ETSYSTEM®

# Bidirektionale AC-Quellen EAC-4Q-GS

# *Bidirectional AC Sources EAC-4Q-GS*

# Manual

**ET System electronic GmbH**
www.et-system.de

Hauptstraße 119 – 121
D – 68804 Altlußheim

Vertrieb Kontakt: **Tel.: +49 (0)6205 / 394 80**
*Sales contact:* **info@et-system.de**

# INFO & CONTACT ADDRESSES

ET System electronic GmbH was founded in 1986 in the heart of the Rhine-Neckar-Triangle. As a subsidiary of a leading electricity utility group, the company quickly took on a leading role in the area of laboratory power electronics and associated electrical measurement. The existing know-how in power technologies in the 90s gave rise to the "Power Solutions" product division as a strong extension of the historical "Test & Measurement" range.

Since 1997, we have been working successfully as an independent, privately held company with customers in all lines of business from industry, medical care, railway technology and automotive electronics.

By means of our high vertical range of manufacture and our ever-expanding development division, we can fast and flexibly adjust to our customers' requirements. Necessary approvals such as CSA, UL, VDE, TÜV etc. are flexibly carried out by qualified personnel. The approval procedures are performed within the scope of development planning and thus do not negatively impact the start of manufacturing. Permanent manufacturing control through accredited laboratories and an ISO 9001 compliant quality management system guarantee a constant high-level series-production quality.

We offer repairs and adjustments for units outside of our warranty period. Please contact your local distributor for further information:


Germany

ET System electronic GmbH
Hauptstraße 119-121
68804 Altlußheim

Germany
Phone: +49 (0) 6205 39480
Fax: +49 (0) 6205 37560
em@il: info@et-system.de

web: www.et-system.de


| | |
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| ***Place of Business:*** | Altlußheim, Germany |
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## Software Statement

EAC-4Q-GS 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.

# 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. ET System electronic GmbH 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 ET System electronic GmbH 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**<br>If improperly operated, it may cause injury or danger immediately. |
|  | **WARNING**<br>Potentially dangerous situation or practice. If not avoided, it will result in serious injury or death. |
|  | **CAUTIOUS**<br>Potentially dangerous situation or practice. If not avoided, may result in product damage or loss of important data. |
|  | **SHOCK HAZARD**<br>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**<br>Important information when operating the equipment/software. |

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# Part I Equipment Introduction

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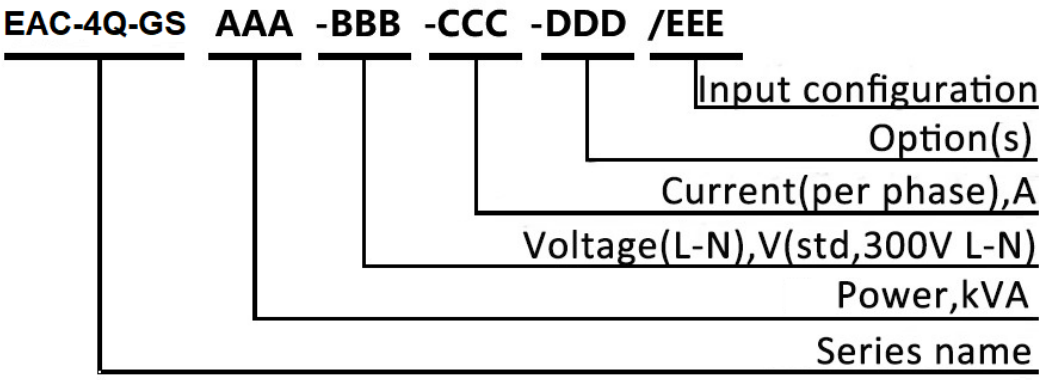
# 1.1 System Overview

## 1.1.1 Overview of EAC-4Q-GS series

The EAC-4Q-GS is a high-performance and multi-functional grid simulator, using advanced PWM technology, which contains multiple output power levels from 30kVA to 500kVA and above for single system, and up to 4 individual systems can be paralleled to achieve power levels up to 2MVA. The maximum output power of the customized system goes up to 4MVA and above. It uses bi-directional design, which can be used as grid simulator in varieties of applications such as in Smart Grid, Energy Storage, Solar etc. With touch panel on the front panel, user can control the power source through GUI software. System status indicators and emergency stop button are installed on the front panel. The programming interface includes standard RS485 and LAN interfaces, as well as optional RS232 and analog control interfaces, which can be used for automated test applications.

## 1.1.2 Model Description




## 1.1.3 Features and configuration

- Single system from 30kVA to 500kVA and parallel up to 4MVA and above
- 4 quadrant operation, regenerative up to 100% of rated output powerback to grid (-R option)
- Independent three-phase output
- Up to 50th harmonic waveform generation
- Voltage drop simulation (LVRT for inverter test)
- Regenerative AC load function (-LD option)
- Line impedance (RL) simulation (-IMP option)
- Voltage and frequency sequencing programming via GUI software, slew rate can be programmed
- ON and OFF output phase angle can be programmed
- Current limit can be programmed, output can be shorted for short circuit test
- Trigger out, TTL signal output for voltage or frequency change
- Extend output frequency to DC (-DC option)
- Add single phase output (-1P option)
- Use water-cooling (-W option)
- Master-Slave interface (-MS option)

- TFT-Touch panel operation
- LAN/RS485 interfaces (standard), RS232/Analog control interfaces (optional)
- Mod-bus/SCPI protocols
- Emergency stop button
- Switchable insulation monitoring
- Output contactor
- Remote sense
- CE conformity
- Customized voltage, current and power ranges

### 1.1.4 General Specification

| **Output** | | **Input** | |
|---|---|---|---|
| Output Modes | AC | AC input Voltage | 3P+N+PE, 380VLL±10%(std) |
| Power Level | 30kVA~500kVA in single controller, 2MVA max power available, Customizable | Frequency | 47-63Hz |
| Voltage Ranges | 0-300V L-N (std), customizable | Efficiency | ≥90% |
| Current Ranges | Customizable | Power Factor | 0.95 |
| Frequency range | Standard 30-100Hz | | |
| Phase output | Phase B/C relative to phase A, 0.0~360.0° | **Measurements** | |
| Harmonic Generation | Up to 50$^{th}$ | Power Accuracy | 0.5%FS |
| Load Regulation | 0.2%FS | Voltage Accuracy | 0.5%FS |
| Line Regulation | 0.1%FS | Current Accuracy | 0.3%FS |
| THD | <1% (Resistive Load) | Frequency Accuracy | 0.01Hz |
| Power Accuracy | 0.5%FS | Phase accuracy | <1.2° (@50Hz) |
| Voltage Accuracy | 0.5%FS | | |
| Current Accuracy | 0.3%FS | **Others** | |
| Frequency Accuracy | 0.01Hz | Protection | OVP, OCP, OTP |
| Phase accuracy | <1.2° (@50Hz) | Regulatory | CE Conformity |
| Power Resolution | 0.1kW | Cooling | Forced Air Cooling |
| Voltage Resolution | 0.1V | Temperature | Operating: 0~40°C<br>Storage: -20~85°C |
| Current Resolution | 0.1A | Operating Humidity | 20-90%RH (None Condensing) |
| Frequency Resolution | 0.01Hz | | |

| **Power Level** | **30kVA** | **60kVA** | **120kVA** | **250kVA** | **500kVA** |
|---|---|---|---|---|---|
| Voltage Range | 0-300V L-N | | | | |
| Output current | 46A/ph | 91A/ph | 182A/ph | 379A/ph | 758A/ph |
| Dimension (W*D*H mm) | 800*800*1900 | 800*800*2200 | 2*800*800*2200 | 2*900*900*2200 | 4*900*900*2200 |
| Weight | <800kg | <1000kg | <1700kg | <2500kg | <5000kg |

*other Power/Voltage Level can be offered. Contact Sales.

# 1.2 Appearance and structure of Equipment

## 1.2.1 Appearance and outline

The overall appearance of the EAC-4Q-GS (take EAC-4Q-GS 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 (optional) on the front panel, product brand, RS485/ LAN interface (standard), TTL interface (standard), ATI interface (optional) which is for automated test applications on the rear panel.

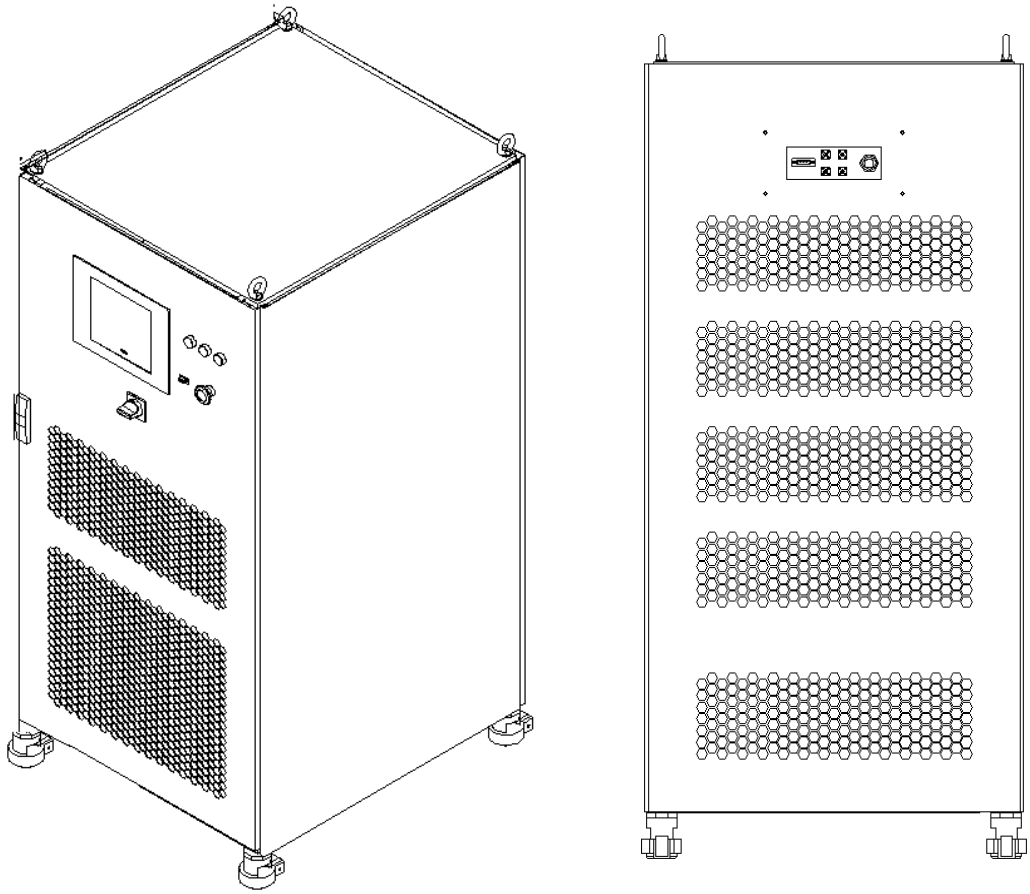


Figure 1-1 Overall appearance

## 1.2.2 Front Panel

The front panel of EAC-4Q-GS series is equipped with a TFT-Touch panel displayer (12 inch), status indicators, power knob, emergency stop button and RS232 interface (optional).

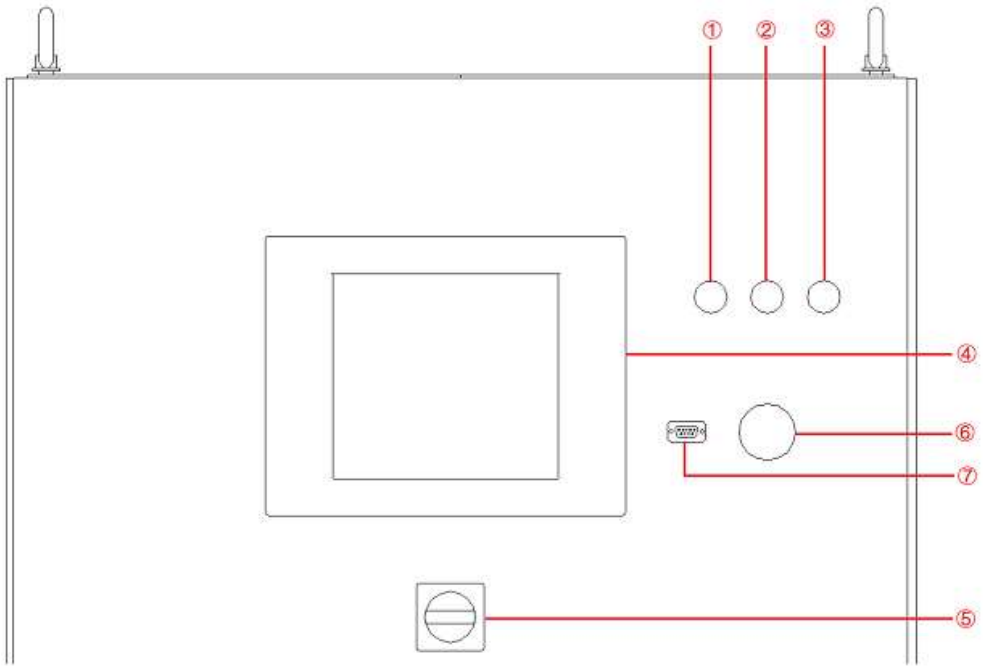



Figure 1-2 Front panel

Table 1-1

| Number | Name | 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** | Capacitive 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 failures. |
| ⑤ | **Power Knob** | The User can use power knob to turn on / off the power without opening the cabinet door. Turn the control module clockwise to power on and turn the control module 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 EAC-4Q-GS is equipped with RS485/LAN interface (standard), TTL interface(standard) and ATI interface (optional).

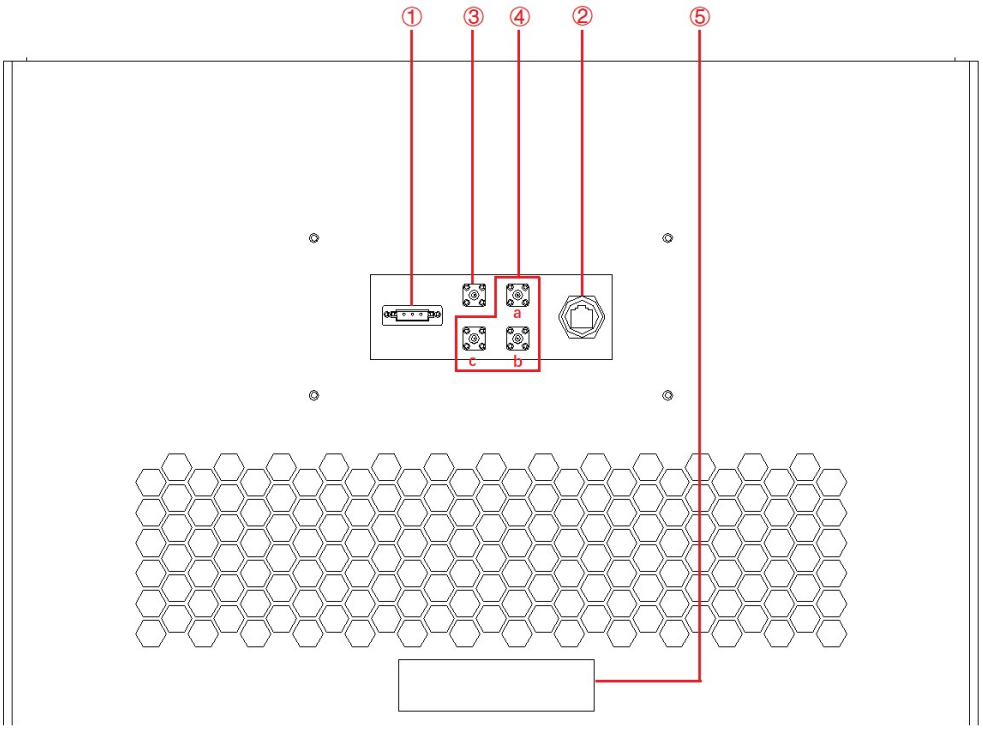



Figure 1-3 Rear panel

Table 1-2

| Number | Name | Note |
|---|---|---|
| ① | **RS485 interface** | Standard configuration, used for remote control. |
| ② | **LAN interface** | Standard configuration, it is a communication interface, and used for remote control. |
| ③ | **TTL** | Standard configuration, for users to observe the trigger signal after connecting with the oscilloscope. |
| ④ | **ATI interface** | a. Analog control interface-Phase A<br>b. Analog control interface-Phase B<br>c. Analog control interface-Phase C<br>Optional, analog control interface (-ATI option) |
| ⑤ | **Product brand** | The input / output configuration of the product is marked. |

### 1.2.4 Internal structure

As shown in Figure 1-4, take EAC-4Q-GS 200-300-300 as an example, from top to bottom, the internal modules of EAC-4Q-GS series are: ①control box layer, ②module layer, ③other input/output component layer, ④wiring layer and other interface layers.

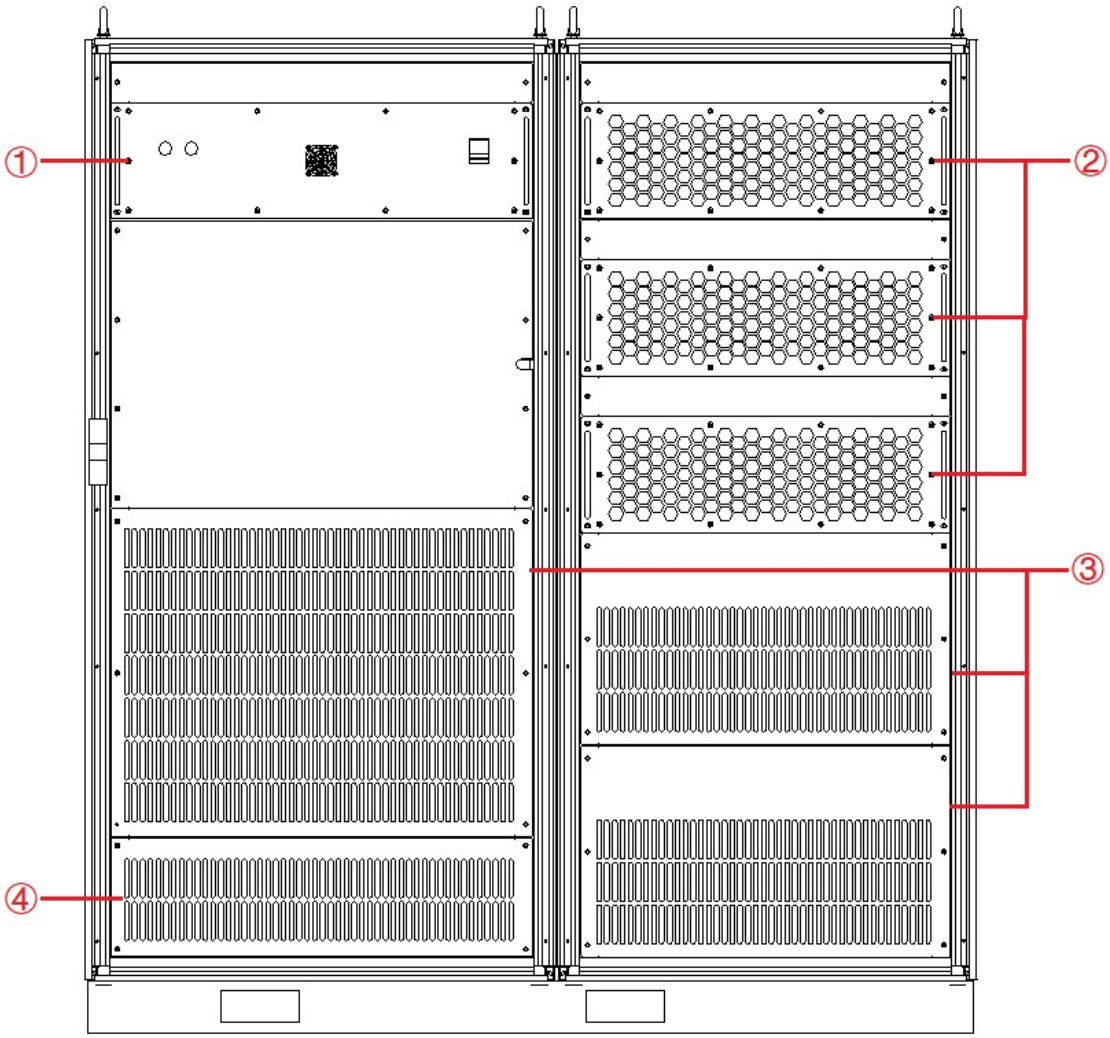



Figure 1-4 Internal structure

### 1.2.5 Front panel of control module

The front panel of EAC-4Q-GS series control module is equipped with LAN interface (standard), Master-Slave interface (option), fan, and power switch.

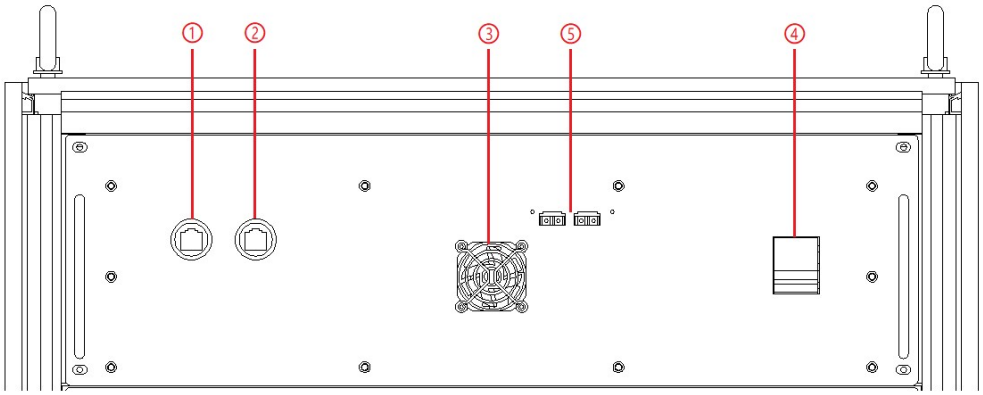



Figure 1-5 Front panel of control module

Table 1-3

| Number | Number | 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 supply of the same power is connected in parallel<br>(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 showed when remove the bottom baffle, as shown in Figure 1-6.

