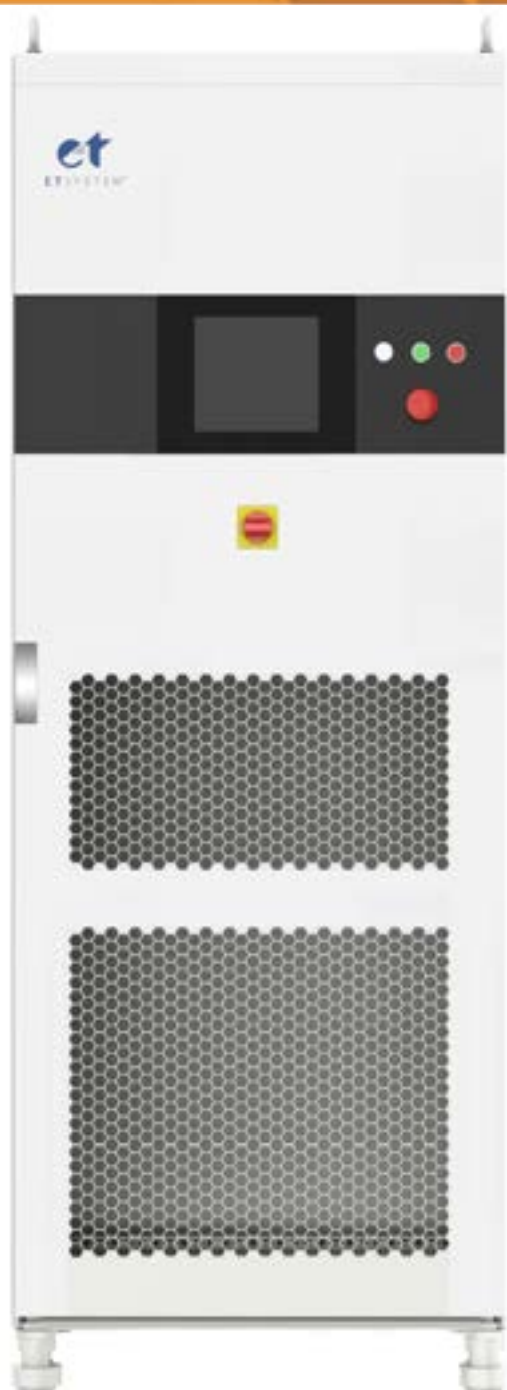


Manual



INFO & CONTACT ADDRESSES

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

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

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

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

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The pictures used in this manual do not represent the pictures of the products actually 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 ET System.

Software Statement

LAB/SLV1 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
May, 2020	Revision 2.0	Complete the manual
January, 2023	Revision 3.0	Update software interface of Battery Test Update software interface of PV Simulation Modified the description of input phase sequence Update the SCPI command and examples

Safety Requirements

Summary of safety requirements

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

- **Unpacking**

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

- **Surroundings**

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

- **Operator**

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

- **Visual Inspection**

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

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, will result in serious injury or death.



WARNING

Potentially dangerous situation or practice. If not avoided, may result in product damage or loss of important data.



SHOCK HAZARD

The risk of electrical hazards. For example: The maximum voltage of LAB / SLV1 series can reach 2000VDC and above, which may cause personal injury or death. To avoid the risk of electrical hazards, the equipment must be firmly connected to the ground wire and other equipment wiring; within a few seconds after turning off the equipment, the high voltage at the output terminal may be maintained, and do not touch the cable or the terminal block immediately.



IMPORTANT INFORMATION

Important information when operating the equipment / software.

Content

Safety Requirements	4
Summary of safety requirements	4
Safety Notices and Symbols	5
Chapter 1 Equipment Introduction	9
1.1 System Overview	10
1.1.1 Overview of LAB/SLV1 series	10
1.1.2 Model description	10
1.1.3 Features and configuration	10
1.1.4 General Specification	11
1.2 Appearance and structure of Equipment	13
1.2.1 Appearance and outline	13
1.2.2 Front Panel	14
1.2.3 Rear panel	15
1.2.4 Internal Structure	16
1.2.5 Front panel of control module	16
1.2.6 Connection layer and the other interface layer	17
1.3 Interface Description	19
1.3.1 LAN interface	19
1.3.2 RS485 interface	20
1.3.3 CAN Interface (-CAN Option)	21
1.3.4 RS232 interface (232 option)	23
1.3.5 ATI Interface (-ATI option)	25
1.3.6 External emergency stop interface (standard)	26
1.3.7 Remote sense interface	27
1.3.8 Master slaver interface (-MS option)	29
Chapter 2 Equipment Installation	30
2.1 Check before Installation	31
2.1.1 Check the packing	31
2.1.2 Check the equipment	31
2.2 Equipment Installation	32
2.2.1 Selection of input/output cables	32
2.2.2 Installation steps	32
2.3 Equipment Installed in Parallel	36

Chapter 3 Equipment Operation	39
3.1 Power-on Operation	40
3.2 GUI Software Operation (Local Control)	42
3.3 GUI Software Operation (Remote Control)	43
3.4 Power-off Operation	43
Chapter 4 Software Introduction	45
4.1 Battery Simulation.....	46
4.2 Battery Test	47
4.3 PV Simulation (-PV Option)	48
4.4 Re-regenerative DC Load (-LD Option)	49
4.5 Low Voltage Operation Mode (-ZV Option)	49
Chapter 5 Software Interface.....	50
5.1 GUI Software Introduction.....	51
5.1.1 Operating status.....	51
5.1.2 Operating mode	52
5.1.3 Input/output controls	53
5.2 Communication Setting.....	54
5.3 Hardware Limits.....	56
5.4 Output Setting	58
5.5 Sequence	59
5.6 Battery Simulation.....	61
5.7 Battery Test	63
5.8 PV Simulation.....	66
5.8.1 I-V curve setting	66
5.8.2 Dynamic MPPT test.....	67
5.8.3 Static MPPT test	69
5.9 Measurement	75
5.10 Waveform.....	72
5.10.1 Real-time waveform browsing.....	72
5.10.2 Historical waveform browsing.....	73
5.11 System Status	74
5.12 Administrator Account.....	75
Chapter 6 Equipment verification and calibration.....	76
6.1 Performance Verification.....	77
6.1.1 Verify equipment and settings	77

6.1.2	Verity content.....	78
6.2	Test Record Form.....	81

Chapter 7 Equipment Maintenance and Repair82

7.1	Equipment Maintenance.....	83
7.1.1	Equipment operating environment.....	83
7.1.2	Equipment maintenance.....	83
7.2	Equipment Repair	84
7.2.1	Equipment self-test.....	84
7.2.2	Maintenance service.....	84
7.2.3	Equipment return	84

Chapter 8 Programming.....85

8.1	Command Format.....	86
8.1.1	Parameters data type	86
8.1.2	Command parameters/Return valve units.....	86
8.1.3	Command format.....	86
8.2	Command Sets	87
8.3	Example.....	94

Chapter 1 Equipment Introduction

1.1 System Overview

- 1.1.1 Overview of LAB/SLV1 series**
- 1.1.2 Model description**
- 1.1.3 Features and configuration**
- 1.1.4 General specification**

1.2 Appearance and Structure of Equipment

- 1.2.1 Appearance and outline**
- 1.2.2 Front panel**
- 1.2.3 Rear panel**
- 1.2.4 Internal structure**
- 1.2.5 Control module of front panel**
- 1.2.6 Connection layer and the other interface layer**

1.3 Interface Description

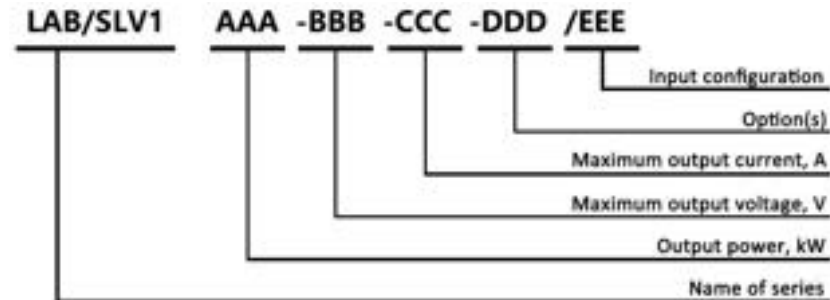
- 1.3.1 LAN interface (standard)**
- 1.3.2 RS485 interface (standard)**
- 1.3.3 CAN interface (-CAN option)**
- 1.3.4 RS232 interface (-232 option)**
- 1.3.5 ATI interface (-ATI option)**
- 1.3.6 External emergency stop interface (standard)**
- 1.3.7 Remote sense interface (standard)**
- 1.3.8 Master slaver interface (-MS option)**

1.1 System Overview

1.1.1 Overview of LAB/SLV1 series

The LAB/SLV1 series is IGBT PWM switching DC power supply, which contains multi output power levels from 30kW to 500kW for single system, up to 4 individual systems can be paralleled to up to 2MW system. Output power level of customized system goes up to 4MW and above, it can be available for automated test applications.

1.1.2 Model description



1.1.3 Features and configuration

- Single system up to 500kW, up to 4MW and above
- Output voltage up to 2000V(std)
- Applications: battery simulation, battery test (-BSS option), PV simulation (-PV option)
- Program accuracy up to 0.1%
- Seamless transition between source and sink modes (-R option)
- Current rise time (10% -90%) <1ms (-BSS option)
- Soft start: effectively restrain the impulse current when power on
- CC/CV/CP/CR mode available
- Regenerative DC load function (-LD option)
- Hardware & software for PV Simulation (-PV option)
- Low-Voltage operation mode (-ZV option)
- Master-Slave interface (-MS option)
- Use water-cooling (-W option)
- LAN/RS485 interfaces (standard)
- CAN/RS232/ATI interfaces (-CAN/-232/-ATI option)
- Emergency stop button and indicators on front panel
- TFT-Touch panel operation

- Mod-bus/SCPI protocols
- Output terminal insulation monitoring function (-INS option)
- Output contactor
- Remote sense
- CE conformity
- Customized voltage, current and power ranges

1.1.4 General Specification

AC Input	
AC input Voltage	3P+N+PE, 380VLL±10%(std)
Frequency	47-63Hz
Efficiency	≥90%
Power Factor	0.95
Output	
Output Modes	CV, CC, CP and CR
Power Level	Up to 500kW in single controller, customized to 4MW and above.
Voltage Ranges	Up to 2000V
Current Ranges	Please refer to the Standard Models Specification
Load Regulation	0.1%FS
Line Regulation	0.1%FS
Voltage Ripple	0.1%FS
Stability	0.1%FS
Current Rise Time (10%~90%)	<3ms (Std), <1ms (BSS Option)
Current Rise Time (-90%~90%)	<5ms (Std), <2ms (BSS Option)
Regulation Time (0-100% Load change)	<3ms (Std), <1.5ms (BSS Option)
Power Accuracy	0.3%FS
Voltage Accuracy	0.1%FS
Current Accuracy	0.3%FS
Power Resolution	0.02kW (~100kW), 0.1kW (100kW~500kW)
Voltage Resolution	0.05V (~800V), 0.1V (800V~2000V)

