user can be view log record through setting panel.

Clock Function

The user can view and set the current time, year, month, day, hour, and minute through setting panel.

LCD Display Test

In the setting and running state, there is no flicker and flower on LCD screen.

Noise test

Temperature test

6.2 Test Record Form

Please refer to the ESA test report.

Chapter 7 Equipment Maintenance and Repair

7.1 Equipment Maintenance

Please be careful of the maintenance environment of equipment. Bridge Technology has no liability for failures caused by breaking equipment rules.

7.1.1 Equipment operating environment

- The equipment is used indoors, and the operating temperature is not higher than 40 ° C and not lower than 0 ° C.
- The temperature of equipment storage is not higher than 85 ° C and not lower than -25 ° C.
- The equipment should be installed indoor with a maximum relative humidity of 20 to 90% RH (no condensation).
- To avoid corrosion of electrical components, the equipment should be isolated from harmful gases such as acids and alkalis which damages the insulation.
- For ventilation, the equipment should be kept more than 600mm away from the wall or other equipment.
- No violent vibrations and shocks during equipment installation.
- The equipment should be kept away from flammable and explosive substances.
- There should be no strong electromagnetic field interference around the equipment.

7.1.2 Equipment maintenance

- No dust accumulation on the equipment and the ground must be clean.
- Cleaning: To prevent dust or moisture which affects the performance of the equipment, keep the surface clean and dry. Please use a soft, lint-free cleaning cloth to clean the outside. Do not use any cleaner.

7.2 Equipment Repair

7.2.1 Equipment self-test

- Whether inlet/outlet and terminal block of the equipment are connected.
- Whether inlet/outlet lines of the equipment are damaged or exposed, and with good insulation.
- Whether the ground wire is good, no looseness, and not overlapped with other metals.
- Whether it sounds normal or not excessively heated of the wiring when the equipment is running.

CAUTIOUS

Do not disassemble the equipment. If there is any problem, please contact the agent or Bridge Technology. Bridge Technology has no liability for equipment failure caused by self-assembly.

7.2.2 Maintenance service

If the purchased equipment failure during the warranty period, Bridge Technology will repair the equipment according to the specific information provided by the customer.

Contact information is on Page 02.

7.2.3 Equipment Returns

If the failure is confirmed by itself rather than the connection problem, please return the power supply to Bridge Technology to repair.

- Please attach a note to the packing, indicating the specific description of the failure, model, and owner of the power supply.
- Please place the power supply in the original load carriers, properly fill the cushioning material, and ensure that the packing box is firm.

Chapter 8 Programming

8.1 Command Format

The parameter data types, parameters and the value range and formats of the programmed commands of the power supply are introduced in this Part. The user shall carefully read the content of the following Parts before developing the control operations.

8.1.1 Parameters data type

Parameters Data Type	Effective Parameters
<boolean>	1 or 0
<NRf1...n>	Floating Point, 0/positive/negative floating points
<NRf>	Floating Point, 0/positive/negative floating points
<string>	Character strings

8.1.2 Command parameters/Return valve units

Physical Qty.	Unit
Voltage	V (Volt)
Current	A (Ampere)
Active Power	KW (Kilowatt)
Reactive Power	KVA (Kilovolt-ampere)
Time	mS (Millisecond)

8.1.3 Command format

The command set of the ESA series are divided into the following two command formats:

- <*>command characters<?> e.g., *IDN? or Remote?
- Command characters_<value> e.g., POWER 1 or SET: VOLT 100.0