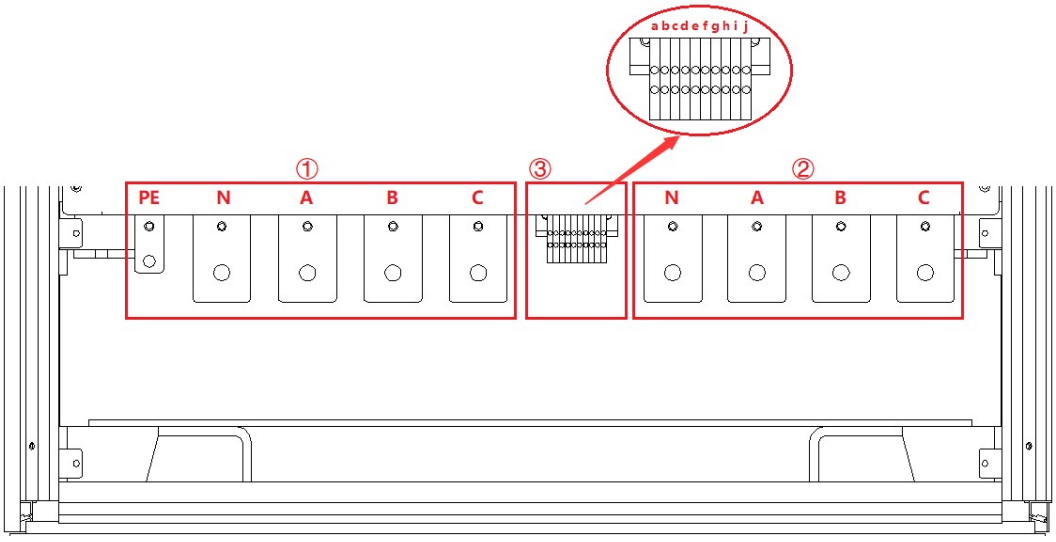


Figure 1-6 connection layer and other interface layers

Table 1-4

| Number | Name | Notes |
|---|---|---|
| ① | **Wiring copper bar of input side** | From left to right are PE, N, A, B, C |
| ② | **Wiring copper bar of output side** | From left to right are 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+f →A phase remote sense interface（+，-）<br>g+h →B phase remote sense interface（+，-）<br>i+j →C phase remote sense interface（+，-） |

**IMPORTANT INFORMATION**

Figure 1-6 takes EAC-4Q-GS 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).

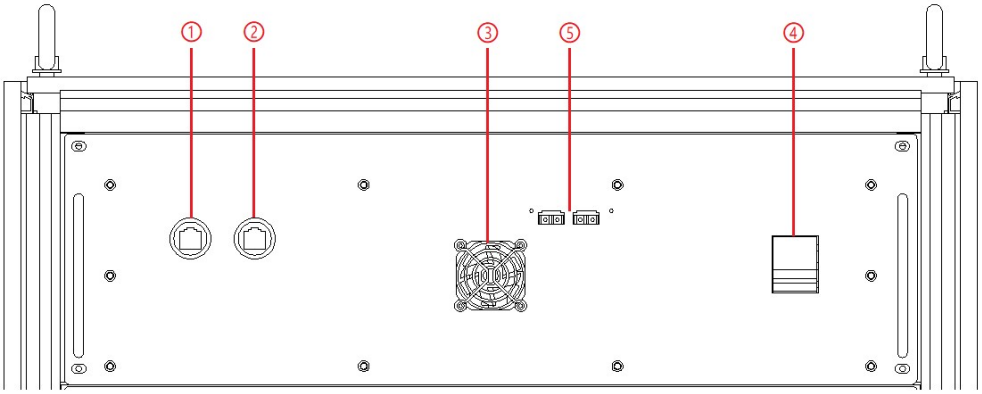



Figure 1-7 front panel of the control module

**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).

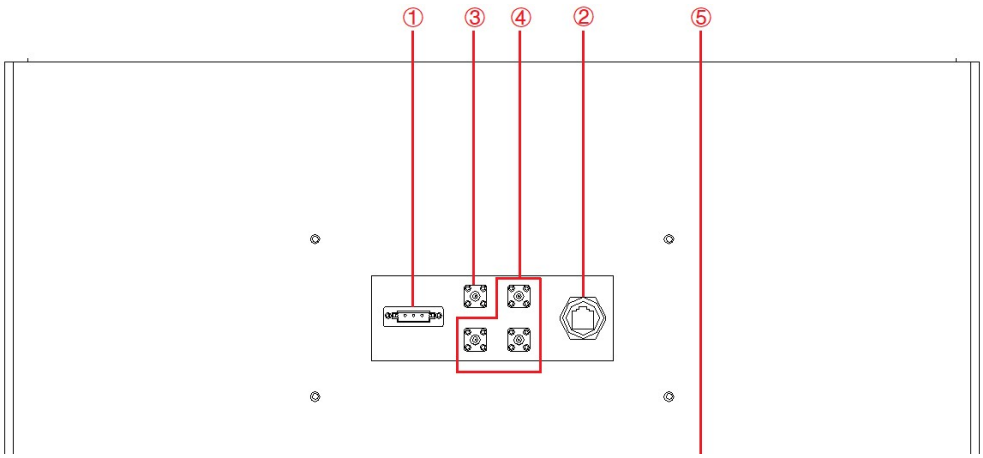



Figure 1-8 Rear panel

#### 1.3.1.2 Connection of LAN interface

Please refer 5.2 for detail connection method.

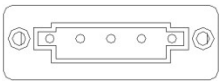
**IMPORTANT INFORMATION**

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 nterface (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 is possible to connect to local network 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).

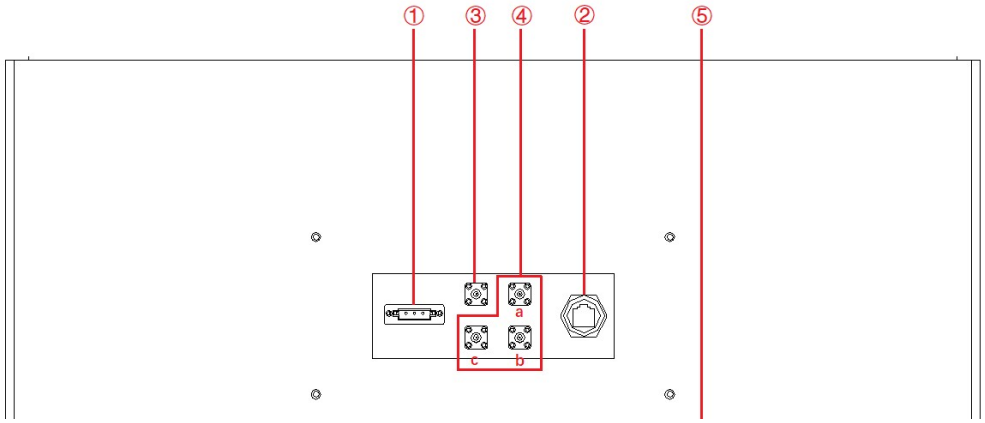



Figure 1-9 Rear panel

#### 1.3.2.2 Connection of RS485 interface

The RS485 interface of EAC-4Q-GS 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.

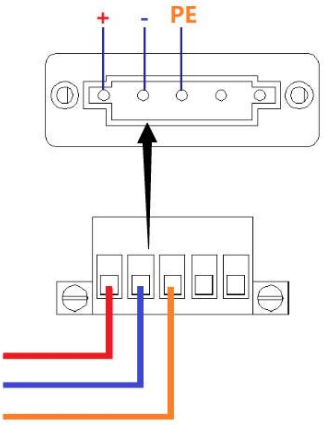
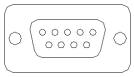



Figure 1-10 Connect RS485

**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).

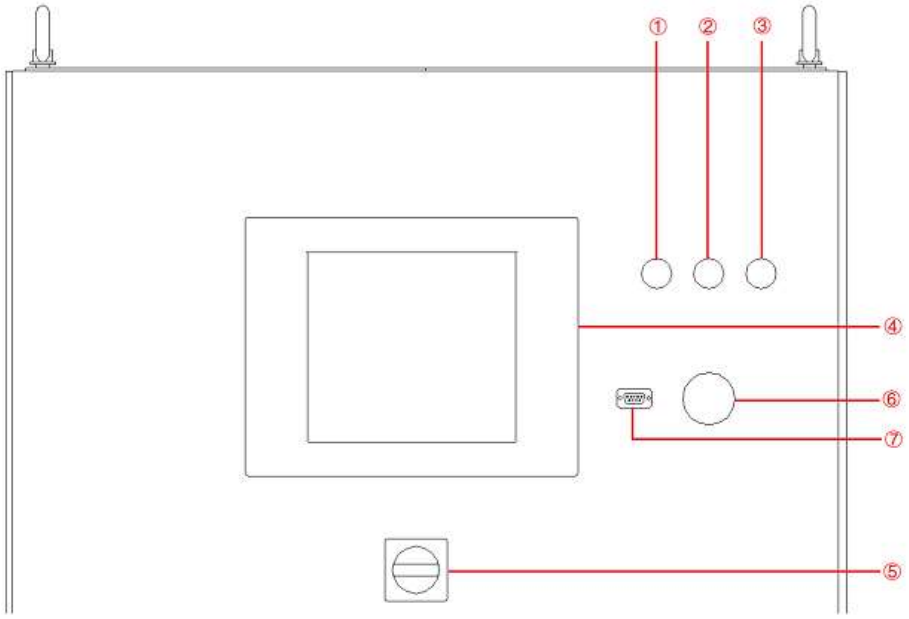



Figure 1-13 Front panel of the power supply

### 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.

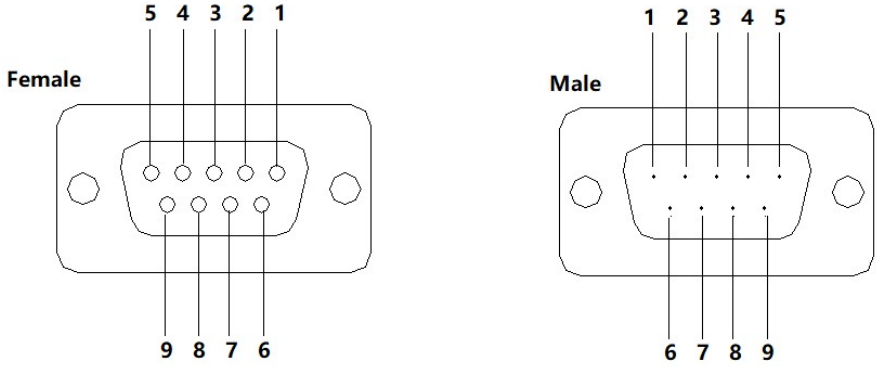



Figure 1-12 RS232 pin

Table 1-5

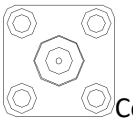
| Pin | Definition | Symbol | Signal transmission direction |
|---|---|---|---|
| 1 | Data Carrier Detect | DCD （Data Carrier Detect） | ← |
| 2 | Received Data | RXD （Received Data） | ← |
| 3 | Transmit Data | TXD （Transmit Data） | → |

| | | | |
|---|---|---|---|
| 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).

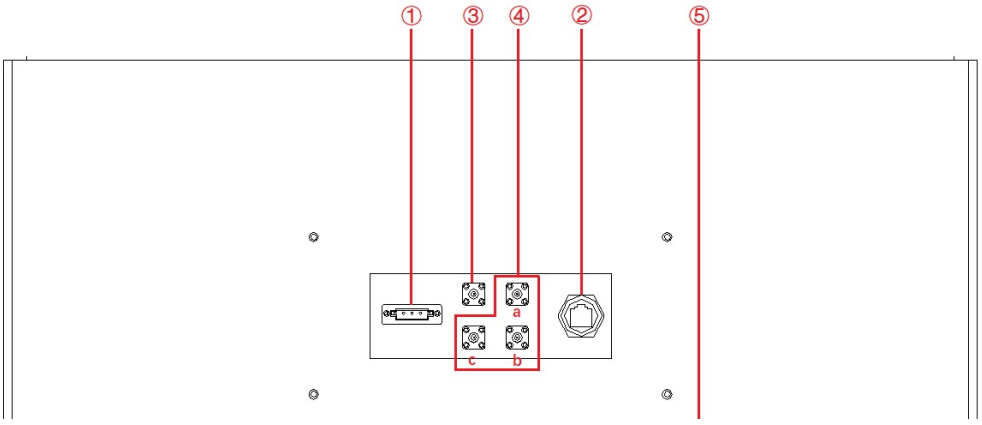



Figure 1-13 Rear panel

### 1.3.4.2 Connection of TTL interface

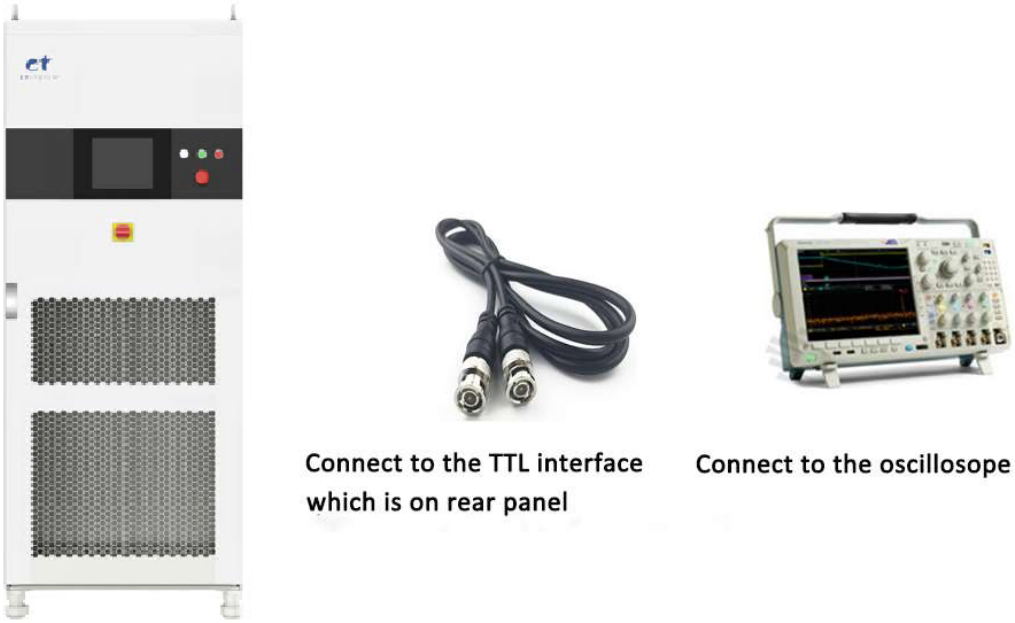
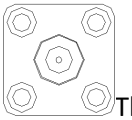



Figure 1-14 TTL interface connection method

## 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). EAC-4Q-GS uses BNC connector for this analog input. The set value is adjusted according to the analog input voltage (0-5 V).

### 1.3.5.1 Location of ATI interface

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

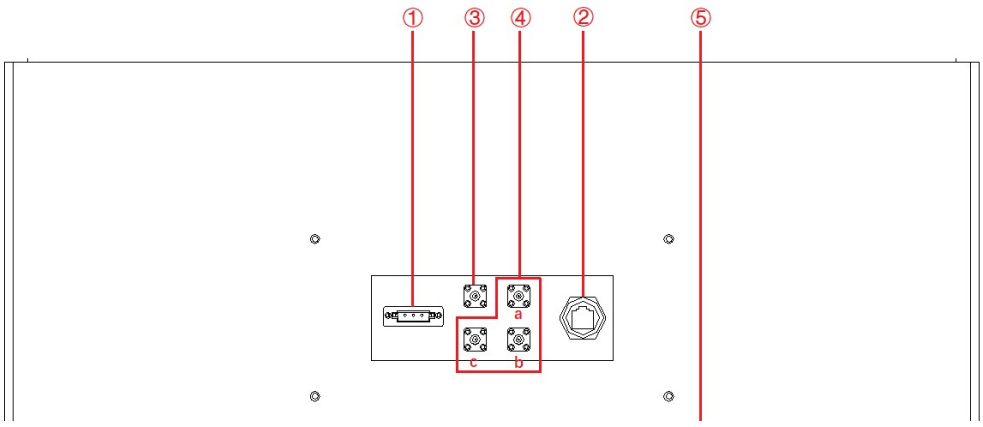



Figure 1-15 Rear panel of power supply

#### 1.3.5.2 Connection of ATI interface

The ATI interface of the EAC-4Q-GS appears as BNC. The connection between the equipment and the signal generator is shown in Figure 1-16.

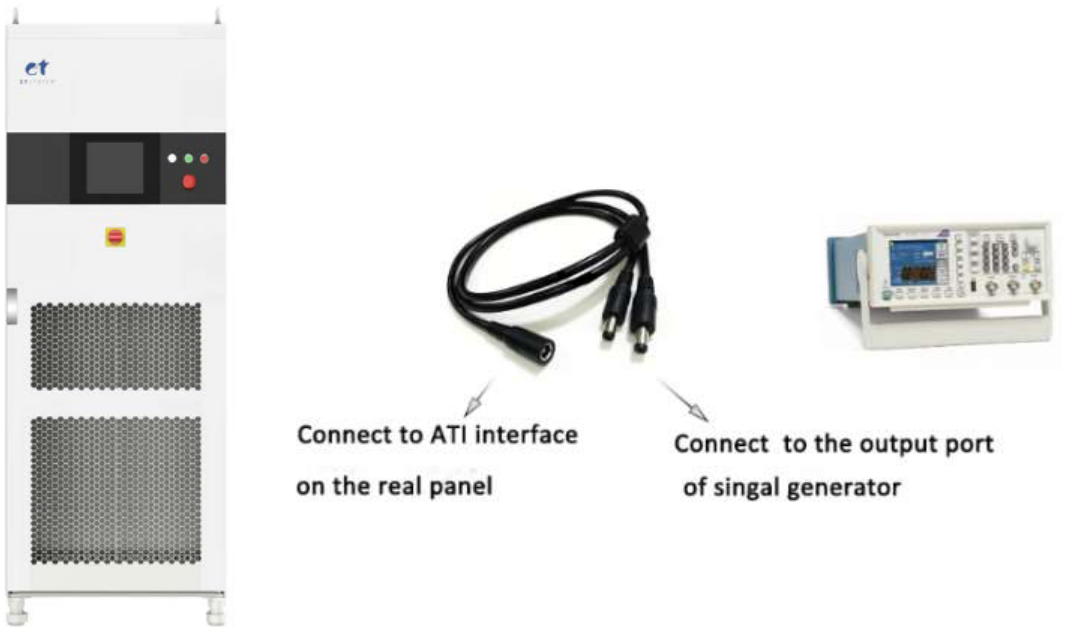



Figure 1-16 ATI interface connection method

### 1.3.6 External emergency stop interface (standard)

EAC-4Q-GS 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 power supply. To achieve protection action quickly, only need to press this switch.

#### 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).

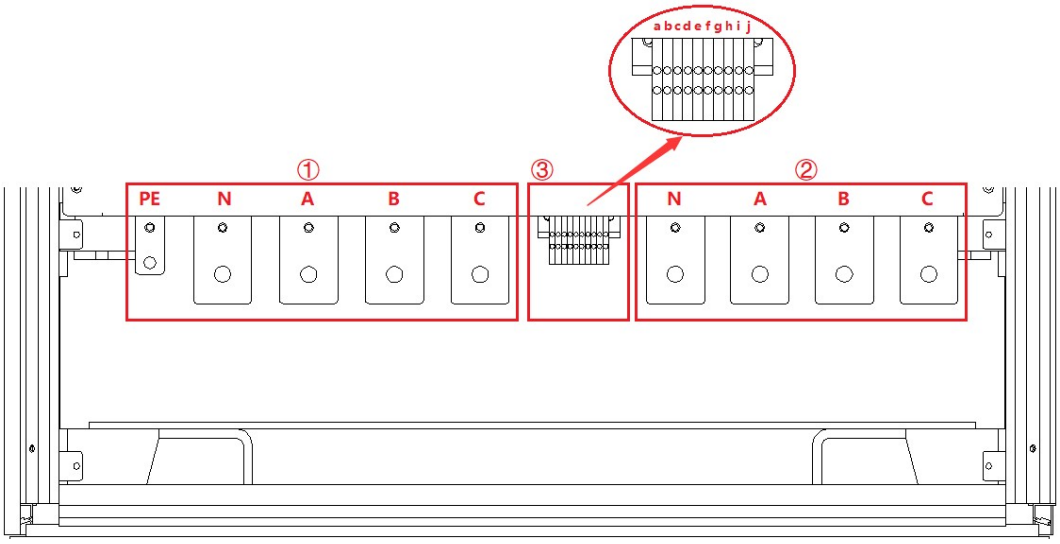



Figure 1-17

### 1.3.6.2 Connection of emergency stop interface

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

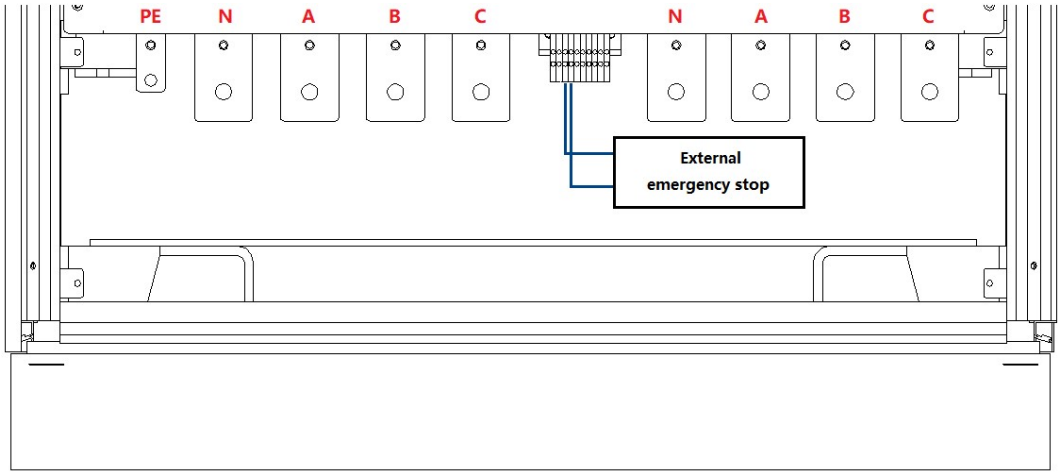


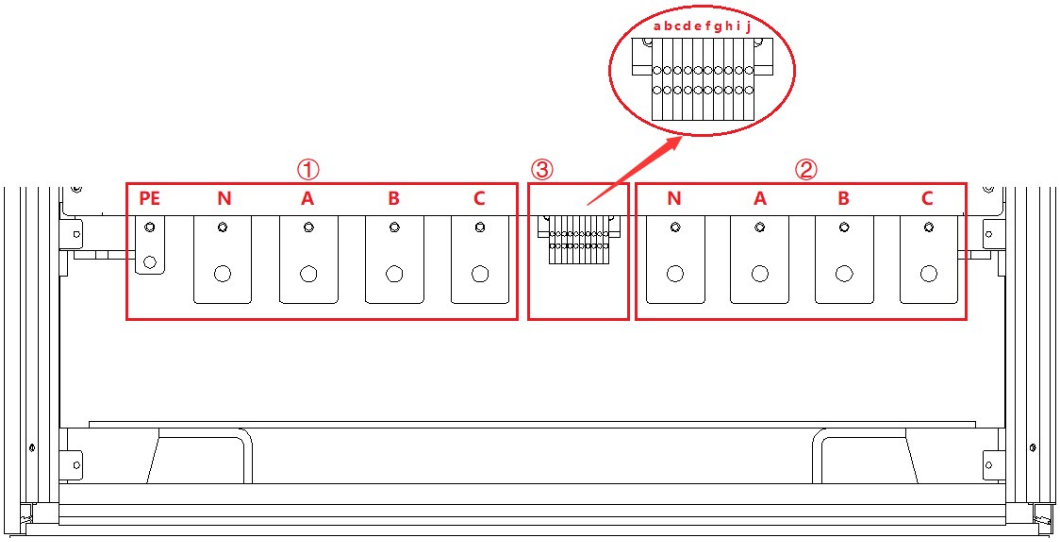

Figure 1-18 Emergency stop interface connection method

## 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).




Fugure 1-19

### 1.3.7.2 Connection of remote sense interface

The remote sense interface is connected to the output terminal of the EAC-4Q-GS power supply by default before leaving the factory, as shown in Figure 1-20.

