BriPower

KGS Series User Manual

About BriPower

Nanjing Bridge New Energy Technology (Bridge Technology) was founded on Jan 12th, 2016, focusing on business of regenerative power supplies and electronic loads. We are devoted to providing high quality products and solutions for customers.

Our product brand is BriPower^{TM}.

> - Bi-directional AC sources
> - Bi-directional DC sources

> - Regenerative loads
> - Custom Power Solutions

The BriPower^{TM} AC&DC power systems are widely used in new energy and related fields.

Our Factory is on ISO Certified and The Quality Management System Confirms to the Standard GB/T19001-2016/ ISO9001-2015.

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Legal Notices

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

Software Statement

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

Date and Reversion

Date	Version	Reversion record
July, 2020	2.0	Complete the manual
Feb, 2024	3.0	Update the specifications, functions and programming protocol

▌▌Safety Requirements

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

- **Unpacking**

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

- **Surroundings**

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

- **Operator**

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

- **Visual Inspection**

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

- **Power Operation**

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

- **Use Suitable Cables**

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

- **Equipment Grounding**

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

- **Appropriate Overvoltage Protection**

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

- **Avoid Exposing Circuits or Wires**

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

Safety Notices and Symbols

Safety Symbols

SHOCK HAZARD

WARNING

PROTECTIVE EARTH TERMAINAL

Other Symbols

IMPORTANT INFORMATION

Safety Information

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

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▌▎Chapter 1 Equipment Introduction

1.1 System Overview

1.1.1 Overview of KGS series

The BriPower KGS series is a high-performance AC/DC power source/load, using SiC MOSFET PWM technology, which contains multi output power levels from 15kVA to 1080kVA. With an output frequency range from DC to 5kHz, max output 450V L-N.

KGS series uses bi-directional design, which makes it possible to be used as grid simulator to test distributed generation systems. KGS Series is well suited for aerospace applications. Remote control interfaces and SCPI command language are provided for easy integration into ATE systems.

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

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

1.1.2 Model Description


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KGS      AAA -BBB -CCC -DDD /EEE
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Input confirgration
Option(s)
Output phase current, A
Output phase voltage, V
Output power, kVA
Series name
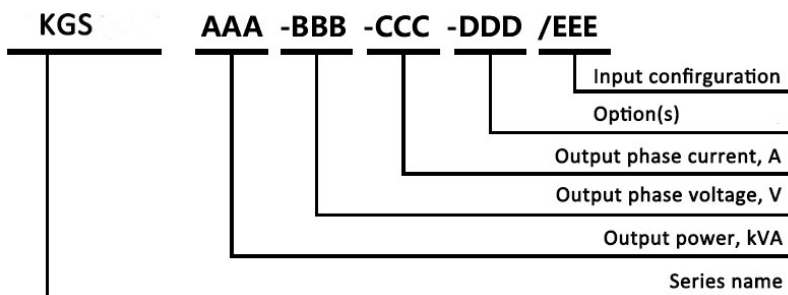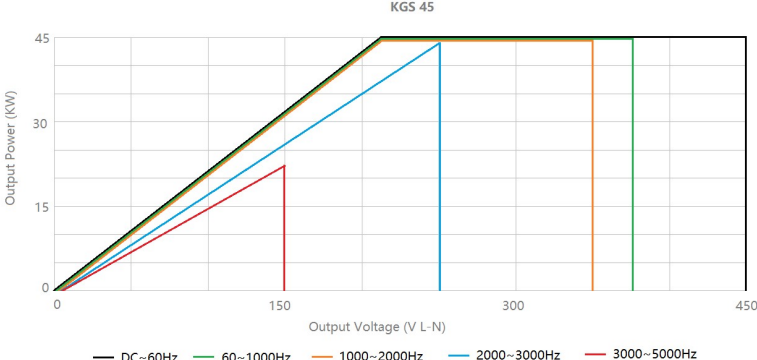
1.1.3 Features and configuration

• Modular design, output power from 15kVA to 1080kVA

• Bi-directional AC/DC power source, seamless transition between source and sink modes

• Regenerative AC/DC load function

• Output: AC, DC, AC+DC

• Independent three-phase output, which can be configured as single-phase output

• Max output 450V L-N within output frequency range from DC to 5kHz

- Frequency Range: DC~ 5kHz max

- Up to 100th harmonic waveform generation, inter-harmonic generation

- Triger out, TTL signal output for voltage or frequency change

- AC output, ON/ OFF output phase angle can be programmed

- Using true current feedback control when working in CC mode

- RLC Load Simulation&RCD Load Simulation

- Current limit can be programmed, output can be shorted for short circuit test

- Bi-Polar DC Source (-BP option)

- Analog signal input for use as a power amplifier (delay $\leqslant$ 20 μs)

- 30 Built-in harmonic waveforms

- Soft start: effectively restrain the impulse current when power on

- TFT-Touch panel operation

- Master-Slave interface

- LAN, RS485, Analog control interface

- Emergency stop button and indicators on front panel

- Mod-bus/ASCII protocols

- CE conformity

- 13 months warranty

1.1.4 General Specification

AC input	
Voltage	3P+N+PE, 400VLL±10%
Frequency	47-63Hz
Efficiency	≥85%
Power Factor	0.99
THDi	<3%FS
Output	
Output Modes	AC, DC, or AC+DC
Power Level	From 15kVA to 1080kVA
Load Regulation	0.1%FS
Line Regulation	0.1%FS
AC Output	

Voltage & Current Range (max output per 15KW module)	Max 450V L-N, 70A @ DC~65Hz Max 375V L-N, 70A @ 65~1000Hz Max 350V L-N, 70A @ 1000~2000Hz Max 250V L-N, 60A @ 2000~3000Hz Max 150V L-N, 50A @ 3000~5000Hz KGS 45
Phase Angle Range	Phase B/C relative to phase A, 0.0~360.0°
Frequency Range	DC -5000Hz
Small signal bandwidth	10kHz
THD	<0.3%FS @15~50Hz (measured at 250V L-N, Resistive Load) <0.4%FS @50~500Hz (measured at 250V L-N, Resistive Load) <0.7%FS @500~2000Hz (measured at 250V L-N, Resistive Load) <1%FS @2000~4000Hz (measured at 100V L-N, Resistive Load) <2%FS @4000~5000Hz (measured at 100V L-N, Resistive Load)
Harmonic Generation	Up to 100th @50/60Hz
	Harmonic accuracy: 1%FS
	Within 50th: total harmonic content ≤ 100% Within 100th: total harmonic content ≤ 30%
Voltage Slew Rate	5V/us
Current Slew Rate	0.5A/us
Current Peak Factor	1 ~ 3
Power Accuracy	DC~45Hz: 0.3%FS 45~70Hz: 0.1%FS 70~2KHz: 0.3%FS
Voltage Accuracy	DC~45Hz: 0.2%FS 45~70Hz: 0.1%FS 70~2KHz: 0.2%FS
Current Accuracy	DC~45Hz: 0.3%FS 45~70Hz: 0.1%FS 70~2KHz: 0.3%FS
Frequency Accuracy	0.01%FS+0.01Hz
Phase Angle Accuracy	DC~45Hz: <1° 45~70Hz: <0.1° 70~2KHz: <1°

Power Resolution	0.001kW
Voltage Resolution	0.1V
Current Resolution	0.01A
Frequency Resolution	0.01Hz (~100Hz), 0.05Hz (>100Hz)
DC Output	
Voltage & Current Range (max output per 15KW module)	0~600V, ±70A/ch
Voltage Accuracy	0.1%FS
Current Accuracy	0.1%FS
Voltage Ripple	0.1%FS
AC+DC Mode	Max Power, Voltage and Current are the same as DC Mode
RLC/RCD Load Simulation[1]	
R	Range: 0.1~1000Ω. Resolution: 0.1Ω. Accuracy: ±0.1%FS
L	Range: 0.1~5000mH. Resolution: 0.5mH. Accuracy: ±0.1%FS
C	Range: 0.001~5mF. Resolution: 0.1mF. Accuracy: ±0.1%FS
Others	
Standard Interface	LAN/RS485/ATI
Protection	OVP, OCP, OPP, OTP
IP Ingress protection	IP21
CE Conformity	EN 62040-1, EN 62040-2
Cooling	Forced Air Cooling
Temperature	Operating: 0~40℃ Storage: -20~85℃
Operating Humidity	20-90%RH (None Condensing)

1.1.5 Standard Models Specification

Model	Output Power	Max AC Output	Max DC Output	Dimension (W*D*H, mm)	Weight (kg)
KGS 15	15kVA	450V L-N, 70A	0~600V, ±70A	800*900*1100	300
KGS 45	45kVA	450V L-N, 70A/ph	0~600V, ±70A	800*900*1500	460

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[1] Measured at 50/60Hz.

KGS 90	90kVA	450V L-N, 140A/ph	0~600V, ±140A	900*900*2200	900
KGS 135	135kVA	450V L-N, 210A/ph	0~600V, ±210A	1600*900*1800	1050
KGS 180	180kVA	450V L-N, 280A/ph	0~600V, ±280A	1600*900*2200	1200
KGS 270	270kVA	450V L-N, 420A/ph	0~600V, ±420A	2400*900*2200	1800
KGS 360	360kVA	450V L-N, 560A/ph	0~600V, ±560A	3200*900*2200	2400
KGS 450	450kVA	450V L-N, 700A/ph	0~600V, ±700A	4000*900*2200	2900
KGS 540	540kVA	450V L-N, 840A/ph	0~600V, ±840A	4800*900*2200	3600

Note:

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

2. The output current above is the 3-phase output current, when configured as single-phase output the output current becomes three times.

1.2 Appearance and structure of Equipment

1.2.1 Appearance and outline

The overall appearance of the KGS (take KGS 45-300-50 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/channel steels at the bottom of the cabinet, which for users to move flexibly. There are TFT-Touch panel displayer (12 inch), status indicator, power knob, emergency stop button on the front panel, product brand, RS485/LAN interface, TTL interface and ATI interfaces which are for automated test applications on the rear panel.
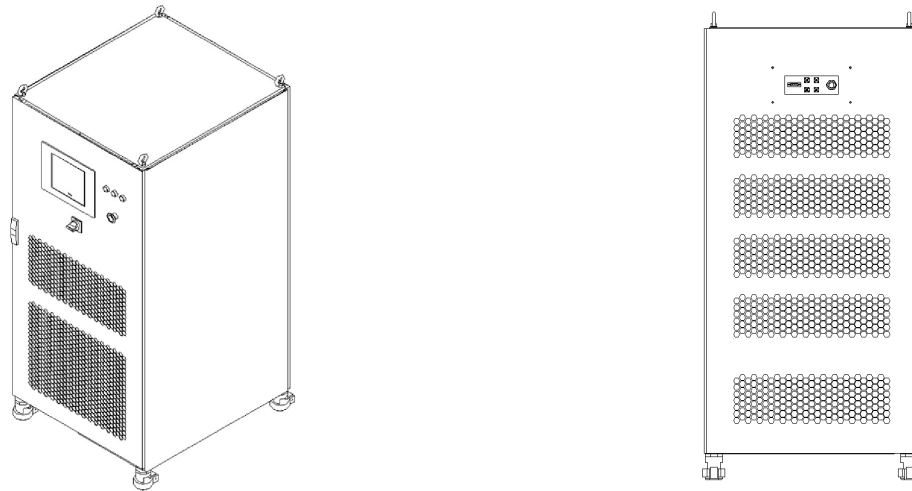

Figure 1-1 Overall appearance

1.2.2 Front Panel

The front panel of KGS series is equipped with a TFT-Touch panel displayer (12 inch), status indicator, power knob and local emergency stop button.
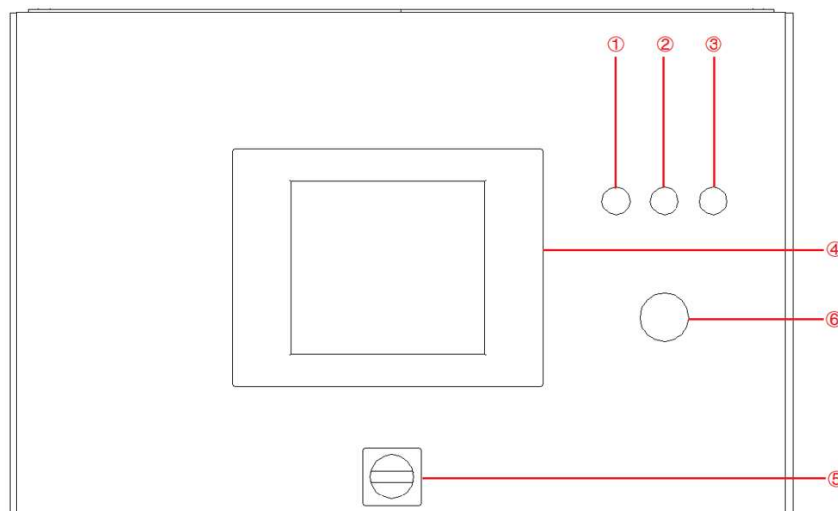
Figure 1-2 Front panel

Table 1-1

No.	Description	Notes
1	**White Light**	The power supply is standby.
2	**Green Light**	The power supply is operating normally.
3	**Red Light**	The power is failure.
4	**TFT-Touch Panel**	TFT touch panel displayer (12 inch), using the windows OS., provides a GUI, 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.

1.2.3   Rear panel

The rear panel of KGS series is equipped with RS485 / LAN interface, TTL interface and ATI interface.
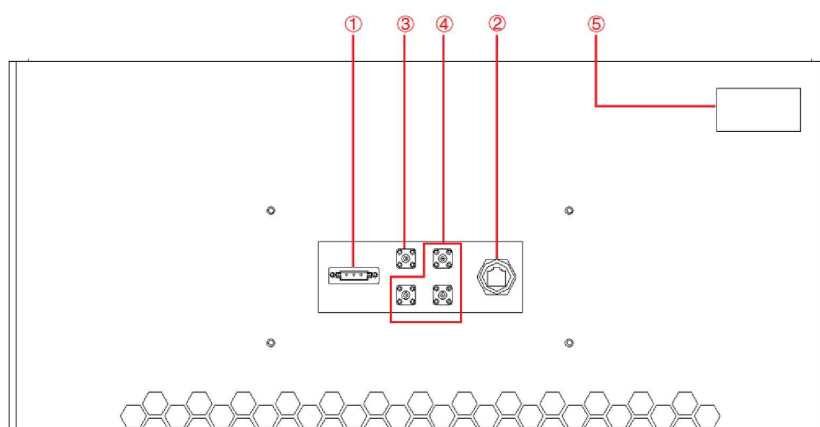
Figure 1-3 Rear panel

Table 1-2

No.	Description	Notes
1	**RS485 interface**	Used for remote control.
2	**LAN interface**	Used for remote control.
3	**TTL**	For users to observe the trigger signal after connecting with the oscilloscope
4	**ATI interface**	Analog control interface-Phase A/Phase B/Phase C
5	**Product brand**	The input / output configuration of the product is marked.

1.2.4 Internal structure

As shown in Figure 1-4, take KGS 45-300-50 as an example, from top to bottom, including: ①control module, ②③power

modules, ④other components, wiring terminals and other interfaces.
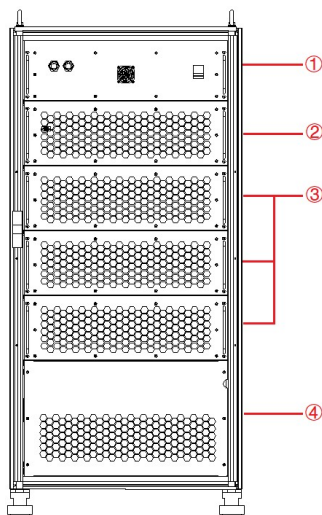
Figure 1-4 Internal structure

1.2.5 Front panel of control module

The front panel of control module is equipped with LAN interfaces, fan, power switch and Master-Slave interface.
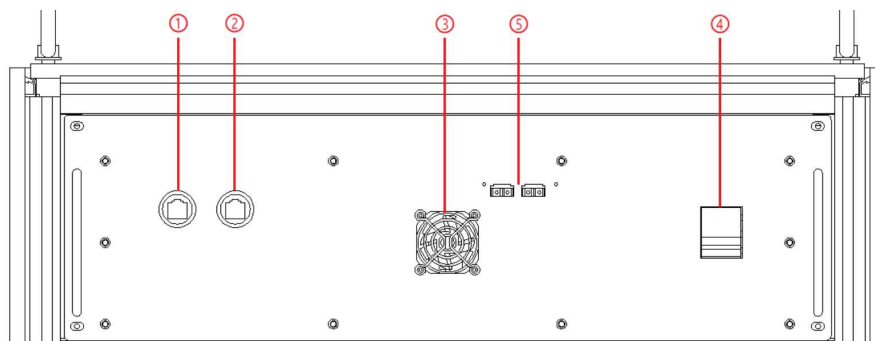
Figure 1-5 Front panel of control module

Table 1-3

No.	Description	Notes
1	**LAN interface 1**	For touch screen communication
2	**LAN interface 2**	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**	Used for communication when power supplies of the same power are connected in parallel.

1.2.6 Other components, wiring terminals and other interfaces

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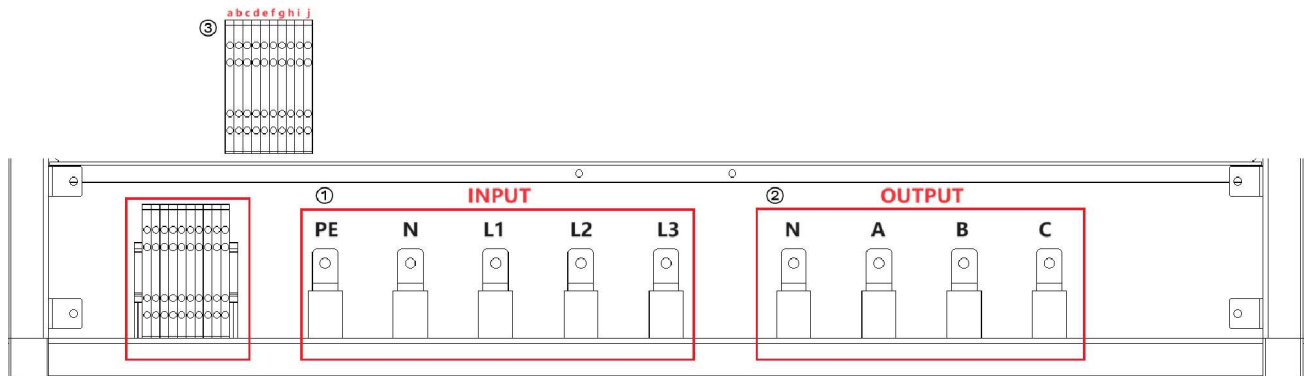
Figure 1-6

Table 1-4

No.	Description	Notes
1	Wiring copper bar of input	From left to right are PE, N, L1, L2, L3
2	Wiring copper bar of output	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 (+, -)
4	Remote sense interface	e + f + g + h + I + j → Remote sense interface: A/B/C/N/N/N

1.3 Interface Description

1.3.1 LAN interface

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).
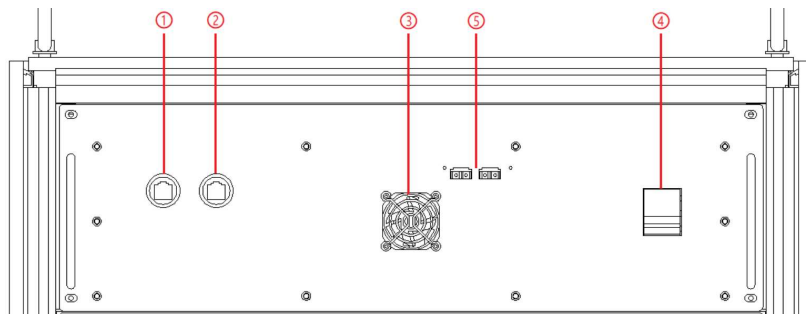
Figure 1-7 front panel of the control module

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).
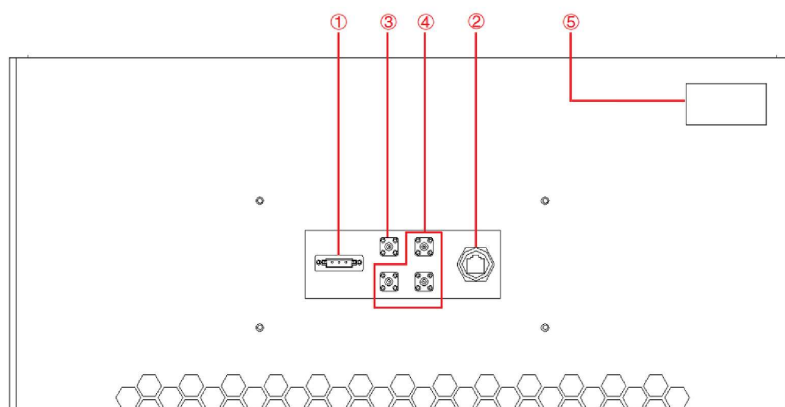
Figure 1-8 Rear panel

1.3.1.2 Connection of LAN interface

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

1.3.2 RS485 Interface
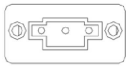
The RS485 interface is one of the equipment communication interfaces, it is used for remote control, and can effectively transmit signals under long-distance conditions and in environments with high electronic noise. RS485 interface makes it possible to connect to local network and configure multi-drop 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).
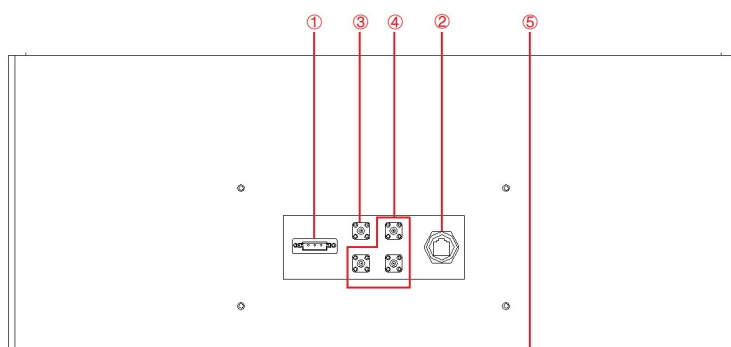
Figure 1-9 Rear panel   Figure 1-10 Connect RS485

1.3.2.2 Connection of RS485 interface

The RS485 interface of KGS 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.