8.2 Command Sets

8.2.1 Common commands

Commands	Return Value	Description
*IDN	Return: ESA-***-*** Firmware Version 1.0	Return the information of equipment
*RST	None	Fault Rest
Remote?	Remote,1/0	Inquire the status of Remote/Local. It will return 1 if working in Remote mode, else return 0.
FAULT?	FAULT,1/0	Check if there is a fault. It would return 1 if fault occurred, else return 0.
POWER ON/OFF	None	Turn ON/OFF the switch of grid side.
OUTPUT ON/OFF	None	Enable/Disable the output of power supply
POWER:STAT?	POWER:STAT,1/0	Return status of switch of grid side 1:ON 0:OFF
OUTPUT:STAT?	OUTPUT:STAT,1/0	Return status of output of power supply 1:ON 0:OFF
OVP <NRf>	None	Set the value of Over Voltage Protection
OCP <NRf>	None	Set the value of Over Current Protection
OPP <NRf>	None	Set the value of Over Power Protection
OPC <NRf>	None	Set Output Peak Current Limit
OVP?	OVP <,NRf>	Inquire the value of Over Voltage Protection
OCP?	OCP <,NRf>	Inquire the value of Over Current Protection
OPP?	OPP <,NRf>	Inquire the value of Over Power Protection
OPC?	OLP <,NRf>	Inquire the value of Output Peak Current Limit
DOVC <NRf>	None	Set the value of DC Offset Voltage climbing
DOVC?	DOVC <,NRf>	Inquire the value of DC Offset Voltage climbing
DOCC <NRf>	None	Set the value of DC Offset Current climbing
DOCC?	DOVC <,NRf>	Inquire the value of DC Offset Current climbing
LIMIT <NRf1>	None	Set the values of following parameters for one time: Output Peak Current Limit
LIMIT?	LIMIT<,NRf1>	Inquire the value of :

		Output Peak Current Limit
MODE CV/CR/CC/CP	None	Set the mode of output to CV/CR/CC/CP
MODE?	MODE 3/2/1/0	Return mode of output 3:CP 2:CC 1:CR 0:CV
MODES SEQ/ATI	None	Set Input mode of reference value SEQ:Software input ATI:Analog input
MODES?	MODES 1/0	Return Input mode of reference value 1:ATI 0:SEQ
MODEA AC/DC/ACDC	None	Set the AC or DC mode of output. AC or DC
MODEA?	MODEA 2/1/0	Return the AC or DC mode of output 2:ACDC 1:DC 0:AC
SET:FREQ <NRf>	None	Set the value of Freq
SET:PHASEA <NRf>	None	Set the phase A
SET:AMPA <NRf>	None	Set the amplitude value of phase A
SET:PHASEB <NRf>	None	Set the phase B
SET:AMPB <NRf>	None	Set the amplitude value of phase B
SET:PHASEC <NRf>	None	Set the phase C
SET:AMPC <NRf>	None	Set the amplitude value of phase C
SET:FREQ?	SET: FREQ<,NRf>	Inquire the value of frequency
SET:PHASEA?	SET: PHASEA<,NRf>	Inquire the value of phase of A
SET: AMPA?	SET: AMPA<,NRf>	Inquire the value of amplitude of A
SET:PHASEB?	SET: PHASEB<,NRf>	Inquire the value of phase of B
SET:AMPB?	SET: AMPB<,NRf>	Inquire the value of amplitude of B
SET:PHASEC?	SET: PHASEC<,NRf>	Inquire the value of phase of C
SET:AMPC?	SET: AMPC<,NRf>	Inquire the value of amplitude of C
SET <NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7>	None	Set the values of following parameters for one time: Frequency; phase of A; amplitude of A; phase of B;

		amplitude of B; phase of C; amplitude of C;
SET?	SET <,NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7>	Inquire the values of following parameters for one time: Frequency; phase of A; amplitude of A; phase of B; amplitude of B; phase of C; amplitude of C;
SET APPLY	None	Validate the parameters that have been set.
OFFSET:A <NRf>	None	Set the dc offset of A
OFFSET:B <NRf>	None	Set the dc offset of B
OFFSET:C <NRf>	None	Set the dc offset of C
OFFSET <NRf1><,NRf2><,NRf3>	None	Set the dc offset of A~C
OFFSET:A?	OFFSET:A<NRf>	Inquire the dc offset of A
OFFSET:B?	OFFSET:B<NRf>	Inquire the dc offset of B
OFFSET:C?	OFFSET:C <NRf>	Inquire the dc offset of C
OFFSET?	OFFSET <NRf1><,NRf2><,NRf3>	Inquire the dc offset of A~C
OFFSET APPLY	None	Validate the offset parameters that have been set.
VOLT:A?	VOLT:A<NRf>	Measure the voltage of output A
VOLT:B?	VOLT:B<NRf>	Measure the voltage of output B
VOLT:C?	VOLT:C<NRf>	Measure the voltage of output C
VOLT?	VOLT<NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6>	Measure the voltage of output A~C
CUR:A?	CUR:A<,NRf>	Measure the current of output A
CUR:B?	CUR:B<,NRf>	Measure the current of output B
CUR:C?	CUR:C<,NRf>	Measure the current of output C
CUR?	CUR<,NRf1><,NRf2><,NRf3>	Measure the current of output A~C
POW:A?	POW:A<,NRf>	Measure the power of output A
POW:B?	POW:B<,NRf>	Measure the power of output B
POW:C?	POW:C<,NRf>	Measure the power of output C