Current Resolution	0.05A (~800A), 0.1A (800A~1600A), 0.2A (1600A~3200A)
Measurements	
Measurement accuracy Power	0.3%FS
Measurement accuracy Voltage	0.1%FS
Measurement accuracy Current	0.3%FS
Others	
Standard Interface	LAN/RS485
Optional Interface	CAN/RS232/AT1
Protection	OVP, OCP, OPP, OTP
CE Conformity	EN 61010, EN 61326
Cooling	Forced Air Cooling
Temperature	Operating: 0~40°C, Storage: -20~85°C
Operating Humidity	20-90%RH (None Condensing)

1.2 Appearance and structure of Equipment

1.2.1 Appearance and outline

The overall appearance of the LAB/SLV1 (take LAB/SLV1 50-400-125 as an example) is shown in Figure 1-1. There are lifting rings at the top of the cabinet for lifting operation, and moving rollers at the bottom of the cabinet, which for users to move flexibly. There are TFT-Touch panel displayer (12 inch), status indicator, power knob, emergency stop button and CAN / RS232 interface (optional) on the front panel, product brand, RS485/LAN interfaces(std) and ATI interface(optional) which for automated test applications on the rear panel.

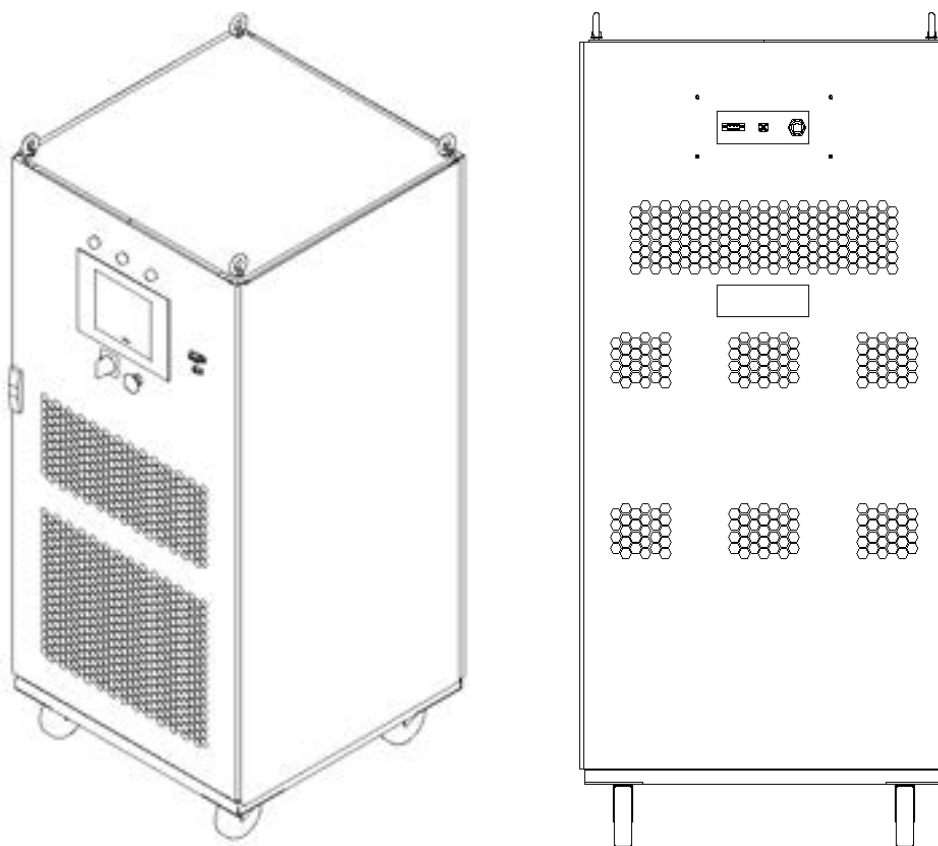


Figure 1-1 Overall appearance



IMPORTANT INFORMATION

The appearance and interface position of the equipment may vary with different voltage levels, please refer to the actual product.

1.2.2 Front Panel

The front panel of LAB / SLV1 series is equipped with a TFT-Touch panel displayer (12 inch), status indicator, power knob, emergency stop button and CAN / RS232 interface (optional).

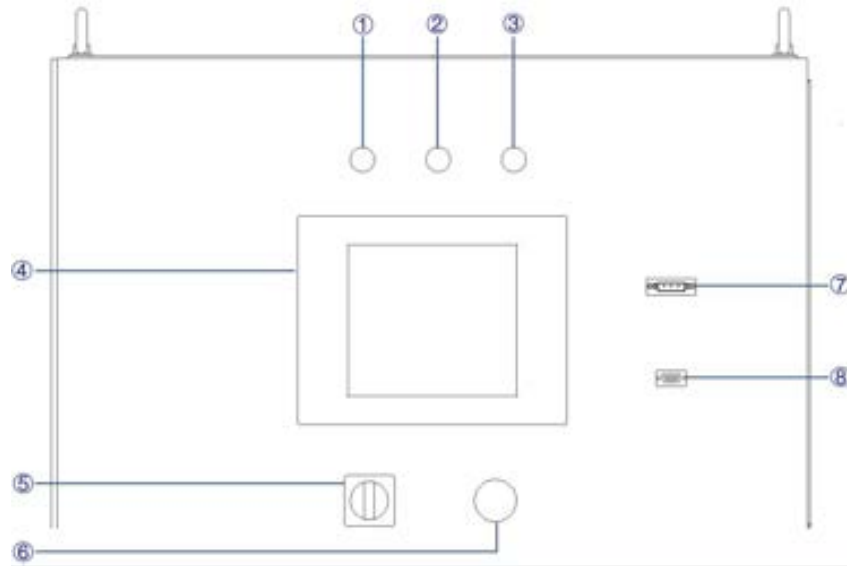


Figure 1-2 Front panel

Table 1-1

Number	Name	Notes
①	White Light	The power supply is standby.
②	Green Light	The power supply is operating normally.
③	Red Light	The power is failure.
④	TFT-Touch Panel	Capacitive TFT touch panel displayer (12 inch), using the windows OS, provides a GUI, and has the functions of setting system parameters, output parameters, measurements, capturing and saving waveform, and displaying failures.
⑤	Power Knob	The User can use power knob to turn on/off the power without opening the cabinet door. Turn the control module clockwise to power on; and turn the control module counterclockwise to power off.
⑥	Emergency Stop Button	The emergency stop button is only used in the event of an emergency. Do not press the button under normal working conditions. Turn the emergency stop button clockwise to the right can cancel the emergency braking.

⑦	CAN interface	Optional, for remote control (-CAN option)
⑧	RS232 interface	Optional, for remote control (-232 option)

IMPORTANT INFORMATION



The touch screen is a resistance screen (Figure 1-2④), which works through pressure sensing and it has good response sensitivity. Support touch input of any object (such as stylus or fingernail).

1.2.3 Rear panel

The rear panel of LAB / SLV1 series is equipped with RS485 / LAN interface (standard) and ATI interface (optional).

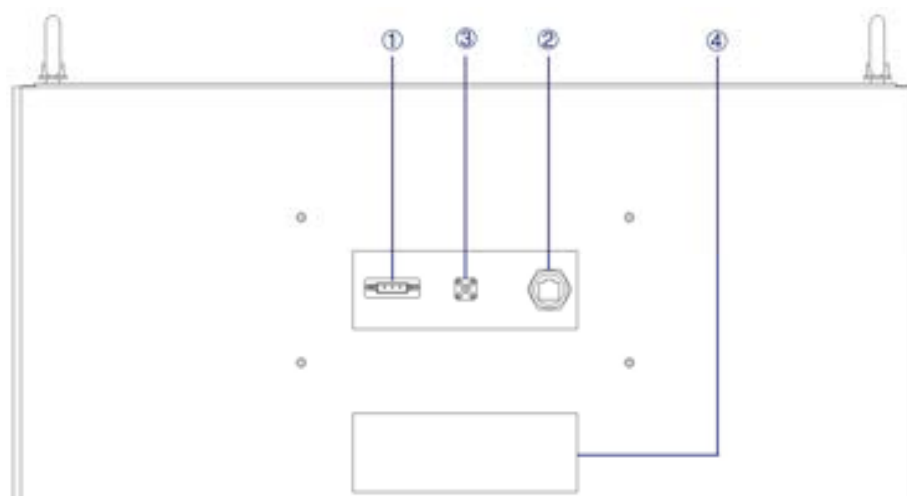


Figure 1-3 Rear panel

Table 1-2

Number	Name	Note
①	RS485 interface	Standard configuration, RS485 interface is used for remote control.
②	LAN interface	Standard configuration, LAN interface is communication interface and used for remote control.
③	ATI interface	Optional, analog control interface (-ATI option)
④	Product brand	The input / output configuration of the product is marked.

1.2.4 Internal Structure

As shown in Figure 1-4, take LAB / LAB / SLV1-400-125 as an example, from top to bottom, the internal modules of LAB/SLV1 series are: ① control box layer, ② module layer, ③ input and output component layer, ④ wiring layer and the other interface layer.

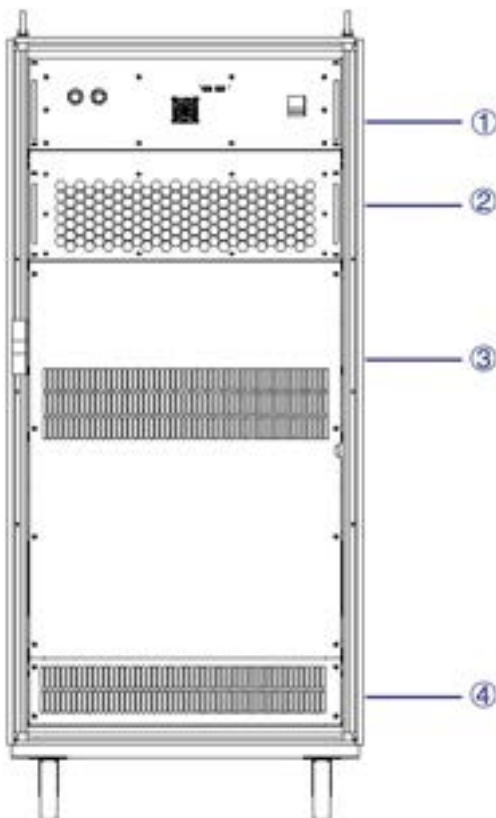


Figure 1-4 Internal structure

1.2.5 Front panel of control module

The front panel of LAB/SLV1 series control module is equipped with LAN interface (standard), parallel communication interface (optional), fan and power switch.