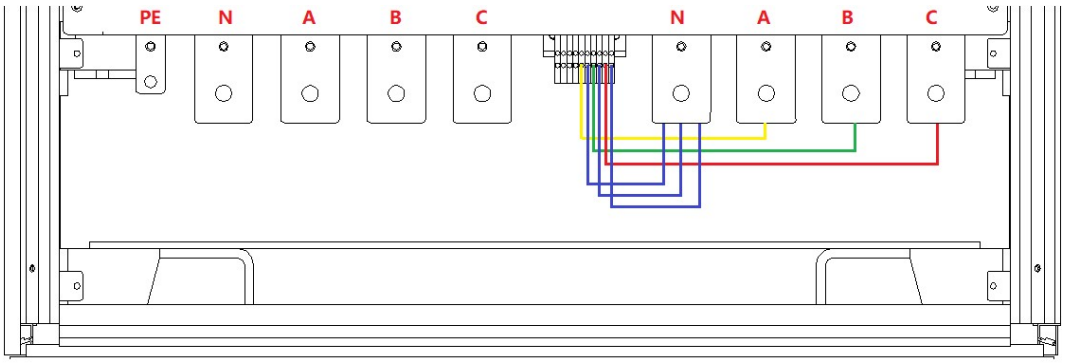



Figure 1-20 Remote sense connection (factory default wiring status)

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.

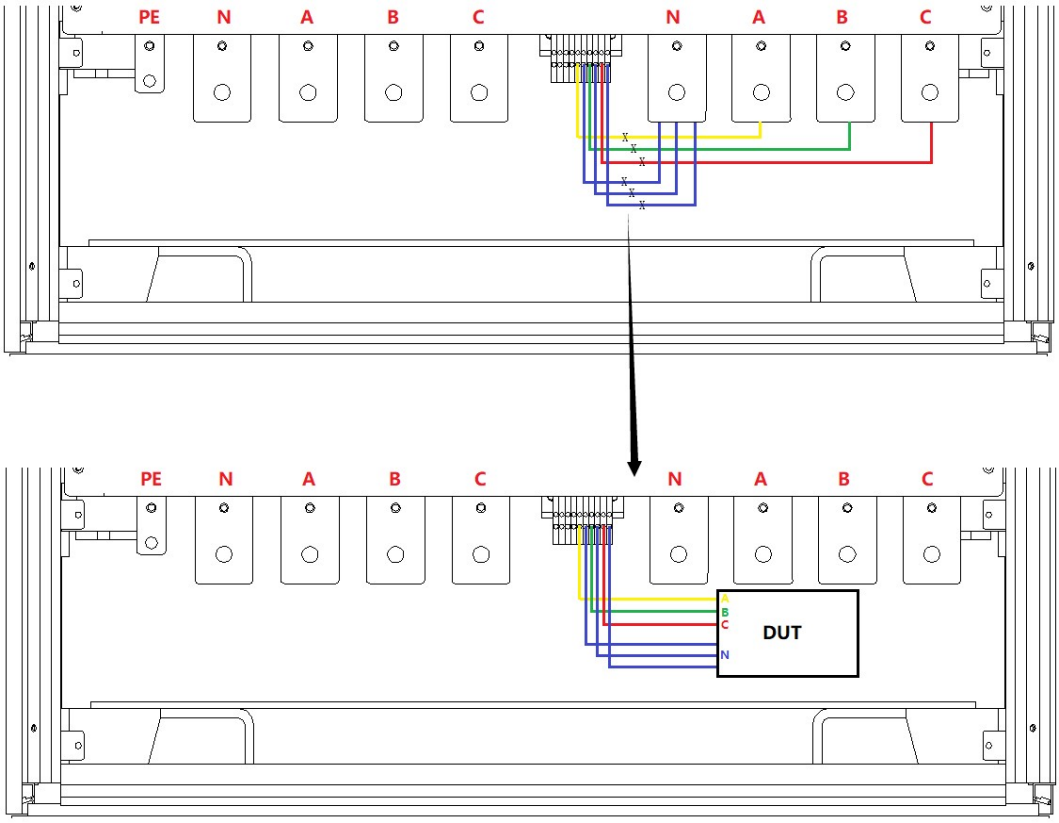



Figure 1-21 Remote sense connection method

## 1.3.8 Master-slave interface （-MS option）

EAC-4Q-GS 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 power supply control box, as shown in Figure 1-22⑤.

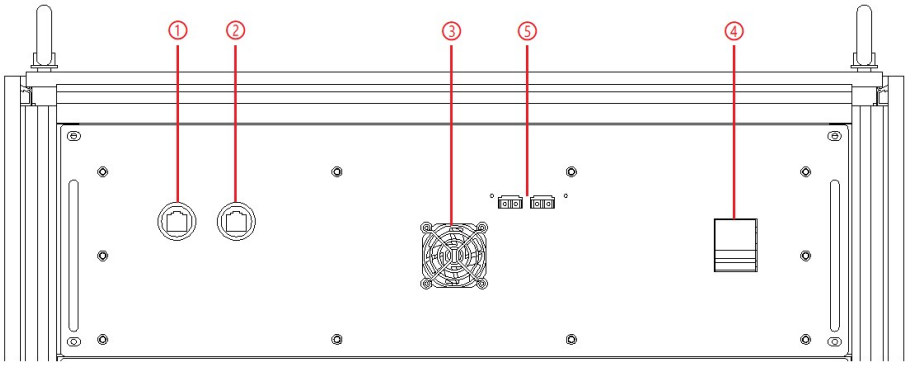



Figure 1-22 Front panel of control module

### 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 hole on the top of the cabinet, as shown in Figure 1-23.

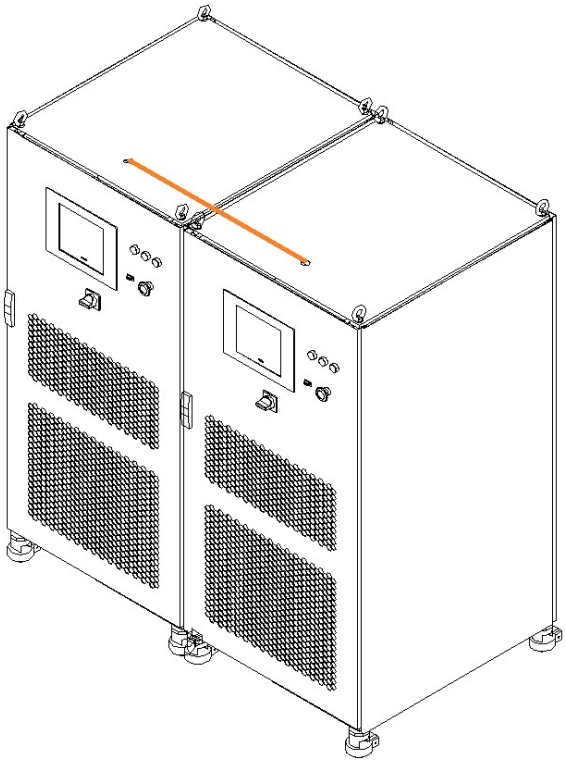


Figure 1-23 Cable hole on the top of the cabinet

**Step 2:**

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

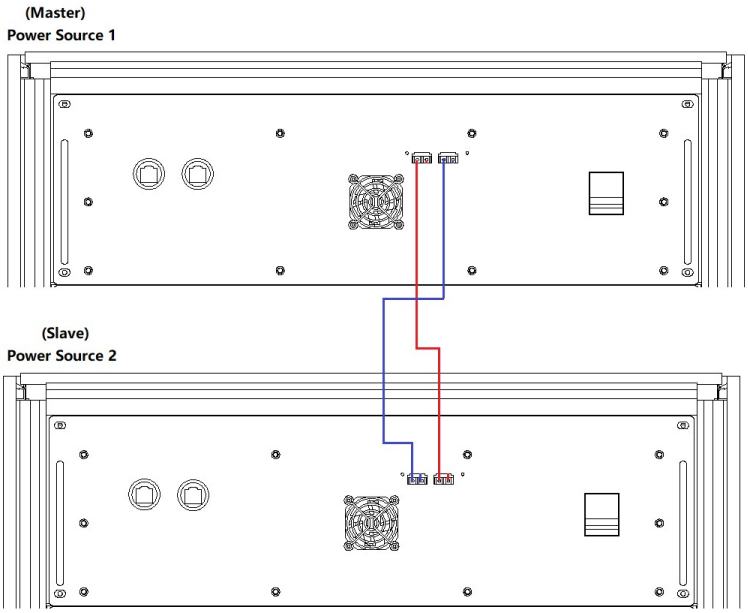



Figure 1-24 Optical fiber cable wiring diagram

**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.

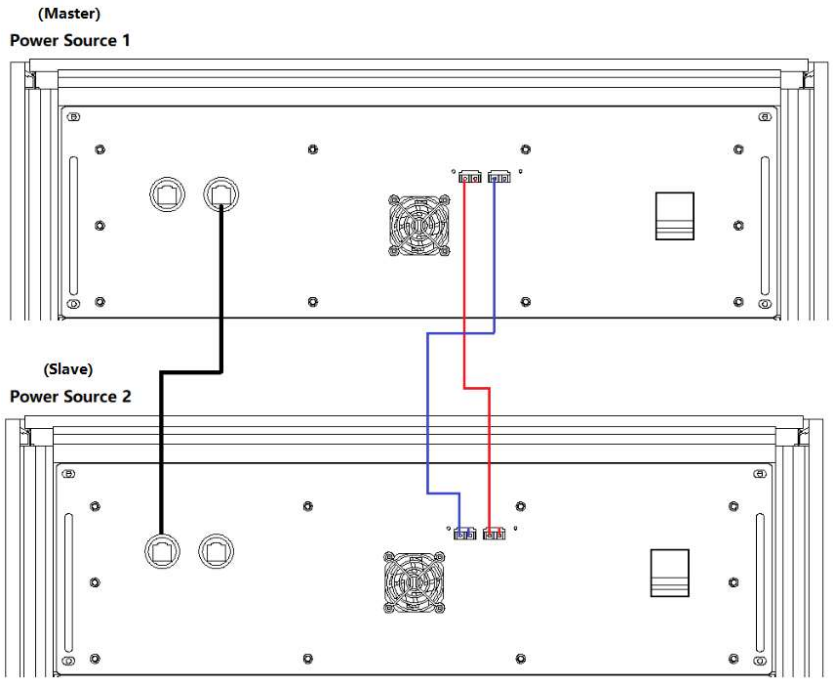



Figure 1-25 Parallel communication cable wiring diagram

**Step 3:**

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

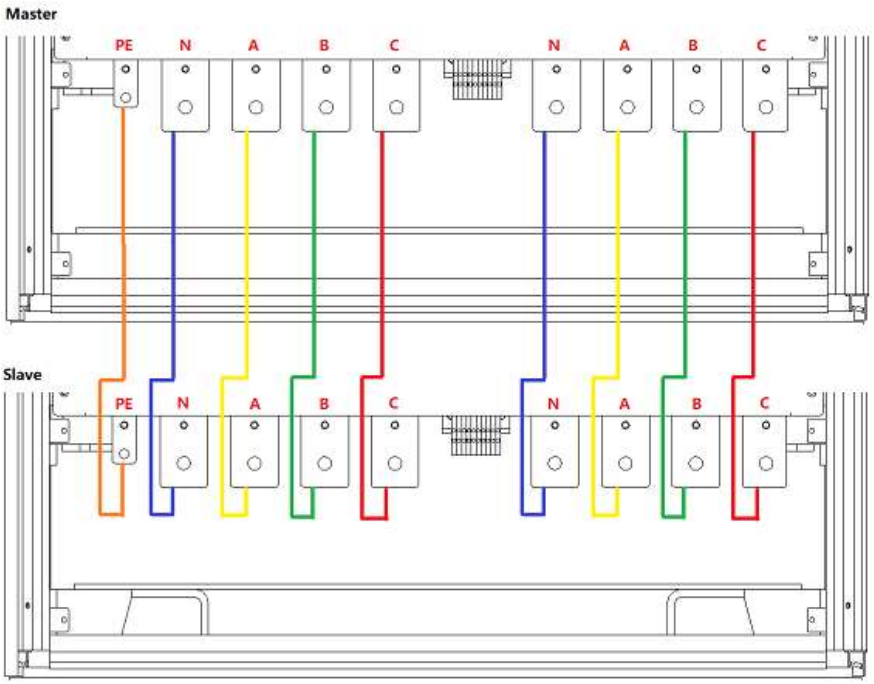



Figure 1-26 Wiring diagram of parallel input/output cables

# Part II Equipment Installation

## 2.1 Check before Installation

### 2.1.1 check the packing

### 2.1.2 check the equipment

## 2.2 Equipment Installation

### 2.2.1 Selection of input/output cables

### 2.2.2 Installation steps

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

## 2.3 Parallel installation of equipment

## 2.1 Check before Installation

### 2.1.1 Check the packing

when receiving the power supply of EAC-4Q-GS, 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 break 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 ET System electronic GmbH.

## 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 side cable and the output side 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.

### 2.2.2 Installation steps

**Step 1:**

Remove the bottom baffle (as shown in Figure 2-2), Lead the PE, N, A, B, and C cables on the input side and N, A, B, and C cables on the output side into the cabinet through the cable etrancehole at the bottom of the cabinet (as shown in Figure 2-3).

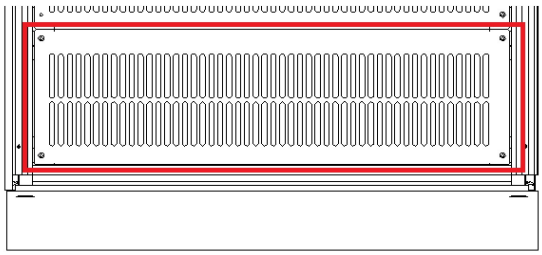


Figure 2-2 bottom baffle.

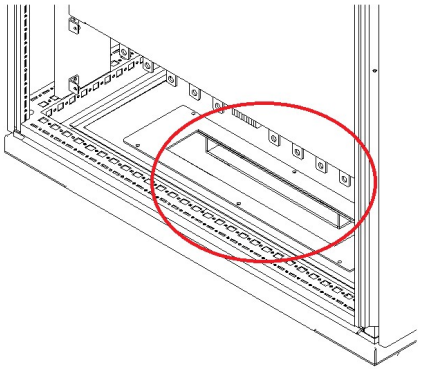


Figure 2-3 Entrance hole

**Step 2:**

The input terminal (PE/N/A/B/C) and output terminal (N/A/B/C) of the equipment are shown in Figure 2-4, pass the cable through the inlet hole at the bottom and connect it to the terminal.

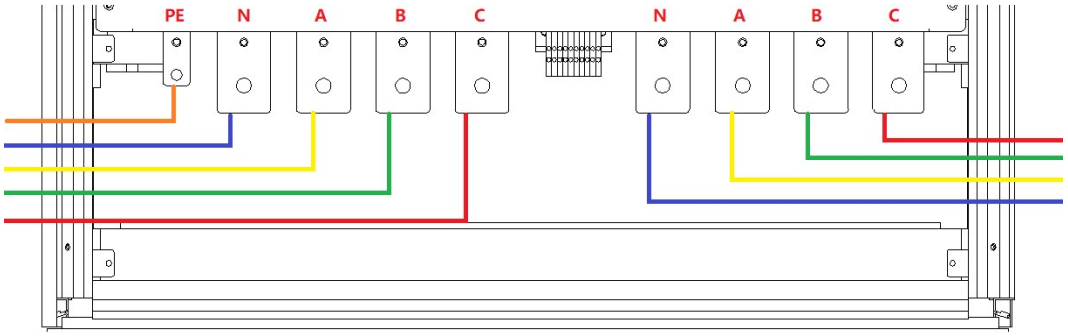



Figure 2-4 Copper bar

**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:**

After completing the above work, the wiring status of power supply is shown in Figure 2-5. Restore the bottom baffle, close the cabinet door, then, the equipment installation is done.

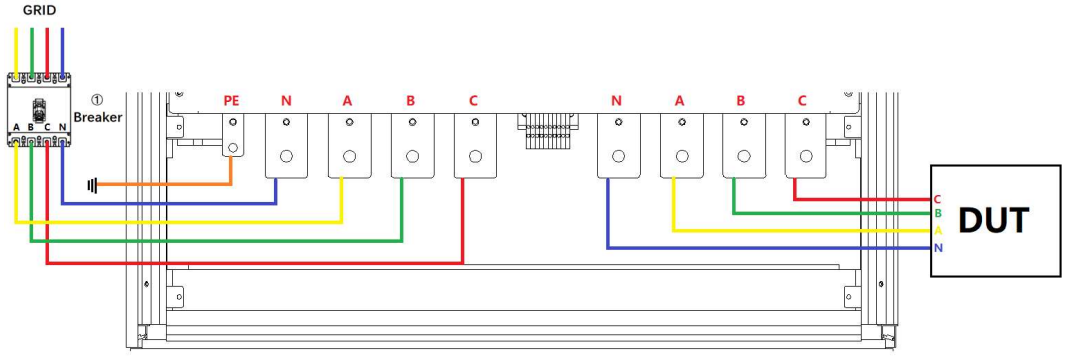



Figure 2-5 Equipment wiring completion status

**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)

EAC-4Q-GS 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.

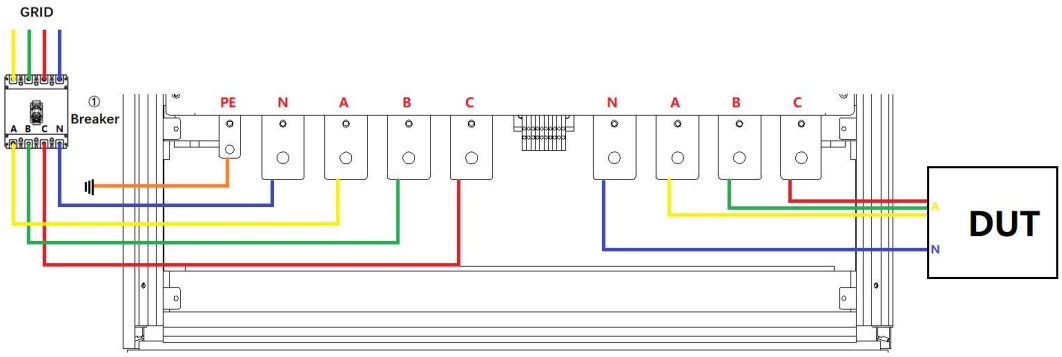



Figure 2-6 Increase single-phase output wiring diagram

## 2.3 Parallel installation of equipment

EAC-4Q-GS support parallel connection of power supply of the same power.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.