POW?	POW <,NRf1><,NRf2><,NRf3>	Measure the power of output A~C
VOLTDC:A?	VOLTDC:A<NRf>	Measure the dc voltage of output A
VOLTDC:B?	VOLTDC:B<NRf>	Measure the dc voltage of output B
VOLTDC:C?	VOLTDC:C<NRf>	Measure the dc voltage of output C
VOLTDC?	VOLTDC<NRf1><,NRf2><,NRf3>	Measure the dc voltage of output A~C
CURDC:A?	CURDC:A<NRf>	Measure the dc current of output A
CURDC:B?	CURDC:B<NRf>	Measure the dc current of output B
CURDC:C?	CURDC:C<NRf>	Measure the dc current of output C
CURDC?	CRUDC <NRf1><,NRf2><,NRf3>	Measure the dc current of output A~C
FREQ:A?	FREQ:A<NRf>	Inquire the frequency of output A
FREQ:B?	FREQ:B<NRf>	Inquire the frequency of output B
FREQ:C?	FREQ:C<NRf>	Inquire the frequency of output C
FREQ?	FREQ<NRf1><,NRf2><,NRf3>	Inquire the frequency of output A~C
MEAS?	MEAS <,NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6>……	Inquire all measured parameters of power supply.
FCODE?	FCODE <,NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6>	Inquire fault code if happened.

*Unit of voltage: V; Unit of voltage: A; Unit of power: kW; Unit of time: ms

8.2.2 SCPI and panel comparison

1. Hardware Limits

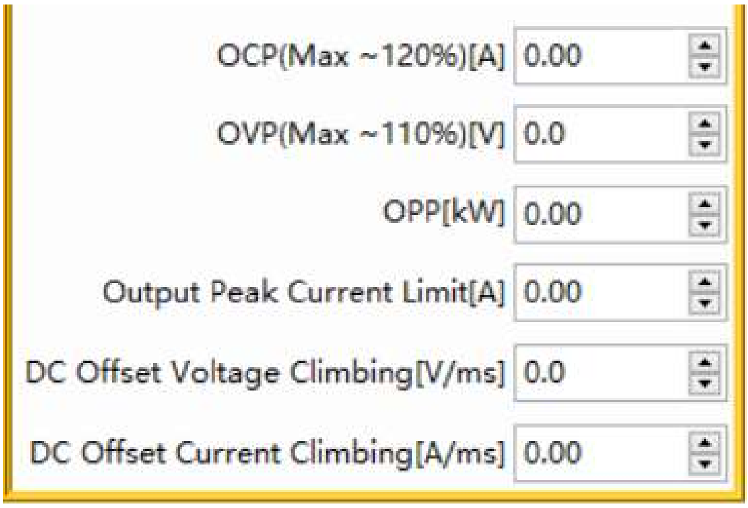


Figure 8-1

Commands	Return Value	Description
OVP<NRf>	None	Set the value of Over Voltage Protection
OCP <NRf>	None	Set the value of Over Current Protection
OPP <NRf>	None	Set the value of Over Power Protection
OPC <NRf>	None	Set Output Peak Current Limit
DOVC <NRf>	None	Set the value of DC Offset Voltage climbing
DOCC <NRf>	None	Set the value of DC Offset Current climbing
DOVC?	DOVC <,NRf>	Inquire the value of DC Offset Voltage climbing
DOCC?	DOVC **<,NRf>**	Inquire the value of DC Offset Current climbing
OVP?	OVP <,NRf>	Inquire the value of Over Voltage Protection
OCP?	OCP <,NRf>	Inquire the value of Over Current Protection
OPP?	OPP <,NRf>	Inquire the value of Over Power Protection
OLP?	OLP <,NRf>	Inquire the value of Over Voltage Protection