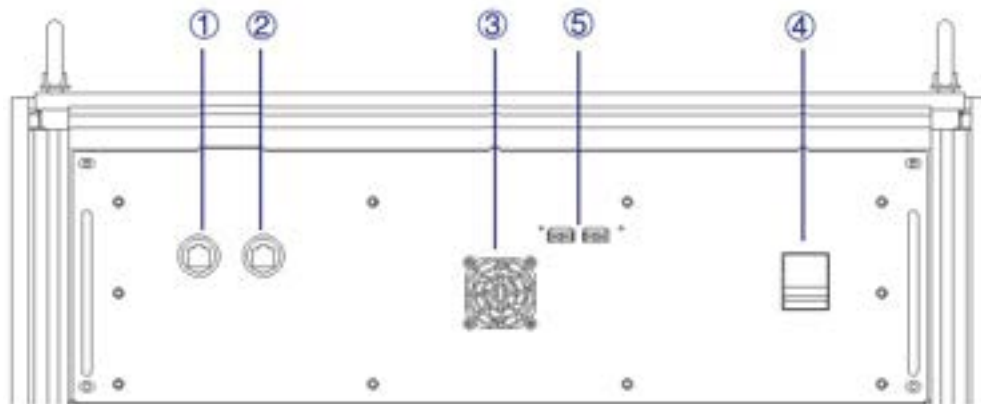


Figure 1-5 Front panel of control module

Table 1-3

Number	Number	Notes
①	LAN interface	Standard configuration, for touch screen communication
②	LAN interface	Standard configuration, for testing and firmware update
③	Fan	For control module heat dissipation
④	Power switch	For the power on/off the control module
⑤	Parallel communication interface	For communication between equipment when equipment with same power are connected in parallel. (Refer to 1.3.8.2 for specific wiring method) (-MS option)

1.2.6 Connection layer and the other interface layer

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

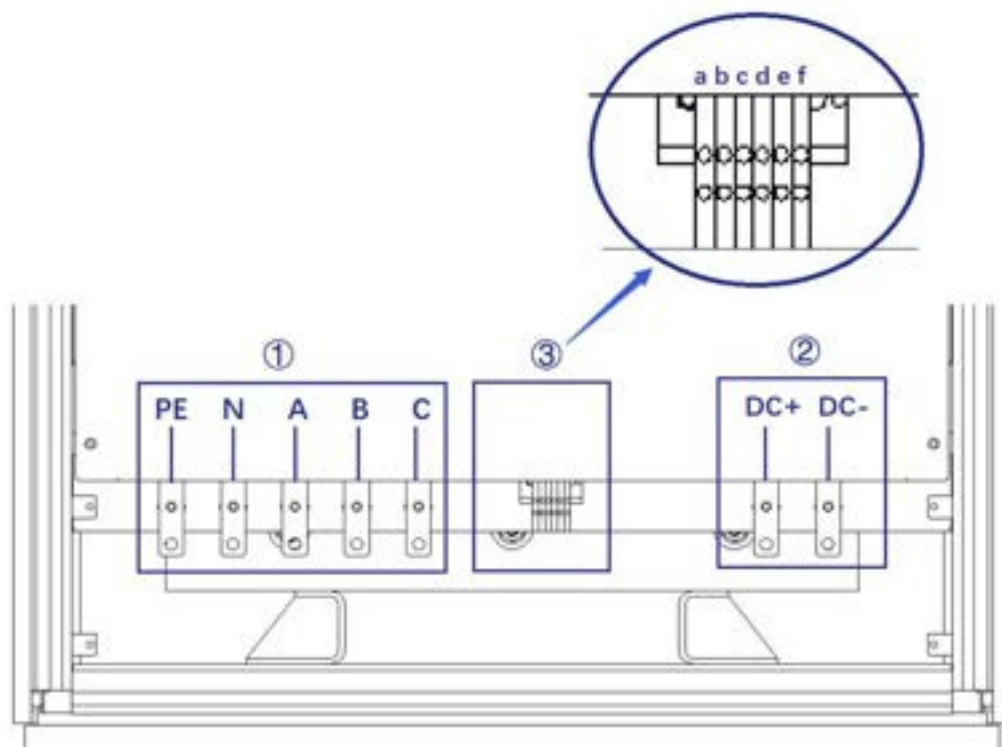


Figure 1-6-1 Power input / output connection layers (Single cabinet)

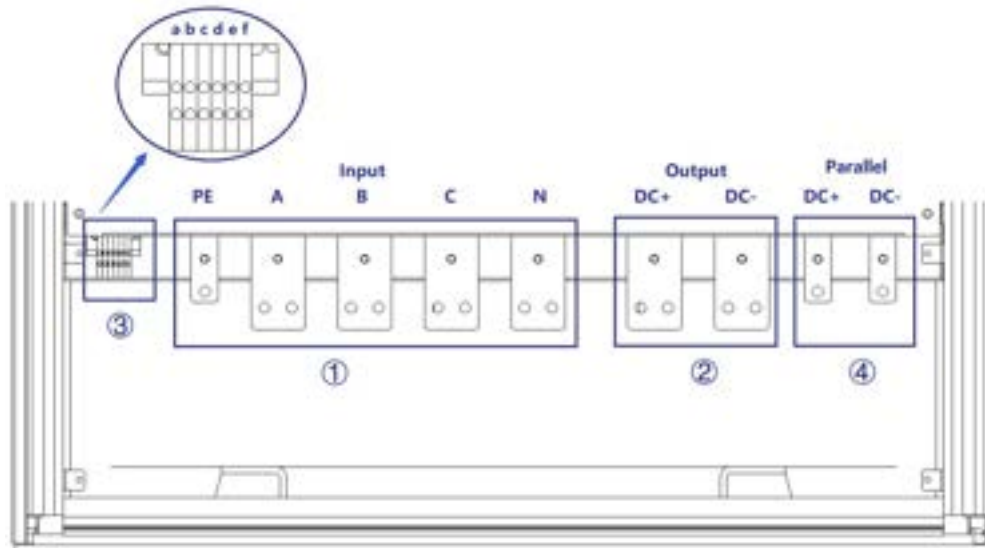


Figure 1-6-2 Power input / output connection layers (Cabinets in parallel)

Table 1-4

Number	Name	Notes
①	Wiring copper bar of the input side	From left to right are PE, N, A, B, C
②	Wiring copper bar of the output side	From left to right are DC +, DC-
③	Other terminals	a + b → Control module 220V auxiliary power terminals (+, -) (No need to wire) c + d → External emergency stop interface (+, -) e + f → Remote sense interface (DC +, DC-) (No need to wire)
④	Parallel copper bar	Used for parallel connection of equipment From left to right are DC +, DC-



IMPORTANT INFORMATION

When a single power supply is used, the power input / output wiring layer is shown as Figure 1-6-1.



IMPORTANT INFORMATION

When the output voltage of the power supply is $\geq 800V$, the position of the terminal strip (Figure 1-6-③) may change due to the clearance and creepage distance, as shown in Figure 1-6-2.



IMPORTANT INFORMATION

When the power supplies are used in parallel, the power input / output wiring layer is shown in Figure 1-6-2. Two smaller copper bars (Figure 1-6-2④) are used for parallel wiring between cabinets.

1.3 Interface Description

1.3.1 LAN interface



The LAN interface is one of the equipment communications 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).

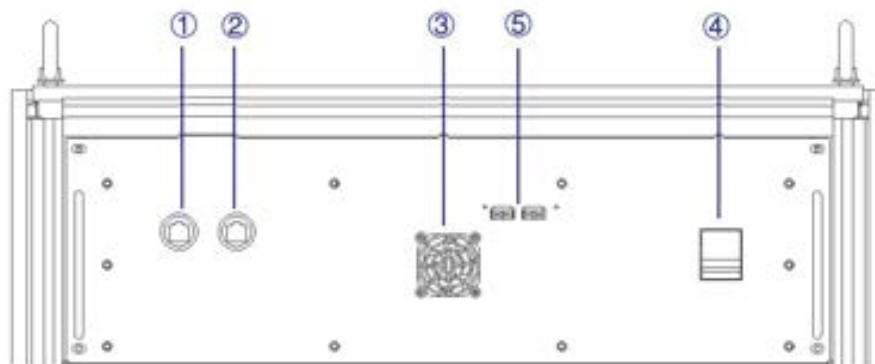


Figure 1-7 Front panel of the control module

IMPORTANT INFORMATION



The LAN interface (Figure 1-7①) is connected to the touch panel by default before shipping. 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 the equipment (Figure 1-8②).

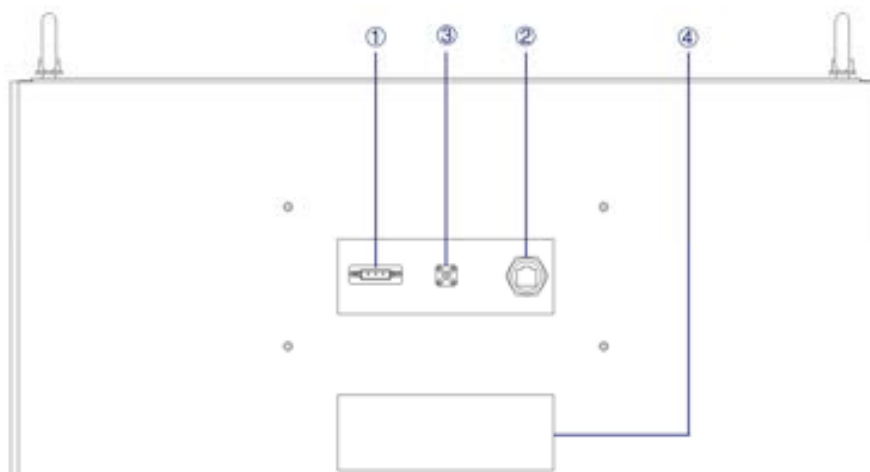


Figure 1-8 Rear panel

1.3.1.2 LAN connection

The detail information of LAN connection is in 5.2.

1.3.1.3 Remote control setting

The detail information of remote control setting is in 5.2.

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 environments with high electronic noise. RS485 makes it possible to connect to a local network and configure multi-drop communication link.