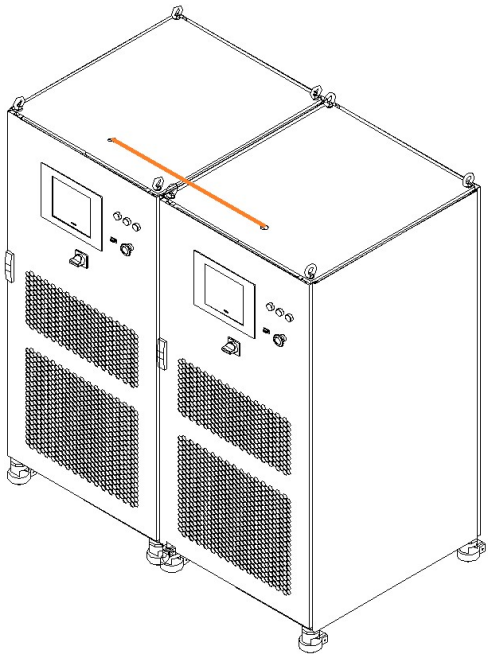


Figure 2-7 Cable hole on the top of the cabinet

**Step 2:**

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

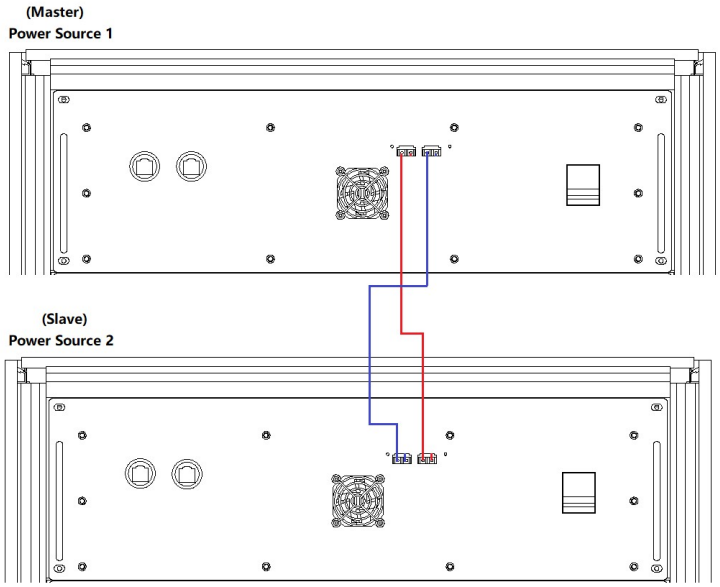



Figure 2-8 Optical fiber cable wiring diagram

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.

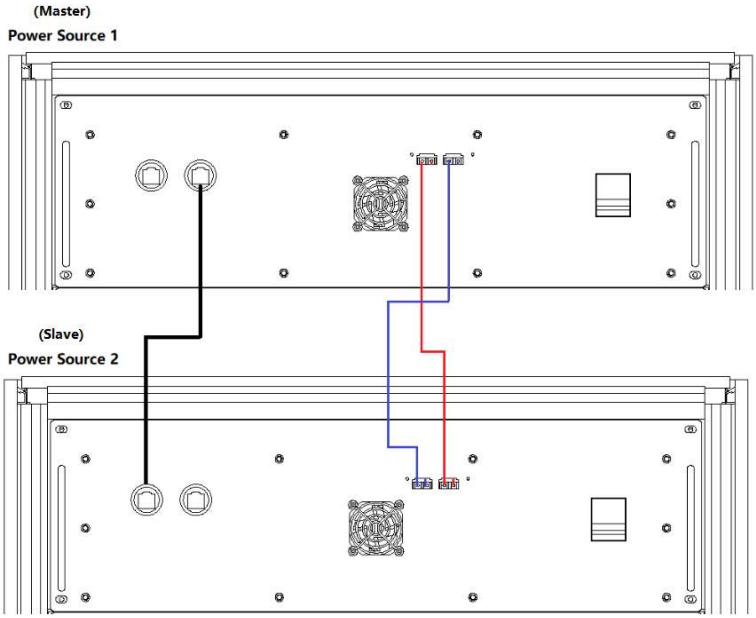



Figure 2-9 Parallel communication cable wiring diagram

**Step 3:**

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

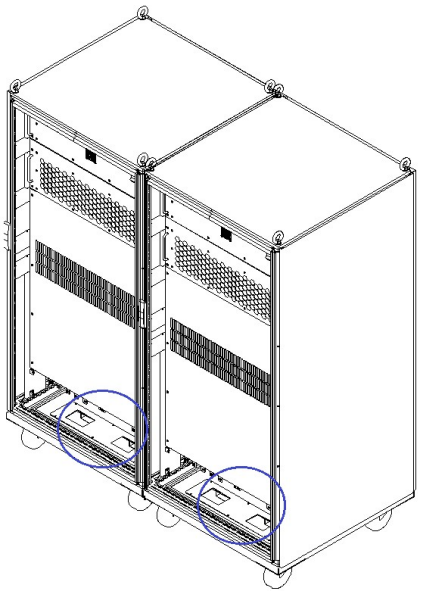


Figure 2-10 Cable holes at the bottom of the cabinet

**Step 4:**

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

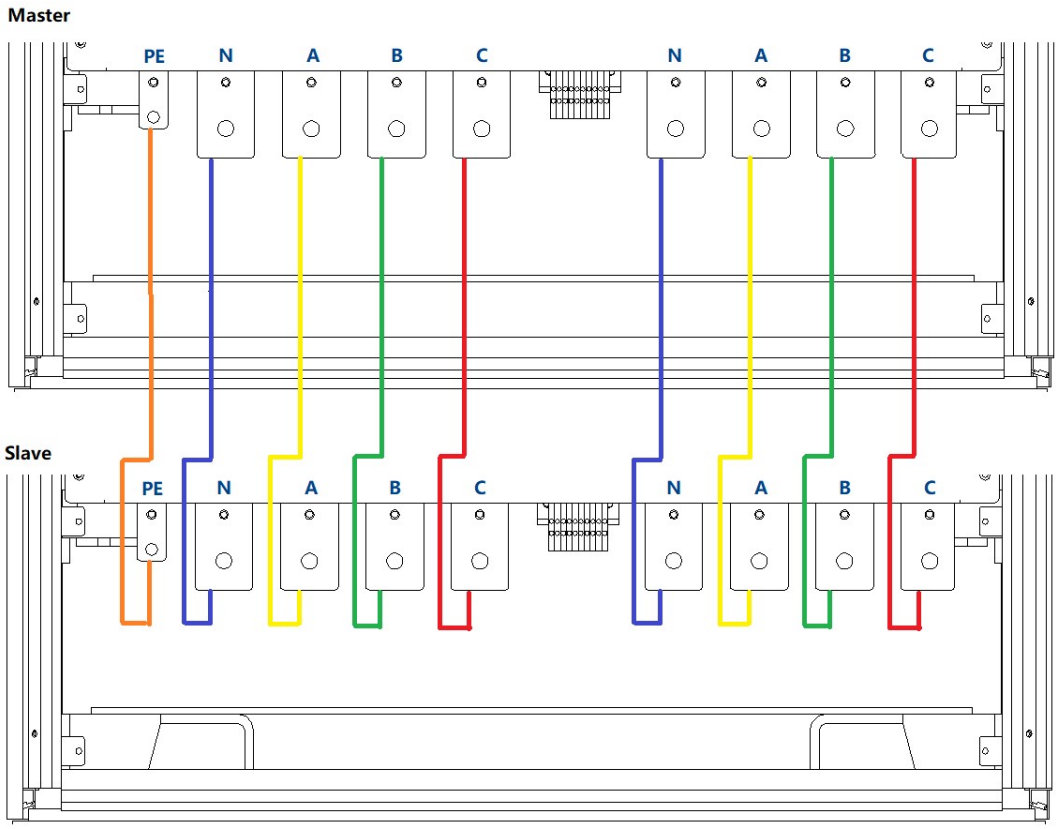



Figure 2-11 Wiring diagram between parallel cabinets

**Step 5:**

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

# Part III Power-on Operation

## 3.1 Power-on Operation

## 3.2 GUI Software Operation (Local Control)

## 3.3 GUI Software Operation (Remote Control)

## 3.4 Power-off Operation

## 3.1 Power-on Operation

**Step 1: Power on the AC input side**

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

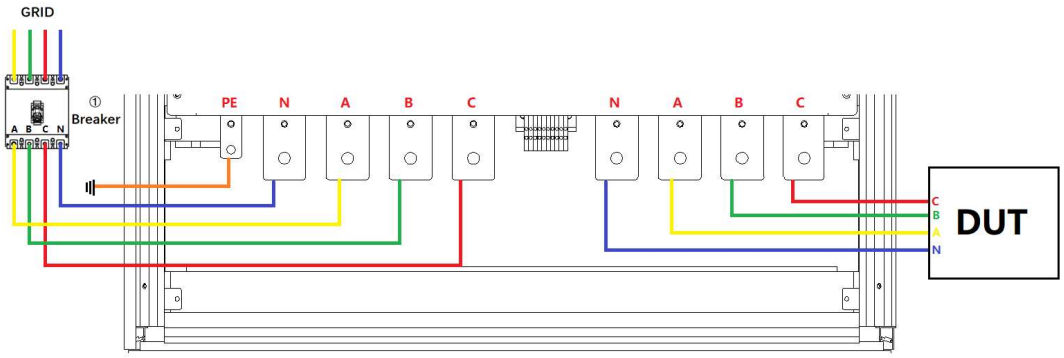



Figure 3-1 Equipment and the circuit breaker

**CAUTIOUS**

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

**SHOCK HAZARD**

The voltage generated by EAC-4Q-GS 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 unit**

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

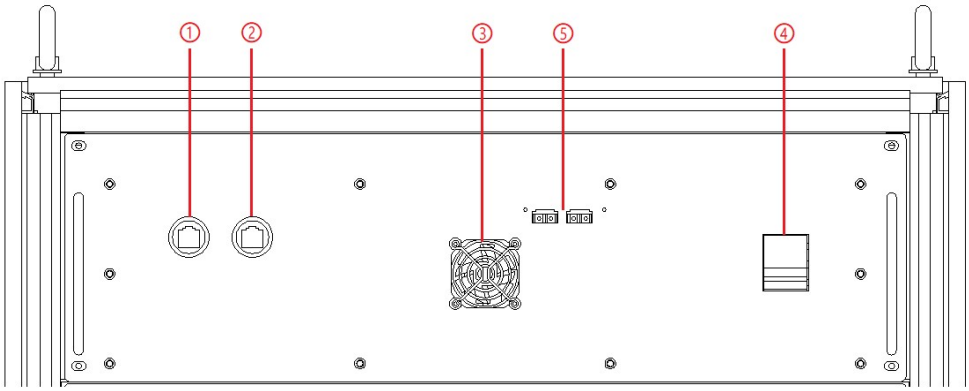



Figure 3-2 Control Modules

**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).

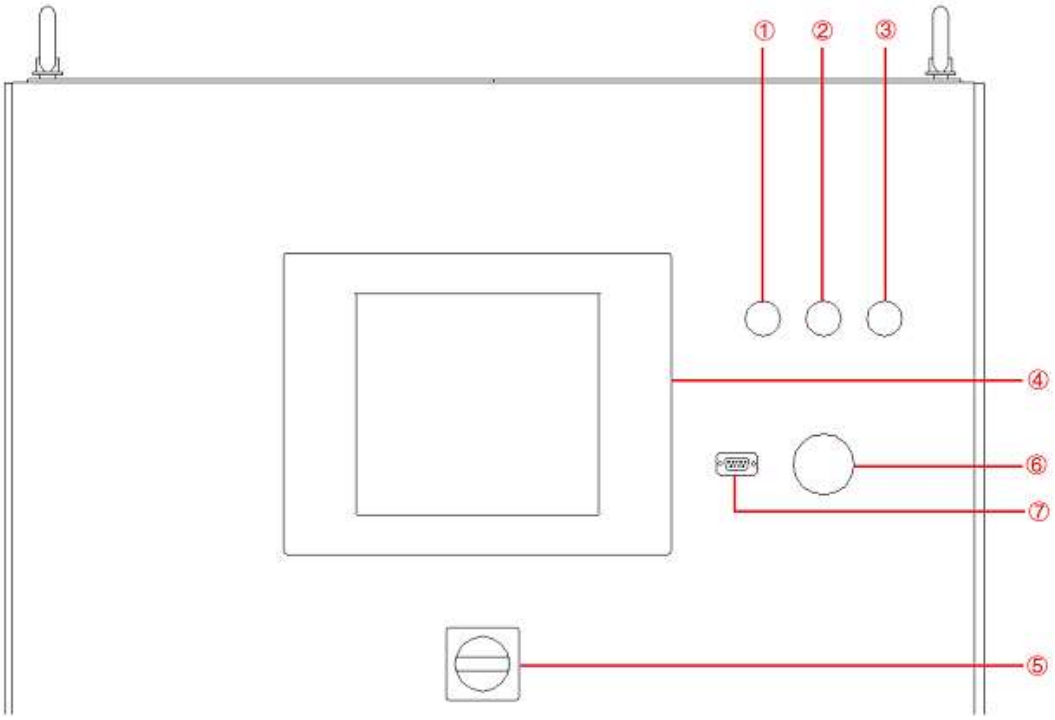



Figure 3-3 Front Panel

## 3.2 GUI Software Operation (Local Control)

EAC-4Q-GS 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).

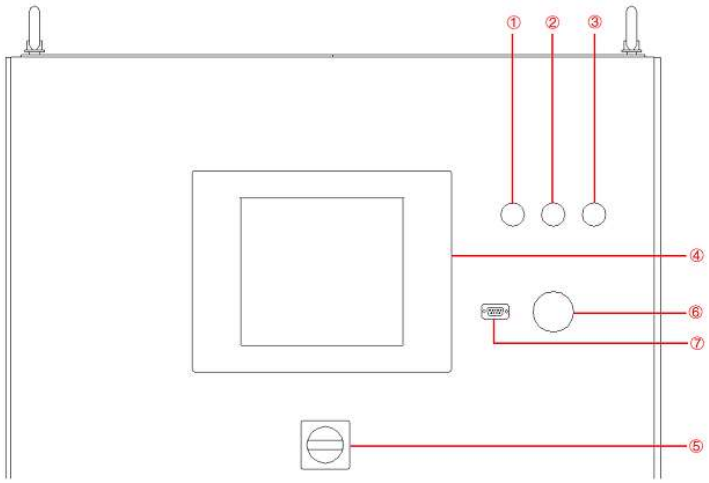



Figure 3-4 Front Panel

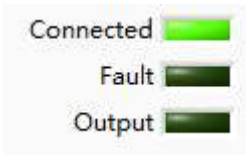



Figure 3-5 Indicators on TFT Touch panel

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)

EAC-4Q-GS 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).

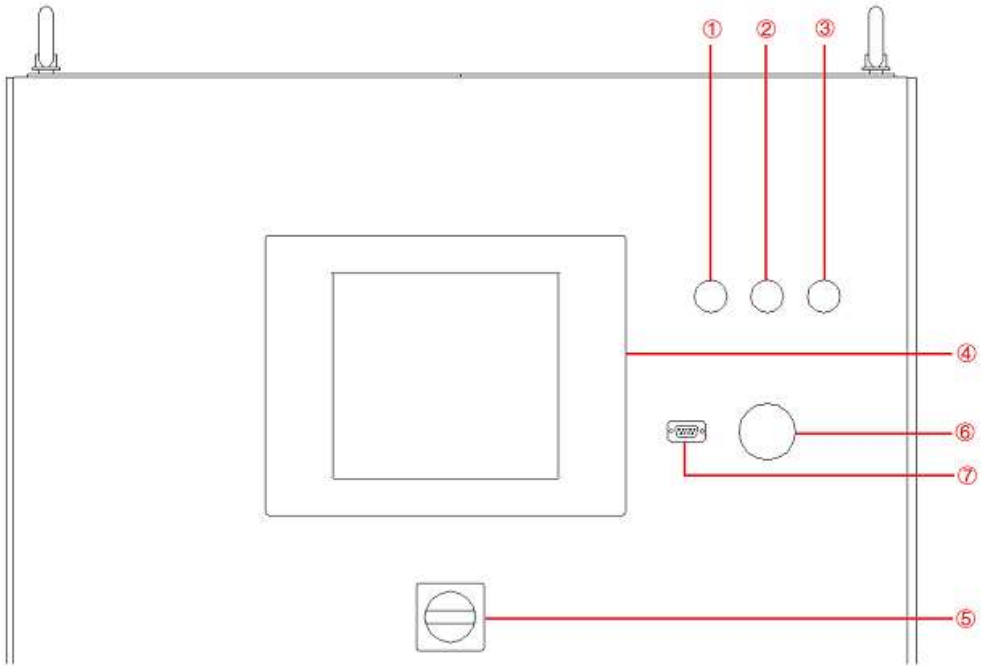



Figure 3-9 Front panel

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

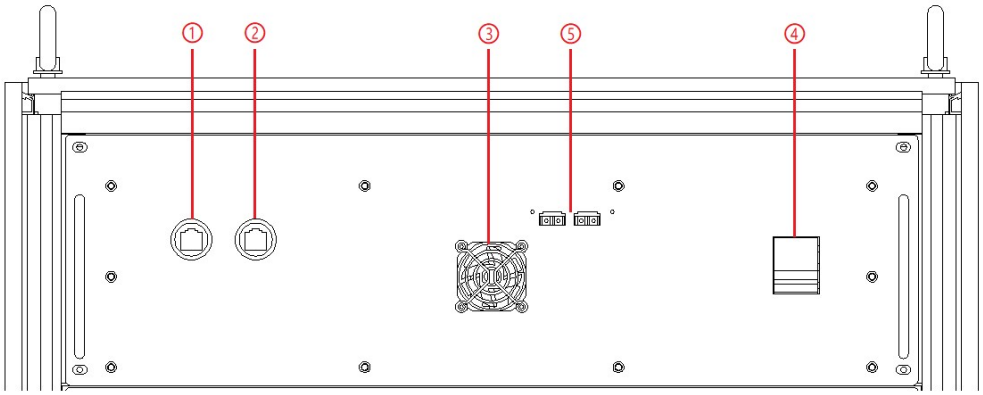



Figure 3-10 Front panel of control module

**IMPORTANT INFORMATION**

Closing the switch on the front panel of the control box 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).

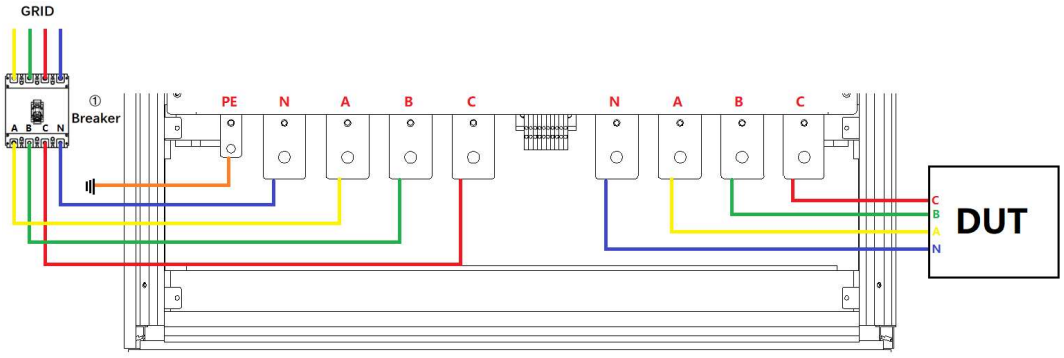



Figure 3-11

# Part IV Function and Feature Introduction

## 4.1 Grid Simulation Function

### 4.1.1 Low/zero voltage ride through test

### 4.1.2 three-phase unbalance, harmonics, and inter-harmonics

### 4.1.3 harmonics and inter-harmonics

## 4.2 Re-generative AC Load (LD option)

## 4.3 Extends to DC output (DC option)

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

# 4.1 Grid Simulation Function

EAC-4Q-GS 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. It have Various simulation functions, including voltage and frequency fluctuations, voltage sags, low/zero voltage ride through, three-phase unbalance, harmonics and inter-harmonics. EAC-4Q-GS 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.

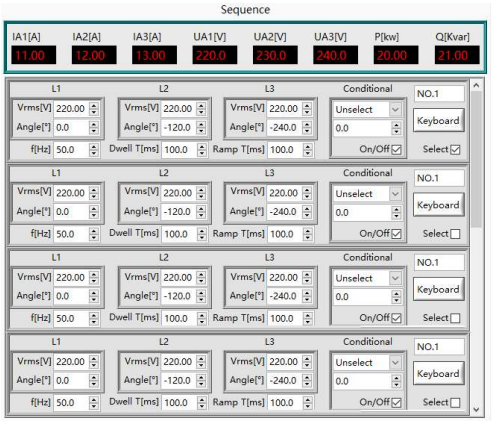



Figure 4-1 Sequence programming

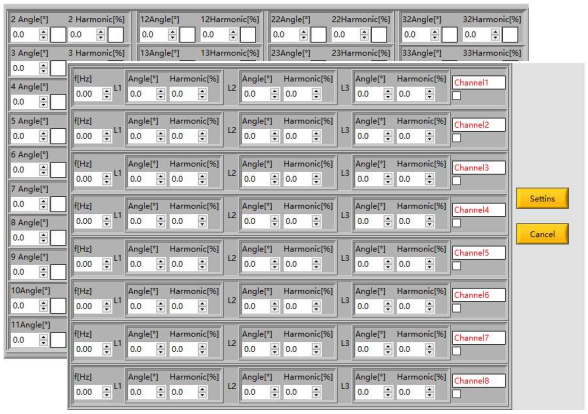



Figure 4-1 Harmonic/Inter-harmonic editing

**Harmonic and inter-harmonic waveforms**

DSP+FPGA technology are use to generate up to 50th harmonic. EAC-4Q-GS 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.

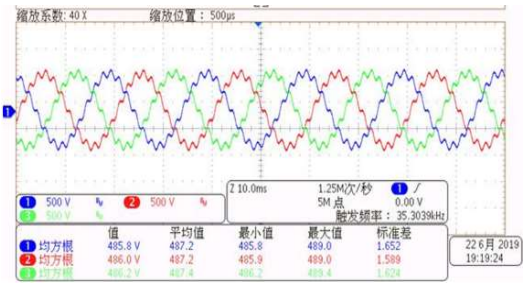



Figure 4-3 Harmonic waveform

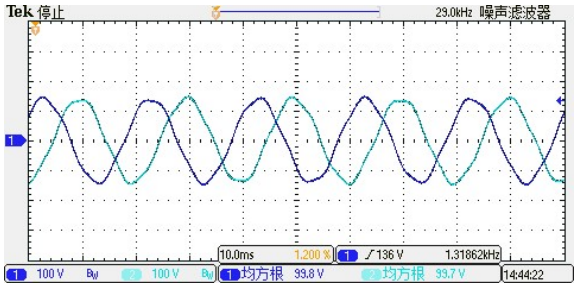



Figure 4-4 Inter-harmonicwaveform

**Voltage drop simulation (LVRT for inverter test)**

EAC-4Q-GS provide firmware and software support for low/zero voltage ride through test for PV inverters. EAC-4Q-GS is used to simulate grid voltage/frequency changes, drops and sags to meet the low voltage ride through test requirements of PV inverters.