2. Sequence

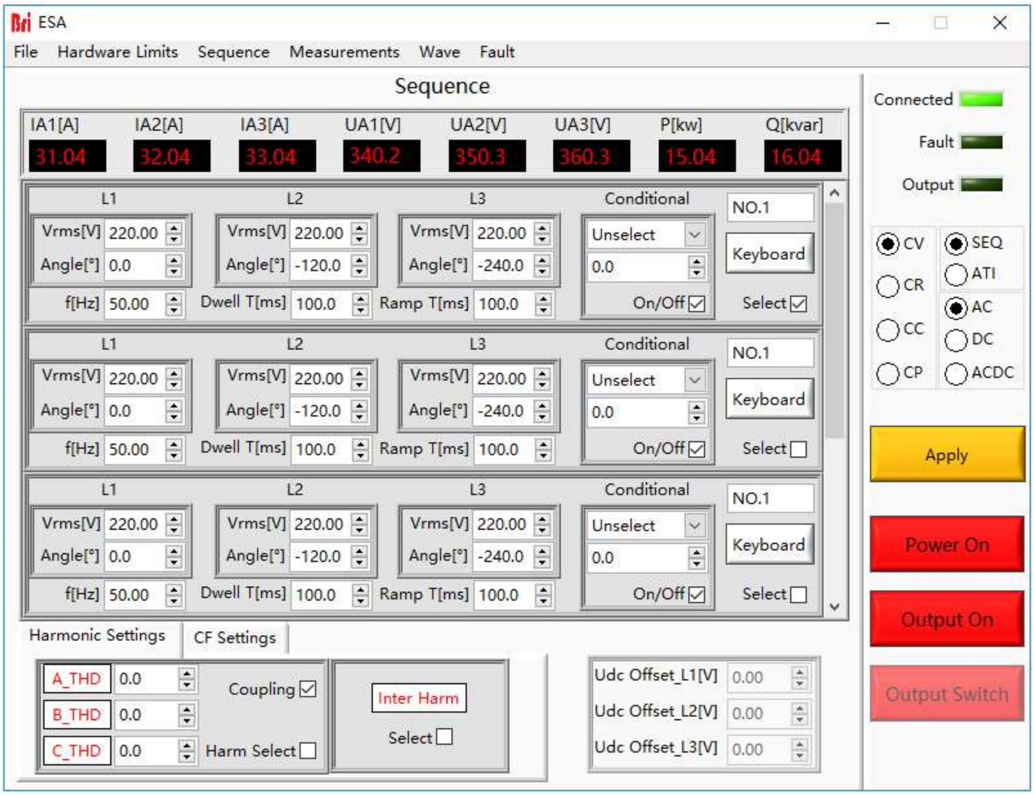


Figure 8-2

Commands	Return Value	Description
POWER ON/OFF	None	Turn ON/OFF the switch of grid side.
OUTPUT ON/OFF	None	Enable/Disable the output of power supply
POWER:STAT?	POWER:STAT,1/0	Return status of switch of grid side 1:ON 0:OFF
OUTPUT:STAT?	OUTPUT:STAT,1/0	Return status of output of power supply 1:ON 0:OFF
MODE CV/CC/CP/CR	None	Set the mode of output to CV or CC or CP or CR
MODE?	MODE ,3/2/1/0	Return mode of output 3:CR 2:CP 1:CC 0:CV
SEQ CLEAR	None	Clear the sequence's parameters in sequence mode and the current step return to 1

SEQ INC	None	Go to next step of sequence in sequence mode
SEQ:FREQ <NRf>	None	Set output frequency inactivated step in sequence mode
SEQ:PHASEA <NRf>	None	Set the phase of output A in activated step in sequence mode
SEQ: AMPA <NRf>	None	Set the amplitude of output A in activated step in sequence mode
SEQ:PHASEB <NRf>	None	Set the phase of output B in activated step in sequence mode
SEQ: AMPB <NRf>	None	Set the amplitude of output B in activated step in sequence mode
SEQ:PHASEC <NRf>	None	Set the phase of output C in activated step in sequence mode
SEQ: AMPC <NRf>	None	Set the amplitude of output C in activated step in sequence mode
SEQ:SWT <NRf>	None	Set switch time
SEQ:DUT <NRf>	None	Set duration
SEQ:CONDSEL NONE/A/B/C	None	Set the selection of the type for condition :NONE/A/B/C
SEQ:CONDVAL <NRf>	None	Set the condition value for phase
SEQ:OUTPUT ON/OFF	None	Enable or Disable the output
SEQ <NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7><,NRf8><,NRf9><,NRf11><,NONE/A/B/C><,ON/OFF>	None	Set the values of following parameters for one time: duration; switch time; output frequency; the phase of output A; the amplitude of output A; the phase of output B; the amplitude of output B; the phase of output C; the amplitude of output C; the condition value; the selectioncondtion; the cmd of output
SEQ:LAB <NRf>		Set the sequence step number
SEQ:LAB?	SEQ:LAB<,NRf>	Inquire the sequence number of current step
SEQ:FREQ?	SEQ:FREQ<,NRf>	Inquire output frequency have been set inactivated step in sequence mode