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 TTL Interface

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.

1.3.3.1 Location of TTL interface

The TTL interface is located on the rear panel of power supply (Figure 1-13③).
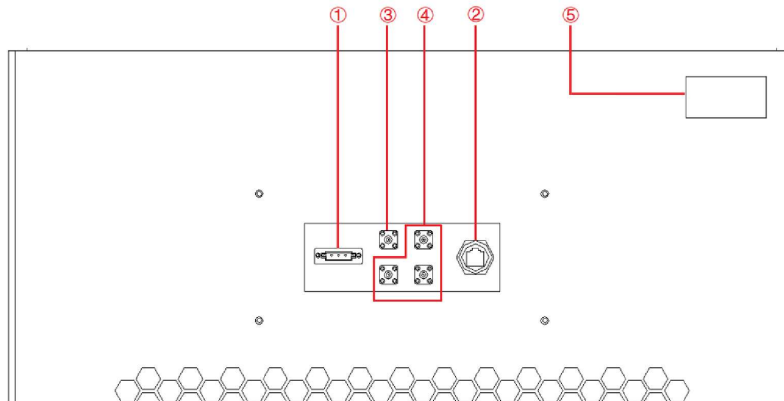
Figure 1-13 Rear panel

1.3.3.2 Connection of TTL interface

Connect to the TTL interface
which is on rear panel

Connect to the oscillosope
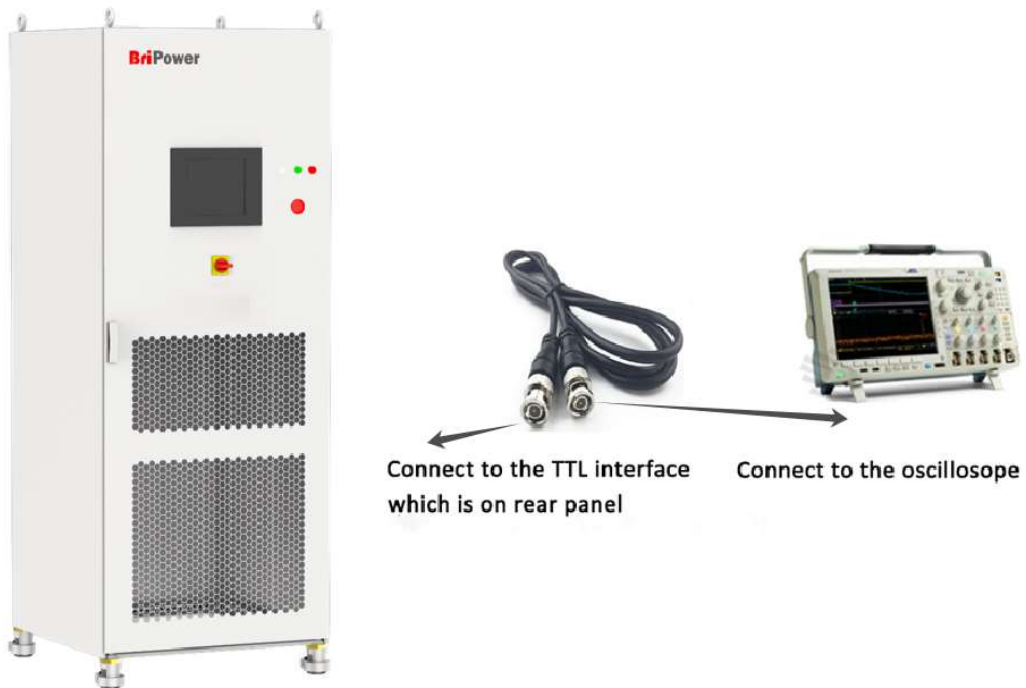
Figure 1-14 Connect TTL interface

1.3.4 ATI Interface

The output voltage of power supply can be controlled via control signals and by using the analog input (ATI interface). KGS uses BNC connector for this analog input. Set points are adjusted as dc voltage (± 5 V) on the analog input.

1.3.4.1 Location of ATI interface

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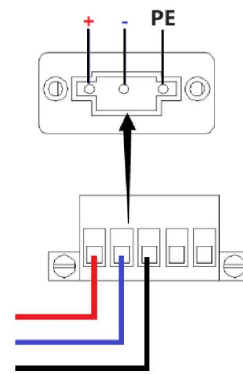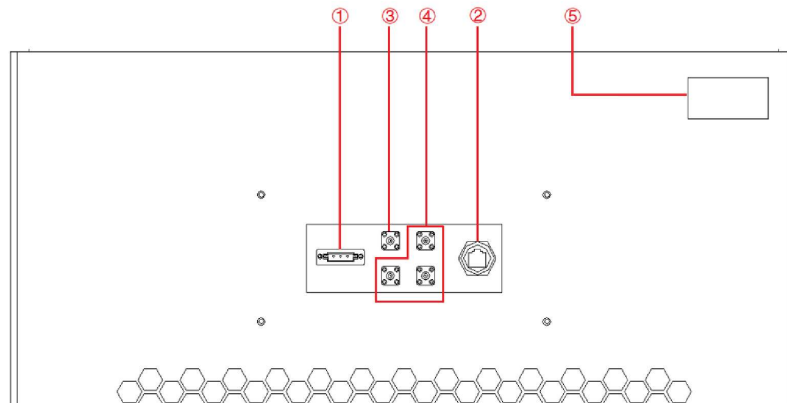

Figure 1-15 Rear panel of power supply

1.3.4.2 Connection of ATI interface

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

Connect to ATI interface on the real panel

Connect to the output port of singal generator
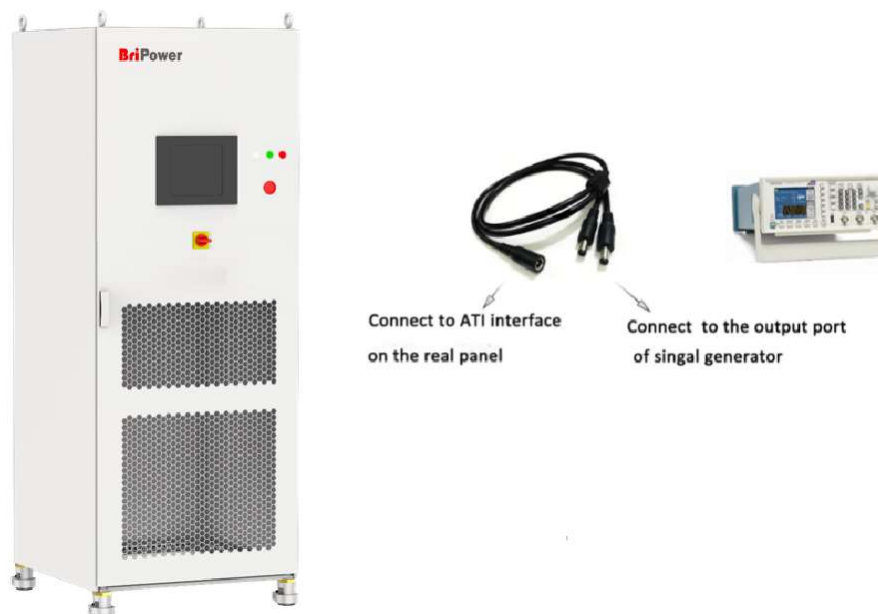
Figure 1-16 Connect ATI interface

1.3.5 External Emergency Stop Interface

The KGS series provides an external emergency stop interface, which can be connected to the user's external emergency stop switch. When an emergency occurs, the user does not need press the emergency button on power supply. To achieve protection action quickly, only need to press this switch.

1.3.5.1 Location of external emergency stop interface

The External emergency stop interface is located in the wiring layer inside the power supply-③：c, d（Figure 1-17）.
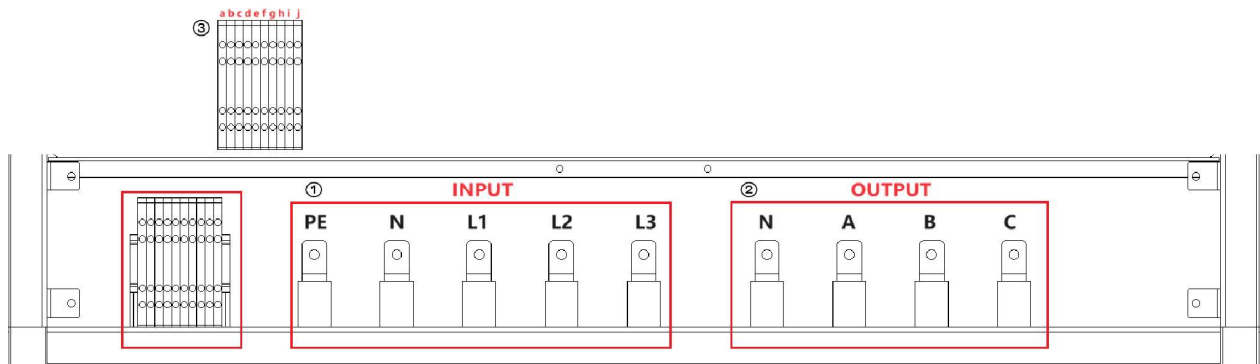
Figure 1-17

1.3.5.2 Connection of external emergency stop interface

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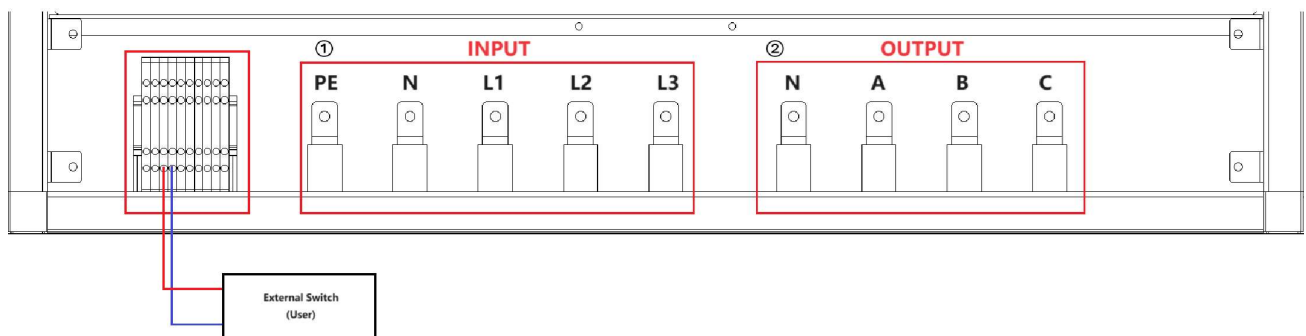
Figure 1-18 Connect emergency stop interface

1.3.6 Remote Sense Interface

The KGS series provides a remote sense interface. KGS will adjust its output to compensate for the voltage drop, so that the voltage across the DUT is equal to the set voltage, so as to achieve the accuracy of the test.

Note: The remote sense cables are connected to the output terminal (default wiring status at factory).

1.3.6.1 Location of remote sense interface

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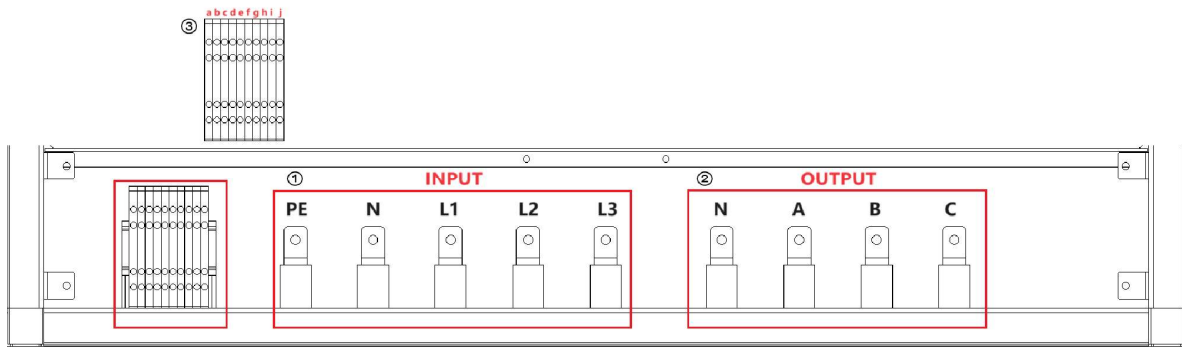
Figure 1-19

1.3.6.2 Connection of remote sense interface

The remote sense interface is connected to the output terminal of the KGS power supply by default before leaving the factory, as shown in Figure 1-20.
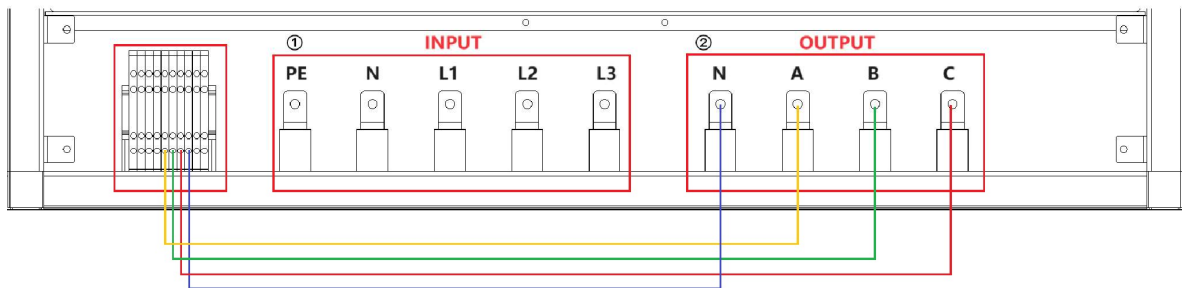
Figure 1-20 Remote sense connection (factory default wiring status)

If the user needs to compensate the input of the DUT, please remove the default connection cables and wrap them with insulating tape, and then connect the remote sense terminal to the input of the DUT, as shown in Figure 1-21.
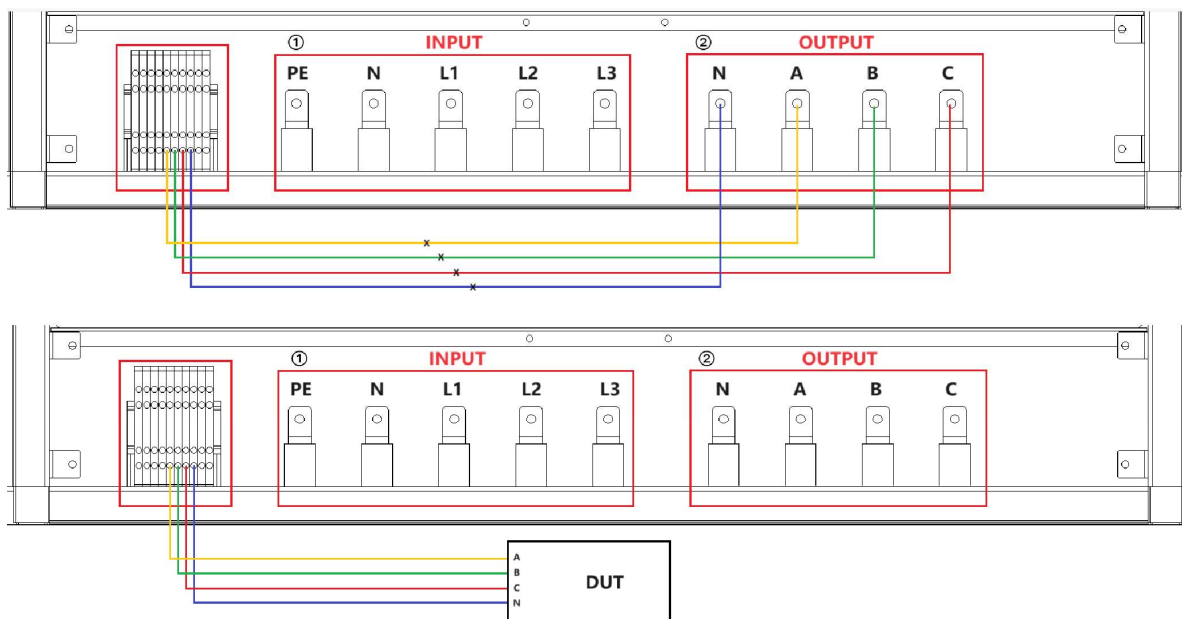
Figure 1-21 Remote sense connection method (connect to DUT)

1.3.7   Master-Slave Interface

The KGS series supports parallel connection of the same unit (same power/voltage/current).