1.3.2.1 Location of RS485 interface

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

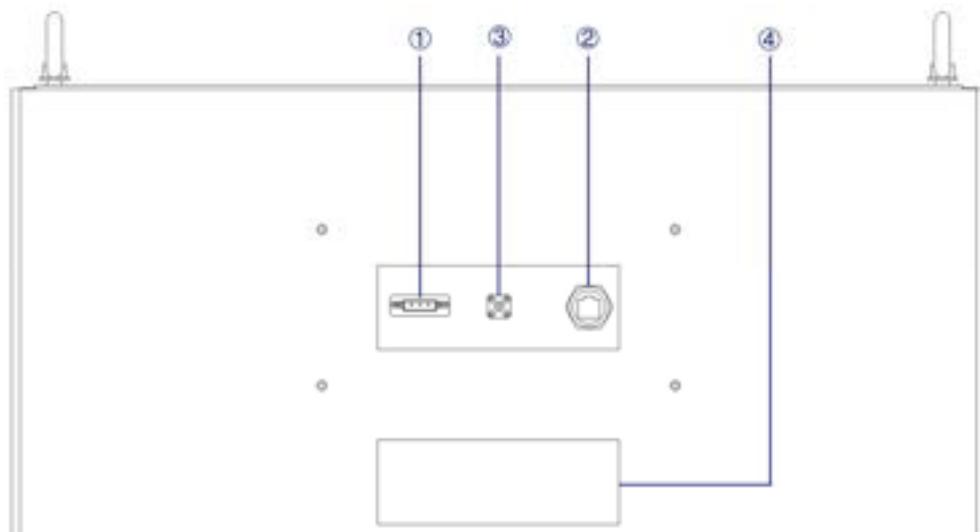


Figure 1-9 Rear panel

1.3.2.2 Connection of RS485 interface

The RS485 interface of LAB / SLV1 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 18AWG) (one pair) with impedance matching (generally 120Ω) must be used. In the environment with severe interference,

armored twisted pair shielded cable (ASTP-120Ω 18AWG) (one pair) should also be used. The connection method is shown in Figure 1-10.

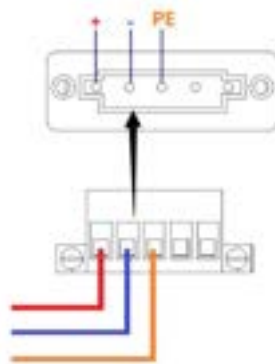


Figure 1-10 Connect RS485

The port setting information:

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

1.3.3 CAN Interface (-CAN Option)



The CAN interface is one of the equipment communications interfaces. It is a serial communication network that effectively supports distributed control or real-time control. The data communication between the nodes of the network is strong in real time.

1.3.3.1 Location of CAN interface

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

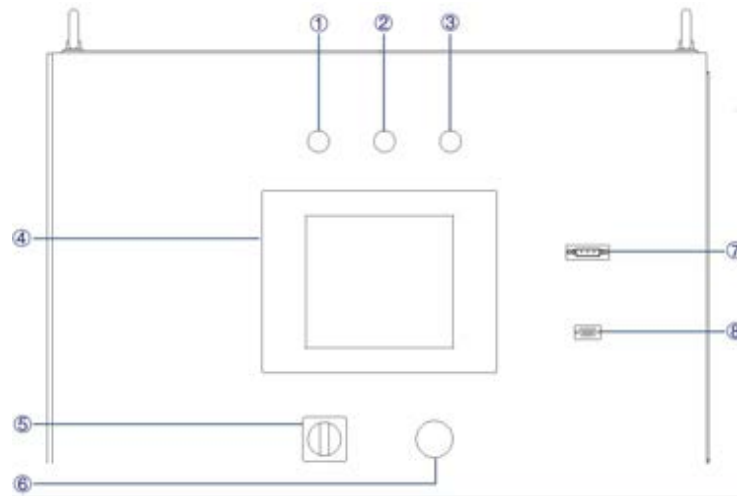


Figure 1-11 Front panel of power supply

1.3.3.2 Connection of CAN interface

The CAN interface of the LAB / SLV1 series adopts the "two-wire + signal ground" wiring method.

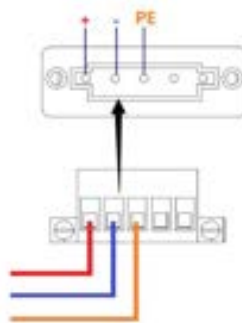


Figure 1-12 Connect CAN

IMPORTANT INFORMATION



CAN protocol might be different according to customer's specific requirement. The detailed description and specification will be provided with each unit with CAN option.

1.3.4 RS232 interface (232 option)



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

1.3.4.1 Location of RS232 interface

The RS232 interface is located on the front panel of power supply (Figure 1-13⑧).

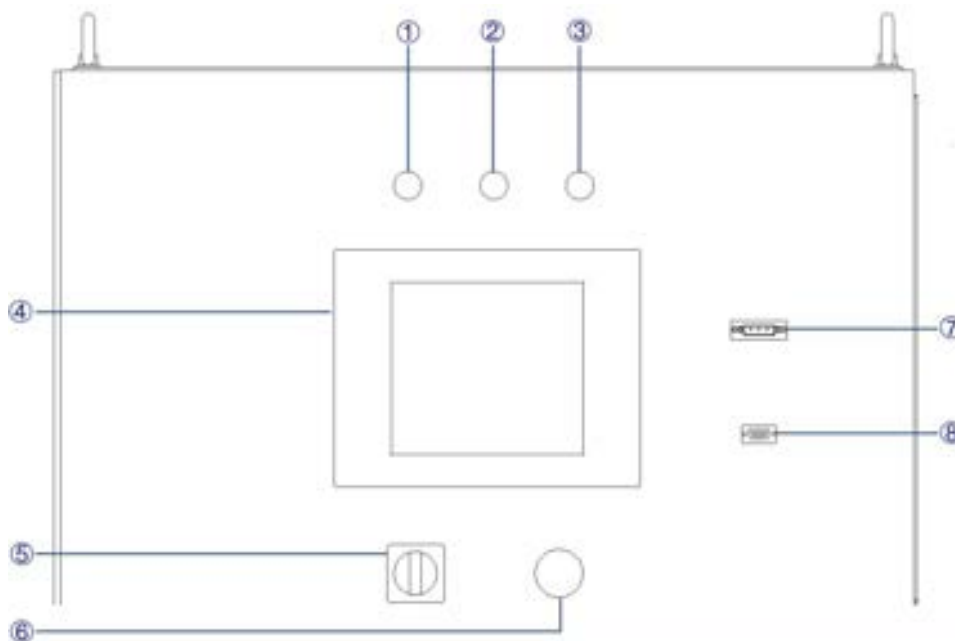


Figure 1-13 Front panel of the power supply

1.3.4.2 Connection of RS232 interface

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

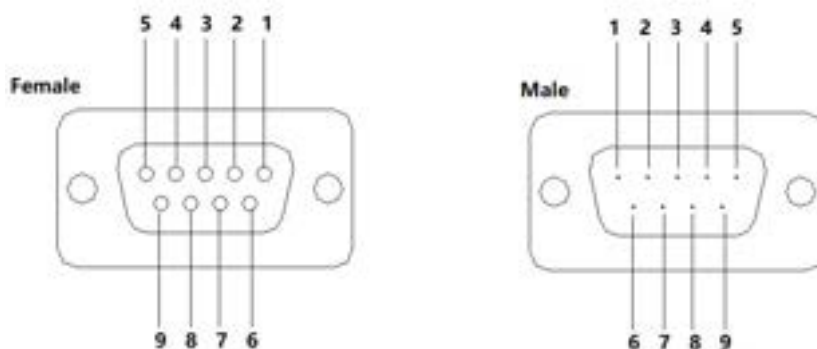


Figure 1-14 RS232 pin

Table 1-5

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

The port setting information:

Port: COM port on control PC

Baud Rate: 9600

Data Bits: 8

Stop Bits: 1

Parity: None

Flow control: None

1.3.5 ATI Interface (-ATI option)



The output voltage of power supply can be controlled via control signals and by using the analog input (ATI interface). LAB/SLV 1 series uses BNC connector for this analog input. Set points can be adjusted as dc voltage (0-5 V) on the analog input.

1.3.5.1 Location of ATI interface

The ATI interface is located on the rear panel of power supply (Figure 1-15③).

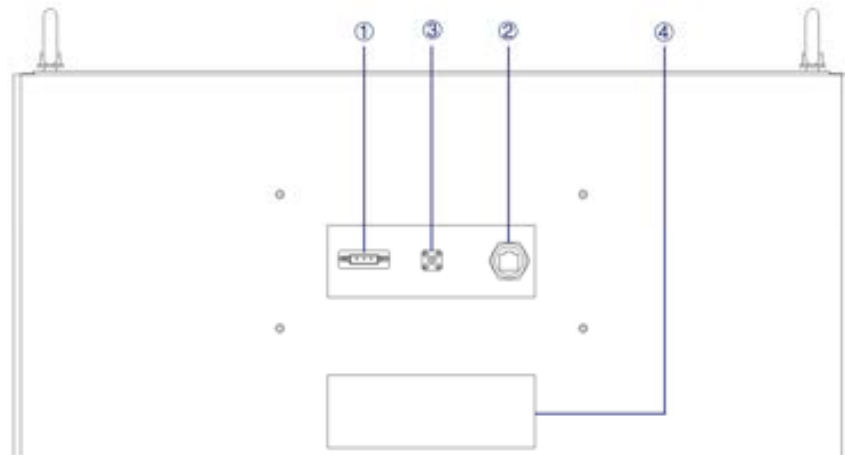


Figure 1-15 Rear panel of power supply

1.3.5.2 Connection of ATI interface

The ATI interface of the LAB / SLV1 series appears as BNC. The connection between the equipment and the signal generator is shown in Figure 1-16.

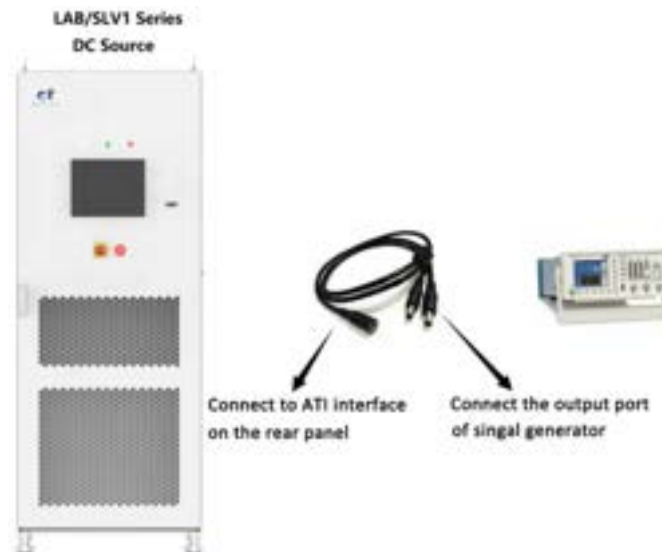


Figure 1-16 Connect ATI interface

1.3.6 External emergency stop interface (standard)

The LAB / SLV1 series provides an external emergency stop interface, which can be connected to the user's external emergency stop switch. When an emergency occurs, no need presses the emergency button on the power supply. To achieve protection action quickly, the user only needs to press this switch.