SEQ:PHASEA?	SEQ: PHASEA<,NRf>	Inquire the phase of output A have been set inactivated step in sequence mode
SEQ:AMPA?	SEQ: AMPA<,NRf>	Inquire the amplitude of output A in activated step in sequence mode
SEQ:PHASEB?	SEQ: PHASEB<,NRf>	Inquire the phase of output B have been set inactivated step in sequence mode
SEQ:AMPB?	SEQ: AMPB<,NRf>	Inquire the amplitude of output B in activated step in sequence mode
SEQ:PHASEC?	SEQ: PHASEC<,NRf>	Inquire the phase of output C have been set inactivated step in sequence mode
SEQ:AMPC?	SEQ: AMPC<,NRf>	Inquire the amplitude of output C in activated step in sequence mode
SEQ:SWT?	SEQ:SWT<,NRf>	Inquire switch time
SEQ:DUT?	SEQ: DUT<,NRf>	Inquire duration
SEQ:CONDSEL?	SEQ: CONDSEL ,0/1/2/3	Inquire the selection of the type for condition; 0:NONE 1:A 2:B 3:C
SEQ:CONDVAL?	SEQ:CONDVAL<,NRf>	Inquire the condition value for phase
SEQ:OUTPUT?	SEQ:OUTPUT ,1/0	Inquire the cmd of output; 1:ON 0:OFF
SEQ?	SEQ <NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7><,NRf8><,NRf9><,NRf10><,NRf11><,NONE/A/B/C><,ON/OFF>	Inquire the values of following parameters for one time: LAB; duration; switch time; output frequency ; the phase of output A; the amplitude of output A; the phase of output B; the amplitude of output B; the phase of output C; the amplitude of output C; the condition value; the selectioncondtion; the cmd of output
MSEQ?	MSEQ <NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7><,NRf8><,NRf9><,NRf10><,NRf11><,NONE/A/B/C><,ON/OFF>	Inquire all the parameters in Sequence one time. In turn, the following is: first: LAB; duration; switch time; output frequency ; the phase of output A;

		the amplitude of output A; the phase of output B; the amplitude of output B; the phase of output C; the amplitude of output C; the condition value; the selectioncondtion; the cmd of output Second : LAB; duration; switch time; output frequency ; the phase of output A; the amplitude of output A; the phase of output B; the amplitude of output B; the phase of output C; the amplitude of output C; the condition value; the selectioncondtion; the cmd of output ……..
SEQ APPLY	None	Validate the parameters that have been set in sequence mode.
MODECF ON/OFF	None	Set the CF mode of outout.
MODECF?	MODECF,1/0	Return the CF mode of outout.
CF:CFA <NRf>	None	Set the CF for the current of A (1.414~3)
CF:CFB <NRf>	None	Set the CF for the current of B (1.414~3)
CF:CFC <NRf>	None	Set the CF for the current of C (1.414~3)
CF:CFA?	CF:CFA<,NRf>	Inquire the value of CFA
CF:CFB?	CF:CFB<,NRf>	Inquire the value of CFA
CF:CFC?	CF:CFC<,NRf>	Inquire the value of CFA
OFFSET:A <NRf>	None	Set the dc offset of A
OFFSET:B <NRf>	None	Set the dc offset of B
OFFSET:C <NRf>	None	Set the dc offset of C
OFFSET <NRf1><,NRf2><,NRf 3>	None	Set the dc offset of A~C
OFFSET:A?	OFFSET:A<NRf>	Inquire the dc offset of A
OFFSET:B?	OFFSET:B<NRf>	Inquire the dc offset of B
OFFSET:C?	OFFSET:C <NRf>	Inquire the dc offset of C

OFFSET?	OFFSET <NRf1><,NRf2><,NRf3>	Inquire the dc offset of A~C
OFFSET APPLY	None	Validate the offset parameters that have been set.