1.3.7.1 Location of master-slave interface

The Master-Slave interface is located on the front panel of control module (Figure 1-22-⑤）．
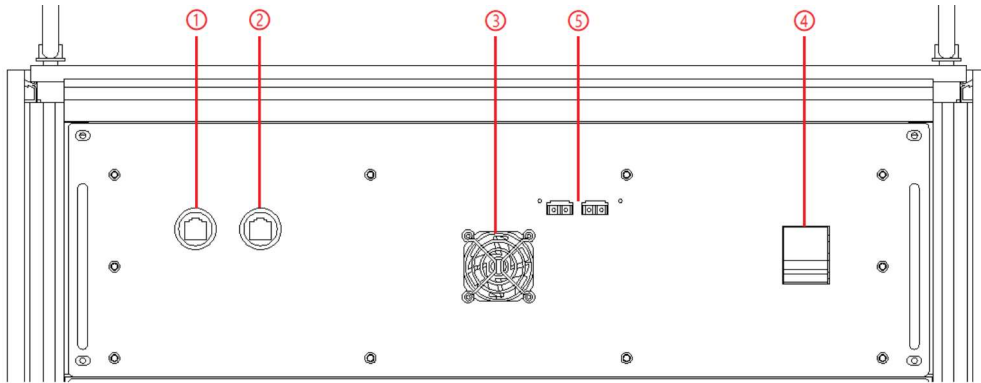
Figure 1-22

1.3.7.2 Connection of master-slave interface

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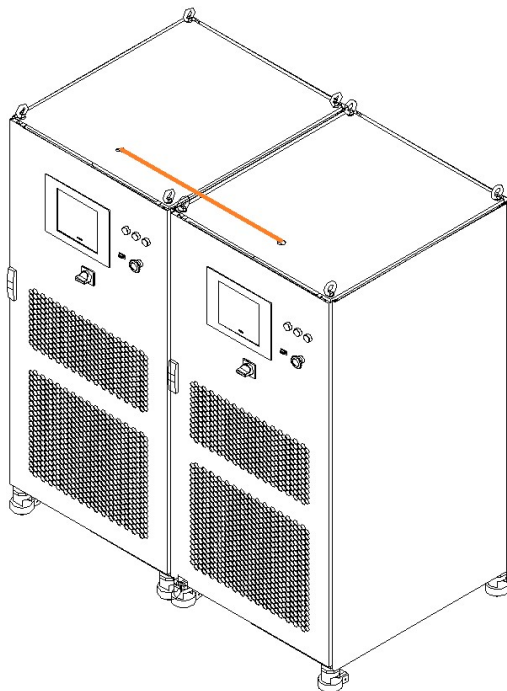
Figure 1-23

Step 2: Connect the fiber optic cables of the two units, as shown in Figure 1-24.
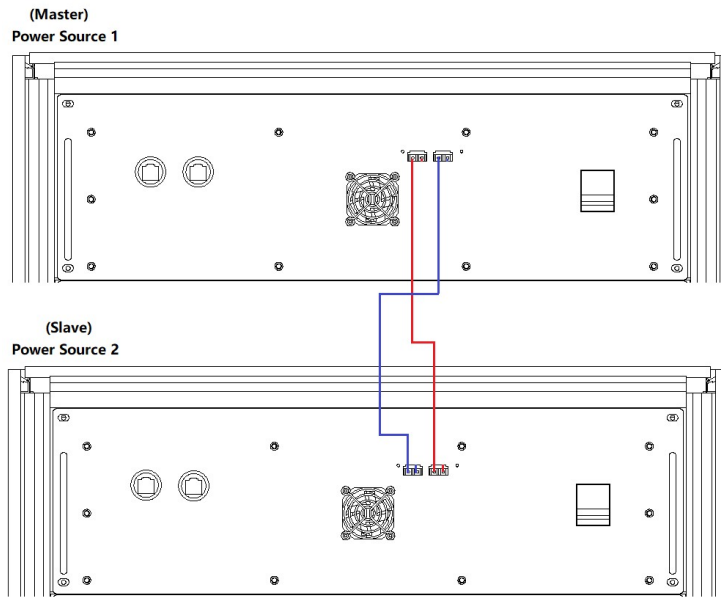
Figure 1-24 Optical fiber cables

Step 3: Connect the input/output cables of the two units in parallel, as shown in Figure 1-25.
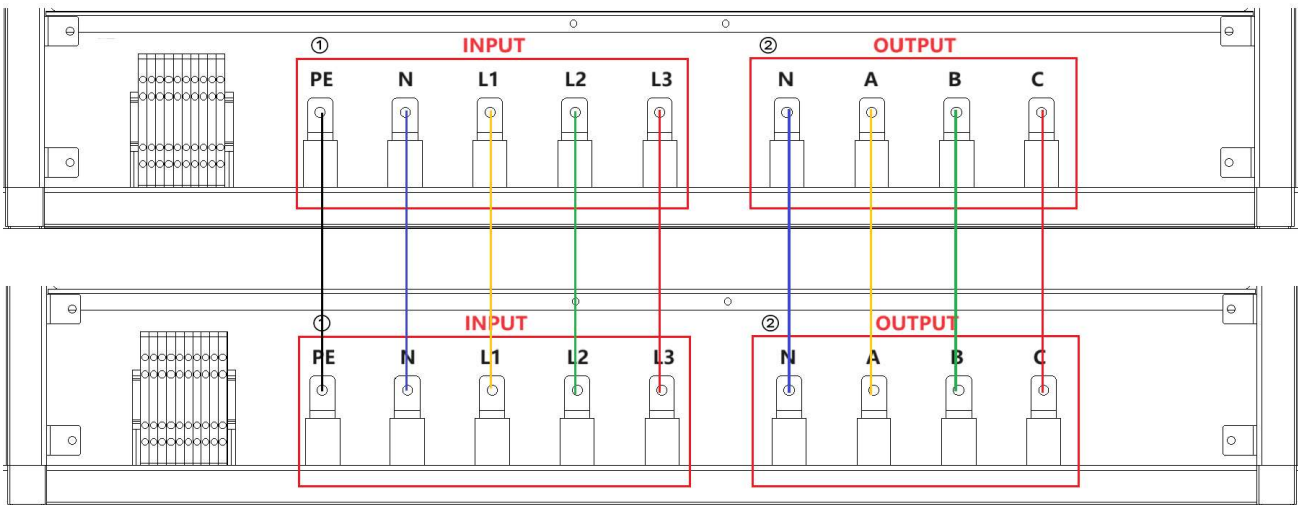
Figure 1-25 Connection of parallel input/output cables

▍Chapter 2 Equipment Installation

2.1 Check before Installation

2.1.1 Check the Packing

When receiving the KGS series power supply, 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 unit.

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 agent of Bridge Technology. Do not disassemble the equipment without permission.

2.2 Equipment Installation

2.2.1 Selection of Input/Output cables

Before installing the equipment, the user should confirm the model no., then select cables of appropriate specifications according to the input/output voltage and current.

Figure 2-1 Cold-pressed terminals

2.2.2 Installation Steps

Step 1: Remove the bottom baffle (Figure 2-2), the user can connect the input cables (PE, N, L1, L2, L3) and output cables (N, A, B, C) into the cabinet through the input side cable entrance holes, which are at the bottom of the cabinet (Figure 2-3).
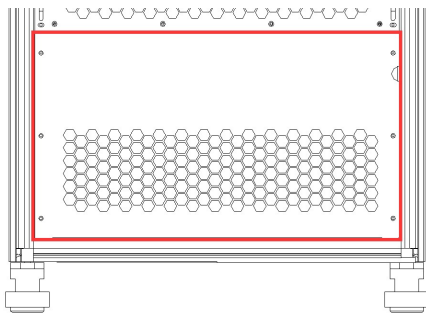
Figure 2-2 bottom baffle   Figure 2-3 Entrance hole
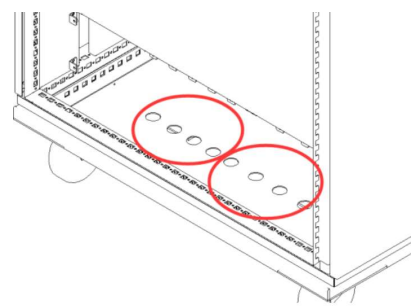
Step 2: Connect the cables to the input and output copper bars (Figure 2-4).
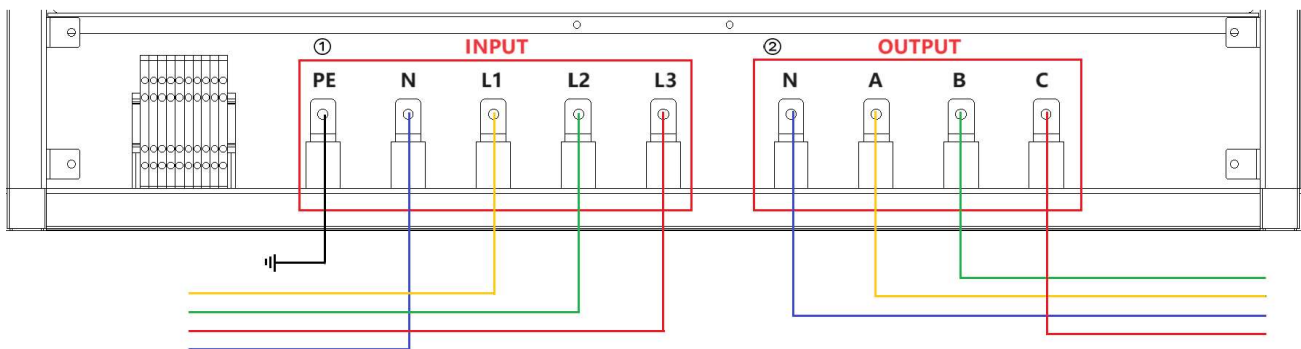
Figure 2-4

Step 3: After completing the above work, the wiring status of power supply is shown in Figure 2-5. Restore the bottom baffle on the front side, close the cabinet door, then, the equipment installation is complete.
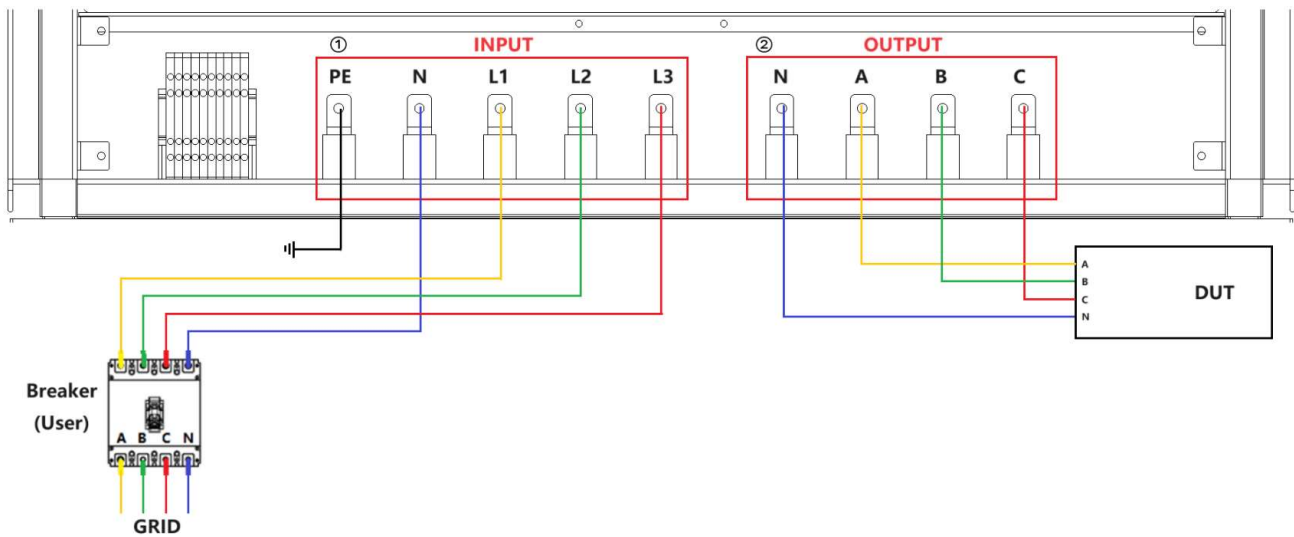
Figure 2-5 Equipment wiring completion status

2.2.3 Add Single-phase Output

The KGS series has single-phase output function. By parallelling three-phase output cables (Figure 2-6), the output current can be increased to three times the single-phase current.
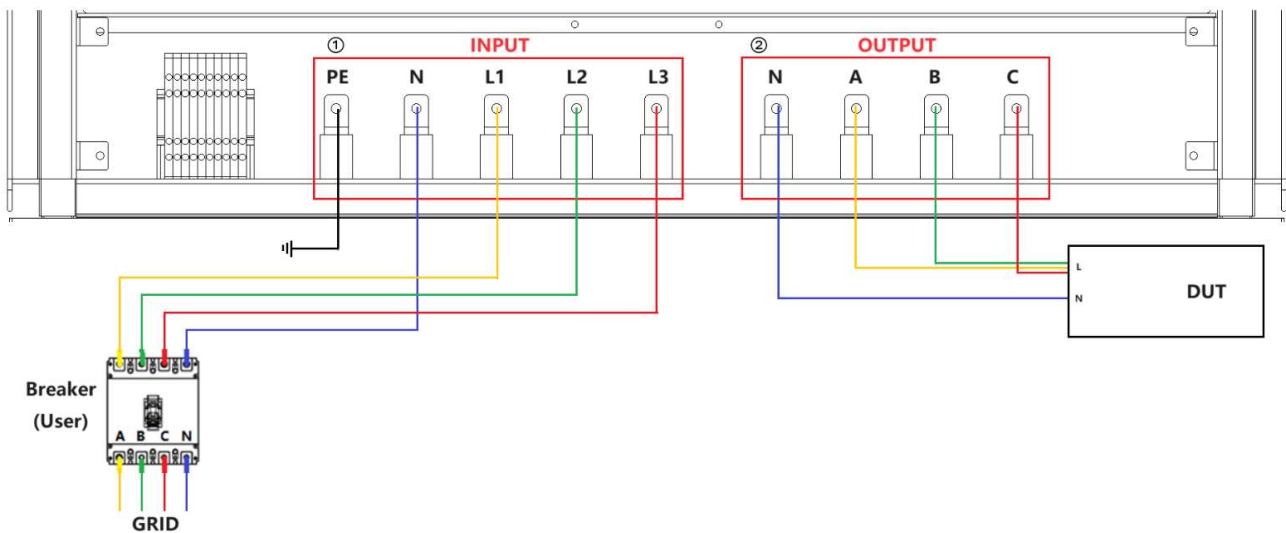
Figure 2-6 Add single-phase output

2.3 Parallel Installation

The KGS series supports parallel connection of the same unit (same power/voltage/current). Please refer to 1.3.7.2 Connection of master-slave interface for connection details.

Chapter 3 Power-on 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 3-1).
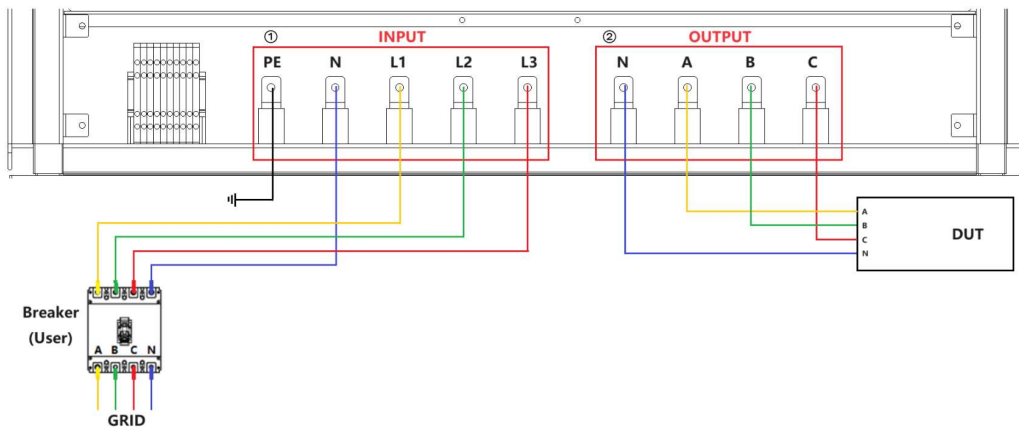
Figure 3-1 Equipment and the circuit breaker

⚠️ **CAUTIOUS**

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

⚡ **SHOCK HAZARD**

The maximum voltage generated by KGS may result in personal injury or death. When power is on, do not touch exposed connectors or components. 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.

⚡ **SHOCK HAZARD**

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

Step 2: Power on the control module

After the AC input is powered on, open the cabinet door, close the power switch of the control module (Figure 3-2④).
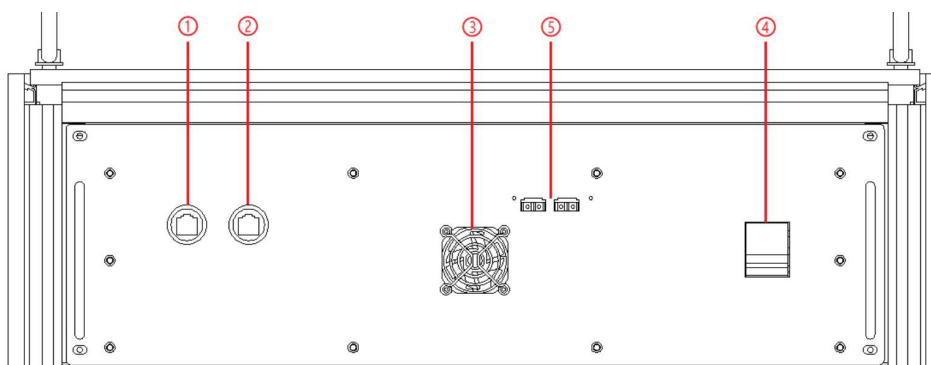
Figure 3-2 Control Modules

Step 3: Turn on power knob on front panel

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).
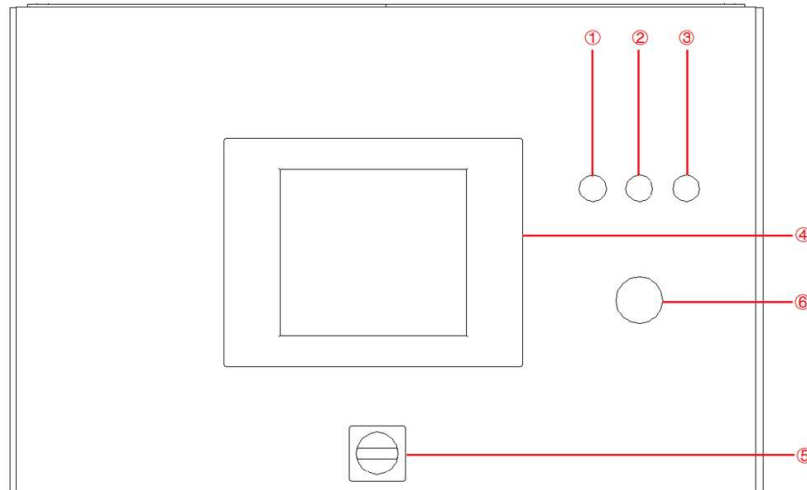
Figure 3-3 Front Panel

3.2 GUI Software Operation (Local Control)

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

A few seconds after the power is initialized, the control unit and touch screen work, the power supply is standby. If the power supply communication is normal, the white light (Figure 3-3①) is always on. If the communication connection is normal, the communication status indicator on the software panel will display "Conn" (Figure 3-4). If the communication connection is abnormal, the communication status indicator will display as "DisConn" (Figure 3-5).

Figure 3-4   Figure 3-5

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.

The specific functions of the software will be introduced in chapter 4.

3.3 Power off Operation

Step 1: Close the GUI software on the TFT-Touch panel displayer/PC and shut down.

Step 2: Turn the power knob counterclockwise (Figure 3-6⑤).
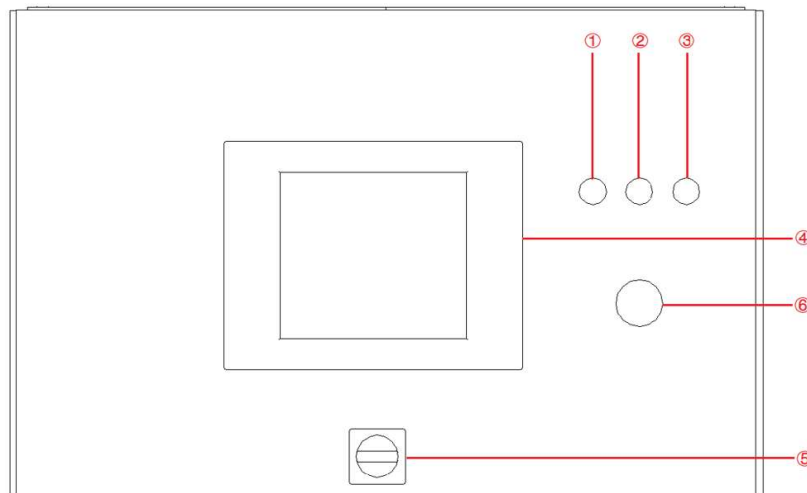
Figure 3-6 Front panel

Step 3: Open the cabinet door and power off the control unit switch (Figure 3-7④).
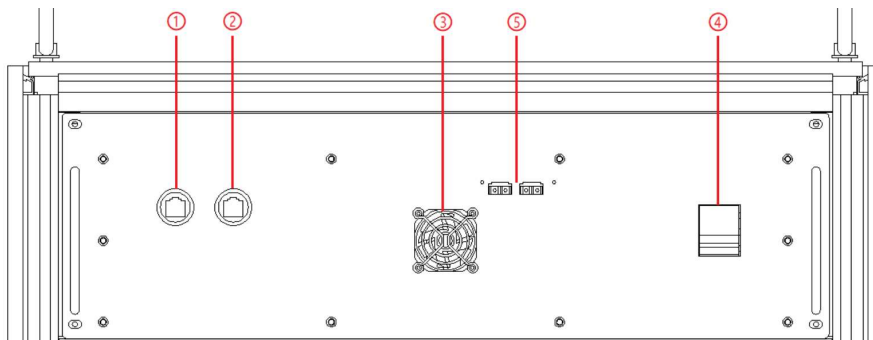
Figure 3-7 Front panel of control module

IMPORTANT INFORMATION

Closing the switch on the front panel of the control box at the first time. This step can be ignored when the power is off, it will always remain closed. when the power supply is turned on, the step of closing the switch can be omitted, which is convenient for users to operate.