1.3.6.1 Location of emergency stop interface

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

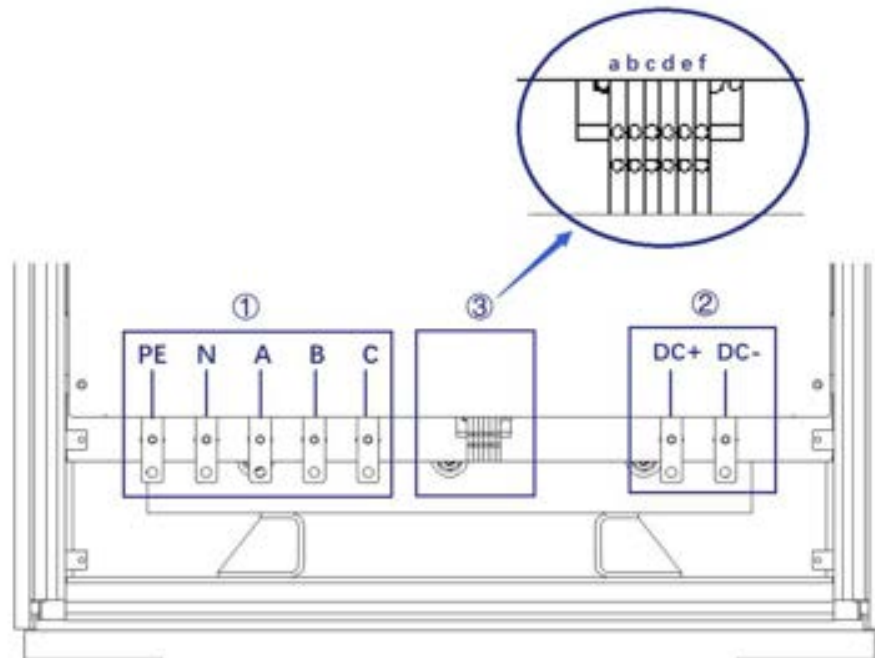


Figure 1-17-1 (Single Cabinet)

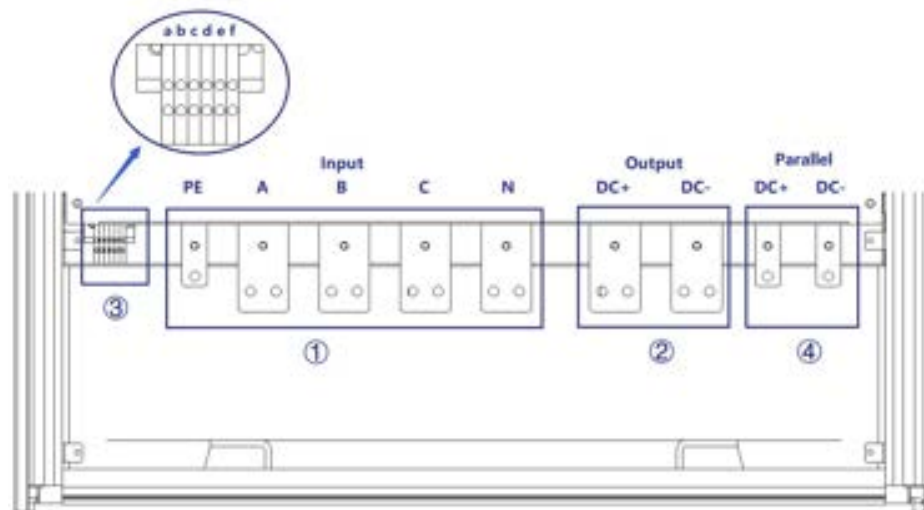


Figure 1-17-2 (Cabinets in parallel)

1.3.6.2 Connection method of emergency stop interface

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

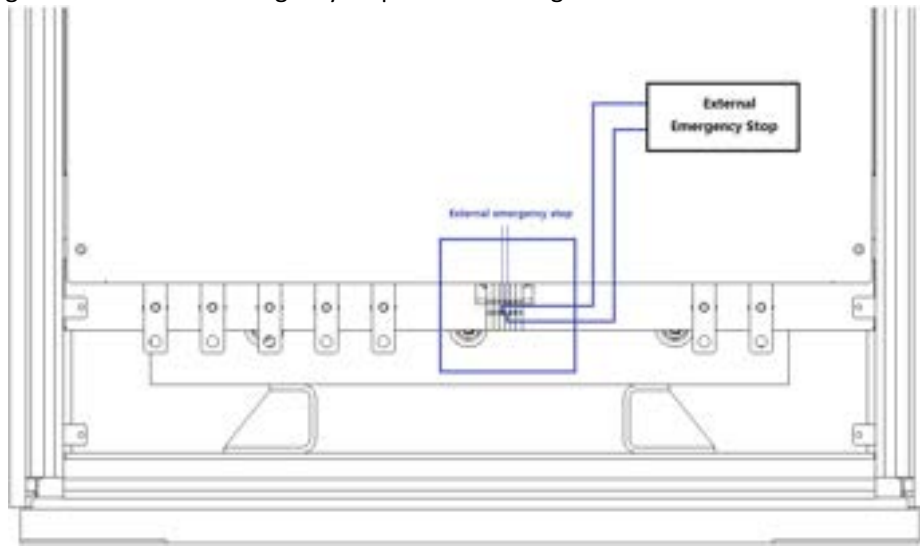


Figure 1-18 Connect emergency stop interface

IMPORTANT INFORMATION



Figure 1-18 shows the external emergency stop connection method of a single cabinet. When the power supply system is composed of cabinets in parallel, the connection method is similar to figure 1-18.

1.3.7 Remote sense interface

The remote sense line connects to the power output terminal from the remote sense port. Output voltage will be feed back to the power control circuit through the remote sense line. To achieve the accuracy, the power supply adjusts its output to compensate for the above voltage drop, so that the voltage at the power output is equal to voltage which is set.

1.3.7.1 Location of remote sense interface

The interface is located in the internal wiring layer of the power supply-③:e,f (Figure 1-19).

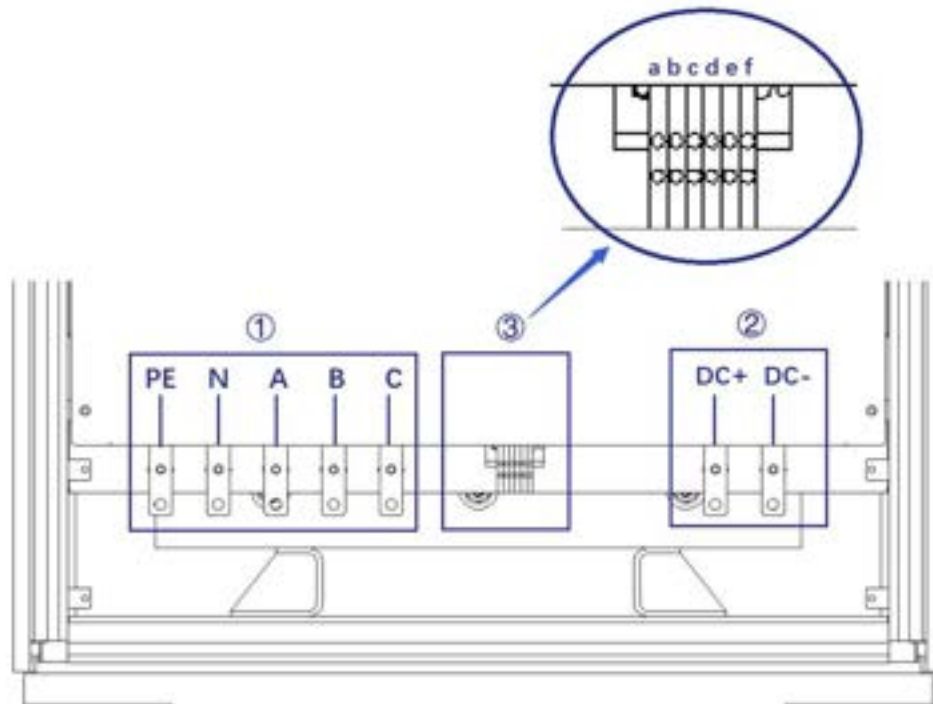


Figure 1-19-1 (Single Cabinet)

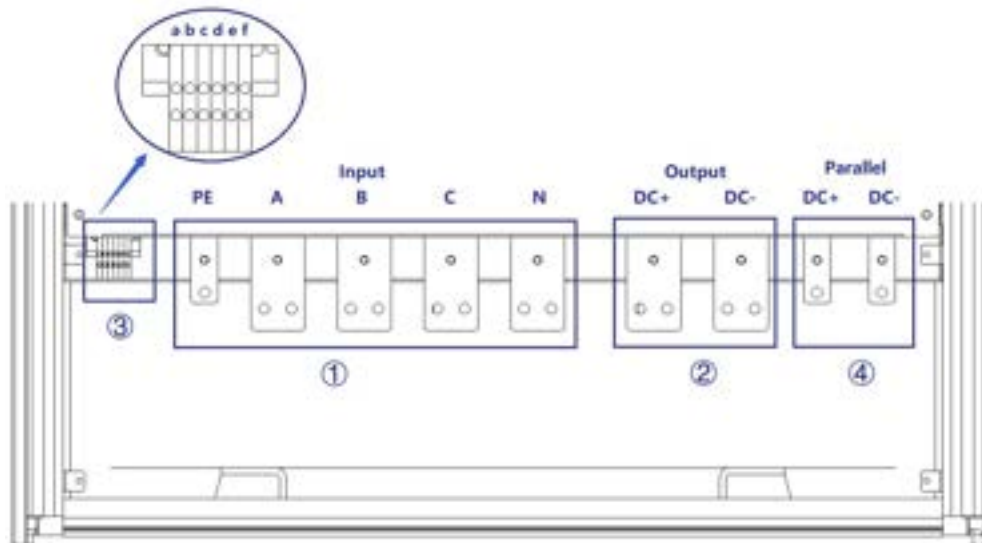


Figure 1-19-2 (Cabinets in parallel)

1.3.7.2 Connection method of remote sense interface

Please refer to 2.2.2 - step 3 for the connection method.