3. Harmonic Setting

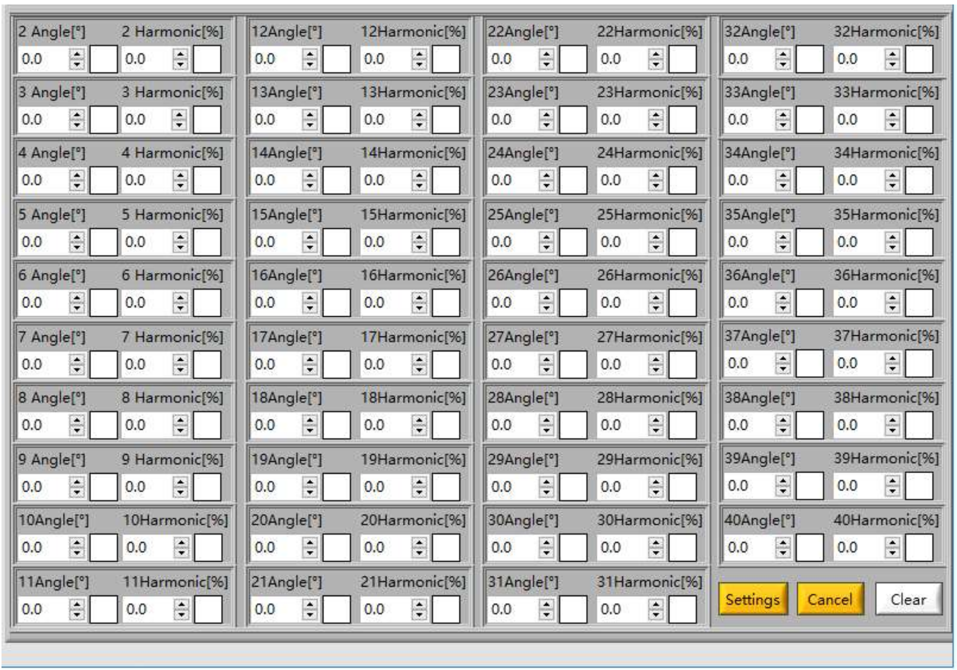


Figure 8-3

Commands	Return Value	Description
HARM <NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7>	None	Set second harmonic parameters： Harmonic order; phase of a; ratio of a; phase of b; ratio of b; phase of c; ratio of c;
HARM?	HARM<NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7>； HARM:<NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7>； …….	Inquire 2-40th harmonic parameters： Harmonic order; phase of a; ratio of a; phase of b; ratio of b; phase of c; ratio of c;

HARM APPLY	None	Validate the parameters that have been set
HARM CLEAR	None	Clear the harmonics parameters