Step 4: Power off circuit breaker of the AC input side (Figure 3-8①).
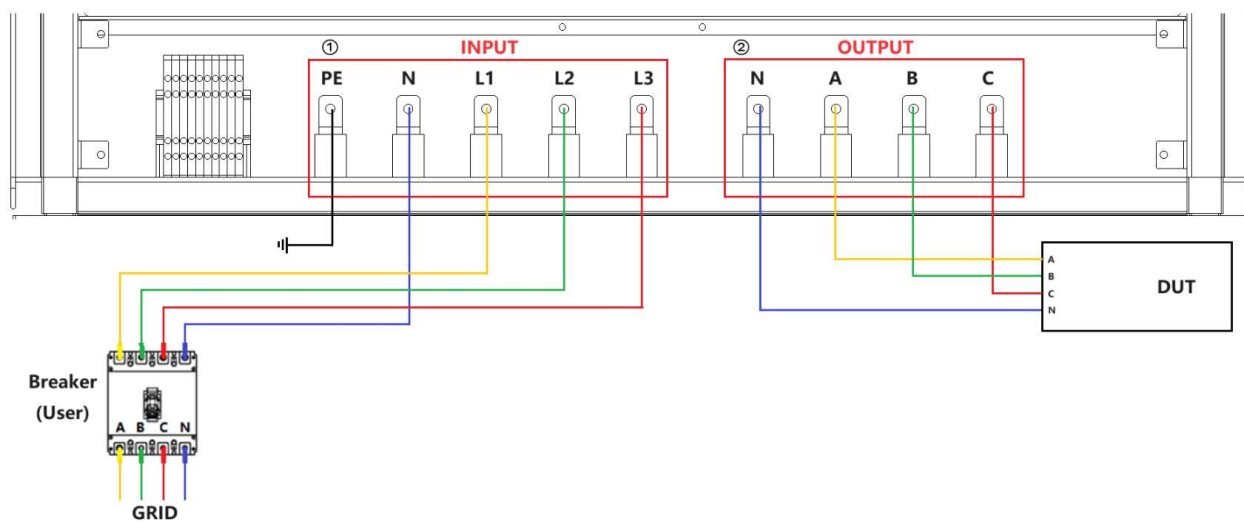
Figure 3-8

▌Chapter 4　Functions and Features

4.1　Grid Simulation Function

KGS series uses bi-directional design, and can be used as grid simulator to test distributed generation systems, such as the electrical characteristics of energy storage PCS, PV inverter, etc. The simulation functions include voltage and frequency fluctuation, voltage drop, low/zero voltage, three-phase unbalance, harmonic and inter-harmonic etc. In the sequence mode, the user can set the output phase voltage, angle, frequency, on/off phase angle, dwell time and switching time of the power supply according to the test requirements (Figure 4-1). In the sequence mode, there is a TTL trigger signal output when voltage or frequency changes, which is easy for the oscilloscope to capture the Waveform (Figure 4-2).
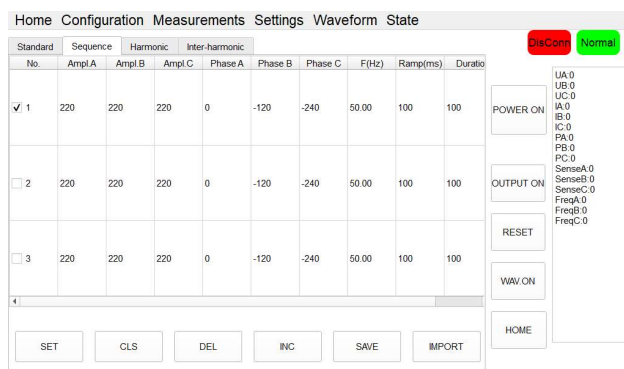
Figure 4-1 AC Sequence mode panel
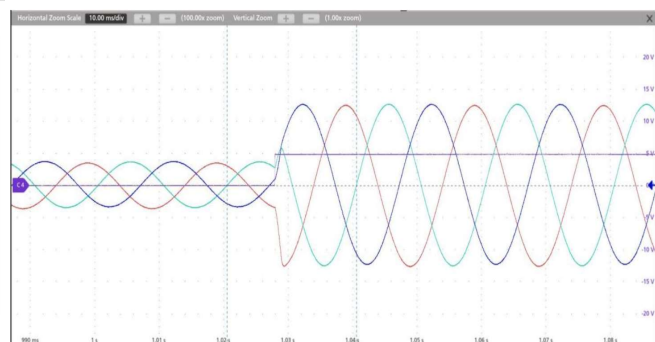
Figure 4-2 TTL trigger Waveform

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 4-3). Users can measure the output voltage/current harmonics on the "Harmonic Analysis" panel (Figure 4-4).
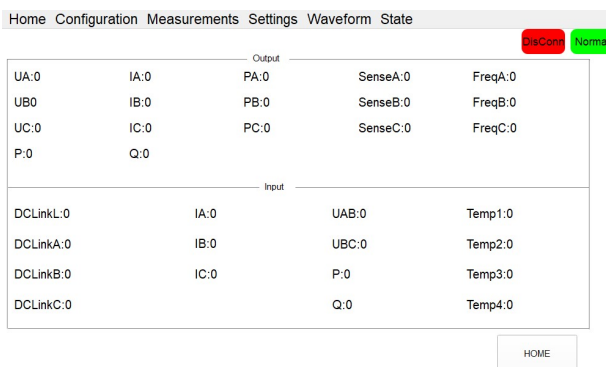
Figure 4-3 Standard Measurements
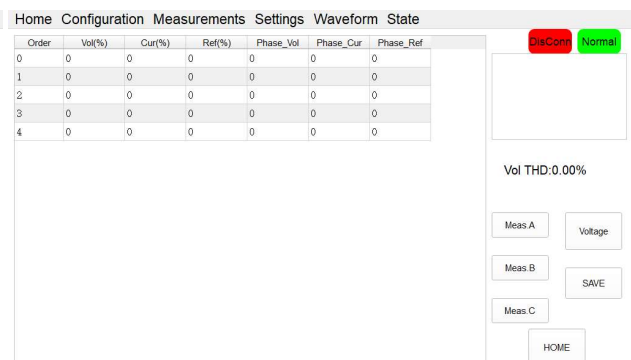
Figure 4-4 Harmonic Analysis

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

Figure 4-5 Waveform browsing panel

The KGS series can edit up to the 100th harmonic and inter-harmonic, and users can capture Waveforms through the oscilloscope.
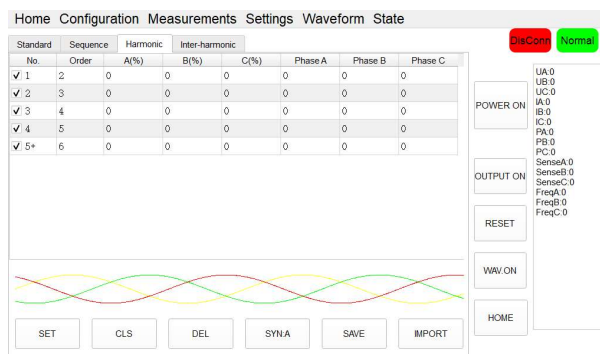
Figure 4-6 Harmonic edit
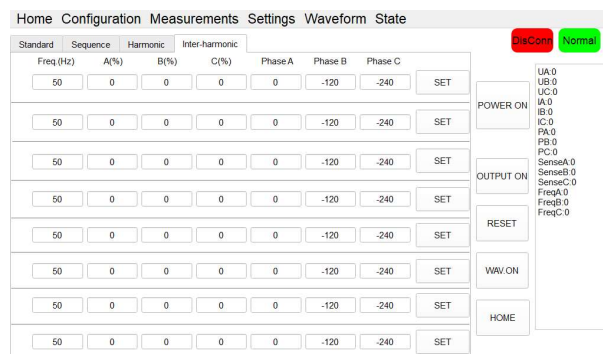
Figure 4-7 Inter-harmonic edit

KGS series can be used for low/zero voltage ride through test. KGS series provide standard software for the low voltage ride through test of photovoltaic inverters, which can be used to simulate grid voltage/frequency changes, drops and sags to meet the low voltage ride through test requirements of photovoltaic inverters.

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

4.2 Re-generative AC Load[2]

In the regenerative AC load mode, CR mode, Rectifier mode, and CC/CP phase lead/lag mode are available. CR mode is used to simulate three-phase resistive loads, the CR mode and three-phase resistance parameters can be set through the panel and can realize the program of 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.

4.3 Constant Current Output Function

The KGS Series uses true current feedback control when working in CC mode. It is different from power supplies using voltage feedback with constant current mode, which is called voltage controlled current. The voltage controlled current power supplies maintain setting current value by adjusting output voltage and have relatively long response time to sudden impedance changes, which typically results in dynamic current overshoot or undershoot as the load impedance changes. KGS series working in CC mode does not have such problem and will always maintain the current at the setting value, regardless of transient load conditions. The details of software settings will be introduced in chapter 5.

4.4 AC+DC/AC/DC Output

The KGS series adopts Bi-directional design and can be used as an AC/DC power supply to test DUT. Output modes include AC, DC, AC+DC. The details of software settings will be introduced in chapter 5.
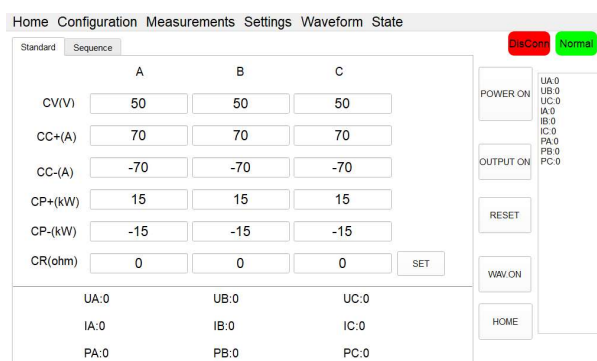
Figure 4-8 DC Settings panel

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[2] KGS can still output a stable and reliable current waveform even when the input voltage is not pure sine wave or the sine wave has large distortion.

4.5   Power Amplifier Function (analog signal input)

The KGS is a power amplifier with high dynamic response and bandwidth. The delay between input external signal and power source output ⩽ 20 μs.

4.6   IEC Related Test Applications

KGS series can meet the requirements for AC power in IEC 61000 3-2, 3-3, 3-11, 3-12, 4-11, 4-13 and other standard tests.

4.7   RLC Load Simulation

The KGS series provides RLC load simulation mode, which simulates the impedance of the combinations of R, L and C components. The three phases are independently programmable, and the R, L, C values can be set respectively.
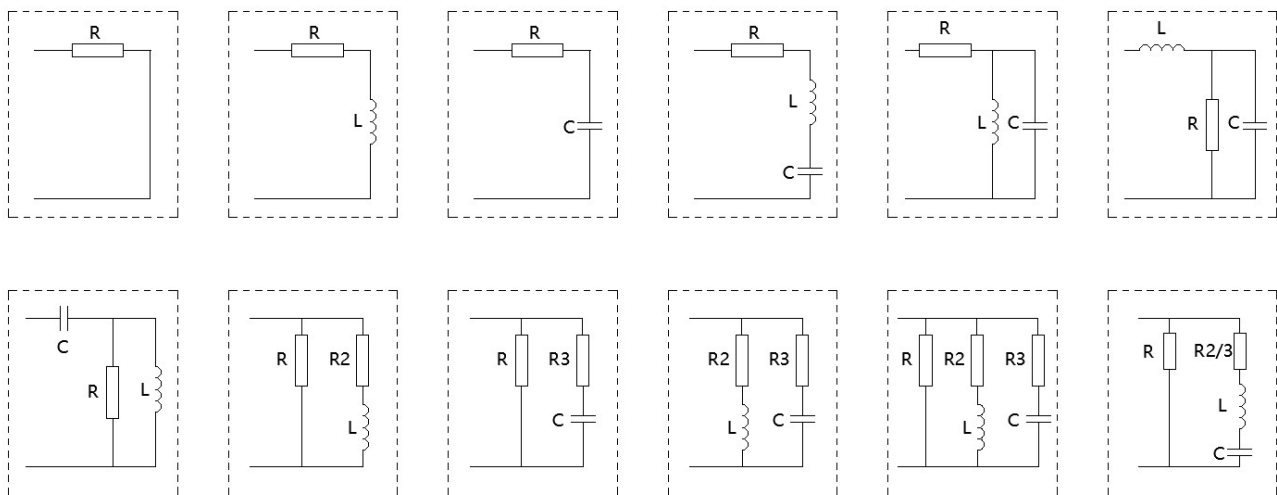
Figure 4-9 Complex Impedance Combinations of KGS-RLC

4.8   RCD Load Simulation

KGS provides RCD non-linear load simulation function for testing UPS power supplies, inverters, etc. The KGS has four built-in RCD electrical topologies, 3-phase independently programmable, with individually programmable R, L and C parameter values.
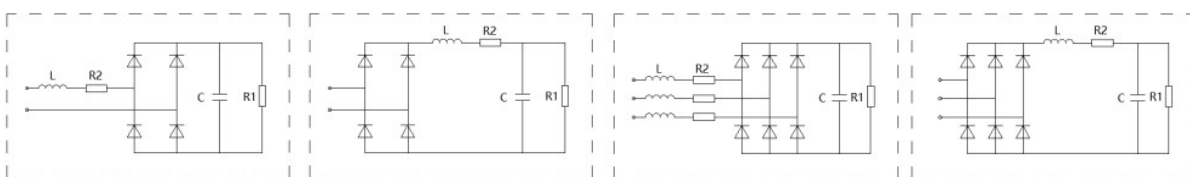
Figure 4-10

4.9　Avionics Power Line Simulation

The KGS series meets the requirements of avionics bus simulation, and can simulate working conditions including normal working, power interruption (conversion), abnormal power supply, emergency power supply, startup, power failure, etc., to meet the requirements of MIL-STD-704 and other test regulations. In addition, remote control interfaces and SCPI command language are provided for easy integration into ATE systems.

4.10　Bi-Polar DC Source (-BP option)

The KGS series also provides bipolar DC output, and in this mode, phase A is used as POS+ output, phase B is used and NEG- output, the Neutral terminal is used as PE. The output power of KGS 45-BP is 30KW in bipolar output mode, and the voltage range is +/-600V, the current range is +/-70A.

Chapter 5 Software

5.1 Software Overview

KGS series provides GUI software, which is installed on the front touch screen. (The software can also be installed on the control PC connected to the power supply).

➢ When Indicator 1 is flashing and Indicator 2 is off —— indicates that the device is in standby mode;

➢ When Indicator 1 is always on and Indicator 2 is flashing —— indicates that the input works normally;

➢ When Indicator 1 is always on and Indicator 2 is always on —— indicates that the Input & Output works normally;

➢ When Indicator 1 is off and Indicator 2 is flashing —— indicates that the device is in fault state.
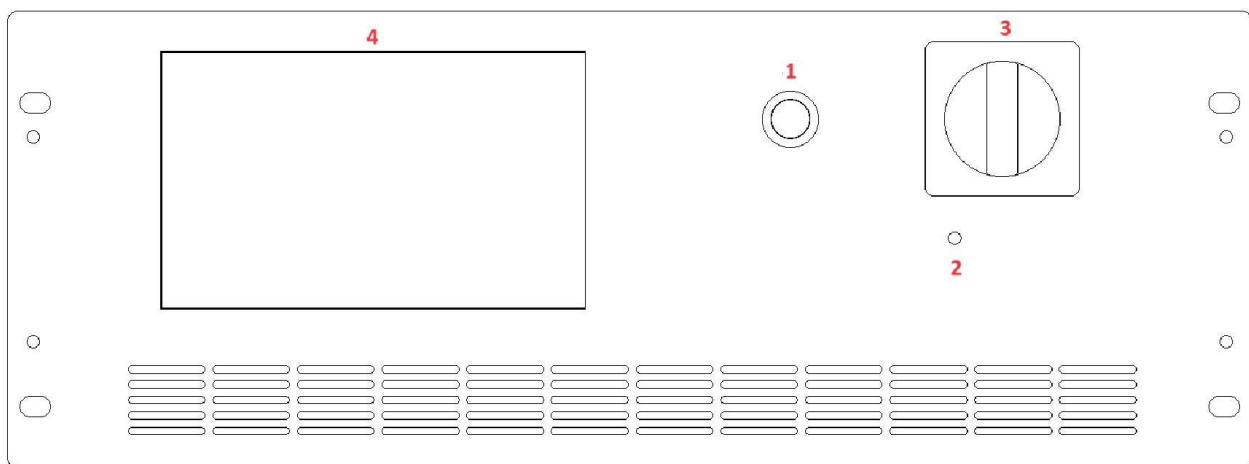
Figure 5-1-1

If the communication connection is normal, the communication status indicator on the software panel will display "Conn" (Figure 5-1-2). If the communication connection is abnormal, the communication status indicator will display as "DisConn" (Figure 5-1-3).

Figure 5-1-2　　　　　　Figure 5-1-3

After setting the parameters, power on the KGS. If the KGS can run normally without any faults, the operating status indicator will display as "Normal" (Figure 5-1-4); If the KGS malfunctions, the operating status indicator will display as "Fault" (Figure 5-1-5).
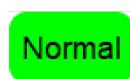
Figure 5-1-4　　　　　　Figure 5-1-5

Figure 5-1-6 shows the main menu.

Figure 5-1-6

The overview of the functions as follows:

➢ HOME (please refer to 5.2 for details):

- Mode selection: including Operating Mode, Output Mode, Control Mode, and Load mode;

- Control Button: user can open different main panels by clicking on different control buttons, including Measurements, Settings, Harmonic Analysis, Display Waveform, System

➢ Configuration (please refer to 5.3 for details)

Including: Communication, System, Display

➢ Measurements (please refer to 5.4 for details)

Including: Standard Measurements, Harmonic Analysis

➢ Settings (please refer to 5.5 for details)

Including: AC Settings, DC Settings, Load Settings, List Mode

➢ WAVE (please refer to 5.6 for details)

Including: Display Waveform

➢ State (please refer to 5.7 for details)

User can query the running status and fault words.