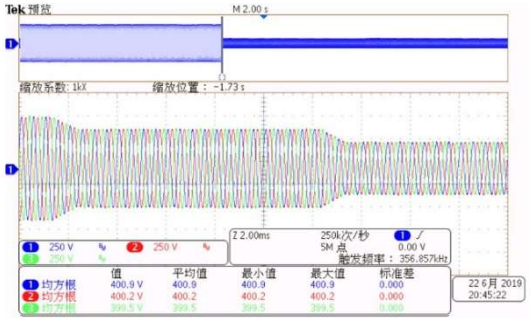


Figure 4-5 Voltage drop

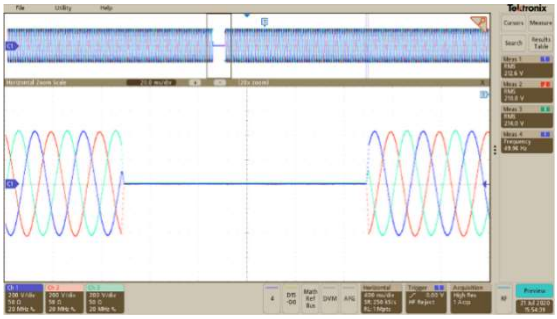


Figure 4-6 Zero voltage ride

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

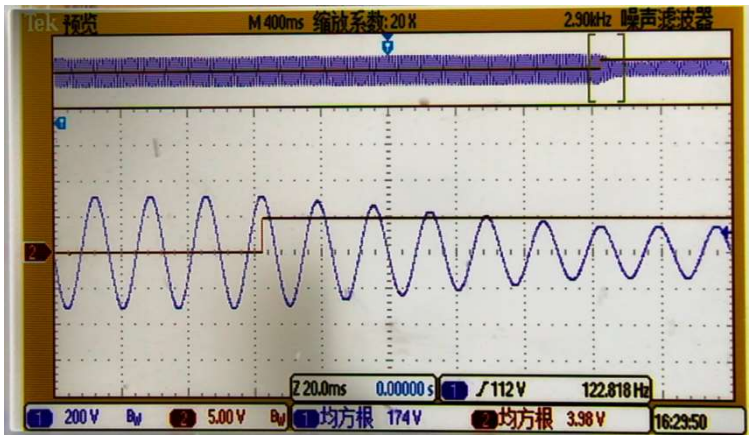


Figure 4-7 TTL trigger Waveform

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.

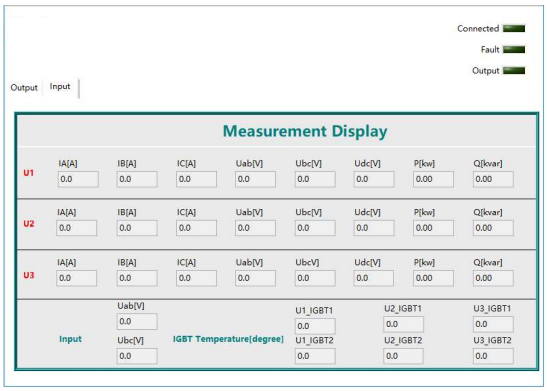



Figure 4-8 Input measurements panel

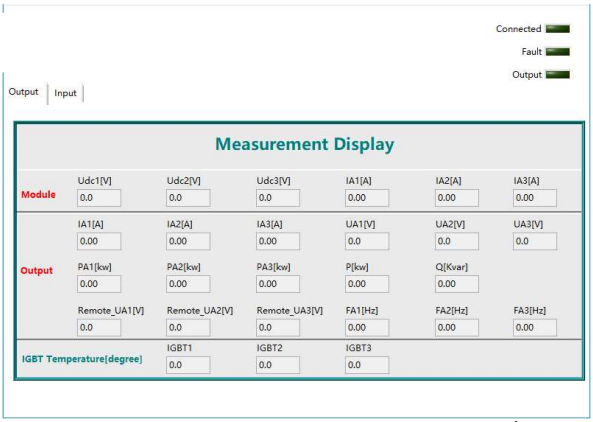



Figure 4-9 Output measurements panel

EAC-4Q-GS 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.

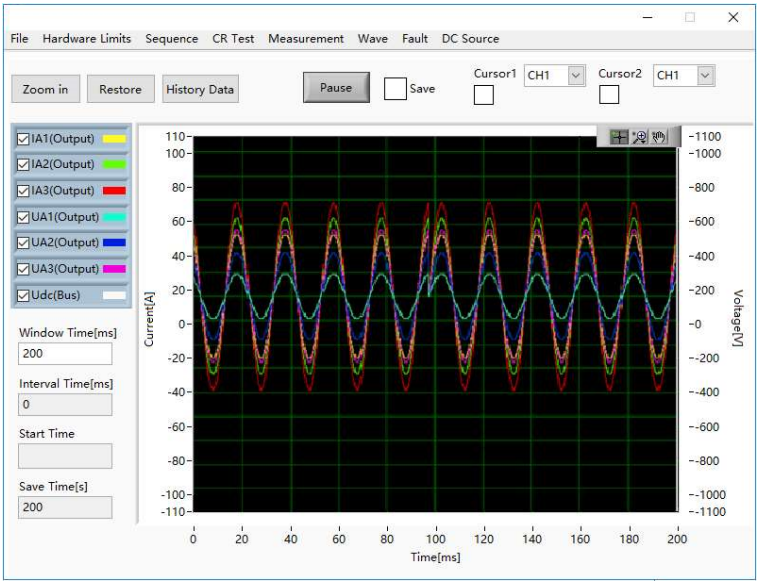
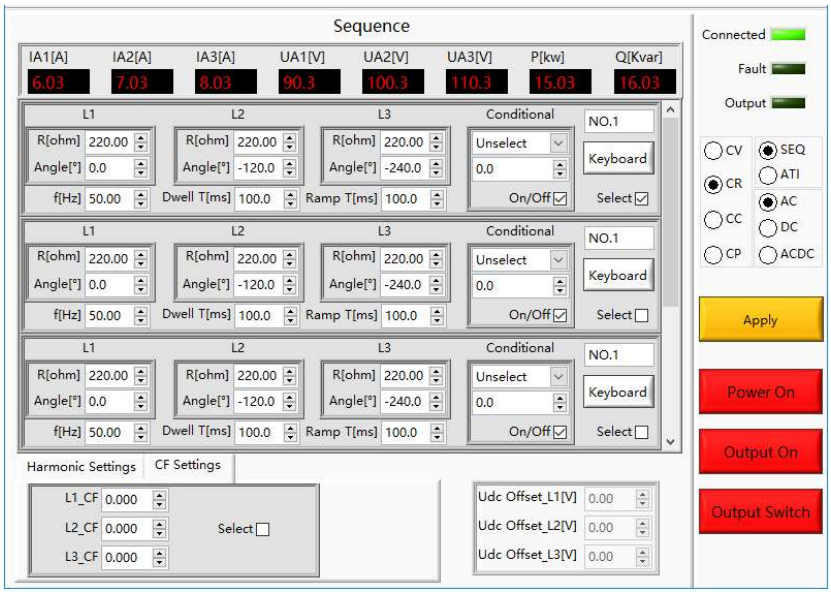


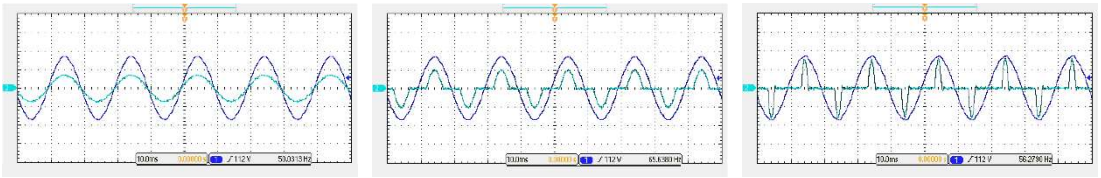

Figure 4-10 Waveform browsing panel

The output terminal of EAC-4Q-GS 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. EAC-4Q-GS 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.

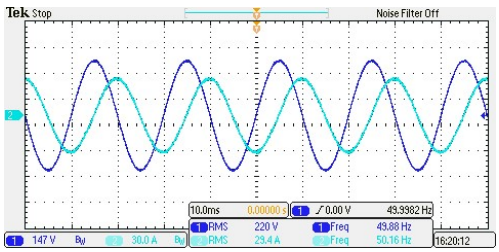
## 4.2 Re-generative AC Load (-LD option)[1]

EAC-4Q-GS 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.

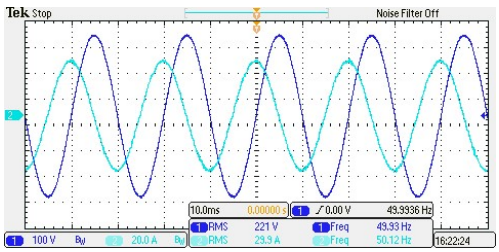


CF=1.414 CF=2 CF=3




Angle=+90°




Angle=-90°

[1] EAC-4Q-GS-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)

In source and sink mode, EAC-4Q-GS can also be DC output, the frequency range will be DC~100Hz. The DC voltage range is 420V (std), and accuracy is 0.2%FS. The output mode can be AC/DC//AC+DC.

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

EAC-4Q-GS with -IMP option can simulate output line impedance (RL). The impedance range is up to Rated V/Rated I. The user can set the percentage in GUI software.

# Part V Software Interface

## 5.1 GUI Software Introduction

### 5.1.1 Operating status

### 5.1.2 Sequence mode

### 5.1.3 Input/output controls

## 5.2 Communication Setting

## 5.3 Hardware Limits

## 5.4 Sequence Mode

## 5.5 Analog Input

## 5.6 AC+DC/AC/DC

### 5.6.1 AC

### 5.6.2 AC+DC

### 5.6.3 DC

## 5.7 Harmonic and inter-harmonic simulation

### 5.7.1 Harmonic simulation

### 5.7.2 Inter-harmonic simulation

## 5.8 Simulation of Re-generative AC Load

### 5.8.1 CR mode

### 5.8.2 Rectifier mode

### 5.8.3 CC/CP phase lead/lag mode

## 5.9 Measurements

## 5.10 Waveform

# 5.1 GUI Software Introduction

## 5.1.1 Operating status

EAC-4Q-GS 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.

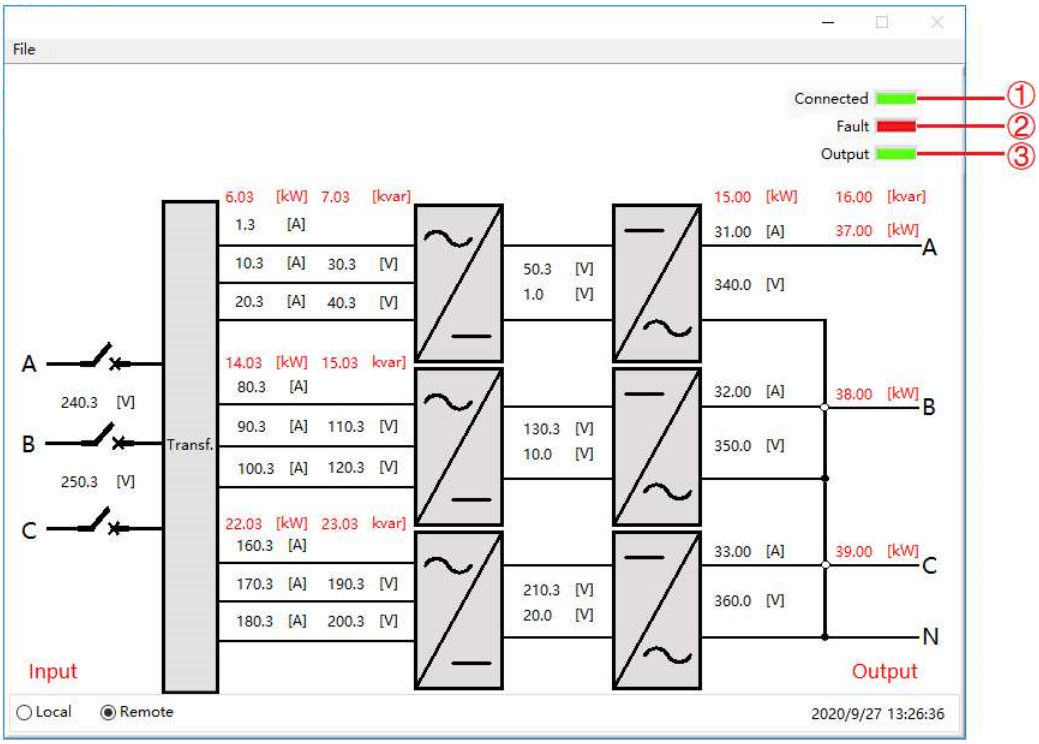



Figure 5-1 Main panel

Table 5-1

| Number | Name | 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).

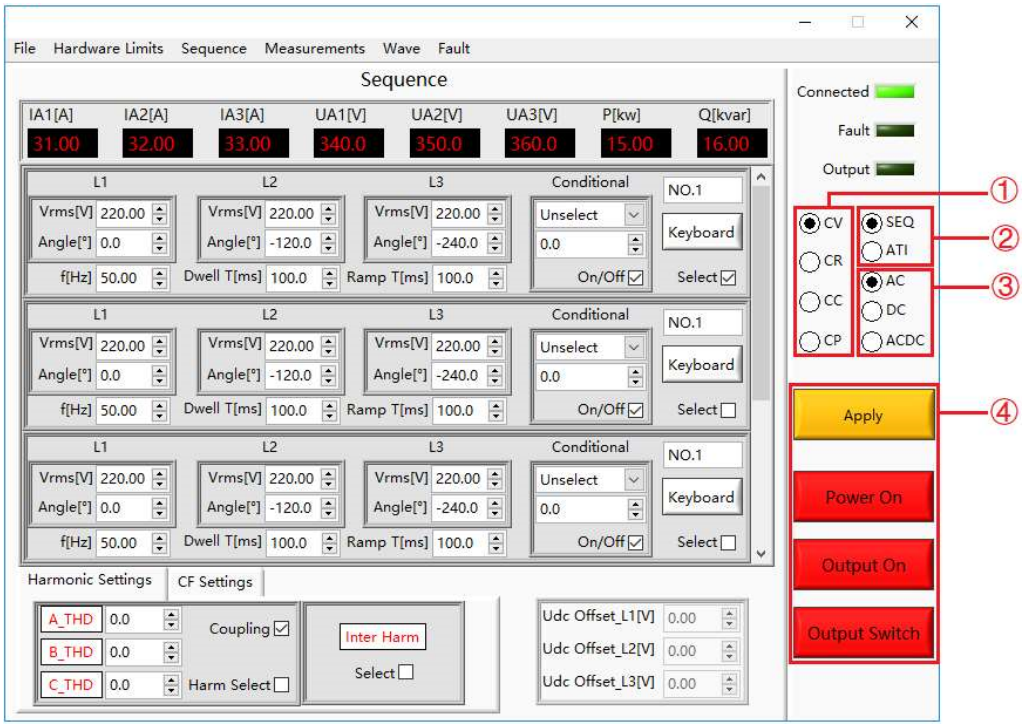



Figure 5-2 Sequence Mode and input/output control

Table 5-2

| Number | Name | | 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.

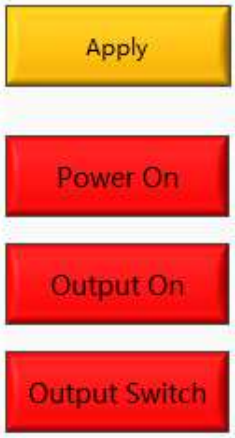



Figure 5-3 Input/output controls

Table 5-3

| Number | Name | Note |
|---|---|---|
| ④ | **Apply** | click "Apply" after the parameter setting is completed, the parameter will take effect. |
| | **Power On** | It is used for the network side on/ off. When the network side is on, the button is green, and when the network 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.

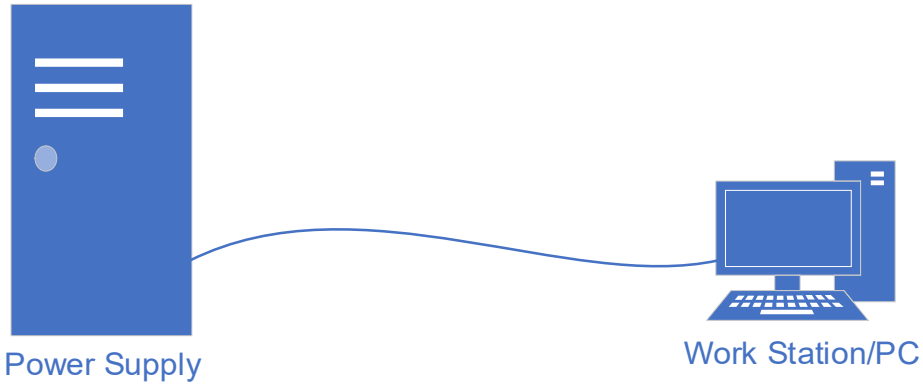



Figure 5-4 Power supply connected to workstation/PC

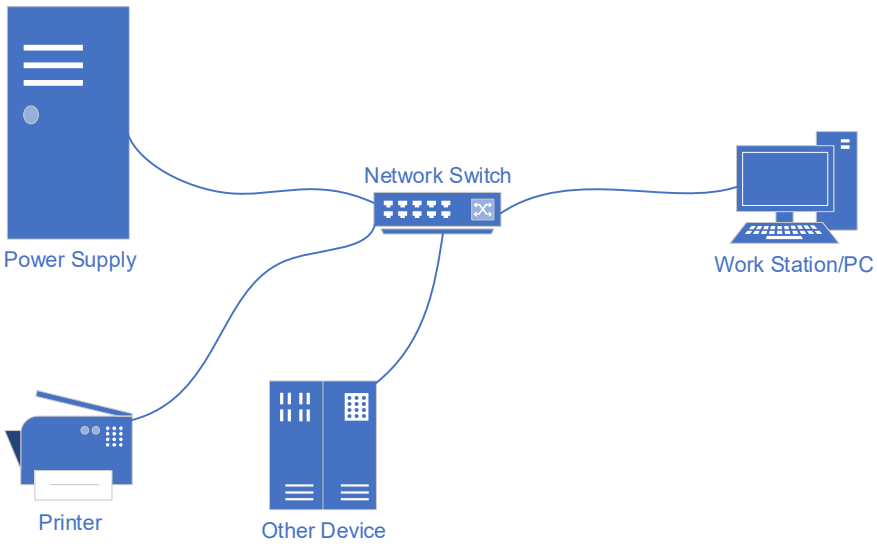
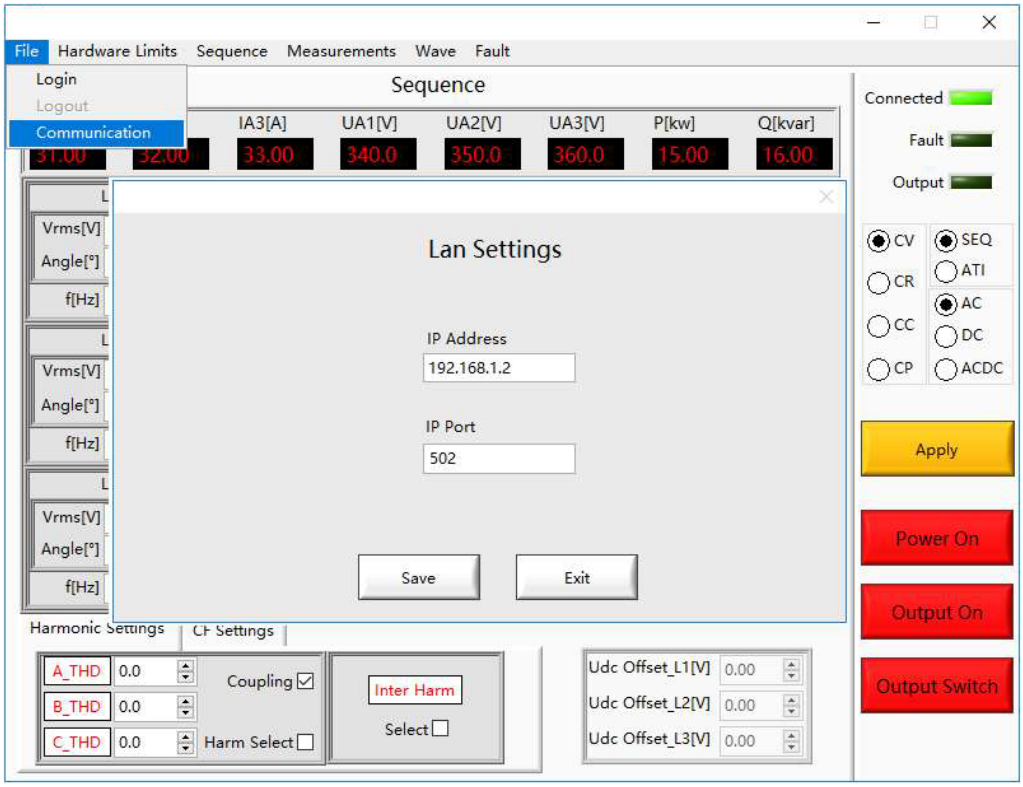



Figure 5-5 LAN connection of power supply and workstation/PC

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




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

**IMPORTANT INFORMATION**

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

[2] The actual demand for the processor and internal storage also depends on the other software actually running on the worKGStation/ 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".