1.3.8 Master slaver interface (-MS option)

The power supply of LAB / SLV1 series supports parallel connection of the same power.

1.3.8.1 Location of master slaver interface

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

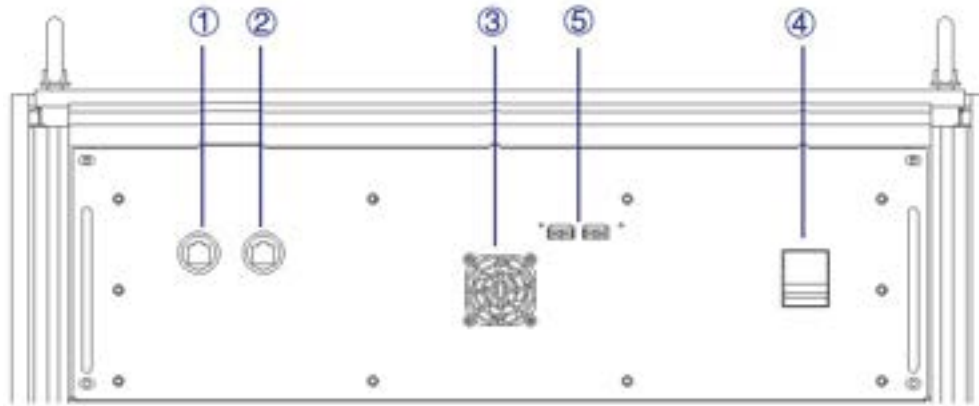


Figure 1-22 Control module of front panel

The parallel copper bar is located at the equipment wiring layer, as shown in Figure 1-23.

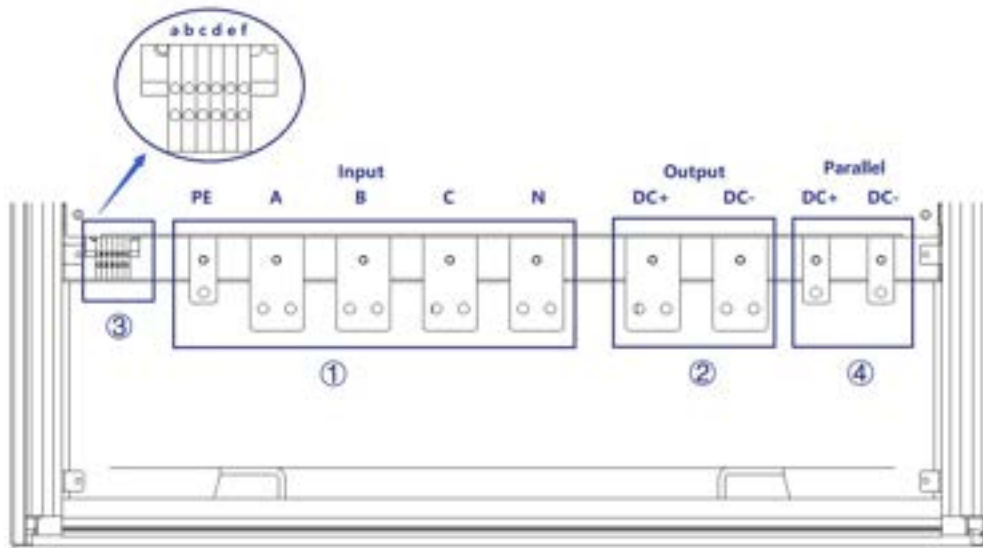


Figure 1-23 Parallel copper bar

1.3.8.2 Connection method of master slaver interface

Please refer to 2.3 for the connection method.

Chapter 2 Equipment Installation

2.1 Check before Installation

2.1.1 check the packing

2.1.2 check the equipment

2.2 Equipment Installation

2.2.1 Selection of input/output cables

2.2.2 Installation steps

2.3 Equipment Installed in Parallel

2.1 Check before Installation

2.1.1 Check the packing

When receiving the power supply of LAB / SLV1 series, if the packing is damaged, do not dispose the damaged packing or cushioning materials before checking the integrity of the goods and electrical/mechanical testing. The shipper/carrier should be responsible for product damage caused by shipment. The factory has no liability for free repair/rework/replacement of products. Please keep the packing box and packing materials and record the type of damage for returning the power supply.

2.1.2 Check the equipment

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

- There are no serious appearance defects caused by product assembly, and there are no bad phenomena such as assembly seams and breaks that exceed specifications.
- There are no defects that seriously affect the appearance of the product: 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 ET System.

2.2 Equipment Installation

2.2.1 Selection of input/output cables

Before installing the product, The user should confirm the model on the nameplate, select cables and cold-pressed terminals of appropriate specifications according to the power supply input/output voltage level and current, and connect to the grid-side AC input cable and DC output cable.



Figure 2-1 Cold-pressed terminals

WARNING



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

2.2.2 Installation steps

Step 1:

Remove the bottom baffle (Figure 2-2), the user can connect the ground protection wires PE, N, three-phase lines of grid side A, B and C, and the positive and negative output lines of DC side into the cabinet through the AC side entrance hole ① and the DC side entrance hole ② (Figure 2-3).

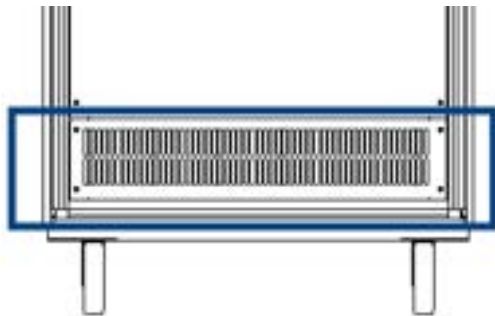


Figure 2-2 bottom baffle.

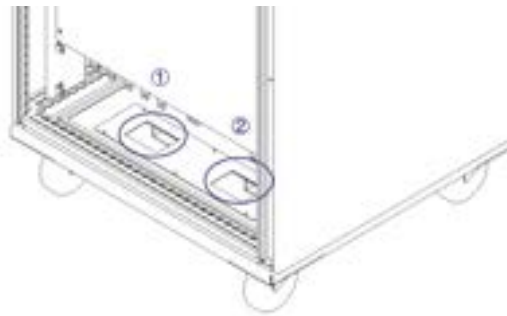


Figure 2-3 Entrance hole

Step 2:

The copper bars (PE/N/A/B/C) for the AC connection on the input side and the copper bars (DC +/DC-) for the DC connection on the output side are shown in Figure 2-4. The cables are connected to the copper bar through the inlet hole at the bottom.

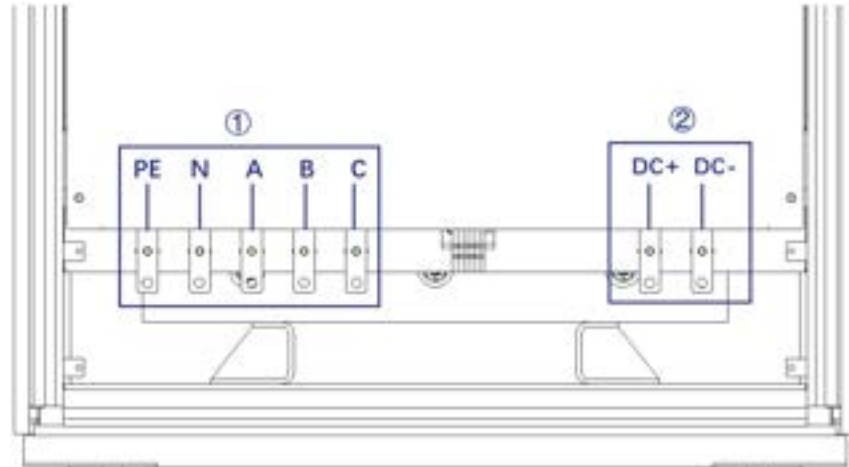


Figure 2-4-1 Copper bar (Single cabinet)

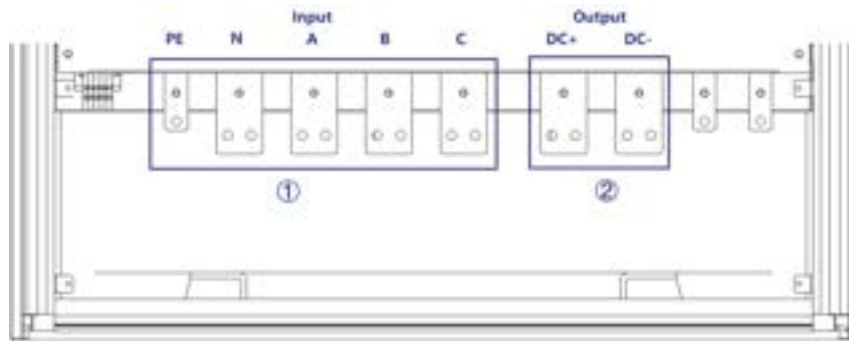


Figure 2-4-2 Copper bar (Cabinets in parallel)

**CAUTION**

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

**SHOCK HAZARD**

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

Step 3:

Check that the output side DC wiring copper bar (DC +/DC-) and the remote sense terminal (+/-) are connected (It has been connected to the output terminal before delivery, as shown in Figure 2-5).

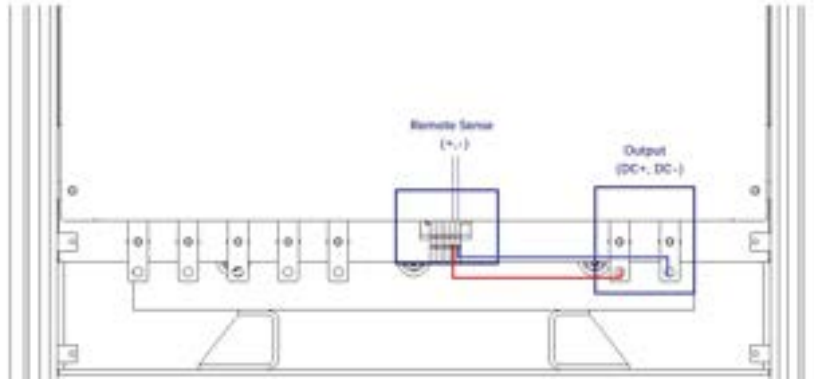


Figure 2-5 Check remote sense connection (default wiring state before delivery)

If the input end of the DUT need to be compensated, please remove the two cables, and then select a suitable cable to connect the remote sense terminal with the input end of the DUT (Figure 2-6).