5.2 HOME

Click "HOME" to enter the main panel (Figure 5-2-1).
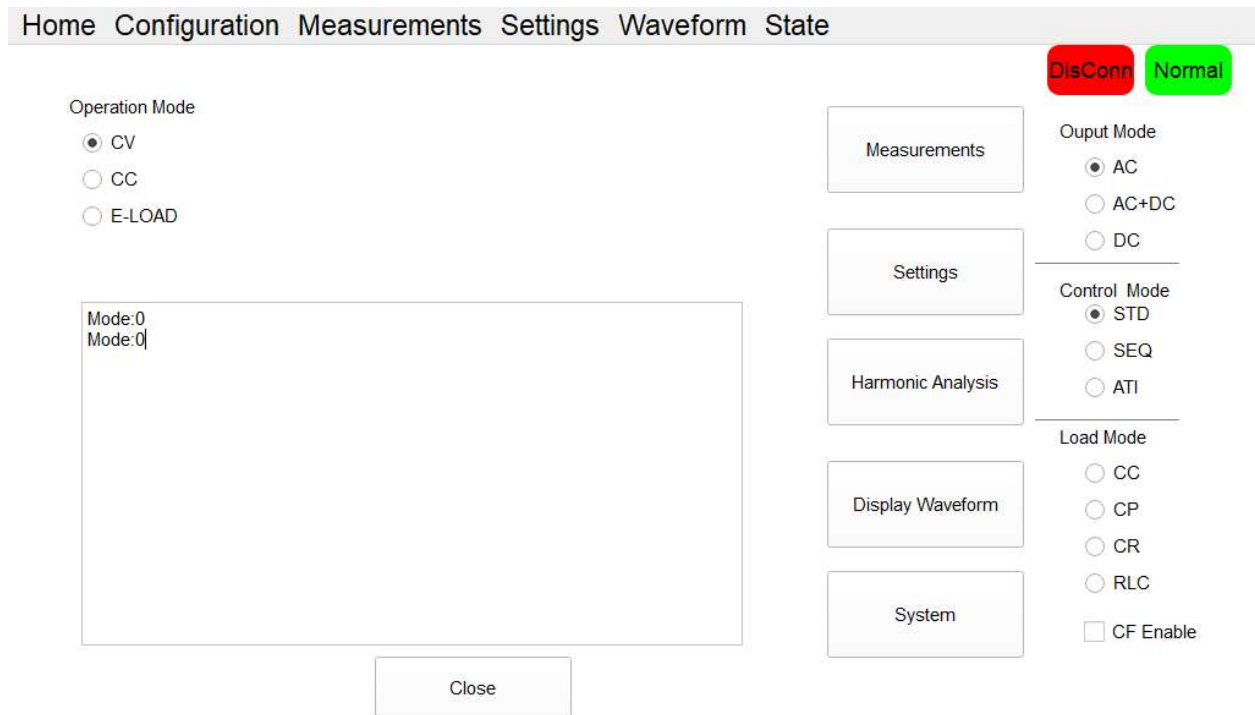
Figure 5-2-1

Table 5-1

No.	Description	Note
1	**Operation Mode**	Including: CV (constant voltage), CC (constant current), E-LOAD
2	**Output Mode**	Including: AC, AC+DC (add DC offset components on AC output), DC
3	**Control Mode**	Including: STD (Standard Mode), SEQ (Sequence Mode), ATI (Analog input signal control output mode)
4	**Load Mode**	Including: CC, CP, CR, RLC, CF Enable **Note:** The "CF Enable" checkbox is usually used in combination with CC or CP modes.
5	**Control Buttons**	By clicking different control buttons, the software will jump to different panels: Click "Measurements" ------ Standard Measurements panel; Click "Settings" ------ AC Settings panel or DC Settings panel or Load Settings panel; Click "Harmonic Analysis" ------- Harmonic Analysis panel; Click "Display Waveform" ------ Display Waveform panel; Click "System" ------ System panel.
6	**Close Button**	Click the "Close" button to exit the software interface
7	**Display Area**	Display fault records

5.3 Configuration

" Configuration " including: Communication, System, Display. (Figure 5-3-1).

Figure 5-3-1

5.3.1 Communication

Users can select Local/Remote control methods, remote control communication settings on "Communication" panel.

Table 5-2

No.	Description	Note
1	Remote/Local	Local control or Remote control
2	Remote Control Communication Settings	Remote PC IP: XXX.XXX.X.XX. Remote PC Port: XXX Device IP: XXX.XXX.X.XX. Device Port: XXX
3	SET	Click the "SET" button, and the parameters set will take effect.
4	HOME	Click the "HOME" button to return to the HOME main interface
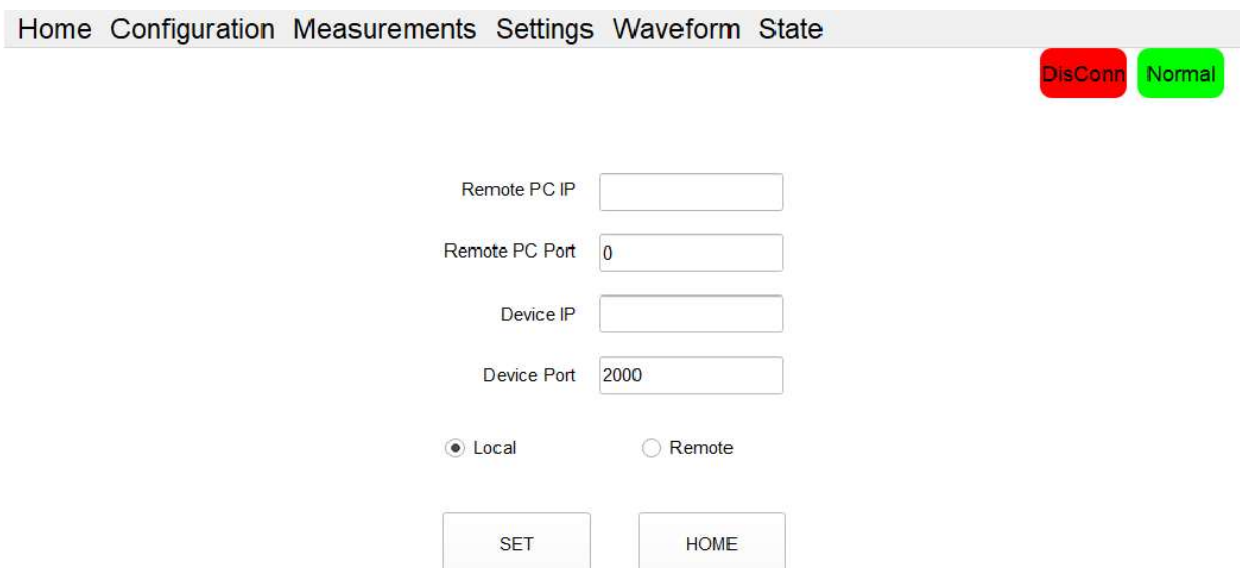
Figure 5-3-2

5.3.2 System

Users can select different functions and set protection parameters on the "System" panel.

Table 5-3

No.	Description	Note
1	**Operation Mode**	Independently/Parallel Master/Parallel Slave
2	**Functions Selection**	**Without N:** please check this option when KGS is used as a load and there is no N-line connected between the DUT and KGS. **External E-Stop:** the external emergency stop is effective when check this option **Load of 3ph PS:** please check this option when KGS is used as a load and the frequency of the DUT remains unchanged (such as three-phase power supply/motor). **Line Impedance:** the line impedance simulation function is effective when check this option. **Remote Sense:** the remote sense function is effective when check this option. **AC220 Input:** the single-phase 1P+N+PE/220VLN input is valid when check this option. **Enable Phase-shifting:** the ON/ OFF output phase angle is effective when check this option. **Disable Transient OCP:** the output overcurrent protection function can be temporarily disabled when check this option (for special tests when overcurrent protection is not required). **Three Phase Parallel:** the three-phase parallel output is valid when check this option.
3	**Protection Parameters Settings**	**OCP:** Overcurrent protection value (rms), when the output current exceeds this value, the output will be cut off. **OVP (Peak):** Overvoltage protection value (peak), when the instantaneous output voltage exceeds this value, the output will be cut off **OPP:** Overpower protection value (rms), when the output power exceeds this value, the output will be cut off **OLP:** Undervoltage protection value (rms), when the input voltage is lower than this value, the output will be cut off **Current Limit (Peak):** Maximum current limit value (peak), when the output current exceeds this value, it will be limited below the current value. **Voltage Ramp:** AC/DC voltage ramp rate **Current Ramp:** AC/DC current ramp rate
4	SET	Click the "SET" button, and the parameters set will take effect.
5	HOME	Click the "HOME" button to return to the HOME main interface

Figure 5-3-3

IMPORTANT INFORMATION

When the KGS is in normal working condition, parameters such as OCP/OVP/OPP/OLP/Current Limit/Voltage Ramp/Current Ramp can be directly modified without powering off.

IMPORTANT INFORMATION

Before checking "External E-Stop"/"Remote Sense"/"AC220 Input"/"Three Phase Parallel", please ensure that the connection of cables is completed.

5.3.3 Display

Users can set the display ratio of the waveforms in "Display" panel.

Table 5-4

No.	Description	Note
1	**Display Ratio**	UA/UB/UC: the Display Ratio for the output voltage waveforms of phase A/B/C
		IA/IB/IC: the Display Ratio for the output current waveforms of phase A/B/C
		Udc: the Display Ratio for the voltage waveform of DC-BUS
2	**Debug Display**	User can enter the Debug display panel when check this option. (*Note: this mode is used for debugging before leaving the factory. Do not use it without permission*)
3	Save Waveform	The KGS will start saving waveform files when check this option (*Note: Checked by default before leaving the factory, please do not change without permission.*)

| 4	Dark Mode	The software display colors will switch when check this option.
5	SET	Click the "SET" button, and the parameters set will take effect.
6	HOME	Click the "HOME" button to return to the HOME main interface

Figure 5-3-4

5.4   Measurements

"Measurements" including Standard Measurements and Harmonic Analysis (Figure 5-4-1).
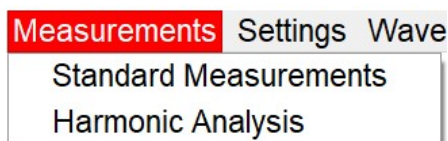
Figure 5-4-1

5.4.1 General Measure

Users can check the input/output measurements and temperature measurements on the " Standard Measurements " panel.
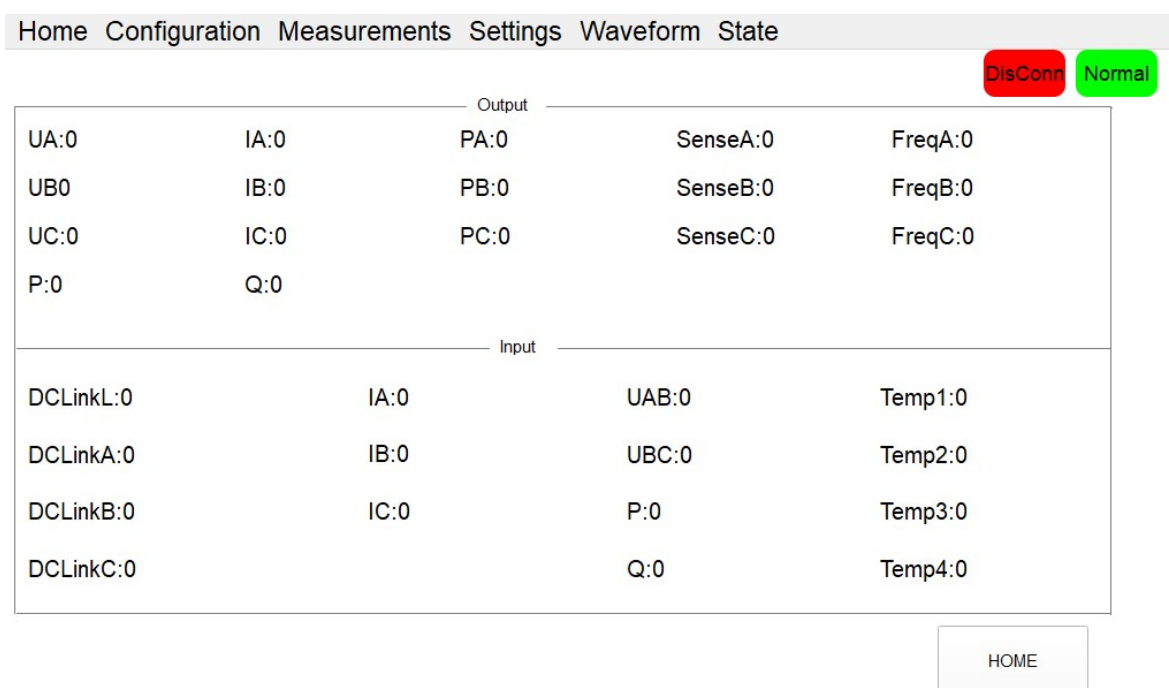
Figure 5-4-2

Table 5-5

No.	Description	Note
1	Output Measurement	Including: output voltage of phase A/B/C (UA/UB/UC), output current phase A/B/C (IA/IB/IC), output power of phase A/B/C (PA/PB/PC), output frequency of phase A/B/C (FreqA/B/C), Output active/reactive power (P/Q), remote sense voltage of phase A/B/C (SenseA/B/C)
2	Input Measurement	Including: DC bus voltage of input (DCLinkL), DC-bus voltage of phase A/B/C (DCLinkA/B/C), input current of phase A/B/C (IA/IB/IC), input voltage (UAB, UBC), input active/reactive power (P/Q)
3	Temperature Measurement	Temperature measurement, displaying the temperature of four heat sinks inside the KGS
4	HOME	Click the "HOME" button to return to the HOME main interface

5.4.2 Harmonic Analysis

Users can measure the output voltage/current harmonics on the "Harmonic Analysis" panel (Figure 5-4-3).
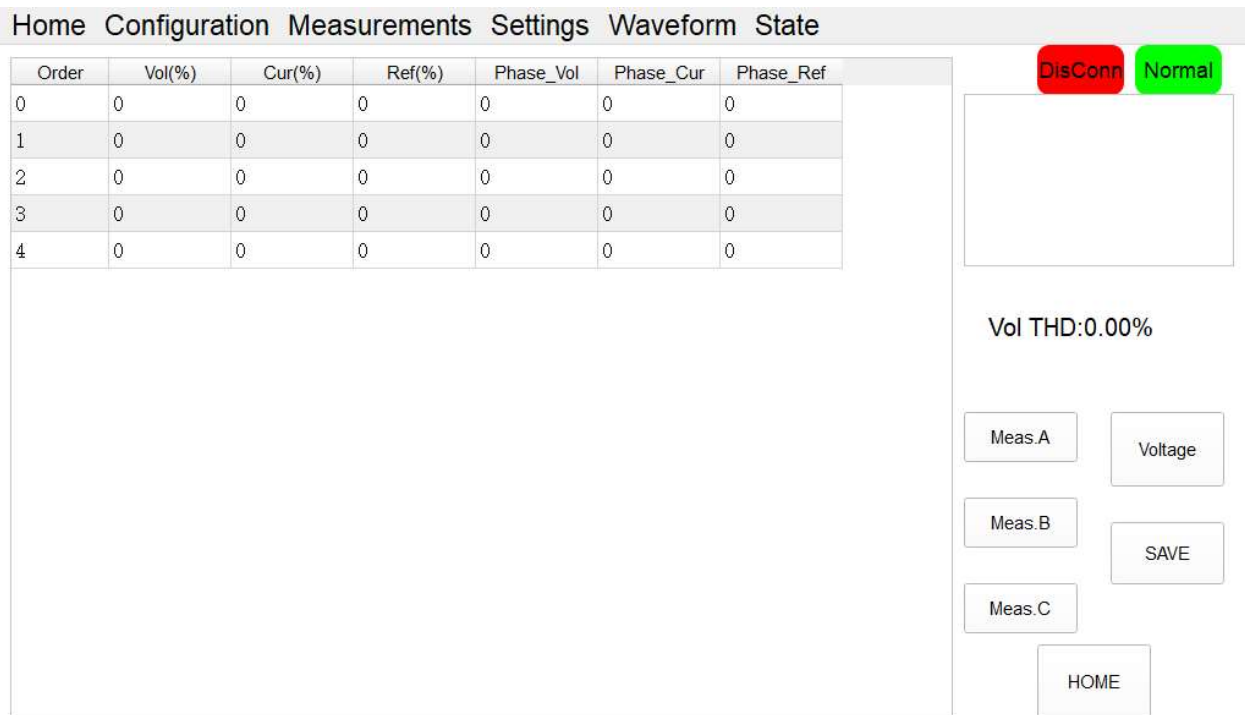
Figure 5-4-3 Harmonic Measure ------ Local Software

Table 5-6

No.	Description	Note
1	Data Dispaly	Display harmonic order, Vol(%)-output voltage harmonic content, Cur(%)-output current harmonic content, Ref(%)-reference harmonic content, Phase_Vol-voltage harmonic phase, Phase_Cur-current harmonic phase, Phase-Ref(%)-reference phase
2	Vol/Cur THD: 0.00%	Display the output voltage or current THD measurement value
3	Meas.A/B/C	Measure phase A/B/C by clicking on different buttons
4	Voltage/Current	The analysis output current/voltage can be switched by clicking "Voltage/Current"
5	SAVE	Click "SAVE" to save the measurement data
6	HOME	Click the "HOME" button to return to the HOME main interface

5.5 Settings

"Settings" including AC Settings, DC Settings, LOAD Settings, List Mode (Figure 5-5-1); Each panel includes multiple modes.

Settings Waveform AC Settings DC Settings LOAD Settings List Mode	POWER ON OUTPUT ON RESET WAV.ON HOME
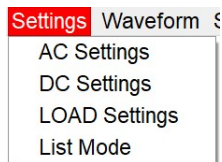
Figure 5-5-1	Figure 5-5-2

The functions of the 5 buttons on the right side of the panel are shown in Table 5-7:

Table 5-7

No.	Description	Note
1	POWER ON/POWER OFF	Used for start or stop the input of KGS
2	OUTPUT ON/OUTPUT OFF	Used for start or stop the output of KGS
3	RESET	Click "RESET", reset the KGS
4	WAV.ON/WAV.OFF	Click "WAVE ON/OFF" and the software will start/stop displaying the waveform
5	HOME	Click the "HOME" button to return to the HOME main interface

5.5.1 AC Settings

"AC Settings" including Standard, Sequence, Harmonic and Inter-harmonic modes.

5.5.1.1 Standard

Users can set a single work step. Select the output mode as AC or AC+DC and control mode as STD on HOME panel. Click "Settings" → "AC Settings" → "Standard". (Figure 5-5-1-1).

Table 5-8

No.	Note
1	The set parameters include: output frequency, output three-phase voltage, output three-phase phase angle, output three-phase current limit, and output three-phase power limit.
2	When selecting AC+DC mode in the output mode on the HOME panel, the three-phase DC offset component can be set
3	When selecting the line impedance simulation function on the "System" panel, the line output impedance parameters can be set: inductance L and resistance R.
4	SET: Click the "SET" button to apply the set parameters.

Figure 5-5-1-1 AC Settings ------ Standard

5.5.1.2 Sequence

Users can set complex combinations of multiple work steps. Select the output mode as AC or AC+DC and control mode as SEQ on HOME panel. Click "Settings" → "AC Settings" → "Sequence". (Figure 5-5-1-2).

Table 5-9

No.	Note		
1	Setting parameters of each step	Ampl.A/Ampl.B/Ampl.C: output voltage of phase A/B/C
		Phase A/Phase B/Phase C: output phase angle of phase A/B/C
		F (Hz): output frequency
		Ramp (ms): The ramp time to switch from the last step to the current step
		Duration (ms): Current step duration
2	SET: Click the "SET" button to apply the set parameters.		
3	CLS: Click the "CLS" button to clear the set parameters		
4	DEL: Click the "DEL" button to delete the step		
5	INC: Click the "INC" button to add a step		
6	SAVE: Click the "SAVE" button to save the set test parameter file (.txt format, default saved in the seq_data folder)		
7	IMPORT: Click the "IMPORT" button to import the saved test parameter file (.txt format, default saved in the		

seq_data folder)

Figure 5-5-1-2 AC Settings ------ Sequence

5.5.1.3 Harmonic

KGS has harmonic simulation function. Up to 100th harmonics waveform generation. Click "Settings" → "AC Settings" → "Harmonic" to enter the harmonic editing panel.

Figure 5-5-1-3 AC Settings ------ Harmonic

Table 5-10

No.	Note
1	set parameters including harmonic order, harmonic content, and harmonic phase angle.
2	SET: Click the "SET" button to apply the set parameters.
3	CLS: Click the "CLS" button to clear the set parameters
4	DEL: Click the "DEL" button to delete the step
5	SYN:A Click the "SYN: A" button to copy the parameters of phase A settings to phases B and phase C
6	SAVE: Click the "SAVE" button to save the set test parameter file (.txt format)
7	IMPORT: Click the "IMPORT" button to import the saved test parameter file or the build-in waveform (.txt format)
8	Waveform Display: Simulated waveforms can be displayed below the panel

Figure 5-5-1-4 Built-in harmonic waveform files

5.5.1.4 Inter-harmonic

KGS has inter harmonic simulation function. Click "Settings" → "AC Settings" → "Inter-harmonic" to enter the inter-harmonic editing panel. Set parameters including inter-harmonic frequency, content, and phase angle. Click the "SET" button to apply the set parameters.

Figure 5-5-1-5 AC Settings ------ Inter-harmonic

5.5.2 DC Settings

"DC Settings" including Standard and Sequence modes.