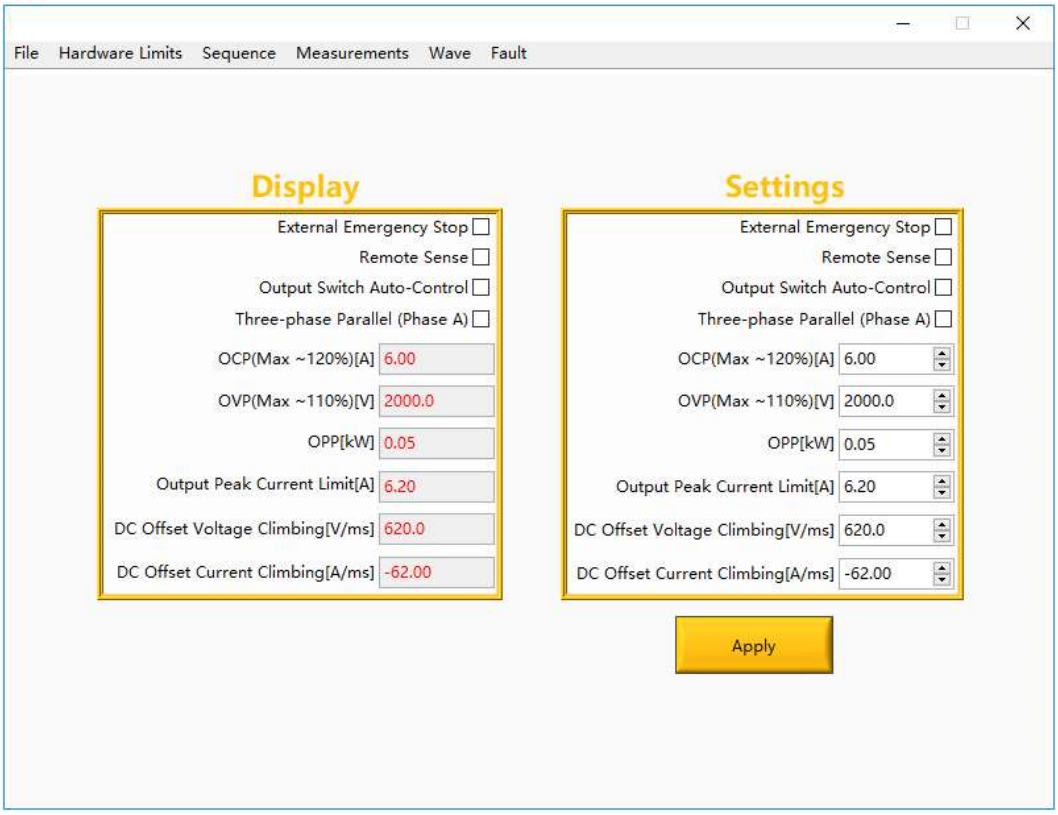



Figure 5-7 Hardware limits panel

Table 5-4

| Number | Name | 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**

①②③④ 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 EAC-4Q-GS 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.

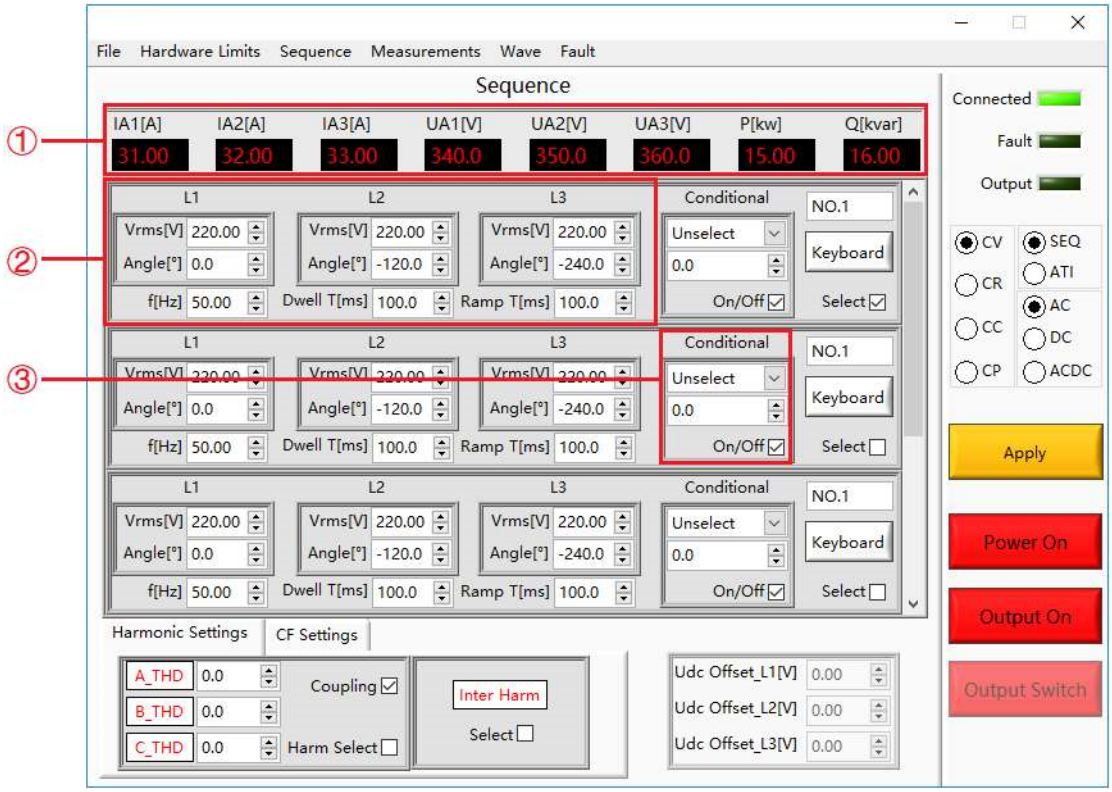



Figure 5-9 Sequence panel

Table 5-5

| Number | Name | 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).

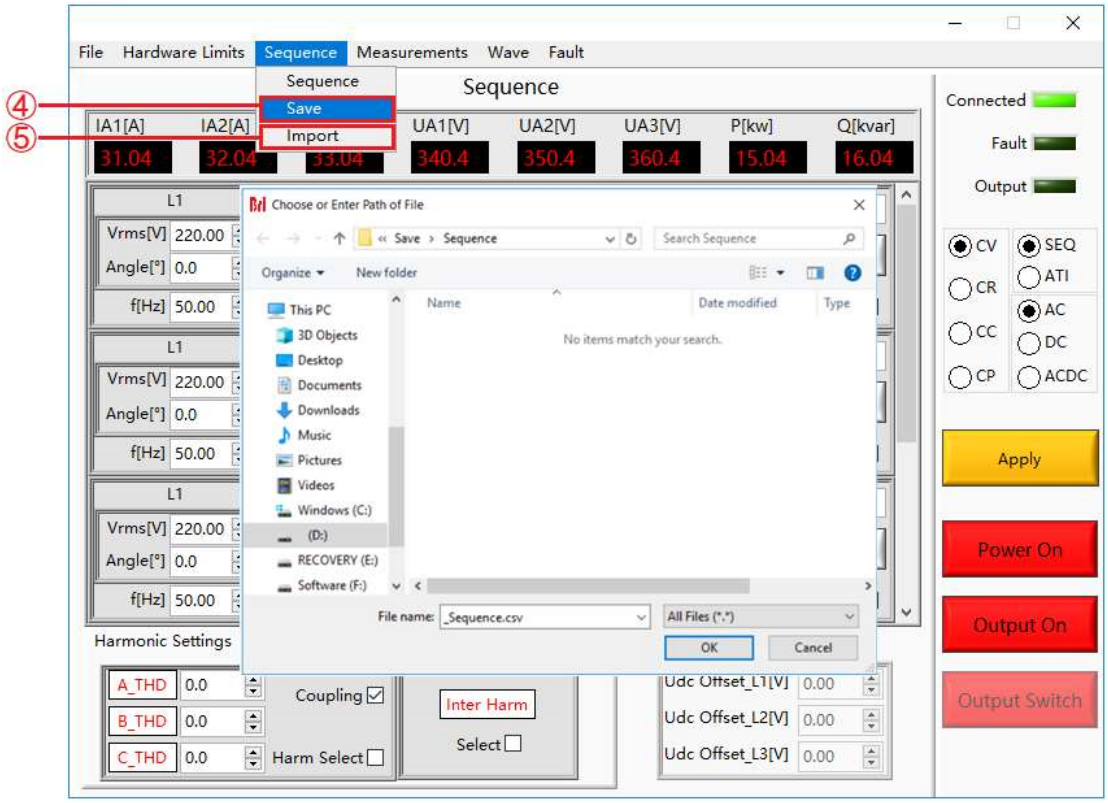



Figure 5-10 Sequence save/Import

Table 5-6

| Number | Name | 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 EAC-4Q-GS 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. The set value will be adjusted according to the AC/DC voltage (0-5 V) of the analog input.

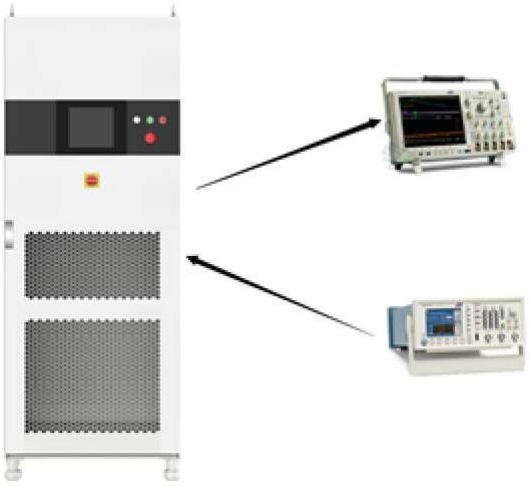


Figure 5-11 Analog input

**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.

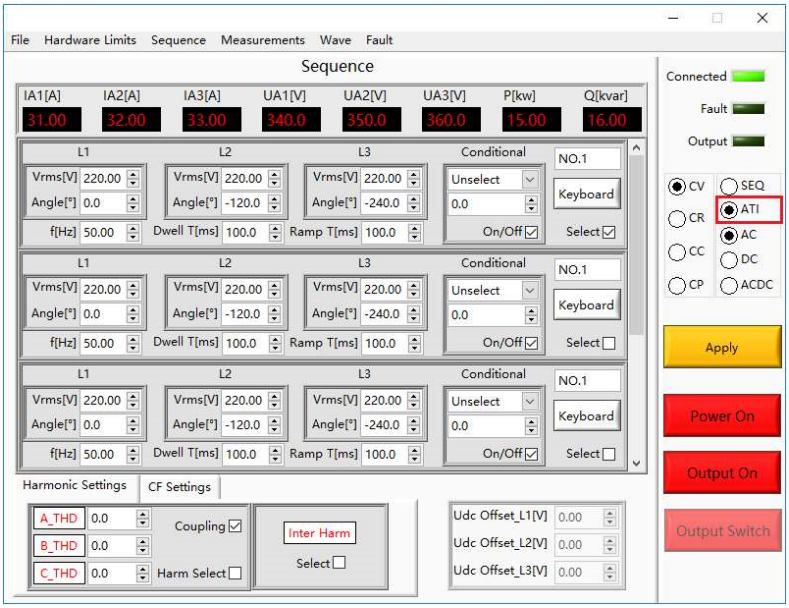



Figure 5-12 Analog input mode

## 5.6 AC/AC+DC/DC

EAC-4Q-GS adopts bidirectional design and can be used as AC/DC power supply for DUT. The output modes include: AC, DC, AC+DC.

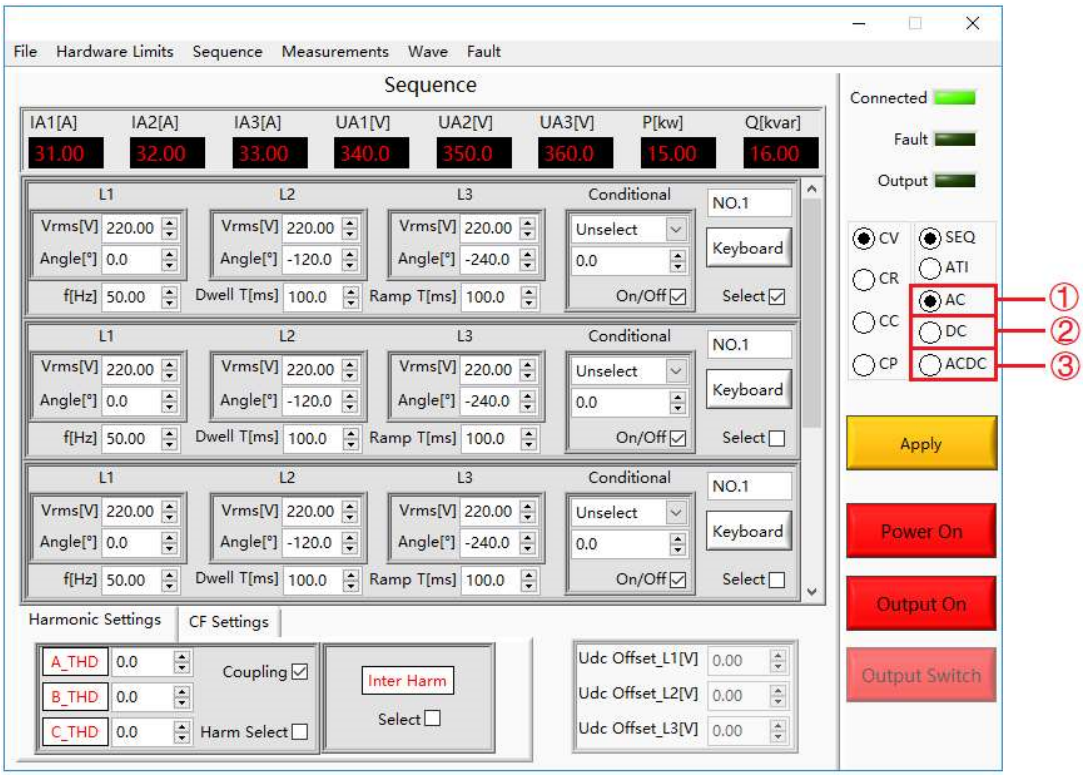



Figure 5-13 Output mode

### 5.6.1 AC

The EAC-4Q-GS 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, in EAC 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 EAC-4Q-GS 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.

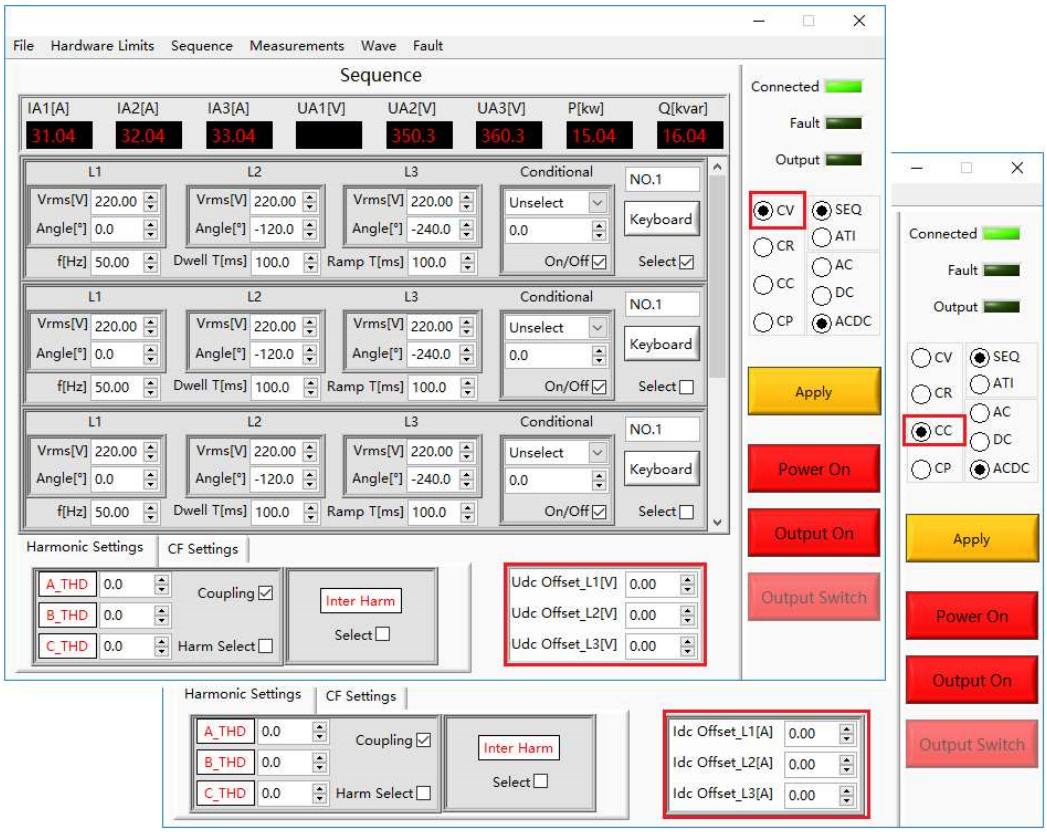



Figure 5-14 DC offset voltage/Current

**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, EAC-4Q-GS 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 EAC-4Q-GS 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

EAC-4Q-GS  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.

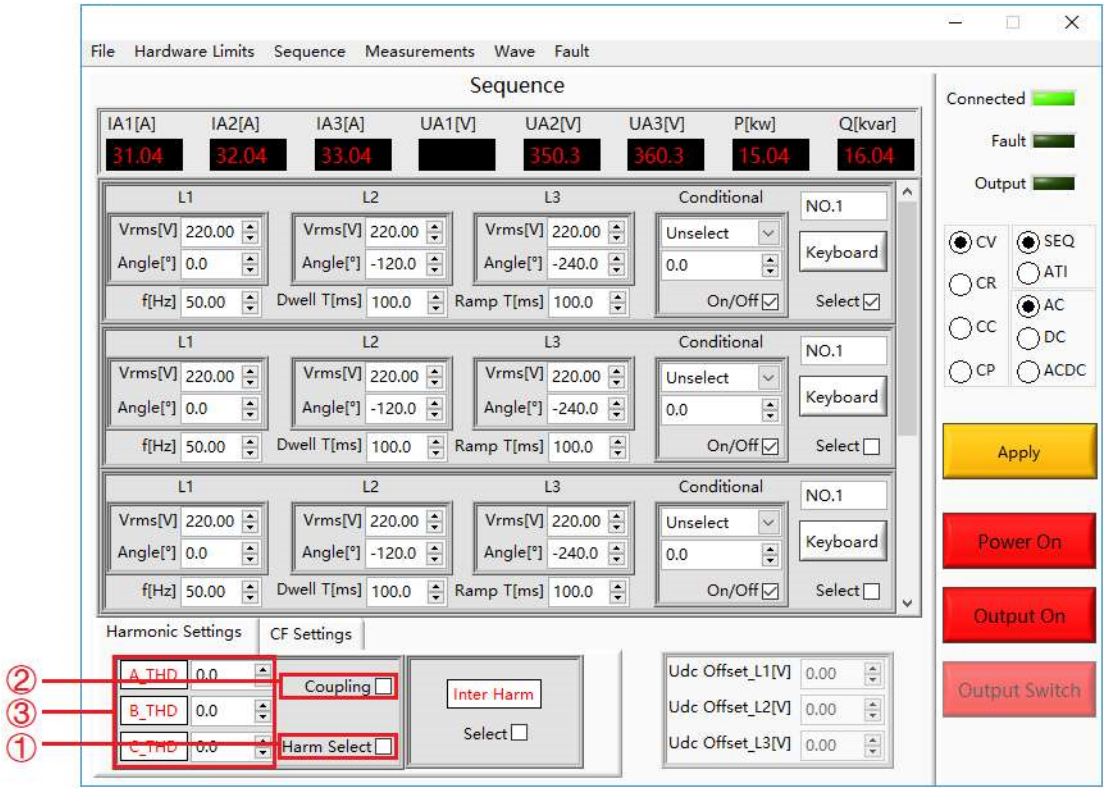



Figure 5-15 Harmonic Edit-1

Table 5-7

| Number | Name | 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. |

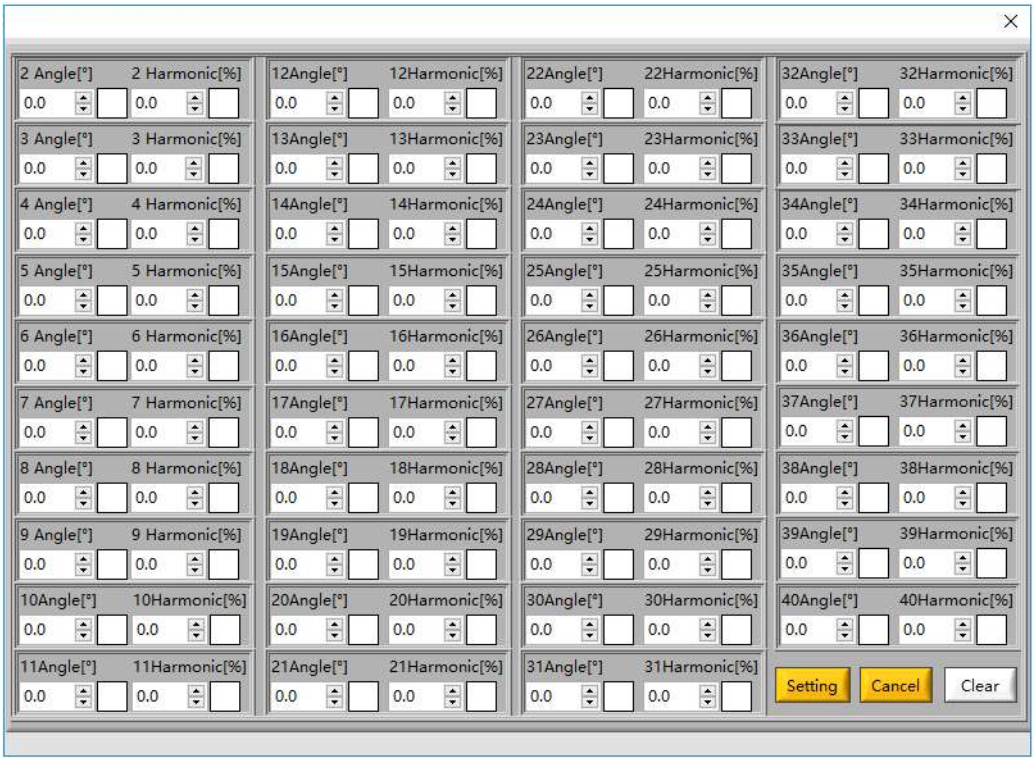



Figure 5-16 Harmonic Edit-1

## 5.7.2 Inter-harmonic simulation

EAC-4Q-GS 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.