4. Inter Harmonic Setting

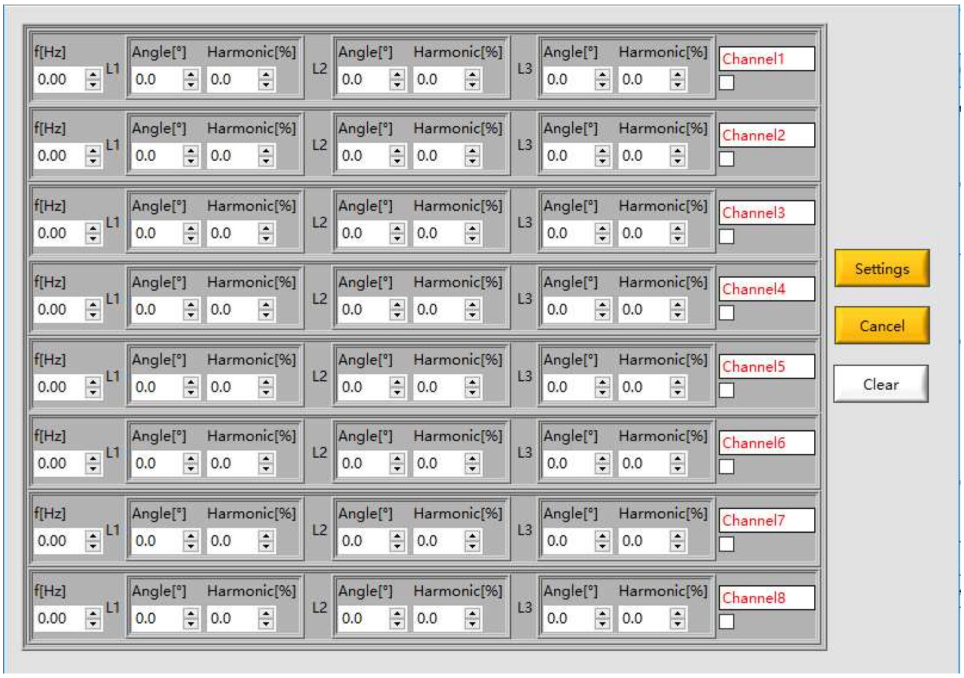


Figure 8-4

Commands	Return Value	Description
IHARM <NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7><,NRf8>	None	Set inter harmonic parameters of Channel Channel; Frequency; phase of a; ratio of a; phase of b; ratio of b; phase of c; ratio of c;
IHARM?	IHARM <NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7> ,<NRf8>	Inquire inter harmonic parameters of Channel Channel; Frequency; phase of a; ratio of a; phase of b; ratio of b; phase of c; ratio of c; …

		Channel; Frequency; phase of a; ratio of a; phase of b; ratio of b; phase of c; ratio of c;
IHARM APPLY	None	Validate the parameters that have been set
IHARM CLEAR	None	Clear the Inter harmonics parameters

8.3 Example

1) Query information

```
*IDN
    ESA-AC***-*** Firmware Versioin 1.0
Remote?
    1
```

2) Set the protection value

```
OVP 300
OVP?
    OVP300.00
OCP 225
OCP?
    OCP225.00
```

3) Set hardware limits

```
LIMIT:CUR 200
LIMIT:CUR?
    LIMIT:CUR200.00
```

4) Check for faults

```
FAULT?
    FAULT0          //No faults

FAULT?
    FAULT1          //Got a fault
OUTPUTOFF
POWEROFF
*RST                    //reset the unit
```

5) Inquire Measure

```
VOLT:A?;VOLT:B?;VOLT:C?
    VOLT:A220.00;VOLT:B220.00;VOLT:C220.00;
```

6) Power up in normal mode

```
MODE CV
SET:FREQ 50
SET:PHASEA 0
SET:AMPA 220
```

SET:PHASEB-120

SET:AMPB 220

SET:PHASEC -240

SET:AMPC 220

SET?

SET50.00,0.00,220.00,-120.00,220.00,-240,220

SET APPLY

POWER ON

POWER:STAT?

POWER:STAT1

OUTPUT ON

OUTPUT:STAT?

OUTPUT:STAT1

VOLT:A?

VOLT:A 220.00

CUR:A?

CUR:A10.00

POW:A?

POW:A 2.20

7) Power up in sequence mode

SEQ:LAB?

SEQ:LAB1

SEQ:FREQ 50

SEQ:PHASEA 0

SEQ:AMPA 220

SEQ:PHASEB -120

SEQ:AMPB 220

SEQ:PHASEC -240

SEQ:AMPC 220

SEQ:SWT 100

SEQ:DUT 100

SEQ:CONDSEL NONE

SEQ:CONDVAL 0

SEQ:OUTPUT ON

SEQ?

SEQ1.00,100.00,100.00,50.00,0.00,220.00,-120.00,220.00,-240.00,220.00,0.00,0.00,1.00

SEQ:INC

SEQ:LAB?

SEQ:LAB2

SEQ:FREQ 50

SEQ:PHASEA 0

SEQ:AMPA100

SEQ:PHASEB -120

SEQ:AMPB 100

SEQ:PHASEC -240

SEQ:AMPC 100

SEQ:SWT 100

SEQ:DUT 100

SEQ:CONDSEL NONE

SEQ:CONDVAL 0

SEQ:OUTPUT ON

SEQ? SEQ2.00,100.00,100.00,50.00,0.00,100.00,-120.00,100.00,-240.00,100.00,0.00,0.00,1.00 SEQ:APPLY

POWER ON

POWER:STAT?

POWER:STAT1

OUTPUT ON

OUTPUT:STAT?

OUTPUT:STAT1

VOLT?

VOLT*.*,*.*,*.*

CUR?

CUR*.*,*.*,*.*

POW?

POW*.*,*.*,*.*