5.5.2.1 Standard

Users can set a single work step. Select the output mode as DC and control mode as STD on HOME panel. Click "Settings" → "DC Settings" → "Standard". (Figure 5-5-2-1).
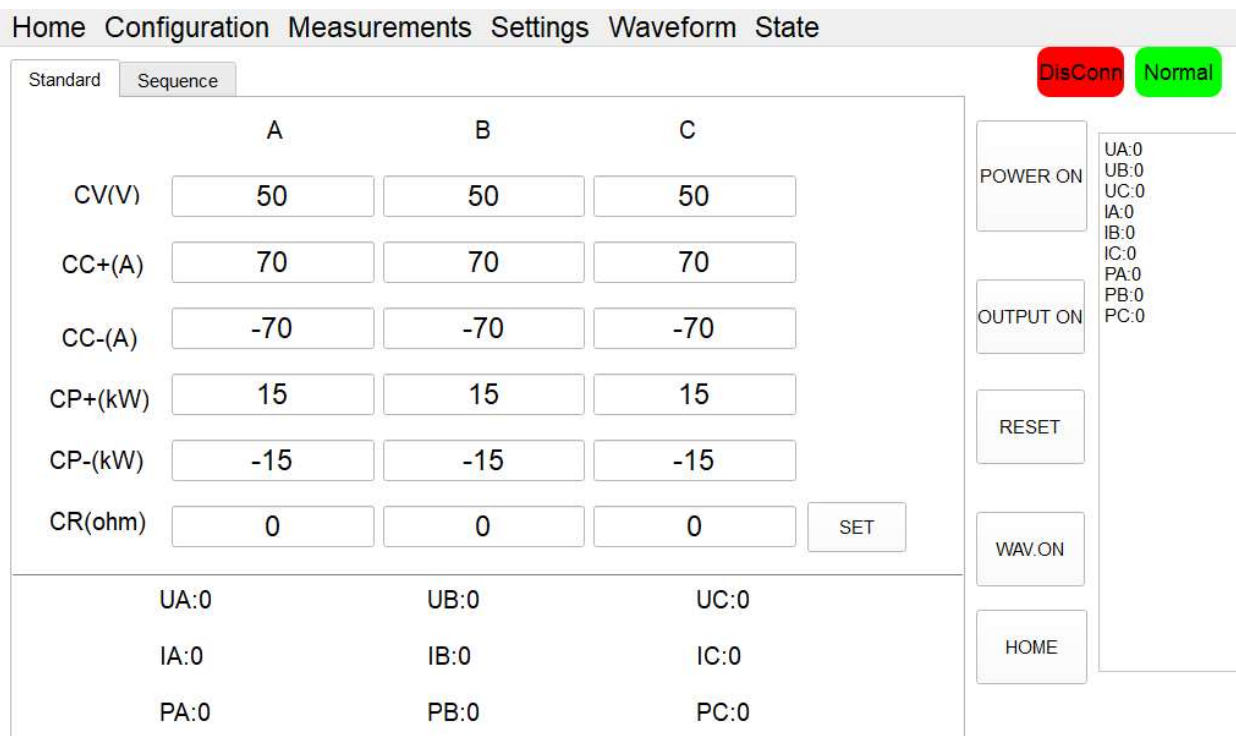
Figure 5-5-2-1 DC Settings ------ Standard

Table 5-11

No.	Note	
1	Setting parameters	CV(V): output voltage
		CC+(A): output current upper limit value
		CC-(A): output current lower limit value
		CP+(kW): output power upper limit value
		CP-(kW): output power lower limit value
		CR: Internal resistance value
2	SET: Click the "SET" button to apply the set parameters.	
3	Real time measurement display: Real time display the DC output voltage (UA/UB/UC), DC output current (IA/IB/IC), DC output power (PA/PB/PC)	

Note: "A/B/C" represents the three channels corresponding to the three phases.

5.5.2.2 Sequence

Users can set complex combinations of multiple work steps. Select the output mode as DC and control mode as SEQ on HOME panel. Click "Settings" → "DC Settings" → "Sequence". (Figure 5-5-2-2).
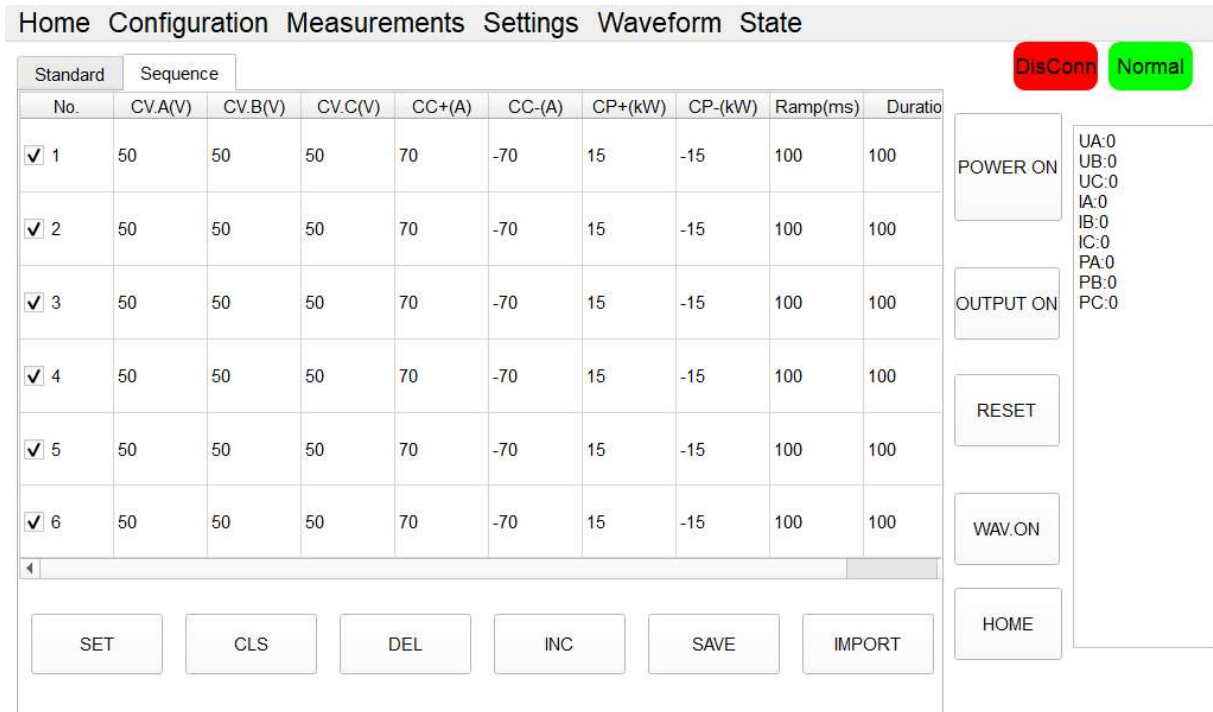
Figure 5-5-2-2 DC Settings ------ Sequence

Table 5-12

No.	Note		
1	Setting parameters of each step	CV.A(V) / CV.B(V) / CV.C(V): output voltage	
		CC+(A) / CC-(A): output current upper/lower limit value	
		CP+(kW) / CP-(kW): output power upper/lower limit value	
		CR: Internal resistance value	
		Ramp (ms): The ramp time to switch from the last step to the current step	
		Duration (ms): Current step duration	
2	SET: Click the "SET" button to apply the set parameters.		
3	CLS: Click the "CLS" button to clear the set parameters		
4	DEL: Click the "DEL" button to delete the step		
5	INC: Click the "INC" button to add a step		
6	SAVE: Click the "SAVE" button to save the set test parameter file (.txt format)		
7	IMPORT: Click the "IMPORT" button to import the saved test parameter file (.txt format)		

5.5.3 Load Settings

The "Load Settings" including SEQ-CC, SEQ-CP, SEQ-CR, E-LOAD and CF rectifier modes.

5.5.3.1 SEQ-CC

SEQ-CC mode used to simulate sinusoidal current, Constant current CC is available to adjust load current, phase angle can be set from 90°to -90° simulating the voltage and current conditions under inductive and capacitive loads.

Users can set complex combinations of multiple work steps. Select the load mode as CC and control mode as SEQ on HOME panel. Click "Settings" → "Load Settings" → "SEQ-CC". (Figure 5-5-3-1).
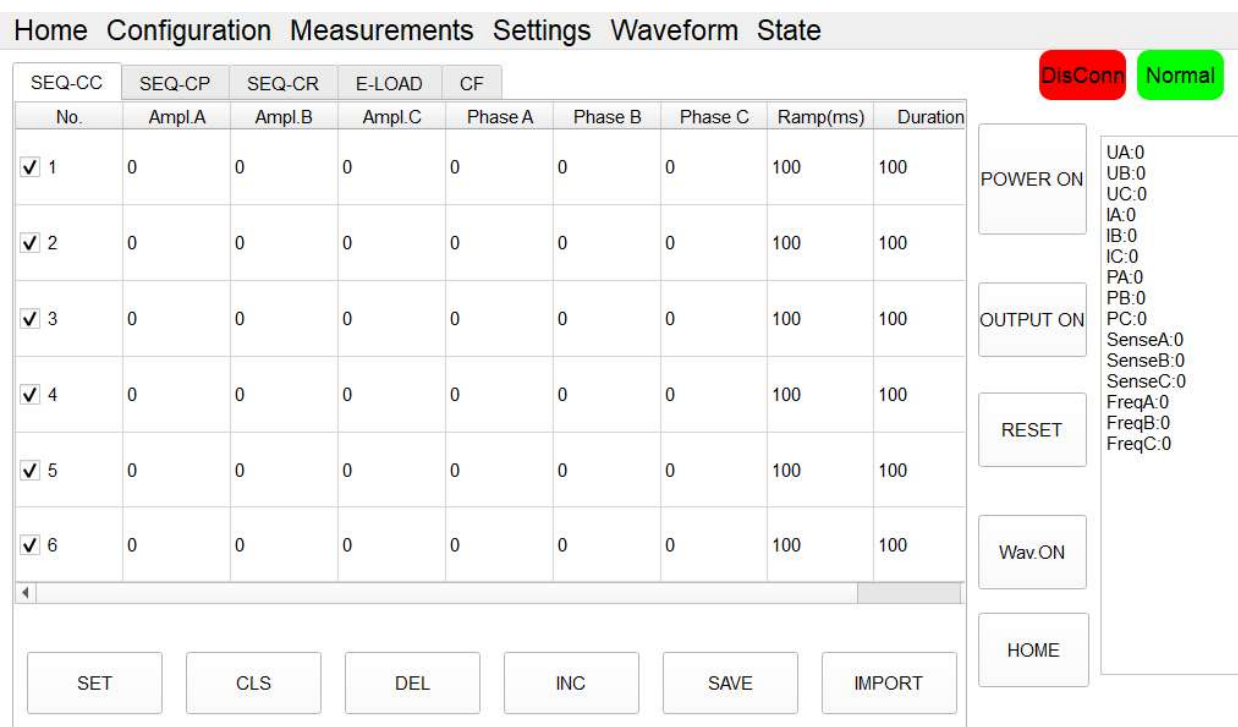
Figure 5-5-3-1 Load Test ------ SEQ-CC mode

Table 5-13

No.	Note		
1	Setting parameters of each step	Ampl.A/Ampl.B/Ampl.C: AC current of phase A/B/C
		Phase A/Phase B/Phase C: AC current phase angle of phase A/B/C
		Ramp (ms): The ramp time to switch from the last step to the current step
		Duration (ms): Current step duration
2	SET: Click the "SET" button to apply the set parameters.		
3	CLS: Click the "CLS" button to clear the set parameters		
4	DEL: Click the "DEL" button to delete the step		

5	INC: Click the "INC" button to add a step
6	SAVE: Click the "SAVE" button to save the set test parameter file (.txt format)
7	IMPORT: Click the "IMPORT" button to import the saved test parameter file (.txt format)

"SEQ-CC" can also be used in conjunction with "CF" to simulate non-linear loads.

Select the Load mode as CC and check the "CF Enable" on the HOME panel. Set the basic operating parameters in SEQ-CC mode, and then overlay the CF value in CF mode (setting range: 1.414~3).

5.5.3.2 SEQ-CP

SEQ-CP mode used to simulate sinusoidal current, Constant power CP is available to adjust load power, phase angle can be set from 90°to -90° simulating the voltage and current conditions under inductive and capacitive loads.

Users can set complex combinations of multiple work steps. Select the load mode as CP and control mode as SEQ on HOME panel. Click " Settings" → "Load Settings" → "SEQ-CP". (Figure 5-5-3-2).

Figure 5-5-3-2 Load Settings ------ SEQ-CP

Table 5-14

No.	Note	
1	Setting parameters of each step	Ampl.A/Ampl.B/Ampl.C: AC power of phase A/B/C
		Phase A/Phase B/Phase C: AC power phase angle of phase A/B/C
		Ramp (ms): The ramp time to switch from the last step to the current step

		Duration (ms): Current step duration
2	SET: Click the "SET" button to apply the set parameters.	
3	CLS: Click the "CLS" button to clear the set parameters	
4	DEL: Click the "DEL" button to delete the step	
5	INC: Click the "INC" button to add a step	
6	SAVE: Click the "SAVE" button to save the set test parameter file (.txt format)	
7	IMPORT: Click the "IMPORT" button to import the saved test parameter file (.txt format)	

"SEQ-CP" can also be used in conjunction with "CF" to simulate non-linear loads.

Select the Load mode as CP and check the "CF Enable" on the HOME panel. Set the basic operating parameters in SEQ-CP mode, and then overlay the CF value in CF mode (setting range: 1.414~3).

5.5.3.3 SEQ-CR

SEQ-CR mode is used to simulate three-phase resistive loads. Users can set complex combinations of multiple work steps. Select the load mode as CR and control mode as SEQ on HOME panel. Click " Settings" → "Load Settings" → "SEQ-CR". (Figure 5-5-3-3), the three-phase resistance parameters can be set through the panel and can realize the program of resistance sequence.

Figure 5-5-3-3 Load Settings ------ SEQ-CR

Table 5-15

No.	Note		
1	Setting parameters of each step	Ampl.A/Ampl.B/Ampl.C: resistance of phase A/B/C	
		Ramp (ms): The ramp time to switch from the last step to the current step	
		Duration (ms): Current step duration	
2	SET: Click the "SET" button to apply the set parameters.		
3	CLS: Click the "CLS" button to clear the set parameters		
4	DEL: Click the "DEL" button to delete the step		
5	INC: Click the "INC" button to add a step		
6	SAVE: Click the "SAVE" button to save the set test parameter file (.txt format)		
7	IMPORT: Click the "IMPORT" button to import the saved test parameter file (.txt format)		

5.5.3.4 E-LOAD

The KGS series provides RLC load simulation function and RCD non-linear load simulation function. Select the operation mode as E-LOAD and Load mode as RLC on HOME panel. Click "Settings" → "Load Settings" → "E-LOAD". (Figure 5-5-3-4). Users can choose different circuit topologies (including 12 RLC load simulation topologies and 4 RCD load simulation topologies), and set three-phase R, L, C, R2, and R3 values separately.
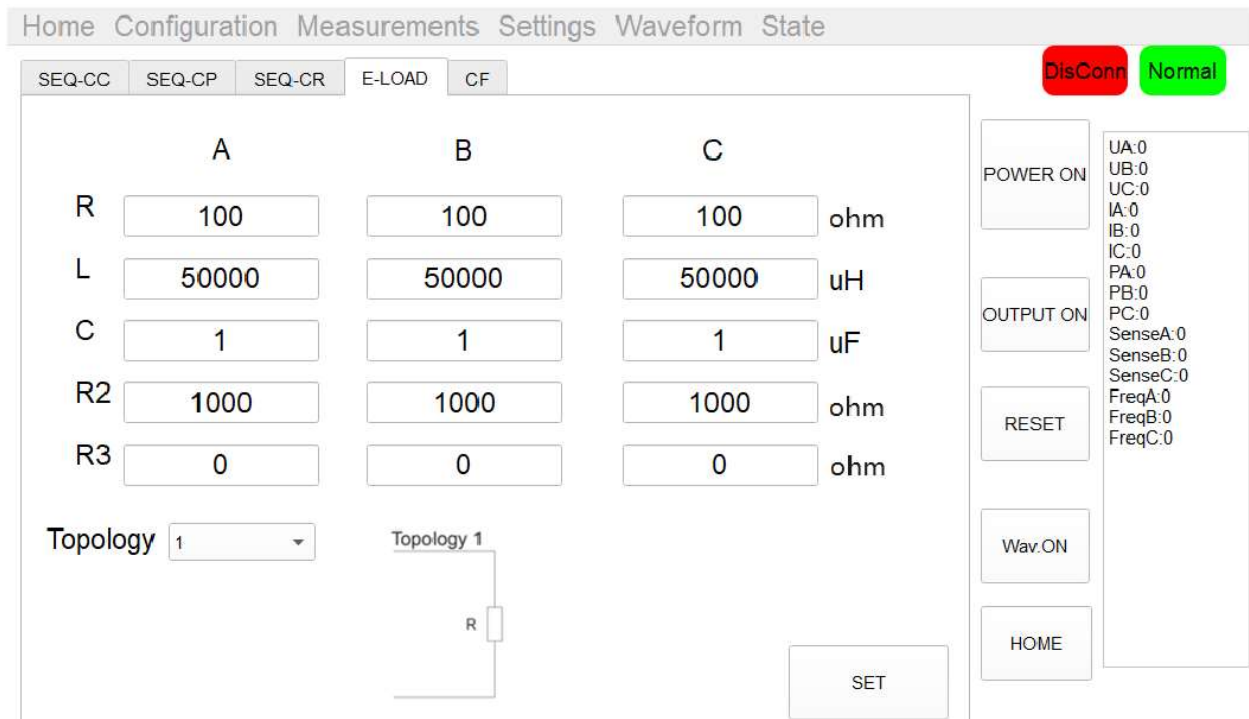
Figure 5-5-3-4 Load Settings ------ E-LOAD

Table 5-16

No.	Note
1	Circuit topologies: including 12 RLC load simulation topologies and 4 RCD load simulation topologies
2	Parameter settings: R, L, C, R2, R3 of phase A/B/C can be set separately
3	SET: Click the "SET" button to apply the set parameters.

5.5.3.5 CF

CF mode (Rectifier mode) can be used to simulate non-linear loads. Select the load mode as CC or CP and check the "CF Enable" box on HOME panel. Set the basic operating parameters in SEQ-CC or SEQ-CP mode, and then overlay the CF value in CF mode (setting range: 1.414~3).
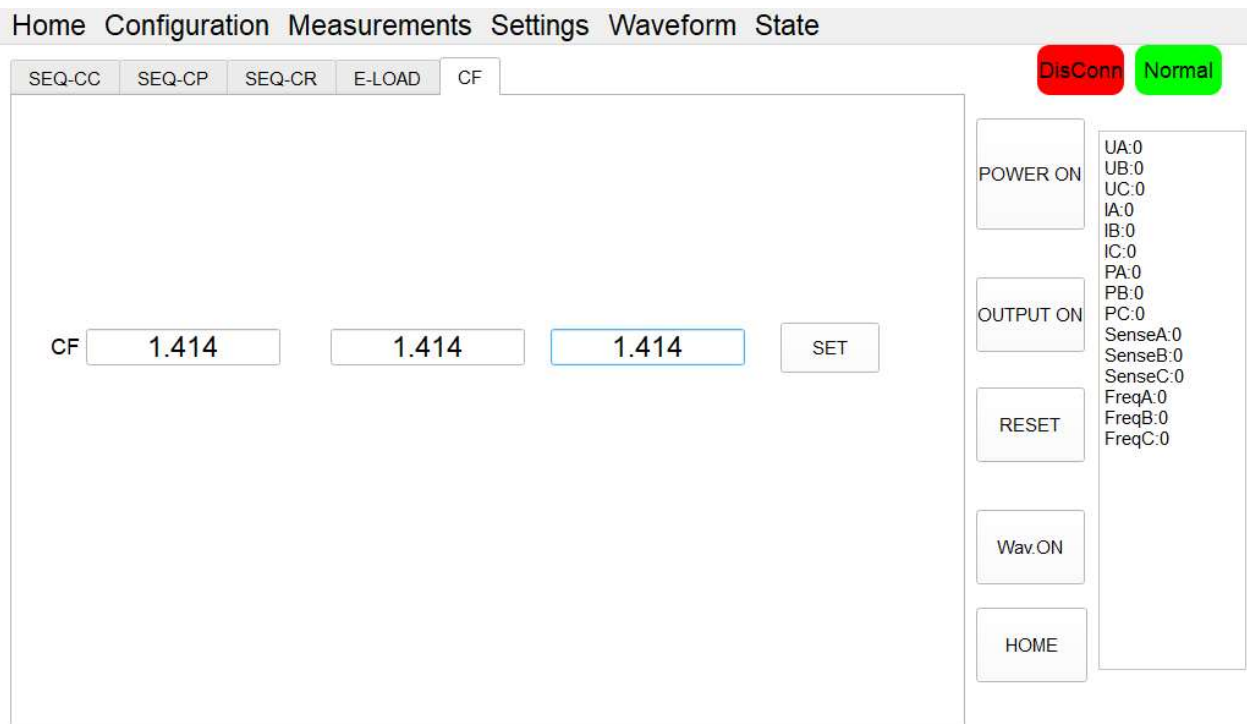
Figure 5-5-3-5 Load Settings ------ CF

5.5.4 List Mode

Click "Settings" → "List Mode", user can manually set more complex combinations of testing commands. In addition, users can also use the SCPI instructions provided in Chapter 7. After importing the test commands file into the software, click "SET" → "POWER ON" → "OUTPUT ON", and the KGS will start running according to the imported test instructions.