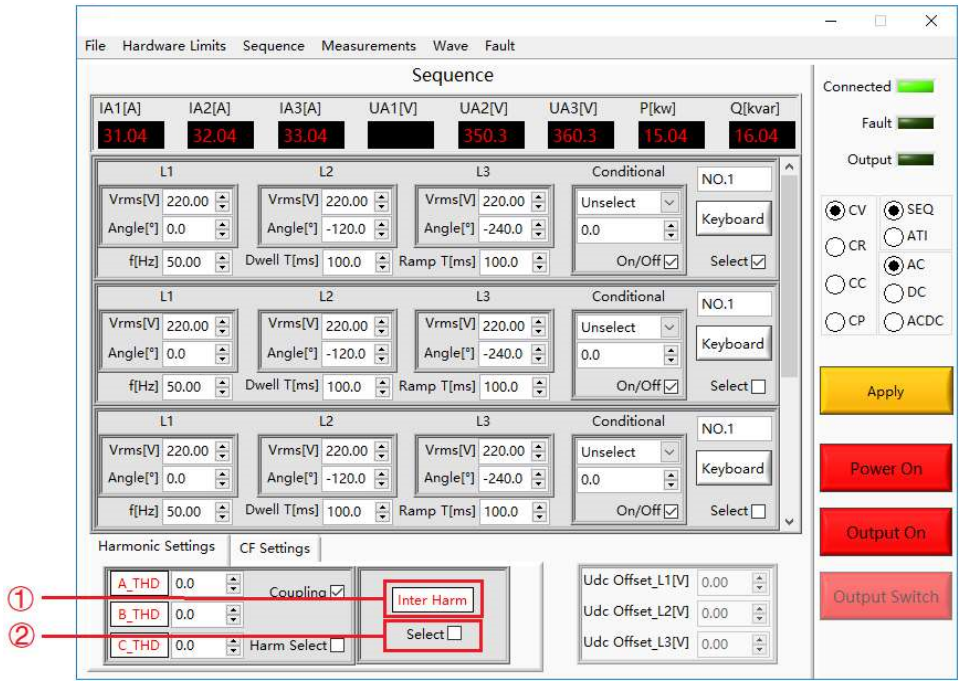



Figure 5-17 Inter-harmonic edit -1

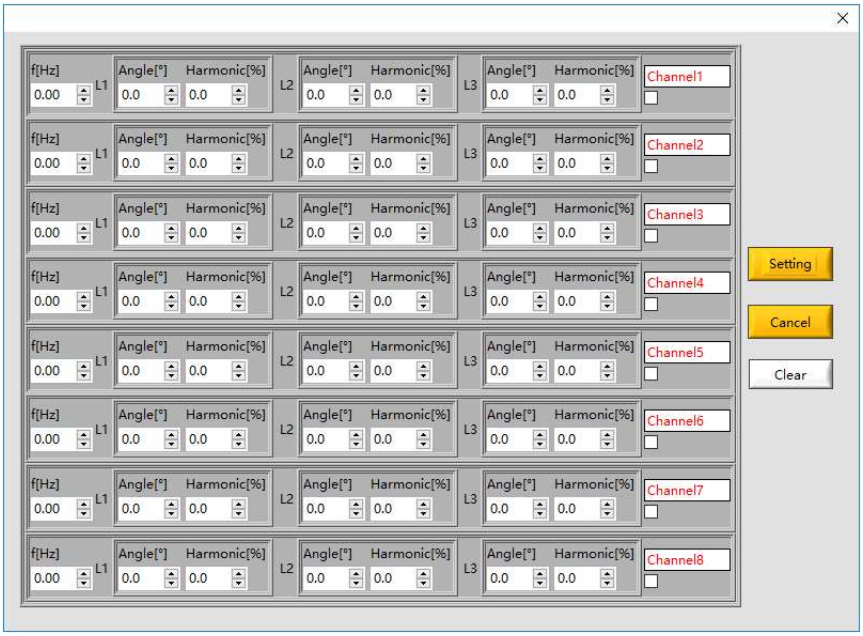



Figure 5-18 Inter-harmonic edit -2

## 5.8 Simulation of Re-generative AC Load

EAC-4Q-GS 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. Rectifier mode can be used to simulate non-linear

**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.

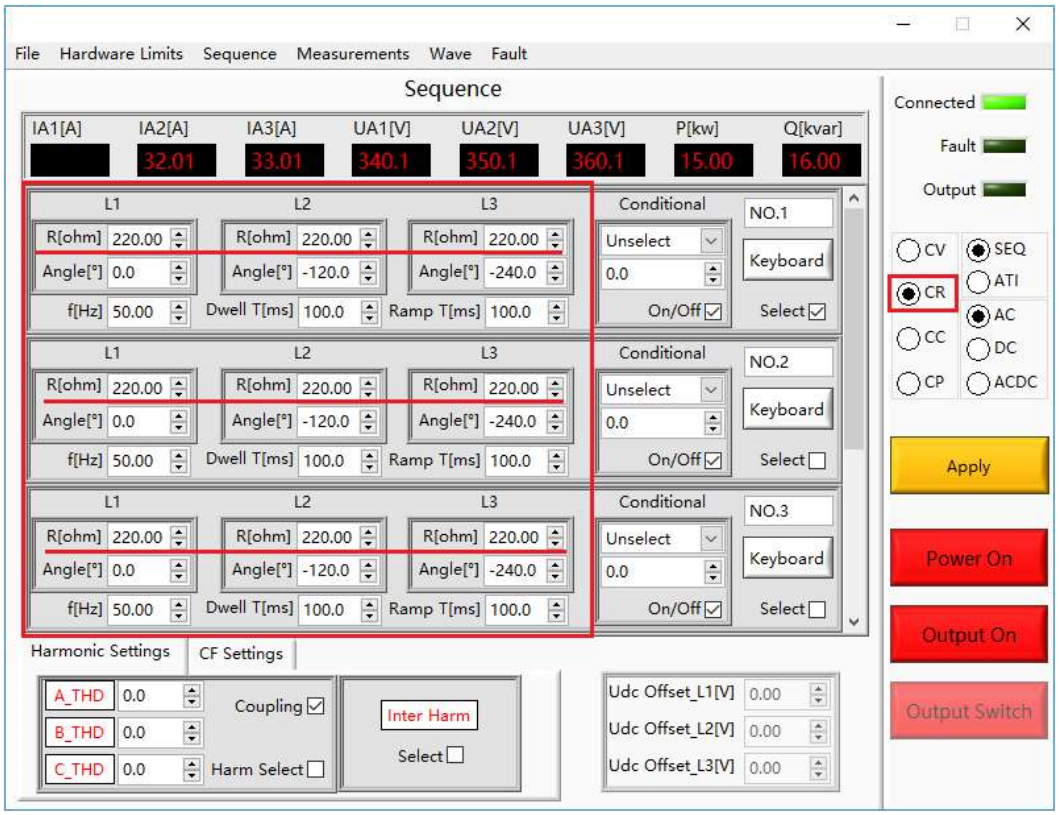



Figure 5-19 CR mode

## 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.

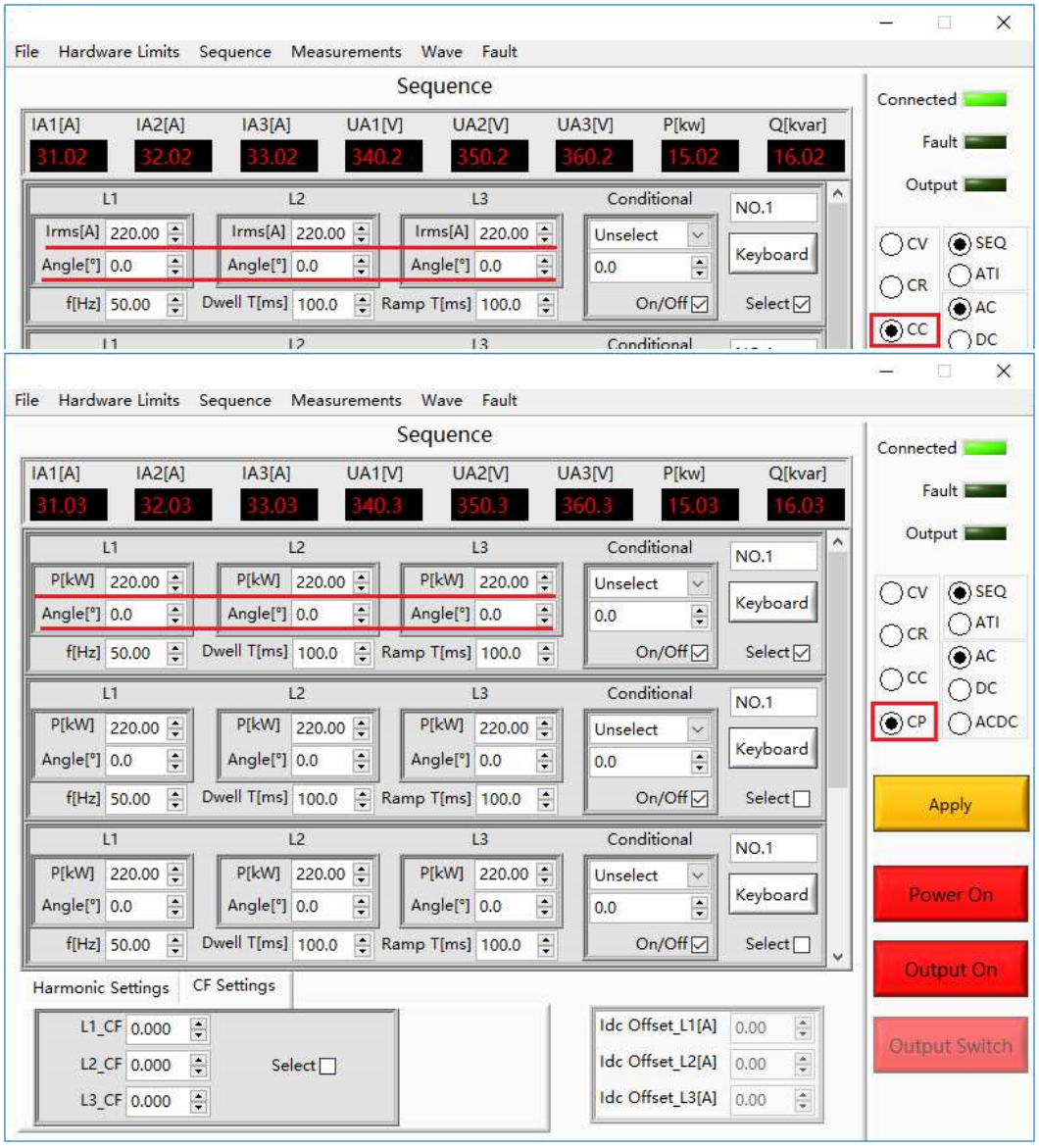



Figure 5-21 the CC/CP phase lead/lag mode

## 5.9 Measurements

The GUI software of EAC-4Q-GS 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).

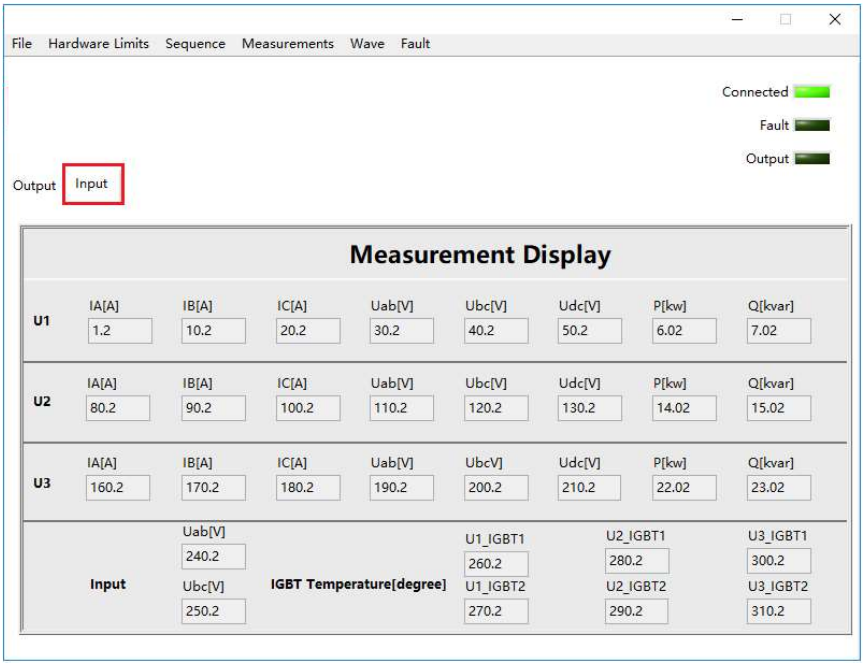



Figure 5-22 Measurements panel-Input

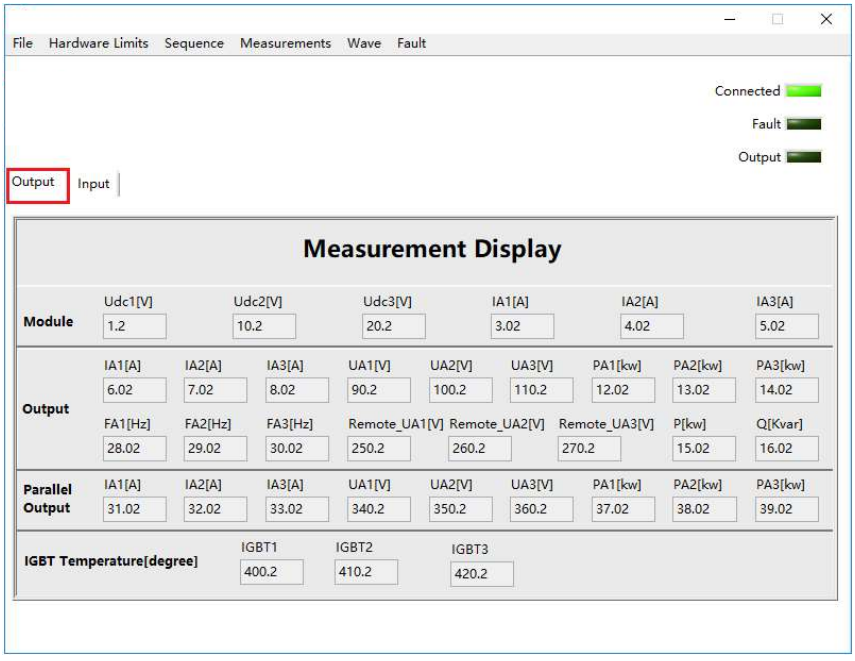



Figure 5-23 Measurements panel-Output

## 5.10 Waveform

### 5.10.1 Real-time waveform browsing

The GUI software of EAC-4Q-GS 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

| Number | Name | 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 EAC-4Q-GS 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).