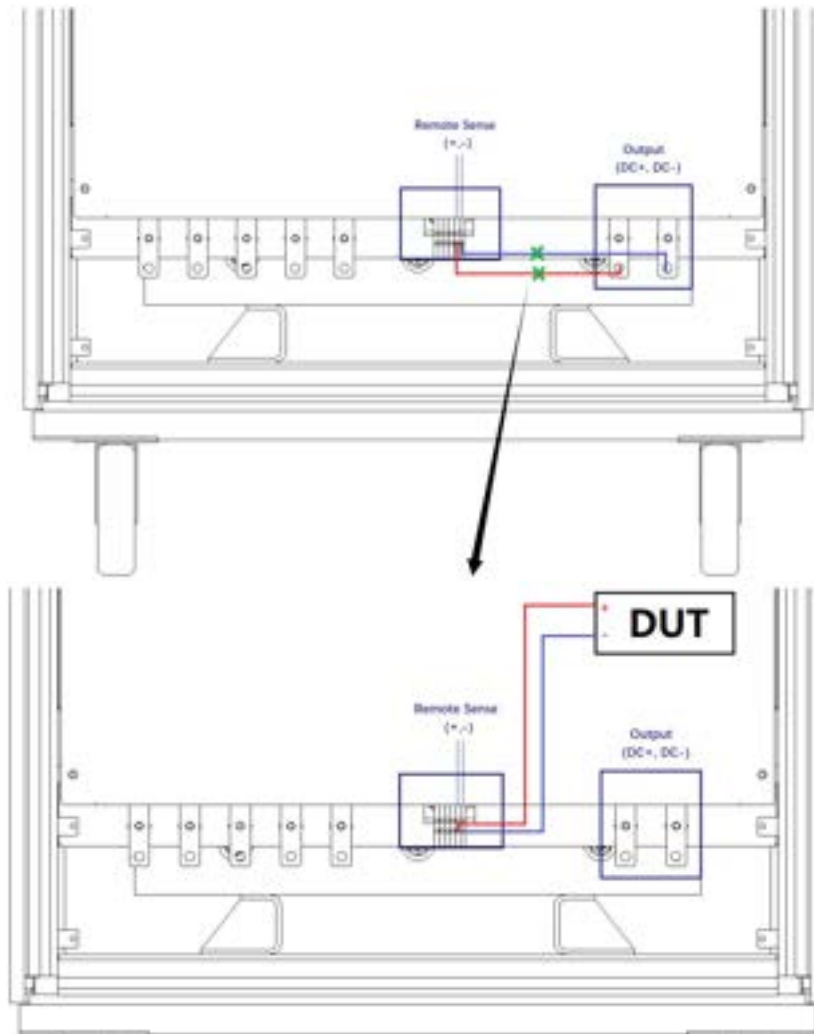


Figure 2-6 Remote sense connection

IMPORTANT INFORMATION



When remove the two lines, please wrap the tail of the lines with insulating tape to prevent electric shock.

Step 4:

After completing the above work, the wiring status of power supply is shown in Figure 2-7. Restore the bottom baffle on the front side, close the cabinet door, then, the equipment installation is complete.

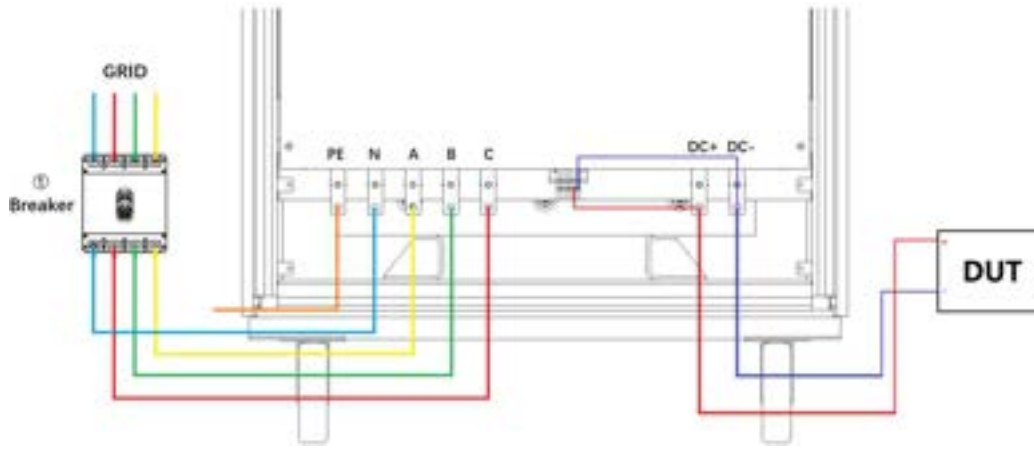


Figure 2-7 Wiring completion status (remote sense is default before shipping)

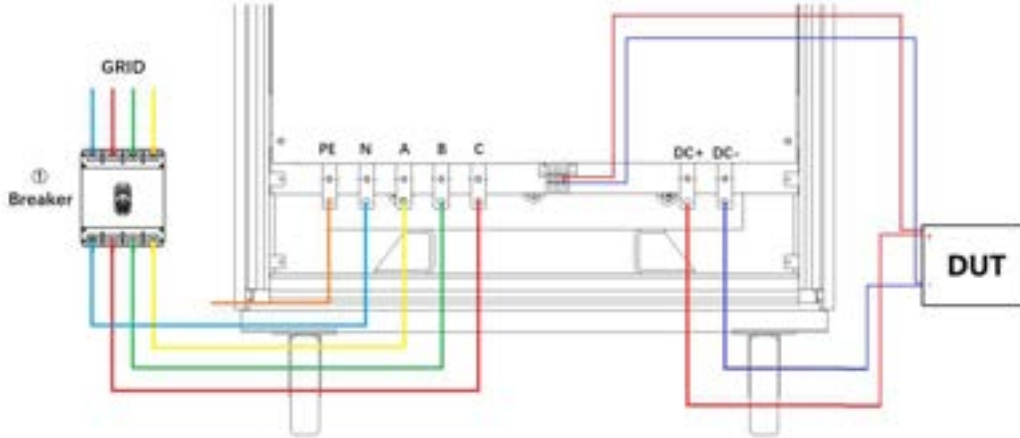


Figure 2-8 Equipment wiring completion status

2.3 Equipment Installed in Parallel

The power supply of LAB / SLV1 series support parallel connection of the same power. When connecting devices in parallel, the specific operation steps are as follows.

Step 1: Insert optical fiber cables through the cable holes on the top of the cabinet, as shown in Figure 2-9.

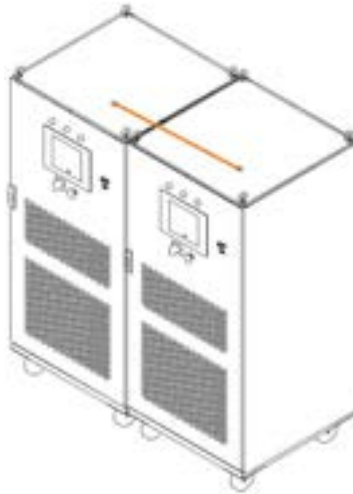


Figure 2-9 Cable holes on the top of the cabinet

IMPORTANT INFORMATION



If the parallel slave is designed to without touch screen, **the optical fiber cable and network cable** need to be inserted through the threading hole on the top of the cabinet.

Step 2: As shown in Figure 2-10, connect the optical fiber cables of the power supply.

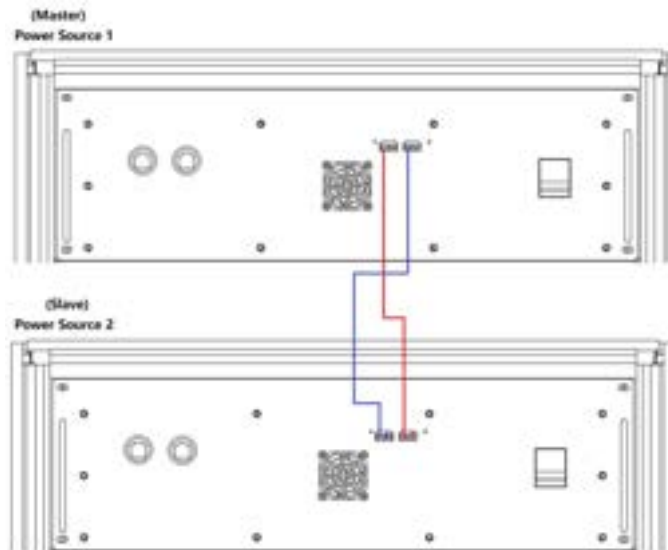


Figure 2-10 Optical fiber cable wiring diagram

IMPORTANT INFORMATION



If the parallel slave is designed without a touch screen, the fiber optic cable and network cable need to be insert through the threading hole on the top of the cabinet and connect according to Figure 2-11.

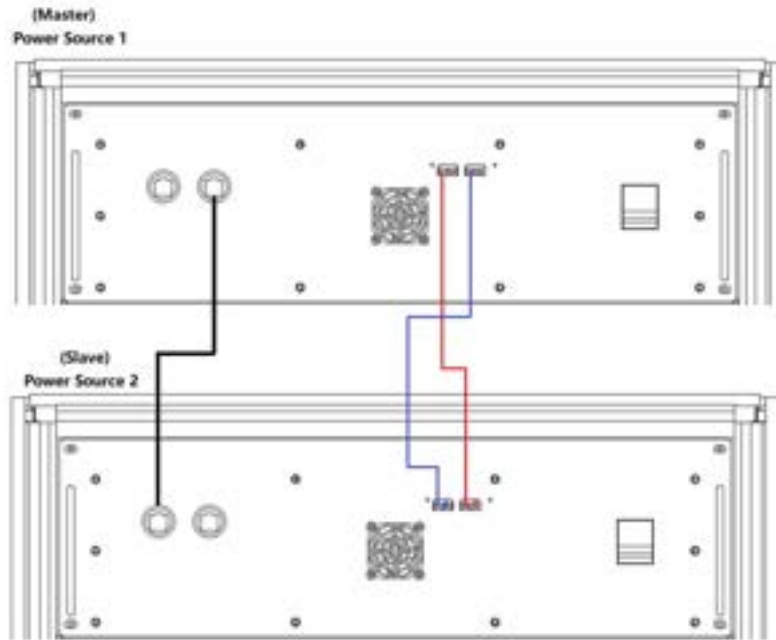


Figure 2-11 Wiring diagram of parallel communication cable

Step 3: Insert the parallel input and output cables through the threading holes at the bottom of the cabinet, as shown in Figure 2-12.