Table 5-17

No.	Note
1	SET: Click the "SET" button to apply the set parameters.
2	CLS: Click the "CLS" button to clear the set parameters
3	DEL: Click the "DEL" button to delete the step
4	INC: click the "INC: button to add a new command. **Note:** After clicking the "INC" button, a new panel will pop up, including: AC SET (Figure 5-5-4-2), Harm SET (Figure 5-5-4-4), Inter-harm SET (Figure 5-5-4-5), and DC SET (Figure 5-5-4-6).
5	SAVE: Click the "SAVE" button to save the set test parameter file (.txt format)
6	IMPORT: Click the "IMPORT" button to import the saved test parameter file (.txt format)
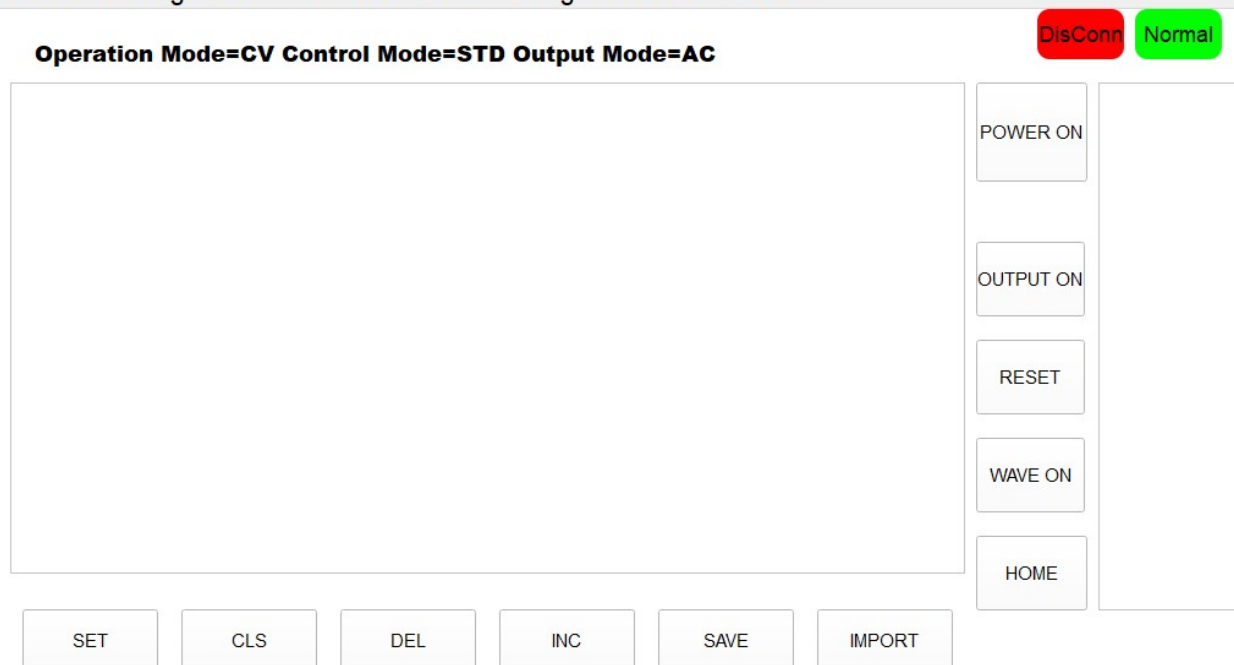
Figure 5-5-4-1 List Mode

5.5.4.1 List Mode ------ AC Settings

After clicking the "INC" button, a new panel will pop up, AC Settings panel as Figure 5-5-4-2.

Table 5-18

No.	Note	
1	Parameters can be set for each command	Ampl.A/Ampl.B/Ampl.C: output voltage of phase A/B/C
		Phase A/Phase B/Phase C: output phase angle of phase A/B/C

		Freq (Hz): output frequency
		Ramp (ms): The ramp time to switch from the last step to the current step
		Duration (ms): Current step duration
		Offset A/Offset B/Offset C: DC component superimposed on AC output
2	TRIG ANGLE (Figure 5-5-4-3)	The ON/PFF phase angle of a phase A/B/C phase. **Note:** The power system refers to the Duration time firstly by default, and then refers to the on/off phase angle.
3	Mode (Figure 5-5-4-3)	Load mode selection: CV/CC/CP/CR. The command will only run effectively when the selected mode on this panel is same as the HOME panel
4	Loop (Figure 5-5-4-3)	**Unselect:** Indicates that the current instruction is only run once
		LOOPBegin: Indicates starting the loop from the current command. The number below represents the total number of cycles.
		LOOPEnd: Indicates the current command is the end of the loop. The number below represents the total number of cycles.
5	Output enable check box	After checking this box, the current command can run normally. **Note:** The commands that are not checked will not run.
6	Ok	Click the "Ok" button to generate a new command
7	Cancel	Click the "Cancel" button to cancel

Figure 5-5-4-2 List Mode ------ AC Settings
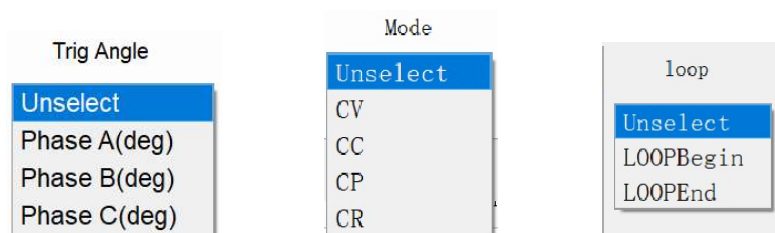
Figure 5-5-4-3

5.5.4.2 List Mode ------ Harmonic

After clicking the "INC" button, a new panel will pop up, Harmonic as Figure 5-5-4-4. Firstly, set the basic operating parameters (such as output voltage, frequency, etc.) in the "AC Settings", then click "Harmonic" to set the harmonic parameters. Then click "Ok" to generate command.

Table 5-19

No.	Note	
1	Parameters can be set for each command	Order: harmonic order
		Ramp (ms): The ramp time to switch from the last step to the current step
		Duration (ms): Current step duration
		Phase A/B/C: harmonic phase angle of phase A/B/C
		Ampl(%) A/B/C: harmonic amplitude of phase A/B/C
2	Loop	**Unselect:** Indicates that the current instruction is only run once
		LOOPBegin: Indicates starting the loop from the current command. The number below represents the total number of cycles.
		LOOPEnd: Indicates the current command is the end of the loop. The number below represents the total number of cycles.
3	Ok	Click the "Ok" button to generate a new command
4	Cancel	Click the "Cancel" button to cancel

Figure 5-5-4-4 List Mode ------ Harmonic

5.5.4.3 List Mode ------ Inter-harmonic

After clicking the "INC" button, a new panel will pop up, Inter-harmonic as Figure 5-5-4-5. Firstly, set the basic operating parameters (such as output voltage, frequency, etc.) in the "AC Settings", then click "Inter-harmonic" to set the inter-harmonic parameters. Then click "Ok" to generate command.

Table 5-20

No.	Note	
1	Parameters can be set for each command	Freq (Hz): inter-harmonic frequency
		Ramp (ms): The ramp time to switch from the last step to the current step
		Duration (ms): Current step duration
		Phase A/B/C: inter-harmonic phase angle of phase A/B/C
		Ampl(%) A/B/C: inter-harmonic amplitude of phase A/B/C
2	CH1/2/3/4/5/6/7/8	Supports 8 different inter harmonic settings, and users can choose different settings according to testing requirements
3	Loop	**Unselect:** Indicates that the current instruction is only run once
		LOOPBegin: Indicates starting the loop from the current command. The number below represents the total number of cycles.
		LOOPEnd: Indicates the current command is the end of the loop. The number below

		represents the total number of cycles.
4	Ok	Click the "Ok" button to generate a new command
5	Cancel	Click the "Cancel" button to cancel
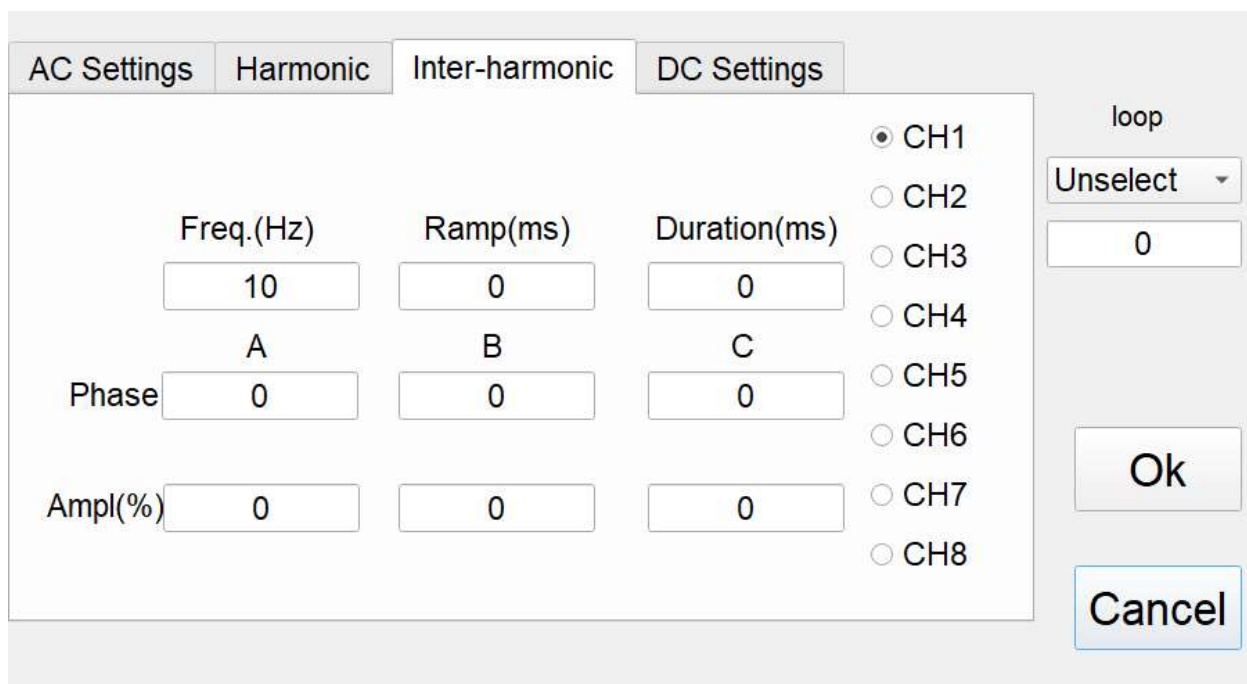
Figure 5-5-4-5 List Mode ------ Inter-harmonic

5.5.4.4 List Mode ------ DC Settings

After clicking the "INC" button, a new panel will pop up, DC Settings panel as Figure 5-5-4-6.

Table 5-21

No.	Note	
1	Parameters can be set for each command	CV.A/CV.B/CV.C(V): output voltage of channel A/B/C
		CC+(A): output current upper limit value
		CC-(A): output current lower limit value
		CP+(kW): output power upper limit value
		CP-(kW): output power lower limit value
		CR: Internal resistance value
		Ramp (ms): The ramp time to switch from the last step to the current step
		Duration (ms): Current step duration
	Loop	**Unselect:**

2		Indicates that the current instruction is only run once
		LOOPBegin: Indicates starting the loop from the current command. The number below represents the total number of cycles.
		LOOPEnd: Indicates the current command is the end of the loop. The number below represents the total number of cycles.
3	Ok	Click the "Ok" button to generate a new command
4	Cancel	Click the "Cancel" button to cancel

Figure 5-5-4-6 List Mode ------ DC Settings

5.6 Wave

Click the "WAVE" to enter the Show wave panel (real-time waveform browsing panel, Figure 5-6-1). The GUI software can monitor the real-time output three-phase voltage/current waveform and DC bus voltage waveform. Users can individually or simultaneously select the waveforms.

- UA/UB/UC: output voltage of phase A/B/C
- IA/IB/IC: output current of phase A/B/C
- Udc: DC bus voltage
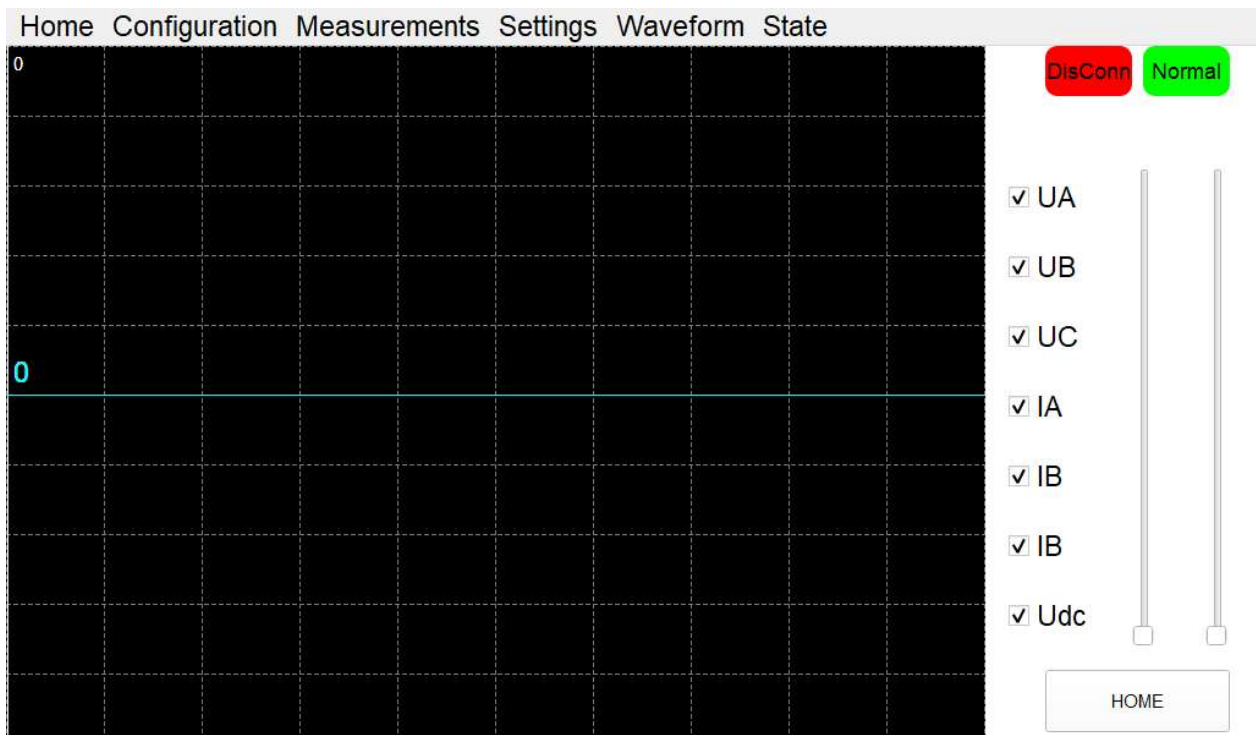
Figure 5-6-1

5.7 State

Click "State" to enter the status query interface (Figure 5-7-1). User can view the running status and fault words on this panel.
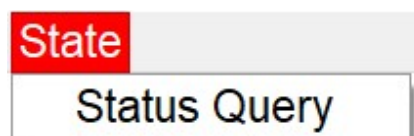
Figure 5-7-1

DisConn   Normal

Running State

| 0 | 0 | 0 | 0 |

Fault Word

| 0 | 0 | 0 |

| 0 | 0 | 0 |

Sequence Pointer

| 0 | 0 | 0 |

| 0 | 0 |

Figure 5-7-2

Chapter 6 Equipment verification and calibration

6.1   Performance Verification

6.1 1   Verity equipment and settings
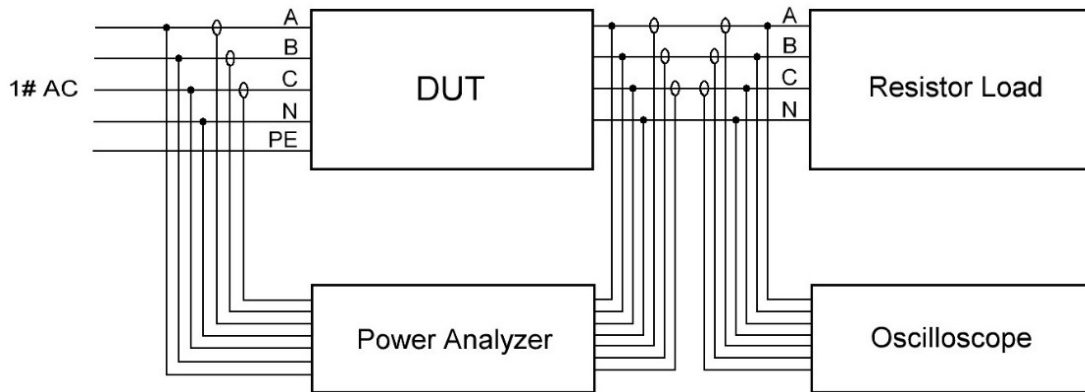
Figure 6-1 Three-phase output test with resistive load
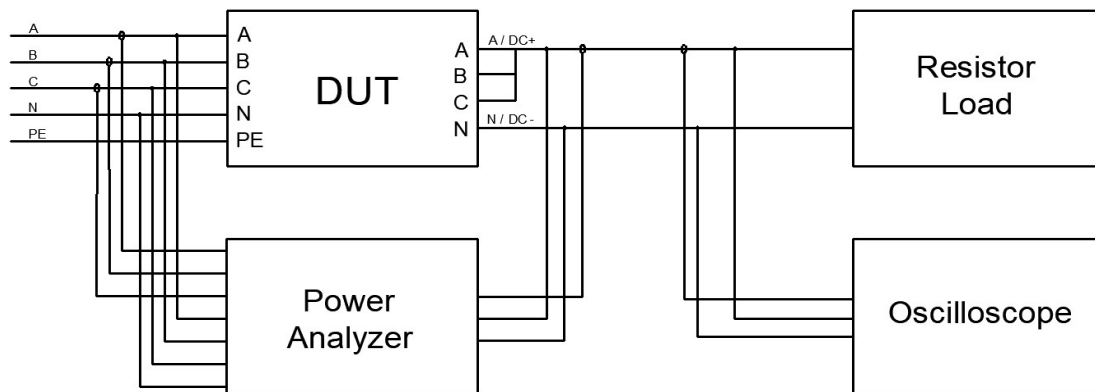
Figure 6-2 Single-phase output test with resistive load
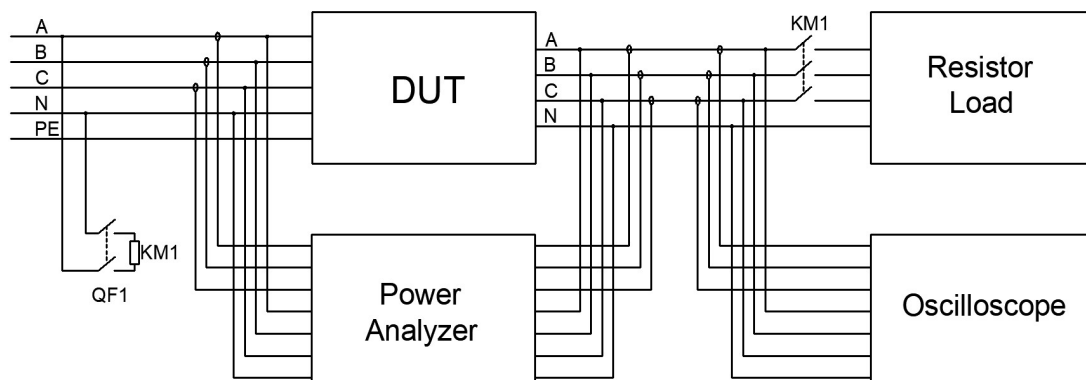
Figure 6-3 Load step change test

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

Make sure that all equipment and load wiring are connected reliably.