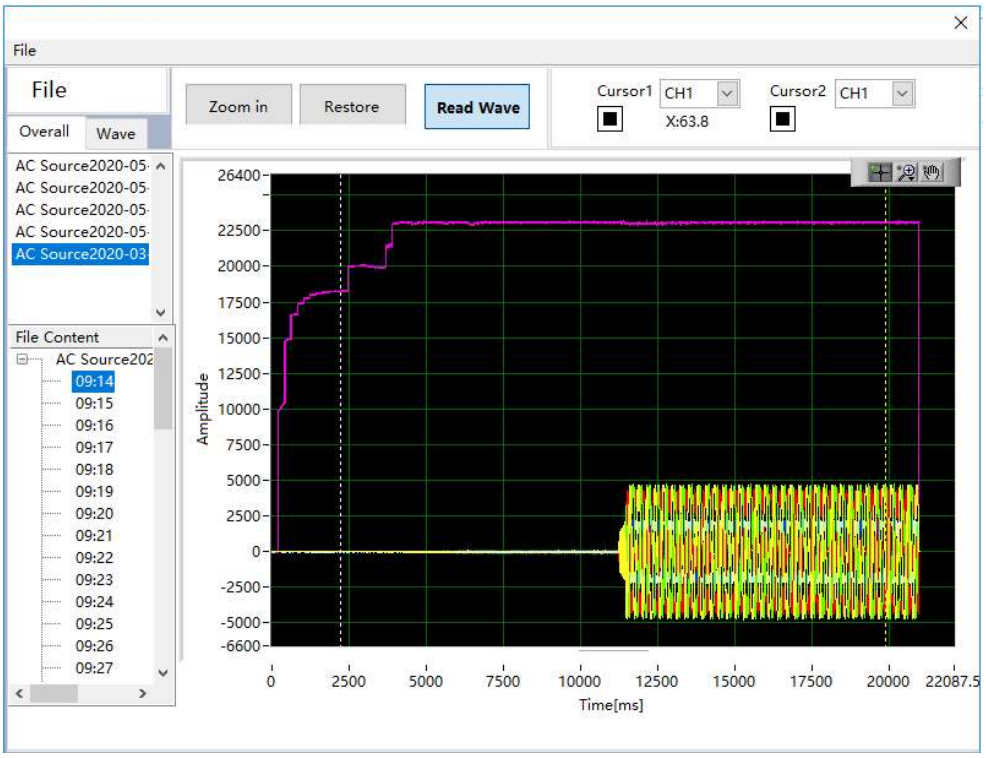


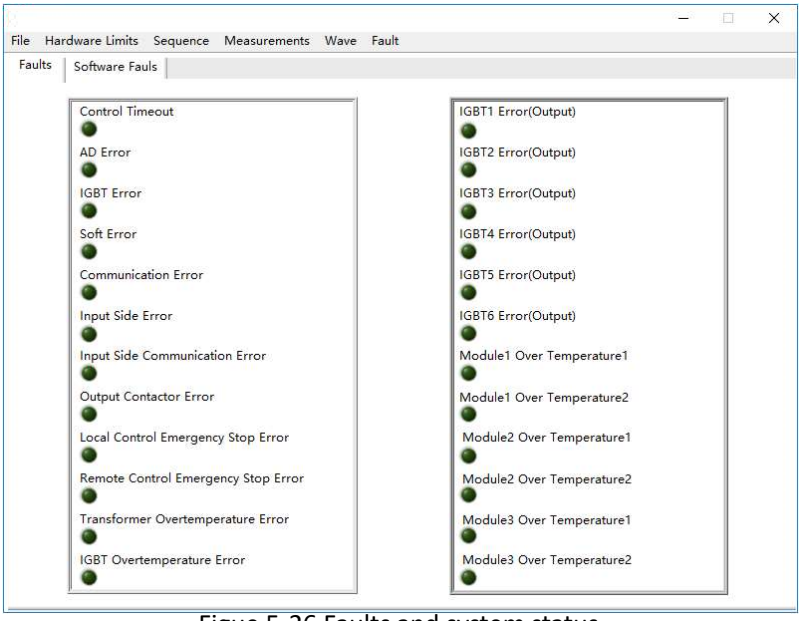

Figure 5-25 Historical waveform panel

# 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.




Figue 5-26 Faults and system status

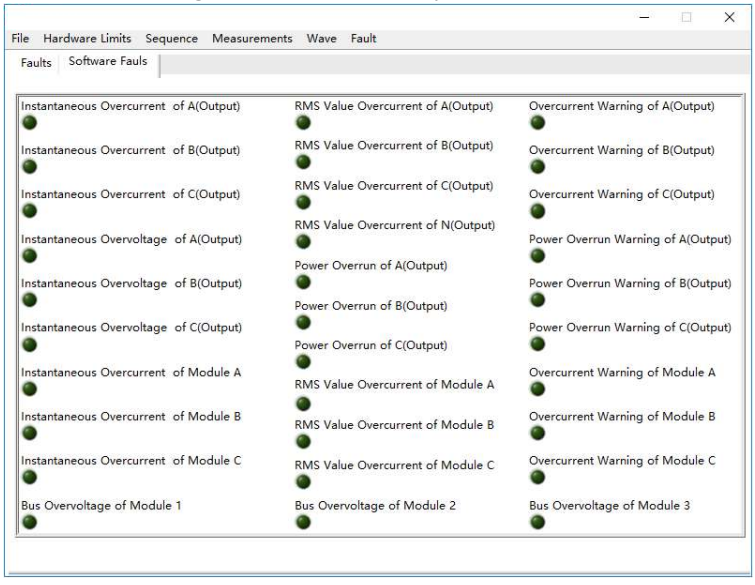



Figure 5-27 Software fault and status

## 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.

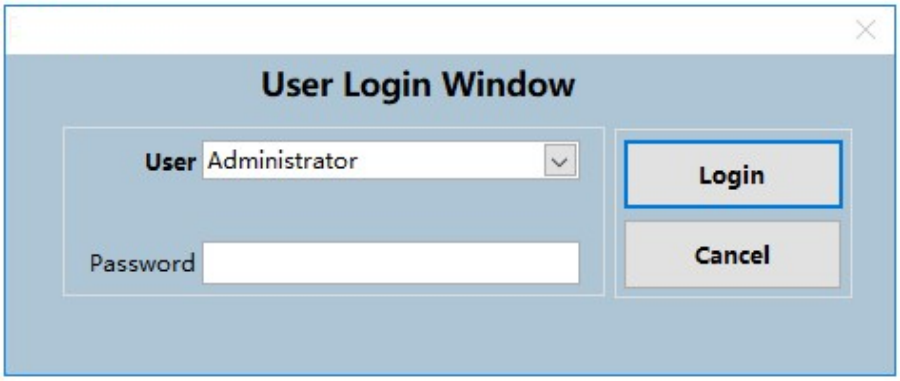



Figure 5-28 System status panel

# Part VI Equipment verification and calibration

## 6.1 Performance Verification

### 6.1.1 Verify equipment and settings

### 6.1.2 Verify content

**Voltage Range**

**Current Range**

**Frequency Range**

**Voltage Accuracy**

**Current Accuracy**

**Frequency Accuracy**

**Power Accuracy**

**Output Characteristics**

**Load Regulation**

**Voltage THD**

**Ripple Test**

**Harmonic Test**

**Inter-harmonic Test**

**Electronic load test**

**Voltage drop Change**

**Three phase Unbalanced Output**

**Step Load Variation**

**Voltage Offset Test**

**TTL Signal Trigger**

**Input impulse current**

**Waveform Injection**

**Protection Function**

**Log Function**

**Clock Function**

**LCD Display Test**

**Noise test**

**Temperature test**

# 6.1Performance Verification

## 6.1 1 Verity equipment and settings

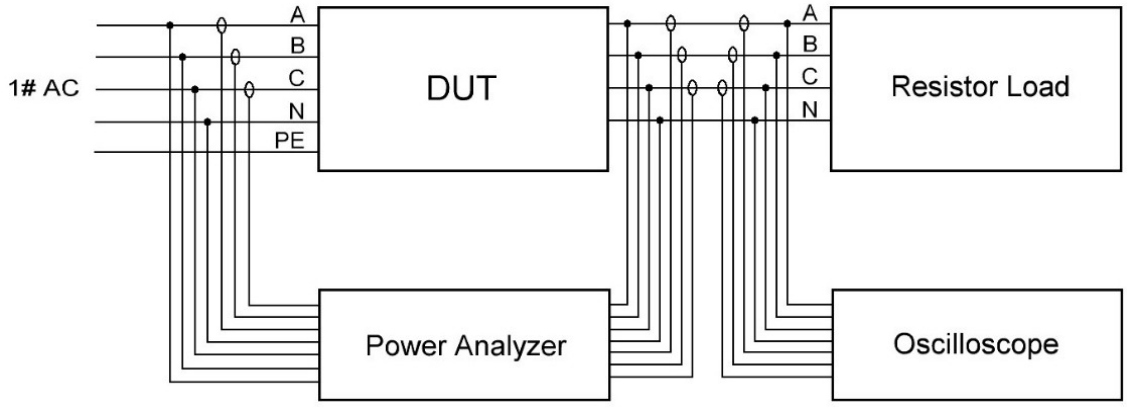



Figure 6-1 Three-phase output test with resistive load

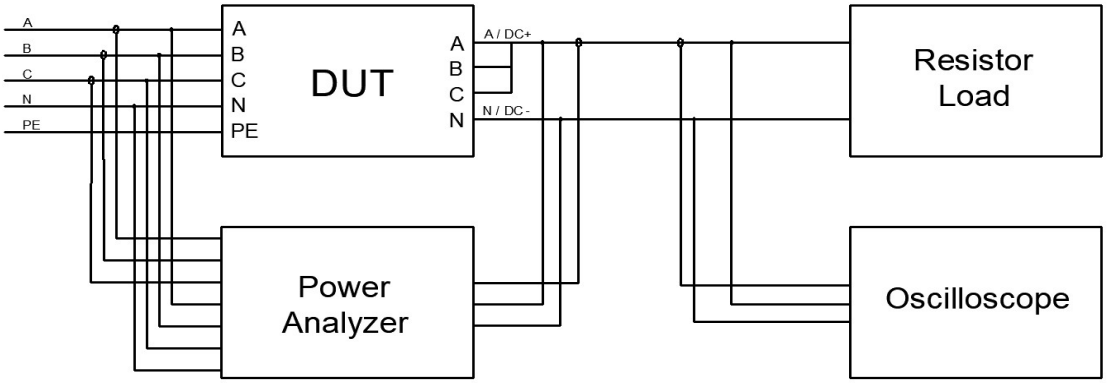



Figure 6-2 Single-phase output test with resistive load

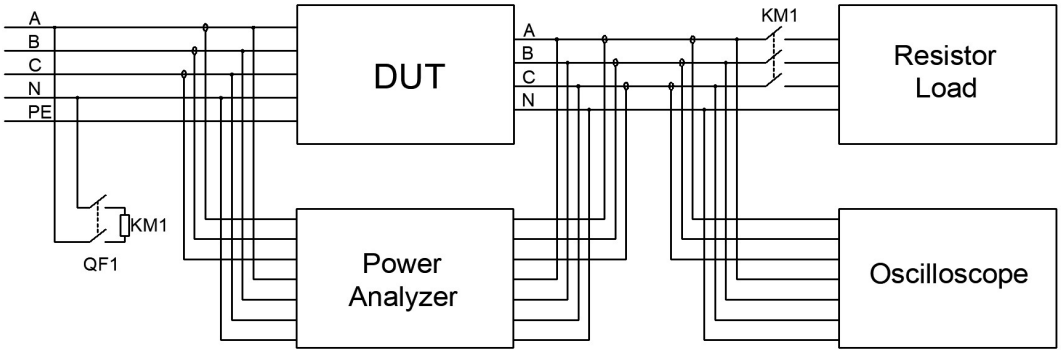



Figure 6-3 Load step change test

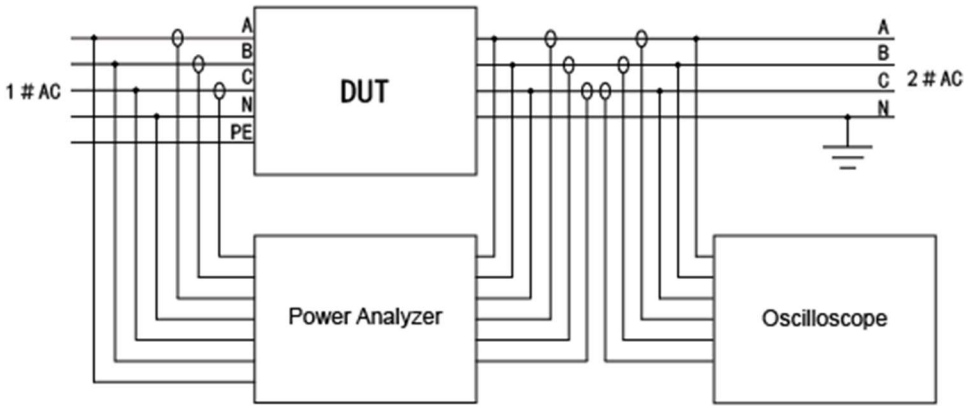



Figure 6-4 Recycling electronic load test

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 EAC-4Q-GS 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 side of the AC/DC source 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. 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 side of the AC/DC source 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. 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 side of the AC/DC source 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 side of the AC/DC source 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, 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:

$\delta_U$——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 side of the AC/DC source 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 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:

$\delta_I$——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 side of the AC/DC source 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：

$\delta_f$——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 side of the AC/DC source 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 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:

$\delta_P$——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 side of the AC/DC source 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, read and record the output measurement value, efficiency, and PF value on the power analyzer.

- **Load Regulation**

  Connect the input side of the AC/DC source 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, 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 side of the AC/DC source 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, 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 side 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 side of the AC/DC source 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 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 side of the AC/DC source 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.

- **Electronic load test**

  Connect the input and output sides of the AC source 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 side of the AC/DC source 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. 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 side of the AC/DC source 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 set the phase angle value, read and record the waveform data on the oscilloscope and power analyzer.

- **Step Load Change**

  Connect the input side of the AC/DC source 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 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 side of the AC/DC source 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/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 side of the AC/DC source 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 side of the AC/DC source 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 side of the AC source 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 EAC-4Q-GS test report.

# Part VII Equipment Maintenance and Repair

## 7.1 Equipment Maintenance

### 7.1.1 Equipment operating environment

### 7.1.2 Equipment maintenance

## 7.2 Equipment Repair

### 7.2.1 Equipment self-test

### 7.2.2 Maintenance service

### 7.2.3 Equipment return

## 7.1 Equipment Maintenance

Please be careful of the maintenance environment of equipment. ET System electronic GmbH 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 ET System electronic GmbH has no liability for equipment failure caused by
self-assembly.

### 7.2.2 Maintenance service

If the purchased equipment failure during the warranty period, ET System electronic GmbH will repair the equipment according to the specific information provided by the customer.

Contact information is on Page 05.

### 7.2.3 Equipment returns

If the failure is confirmed by itself rather than the connection problem, please return the power supply to ET System electronic GmbH 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.

# Part VIII Programming

## 8.1 Command Format

### 8.1.1 Parameters data type

### 8.s1.2 Command parameters/Return value units

### 8.1.3 Command format

## 8.2 Command Sets

### 8.2.1 Common commands

### 8.2.2 SCPI and panel comparison

## 8.3 Example

## 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 EAC-4Q-GS 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: EAC-4Q-GS-***-*** 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<br>1:ON<br>0:OFF |
| OUTPUT:STAT? | OUTPUT:STAT,1/0 | Return status of output of power supply<br>1:ON<br>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<br>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 :<br>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<br>3:CP<br>2:CC<br>1:CR<br>0:CV |
| MODES SEQ/ATI | None | Set Input mode of reference value<br>SEQ:Software input<br>ATI:Analog input |
| MODES? | MODES 1/0 | Return Input mode of reference value<br>1:ATI<br>0:SEQ |
| MODEA AC/DC/ACDC | None | Set the AC or DC mode of output.<br>AC or DC |
| MODEA? | MODEA 2/1/0 | Return the AC or DC mode of output<br>2:ACDC<br>1:DC<br>0:AC |
| SET:FREQ <NRf> | None | Set the value of voltage of Freq |
| SET:PHASEA <NRf> | None | Set the value of phase of A |
| SET:AMPA <NRf> | None | Set the value of amplitude of A |
| SET:PHASEB <NRf> | None | Set the value of phase of B |

| | | |
|---|---|---|
| SET:AMPB <NRf> | None | Set the value of amplitude of B |
| SET:PHASEC <NRf> | None | Set the value of phase of C |
| SET:AMPC <NRf> | None | Set the value of amplitude of 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:<br>Frequency;<br>phase of A;<br>amplitude of A;<br>phase of B;<br>amplitude of B;<br>phase of C;<br>amplitude of C; |
| SET? | SET <,NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7> | Inquire the values of following parameters for one time:<br>Frequency;<br>phase of A;<br>amplitude of A;<br>phase of B;<br>amplitude of B;<br>phase of C;<br>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）**

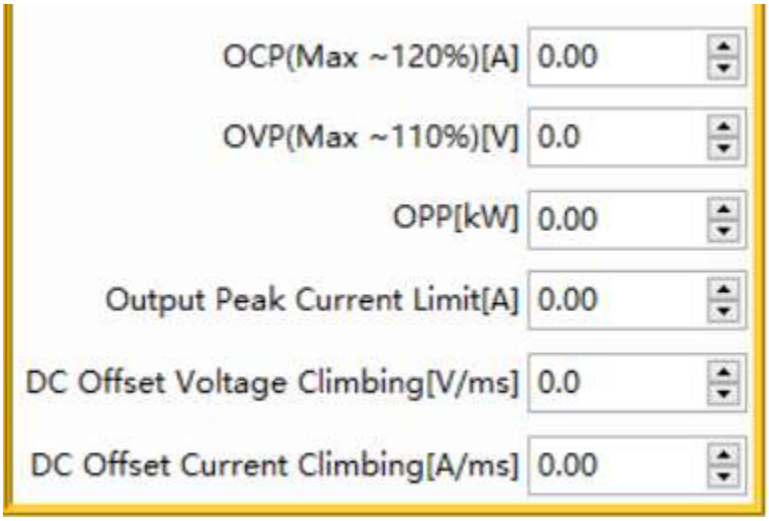



Figure 8-1

| 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）

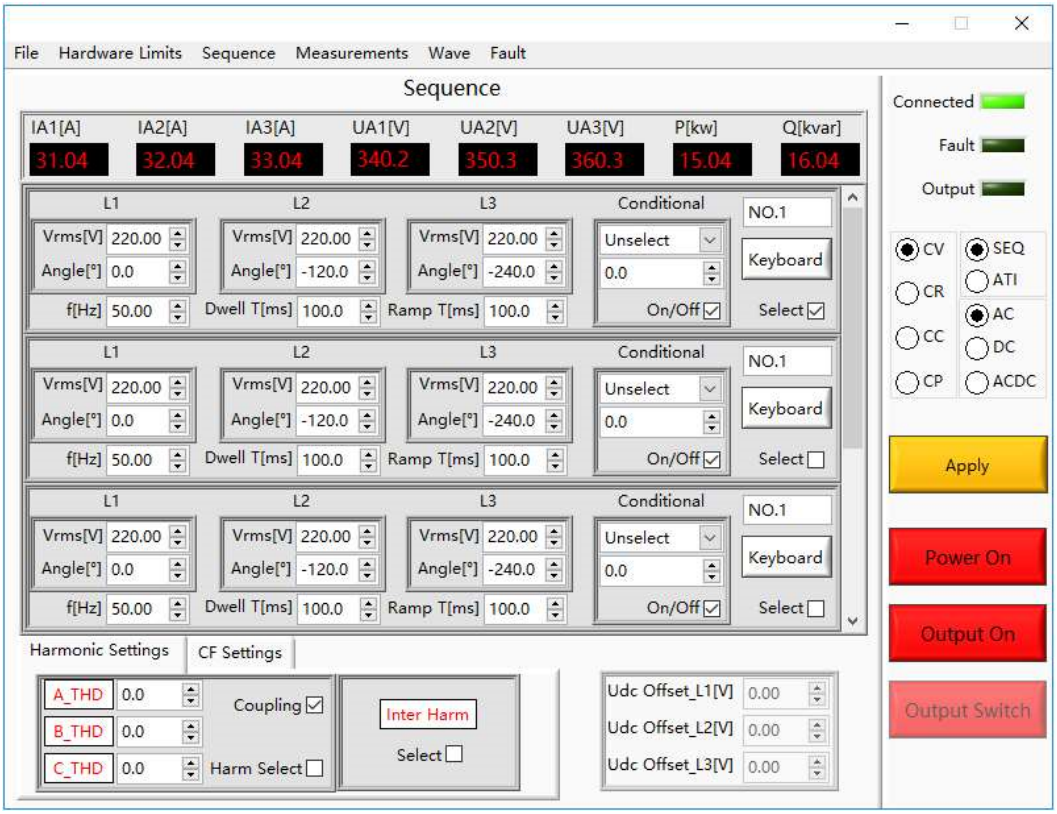



Figure 8-2

| 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<br>1:ON<br>0:OFF |
| OUTPUT:STAT? | OUTPUT:STAT,1/0 | Return status of output of power supply<br>1:ON<br>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<br>3:CR<br>2:CP<br>1:CC<br>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:<br>duration;<br>switch time;<br>output frequency;<br>the phase of output A;<br>the amplitude of output A;<br>the phase of output B;<br>the amplitude of output B;<br>the phase of output C;<br>the amplitude of output C;<br>the condition value;<br>the selectioncondtion;<br>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;<br>0:NONE<br>1:A<br>2:B<br>3:C |
| SEQ:CONDVAL? | SEQ:CONDVAL<,NRf> | Inquire the condition value for phase |
| SEQ:OUTPUT? | SEQ:OUTPUT ,1/0 | Inquire the cmd of output;<br>1:ON<br>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:<br>LAB;<br>duration;<br>switch time;<br>output frequency ;<br>the phase of output A;<br>the amplitude of output A;<br>the phase of output B;<br>the amplitude of output B;<br>the phase of output C;<br>the amplitude of output C;<br>the condition value;<br>the selectioncondtion;<br>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:<br>first:<br>LAB;<br>duration;<br>switch time;<br>output frequency ;<br>the phase of output A;<br>the amplitude of output A;<br>the phase of output B;<br>the amplitude of output B;<br>the phase of output C;<br>the amplitude of output C;<br>the condition value;<br>the selectioncondtion;<br>the cmd of output |

| | | |
|---|---|---|
| | | Second :<br>LAB;<br>duration;<br>switch time;<br>output frequency ;<br>the phase of output A;<br>the amplitude of output A;<br>the phase of output B;<br>the amplitude of output B;<br>the phase of output C;<br>the amplitude of output C;<br>the condition value;<br>the selectioncondtion;<br>the cmd of output<br><br>…….. |
| 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><,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. |

### 3. （Harmonic Setting）

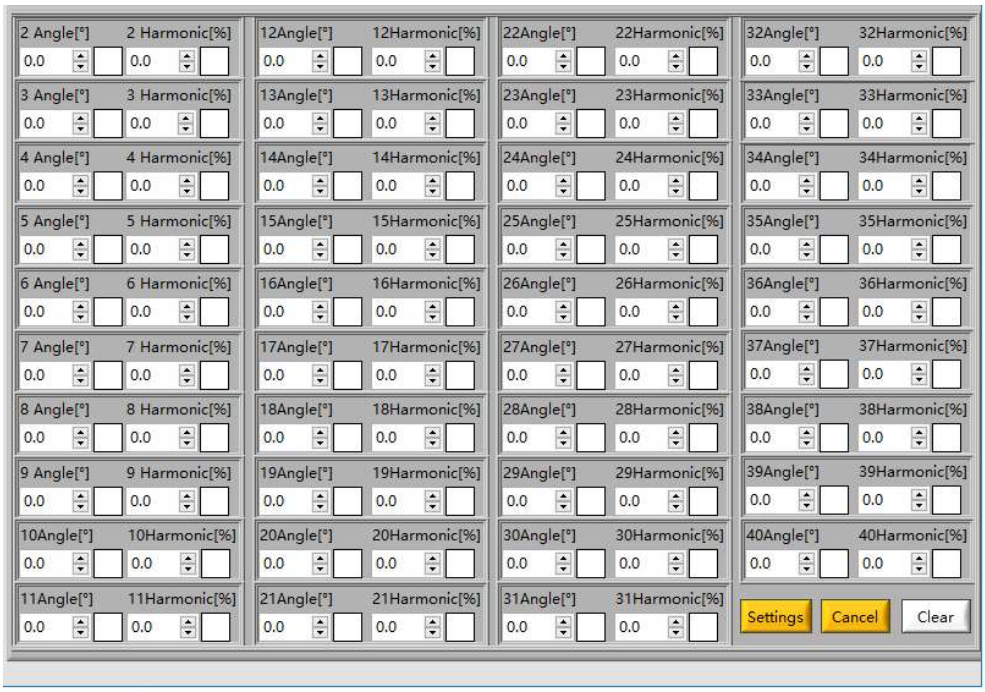



Figure 8-3

| Commands | Return Value | Description |
|---|---|---|
| HARM <NRf1><,NRf2><,NRf3><, NRf4><,NRf5><,NRf6><, NRf7> | None | Set second harmonic parameters：<br>Harmonic order;<br>phase of a;<br>ratio of a;<br>phase of b;<br>ratio of b;<br>phase of c;<br>ratio of c; |
| HARM? | HARM<NRf1><,NRf2><, NRf3><,NRf4><, NRf5><,NRf6><, NRf7>;<br>HARM:<NRf1><,NRf2><, NRf3><, NRf4><, NRf5><,NRf6><, NRf7>;<br>……. | Inquire 2-40th harmonic parameters：<br>Harmonic order;<br>phase of a;<br>ratio of a;<br>phase of b;<br>ratio of b;<br>phase of c;<br>ratio of c; |
| HARM APPLY | None | Validate the parameters that have been set |
| HARM CLEAR | None | Clear the harmonics parameters |

## 1. （Inter Harmonic Setting）

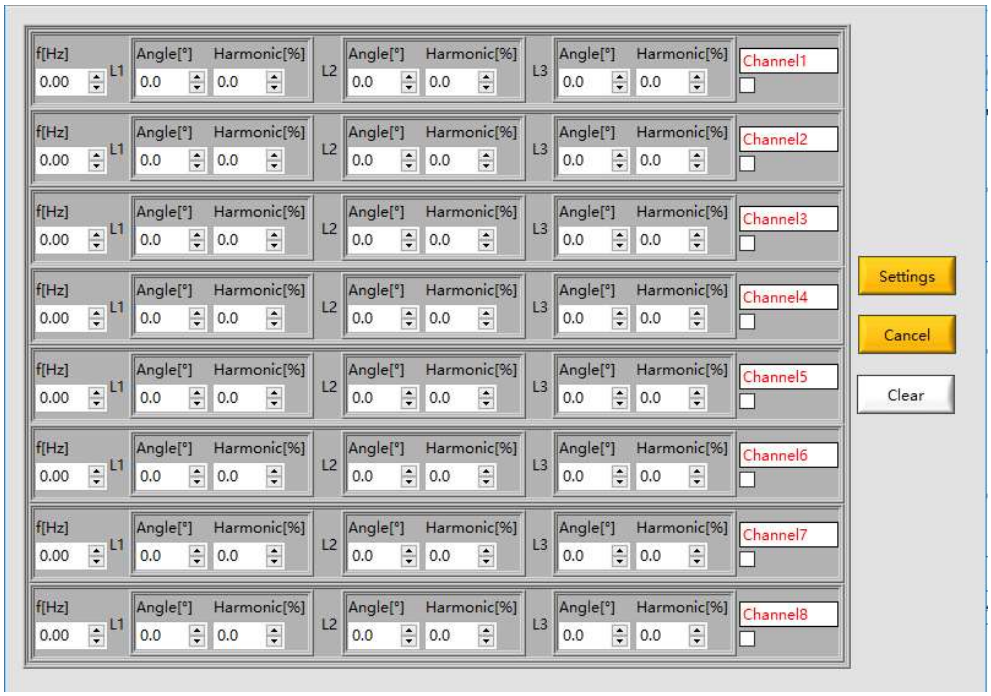



Figure 8-4

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

| | | |
|---|---|---|
| | | Frequency;<br>phase of a;<br>ratio of a;<br>phase of b;<br>ratio of b;<br>phase of c;<br>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

EAC-4Q-GS-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*.*,*.*,*.*