When connecting / disconnecting any equipment which connected to the power supply or changing the wiring, turn off the power supply, and do not live working.

6.1.2   Verity content

Voltage Range

Connect the input of the KGS to the 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. (Including DC voltage and AC voltage)

Current Range

Connect the input of the KGS to the 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 (including DC current and AC current).

Frequency Range

Connect the input of the KGS to the 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.

Voltage Accuracy

Connect the input of the KGS to the 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:

δ_U——VoltageAccuracy;

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

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

U_N——Rated Voltage, V;

Current Accuracy

Connect the input of the KGS to the 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:

δ_I——Current Accuracy;

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

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

I_N——Rated Current, A;

Frequency Accuracy

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

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

And：

δ_f——Power accuracy;

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

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

f_N——Rated Frequency，Hz；

Power Accuracy

Connect the input of the KGS to the 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:

δ_P——Power Accuracy;

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

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

P_N——Rated Power, kW;

Output Characteristics

Connect the input of the KGS to the 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 of the KGS to the 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 of the KGS to the 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 of the KGS to the 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 of the KGS to the 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.

Voltage Drop Change

Connect the input of the KGS to the 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 of the KGS to the 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 of the KGS to the 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 of the KGS to the 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 of the KGS to the 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.

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.

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.

6.2 Test Record Form

Please refer to the KGS test report.

▌▌ Chapter 7 Equipment Maintenance and Repair

7.1　Equipment Maintenance

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

7.1.1 Equipment operating environment

- The equipment is used indoors, and the operating temperature is not higher than 40 ° C and not lower than 0 ° C.

- The temperature of equipment storage is not higher than 85 ° C and not lower than -25 ° C.

- The equipment should be installed indoor with a maximum relative humidity of 20 to 90% RH (no condensation).

- To avoid corrosion of electrical components, the equipment should be isolated from harmful gases such as acids and alkalis which damages the insulation.

- For ventilation, the equipment should be kept more than 600mm away from the wall or other equipment.

- No violent vibrations and shocKGS during equipment installation.

- The equipment should be kept away from flammable and explosive substances.

- There should be no strong electromagnetic field interference around the equipment.

7.1.2 Equipment maintenance

- No dust accumulation on the equipment and the ground must be clean.

- Cleaning: To prevent dust or moisture which affects the performance of the equipment, keep the surface clean and dry. Please use a soft, lint-free cleaning cloth to clean the outside. Do not use any cleaner.

7.2   Equipment Repair

7.2.1   Equipment self-test

- Whether inlet/outlet and terminal block of the equipment are connected.

- Whether inlet/outlet lines of the equipment are damaged or exposed, and with good insulation.

- Whether the ground wire is good, no looseness, and not overlapped with other metals.

- Whether it sounds normal or not excessively heated of the wiring when the equipment is running.

⚠️ **CAUTIOUS**

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

7.2.2   Maintenance service

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

7.2.3 Equipment returns

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

Please attach a note to the packing, indicating the specific description of the failure, model, and owner of the power supply.

Please place the power supply in the original load carriers, properly fill the cushioning material, and ensure that the packing box is firm.

Ⅱ Chapter 8 Programming

8.1　Command Format

The parameter data types, parameters and the value range and formats of the programming commands are introduced in this Chapter. The user shall carefully read the content before developing the control operations.

8.1.1 Parameters Data Type

No.	Parameters Data Type	Effective Parameters
1	<boolean>	1 or 0
2	<NRf1...n>	Floating Point, 0/positive/negative floating points
3	<NRf>	Floating Point, 0/positive/negative floating points
4	<string>	Character strings

8.1.2 Command Parameters/Return Valve Units

No.	Physical Qty.	Unit
1	Voltage	V (Volt)
2	Current	A (Ampere)
3	Active Power	KW (Kilowatt)
4	Reactive Power	KVA (Kilovolt-ampere)
5	Time	mS (Millisecond)

8.1.3 Command Format

The command set of the KGS 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

The parameter data types, parameters and the value range and formats of the programming commands are introduced in this Chapter. The user shall carefully read the content before developing the control operations.

(1) Common Commands

Commands	Return Value	Description
*IDN	"BriPower, KGS"	Return the information of equipment
*RST	None	Fault Reset
*FAULT?	No Faults: "NULL" Faulty: "Fault Code"	
POWER	ON/OFF	Turn ON/OFF the switch of grid side.
OUTPUT	ON/OFF	Enable/Disable the output of power supply
MODE:SRC	0/1/2	0: STD 1: SEQ 2: ATI
MODE:ACDC	0/1/2	0: AC 1: AC+DC 2: DC
MODE:VCL	0/1/2	0: CV 1: CC 2: E-LOAD Mode
MODE:CF	0/1	1: Enable CF setting value 0: Block CF settings
MODE:LD	1/2/4/8	1: CC 2: CP 4: CR 8: CE/RLC
RLC:SEL	1~16	When simulating RLC/RCD loads, the circuit topologies can be selected
STAT:POWER?	1/0	Return status of switch of grid side 1: ON 0: OFF
STAT:OUPUT?	1/0	Return status of output of power supply 1: ON 0: OFF
STAT:FAULT?	1/0	1: Faulty 0: No Faults

STAT: READY?	1/0	1: Standby 0: Not Standby
PARA:OCP <NRf>	<NRf>	Set the value of Over Current Protection
PARA:OVP <NRf>	<NRf>	Set the value of Over Voltage Protection
PARA:OLP <NRf>	<NRf>	Set the undervoltage protection value, used in E-LOAD mode
PARA:ILIM <NRf>	<NRf>	Set the limit value of output current
PARA:URAMP	<NRf>	Set the ramp rate of output voltage, used in STD mode
PARA:IRAMP <NRf>	<NRf>	Set the ramp rate of output current, used in STD mode

(2) Measurements Commands

Commands	Return Value	Description
MEAS:HEART?	<NRf>	
MEAS:UA?	<NRf>	RMS AC output voltage of phase A. Unit: V
MEAS:UB?	<NRf>	RMS AC output voltage of phase B. Unit: V
MEAS:UC?	<NRf>	RMS AC output voltage of phase C. Unit: V
MEAS:IA?	<NRf>	RMS AC output current of phase A. Unit: A
MEAS:IB?	<NRf>	RMS AC output current of phase B. Unit: A
MEAS:IC?	<NRf>	RMS AC output current of phase C. Unit: A
MEAS:PA?	<NRf>	Output power of phase A. Unit: kW
MEAS:PB?	<NRf>	Output power of phase B. Unit: kW
MEAS:PC?	<NRf>	Output power of phase C. Unit: kW
MEAS:URA?	<NRf>	Remote sense output voltage of phase A. Unit: V
MEAS:URB?	<NRf>	Remote sense output voltage of phase B. Unit: V
MEAS:URC?	<NRf>	Remote sense output voltage of phase C. Unit: V
MEAS:FREQA?	<NRf>	Output frequency of phase A. Unit: Hz
MEAS:FREQB?	<NRf>	Output frequency of phase B. Unit: Hz
MEAS:FREQC?	<NRf>	Output frequency of phase C. Unit: Hz
MEAS:OUTP?	<NRf>	Total output power. Unit: kW
MEAS:OUTQ?	<NRf>	Total output reactive power. Unit: kvar
MEAS:VDCA?	<NRf>	DC output voltage of phase A (channel A). Unit: V
MEAS:VDCB?	<NRf>	DC output voltage of phase B (channel B). Unit: V
MEAS:VDCC?	<NRf>	DC output voltage of phase C (channel C). Unit: V

MEAS:IDCA?	<NRf>	DC output voltage of phase A (channel A). Unit: V
MEAS:IDCB?	<NRf>	DC output voltage of phase B (channel B). Unit: V
MEAS:IDCC?	<NRf>	DC output voltage of phase C (channel C). Unit: V

(3) AC Settings Commands

Commands	Return Value	Description
ACSET:FREQ	0~1000.00	Set the output frequency
ACSET:UA	<NRf>	Set the output voltage of phase A. Unit: V
ACSET:UB	<NRf>	Set the output voltage of phase B. Unit: V
ACSET:UC	<NRf>	Set the output voltage of phase C. Unit: V
ACSET:PHASEA	<NRf>	Set the phase angle of phase A. Unit: °
ACSET:PHASEB	<NRf>	Set the phase angle of phase B. Unit: °
ACSET:PHASEC	<NRf>	Set the phase angle of phase C. Unit: °
ACSET:ILIMA	<NRf>	Set the output current limit value of phase A. Unit: A
ACSET:ILIMB	<NRf>	Set the output current limit value of phase B. Unit: A
ACSET:ILIMC	<NRf>	Set the output current limit value of phase C. Unit: A
ACSET:PLIMA	<NRf>	Set the output power limit value of phase A. Unit: kW
ACSET:PLIMB	<NRf>	Set the output power limit value of phase B. Unit: kW
ACSET:PLIMC	<NRf>	Set the output power limit value of phase C. Unit: kW
ACSET:OFFSETA	<NRf>	Set the DC offset voltage of phase A. Unit: V
ACSET:OFFSETB	<NRf>	Set the DC offset voltage of phase B. Unit: V
ACSET:OFFSETC	<NRf>	Set the DC offset voltage of phase C. Unit: V
ACSET:XL	0~50000	Set the internal inductance. Unit: uH
ACSET:XR	0~50000	Set the internal resistance. Unit: mΩ

(4) DC Settings Commands

Commands	Return Value	Description
DCSET#:U	<NRf>	Set the DC output voltage. Unit: V
DCSET#:I+	<NRf>	Set the DC output positive current limit value. Unit: A
DCSET#:I-	<NRf>	Set the DC output negative current limit value. Unit: A
DCSET#:P+	<NRf>	Set the DC output positive power limit value. Unit: kW
DCSET#:P-	<NRf>	Set the DC output negative power limit value. Unit: kW

DCSET#:R	<NRf>	Set the output internal resistance. Unit: Ω

Note: "#=0" represents phase A. "#=1" represents phase B. "#=2" represents phase C.

(5) CF Settings Commands

Commands	Return Value	Description
CF:A	1.414~5	Set the CF value of phase A
CF:B	1.414~5	Set the CF value of phase B
CF:C	1.414~5	Set the CF value of phase C

(6) CE Settings Commands (E-LOAD RLC/RCD Mode)

Commands	Return Value	Description
CE#:R	0.1~5000 Ω	
CE#:L	1~50000 uH	
CE#:C	1~50000 uF	
CE#:R2	0.1~5000 Ω	
CE#:R3	0.1~5000 Ω	

Note: "#=0" represents phase A. "#=1" represents phase B. "#=2" represents phase C.

(7) Harmonic Settings Commands

Commands	Return Value	Description
HARM###:KA	<NRf>	Set the harmonic content of phase A. Unit: %
HARM###:KB	<NRf>	Set the harmonic content of phase B. Unit: %
HARM###:KC	<NRf>	Set the harmonic content of phase C. Unit: %
HARM###:PHASEA	<NRf>	Set the harmonic phase angle of phase A. Unit: °
HARM###:PHASEB	<NRf>	Set the harmonic phase angle of phase B. Unit: °
HARM###:PHASEC	<NRf>	Set the harmonic phase angle of phase C. Unit: °

Note: "###=002~100" represents 2rd~100th harmonics.

(8) Inter-Harmonic Settings Commands

Commands	Return Value	Description
IHARM#:FREQ	0~5000.00	Set the inter-harmonic frequency
IHARM#:KA	<NRf>	Set the inter-harmonic content of phase A. Unit: %

IHARM#:KB	<NRf>	Set the inter-harmonic content of phase B. Unit: %
IHARM#:KC	<NRf>	Set the inter-harmonic content of phase C. Unit: %
IHARM#:PHASEA	<NRf>	Set the inter-harmonic phase angle of phase A. Unit: °
IHARM#:PHASEB	<NRf>	Set the inter-harmonic phase angle of phase B. Unit: °
IHARM#:PHASEC	<NRf>	Set the inter-harmonic phase angle of phase C. Unit: °

Note: "#=0~7" represents the channels of inter-harmonic.

(9) LIST Mode Settings Commands

Commands	Return Value	Description
LIST:CMD EXE		Execution Sequence
LIST:CMD CLS		Reset Sequence
LIST:CMD DEL		Delete Sequence
LIST:COUNT?		Query how many sequences are set
LIST:RUN?		Queries the number of times the EXE command has been executed.
LIST:DATA001?		Query the first row of sequence data
LIST:DATAXXX?		Query the XXXth row of sequence data

8.3　Examples

(1) Set the AC output (up to 100 steps can be set)

- **Commands:**

  LIST:DATA001 AMP 220,220,220;PHASE 0,-120,-240;FREQ 50;OFFSET 0,0,0;RAMP 1000;Duration 1000；

- **Description:**

  Set three-phase voltage of 220V L-N, phase angles of 0, -120 °, -240 °, and frequency of 50Hz. The DC offset is 0V, with the Ramp time of 1 second, the duration of 1 second.

(2) Set the DC output

- **Commands:**

  LIST:DATA001 DCV 100,200,300;DCC 10,5;DCP 1.5,2.0;DCR 0;RAMP 1000;Duration 1000；

- **Description:**

  Set the DC voltage of phase A to 100V, DC voltage of phase B to 200V, and DC voltage of phase C to 300V; Positive current limit of 10A, negative current limit of 5A, positive power limit of 1.5kW, negative power limit of 2kW, internal resistance of 0 ohms.

(3) Set the Harmonic

- **Commands:**

  LIST:DATA001 HARM 5; PHASE 0,0,0;AMP 30,30,30;RAMP 1000;Duration 1000；

- **Description:**

  Set the 5th harmonic, 30% for phase A, 30% for phase B, and 30% for phase C. Ramp time 1000ms, duration 1000ms. To achieve the effect of harmonic gradually increasing or decreasing.

(4) Set the Inter-Harmonic

- **Commands:**

  LIST:DATA001 IHARM 0; FREQ 100;PHASE 0,0,0;AMP 30,30,30;RAMP 100;Duration 100;

  LIST:DATA002 IHARM 0; FREQ 5000;PHASE 0,0,0;AMP 30,30,30;RAMP 50000;Duration 1000；

- **Description:**

  Set two steps to achieve inter harmonic frequency sweep.

Step 1: Set channel 1, with inter-harmonic frequency of 100Hz and each phase's content of 30%;

Step 2: Set the inter harmonic frequency changes from 100Hz to 5000Hz in 50s.

(5) Set the start of the loop (LOOPB)

- **Commands:**

  LIST:DATA001 LOOPB; DCV 100,100,100;DCC 10,10;DCP 10,10;DCR 0;RAMP 1000;Duration 1000

- **Description:**

  Set the loop starts.

(6) Set the end of the loop and the number of loops (LOOPE)

- **Commands 1:**

  LIST:DATA003 LOOPE 5; DCV 50,50,50;DCC 10,10;DCP 10,10;DCR 0;RAMP 1000;Duration 1000

- **Description 1:**

  After the sequence execution ends at 3, it will return to the sequence marked with LOOPB and repeat 5 times

- **Commands 2:**

  LIST:DATA001 LOOPB;AMP 220,220,220;PHASE 0,-120,-240;FREQ 50;RAMP 1000;Duration 1000;

  LIST:DATA002 AMP 0,0,0;PHASE 0,-120,-240;FREQ 50;RAMP 0;Duration 200;

  LIST:DATA003 AMP 220,220,220;PHASE 0,-120,-240;FREQ 50;RAMP 0;Duration 2000;

  LIST:DATA004 AMP 110,110,110;PHASE 0,-120,-240;FREQ 50;RAMP 0;Duration 500;

  LIST:DATA005 LOOPE 9; AMP 220,220,220;PHASE 0,-120,-240;FREQ 50;RAMP 0;Duration 2000;

- **Description 2:**

  5 steps simulate a voltage drop to 0, recovery, then a drop to 50%, then recovery, using a cyclic command to achieve

  repeat execution 10 times.

* **Note:** Can be set to loop 50000 times. And it supports nested loops, up to 16 layers.

(7) Jump to next step when the phase angle is XXX degrees (COND_PHASE1, COND_PHASE2, COND_PHASE3)

- **Commands:**

  LIST:DATA001 AMP 220,220,220;PHASE 0,-120,-240;FREQ 50;OFFSET 0,0,0;RAMP 1000;Duration 1000;

  COND_PHASE1 90;

- **Description:**

  Set to jump to the next step when the phase angle of phase A is 90°.

(8) When setting the AC sequence, user need to add the mode identification when choose the CC/CP/CR mode in load mode.

- **Commands:**

  LIST:DATA001 CC;AMP 10,10,10;PHASE 0,0,0;RAMP 1000;Duration 1000;

  LIST:DATA001 CP;AMP 5,5,5;PHASE 0,0,0;RAMP 1000;Duration 1000;

  LIST:DATA001 CR;AMP 20,20,20; RAMP 1000;Duration 1000;

- **Description:**

  When setting the AC sequence, user need to add the mode identification when choose the CC/CP/CR mode in load mode.

* **Note:** If the mode identification in the steps does not match the mode in the HOME - MODE, the parameters set by the sequence will not be executed.

(9) Set the Ramp Time

- **Commands:**

  Ramp 100;

- **Description:**

  Set the Ramp Time to 100ms

(10) Set the Duration Time

- **Commands:**

  Duration 100;

- **Description:**

  Set the Duration Time to 100ms

(11) Output enable identification (OUTEN)

- **Commands:**

  OUTEN 0/1;

- **Description:**

  Set the output enable 0 or 1; if the output enable is 0 when the current step is executed, the output pulse will be blocked.

* **Note:** It will effective only when "Enable Phase-shifting" is checked in the "Configuration" – "System".

(12) Query information

     *IDN

       BriPower, KGS15

(13) Set the protection value

     PARA:OVP 300

     PARA:OVP?

       300.00

     PARA:OCP 225

     PARA:OCP?

       225.00

(14) Set the hardware limits value

    PARA:ILIM 30

    PARA:ILIM?

      30.00

(15) Check status

     STAT:FAULT?

       0   //No faults

     STAT:READY?

       1   //the unit is in standby status

   STAT?

    0 0 0 1

(16) Inquire Measurements

   MEAS:UA?;MEAS:UB?;MEAS:UC?

     220.00; 220.00;220.00;

(17) Power on in standard mode

     MODE:VCL 0

     MODE:SRC 0

STAT:READY?

    1

ACSET 50,220,220,220,0,-120,-240,30,30,30,5,5,5,0,0

POWER ON

STAT:POWER?

    1

OUTPUT ON

STAT:OUTPUT?

    1

MEAS:UA?

    220.00

(18) Power on in sequence mode

MODE:VCL 0

MODE:SRC 1

STAT:READY?

    1

LIST:CMD CLS   *// Clear the sequence commands that may be executing normally*

LIST:CMD DEL   *// Delet the previously set sequence commands*

LIST:DATA001 AMP 220,220,220;PHASE 0,-120,-240;FREQ 50;OFFSET 0,0,0;RAMP 1000;Duration 1000;

LIST:DATA002 AMP 110,110,110;PHASE 0,-120,-240;FREQ 50;OFFSET 0,0,0;RAMP 1000;Duration 1000;

LIST:COUNT?   *// Queries how many sequences are currently set*

    2

LIST:CMD EXE   *// Execute the sequence, if the output is not started, wait for the output to start before starting*

execution

POWER ON   *//Power on*

STAT:POWER?   *// Check if the power on is successful*

    1

OUTPUT ON   *// Output on*

STAT:OUTPUT?   *// Check if the output on is successful*

    1

MEAS:UA?   *// Query the voltage measurement of phase A*

220.00

MEAS:UA?

110.00