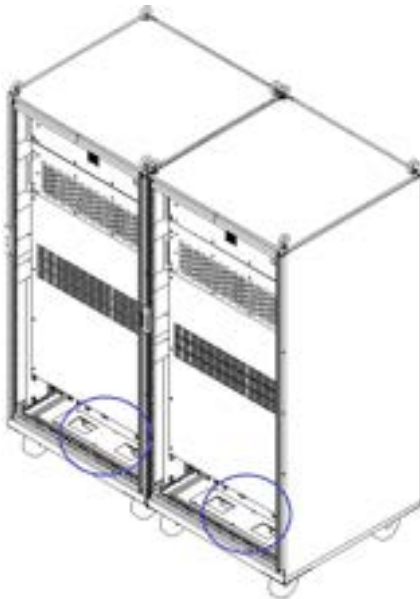


Figure 2-12 Threading holes at the bottom of the cabinet

Step 4: As shown in Figure 2-13, connect the input and output parallel cables of the two equipments.

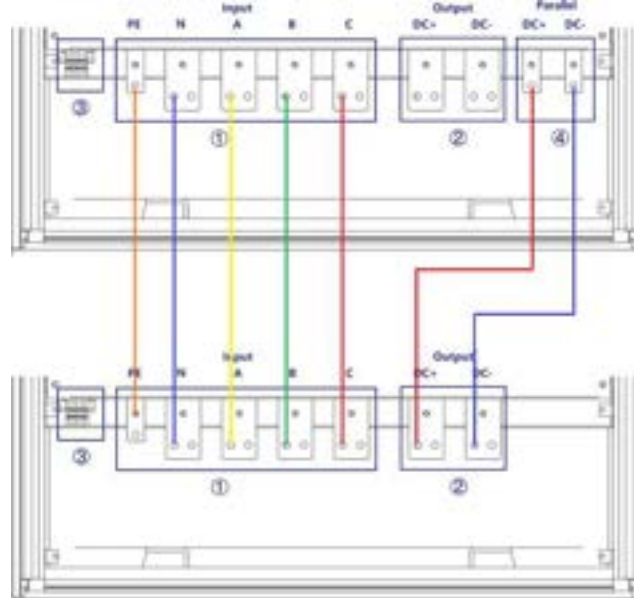


Figure 2-13 Parallel input and output cables connection

Step 5: After completing the above work, the wiring status of power supply is shown in Figure 2-14. Restore the bottom baffle on the front side, close the cabinet door, then, the equipment installation is complete.

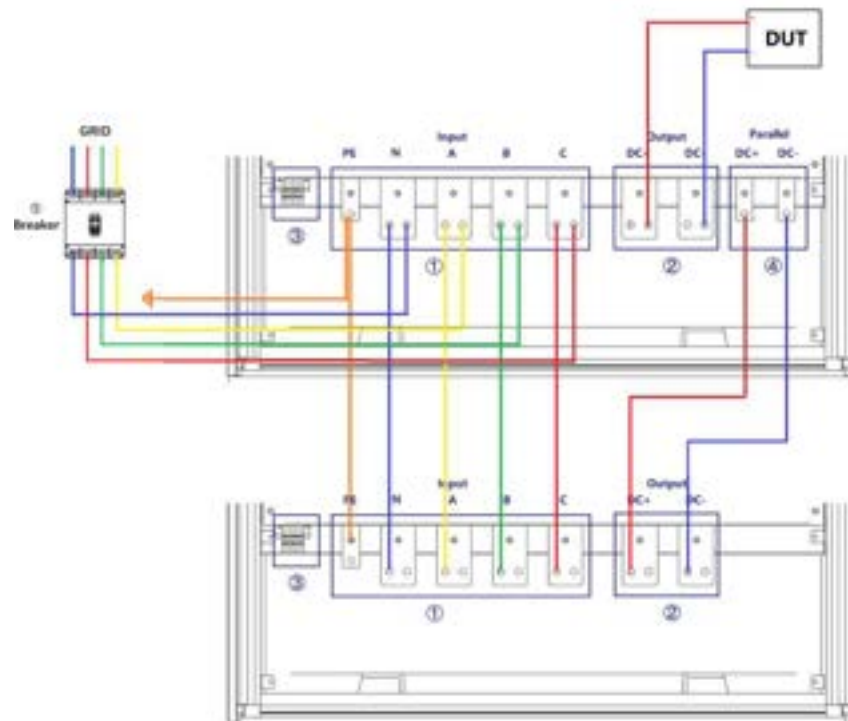


Figure 2-14 Equipment wiring completion status

Chapter 3 Equipment Operation

3.1 Power-on Operation

3.2 GUI Software Operation (Local Control)

3.3 GUI Software Operation (Remote Control)

3.4 Power-off Operation

3.1 Power-on Operation

Step 1: Power on the AC input side

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

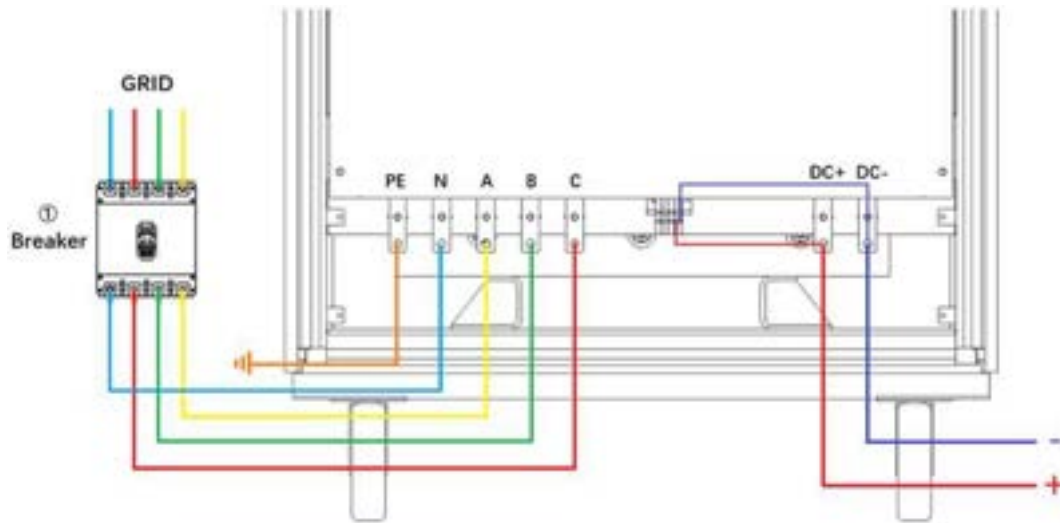


Figure 3-1 Equipment and the circuit breaker



CAUTION

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



SHOCK HAZARD

The maximum voltage generated by LAB/SLV1 series can reach to 2000VDC and above, which could 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 unit

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

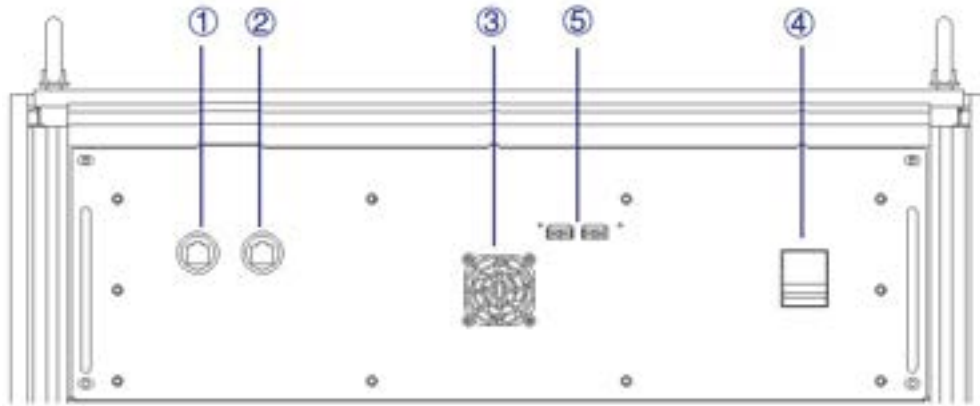


Figure 3-2 Control Modules

Step 3: Turn on power knob

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

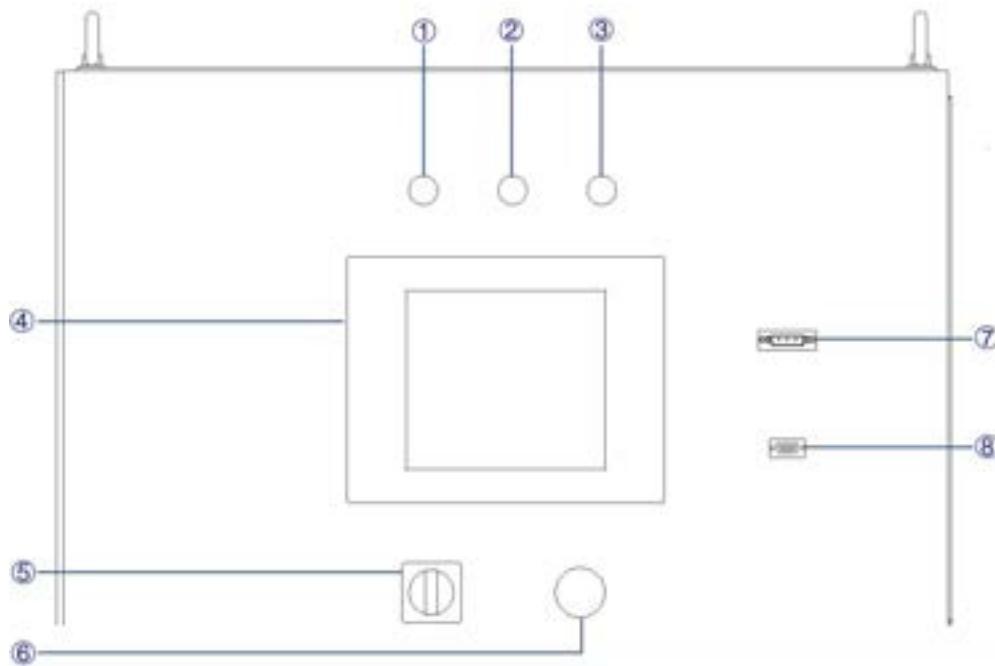


Figure 3-3 Front Panel

IMPORTANT INFORMATION



When the power supply system is composed of cabinets connected in parallel, in the step 2/3, the switches or knobs of all parallel cabinets should be switched on in sequence.

3.2 GUI Software Operation (Local Control)

GUI software is included in LAB/SLV1, and is installed on front touch panel, which uses windows OS. (the software can also be installed on the control PC connected to the power supply).

A few seconds after the power is initialized, the control unit and touch screen work, the power supply is standby. If the power supply communication is normal, the white light (Figure 3-4①) is always on. All functions and parameters can be accessed through the TFT-Touch panel or GUI software to set up and run, the "Connect" indicator on the touch screen software interface is green (Figure 3-5).

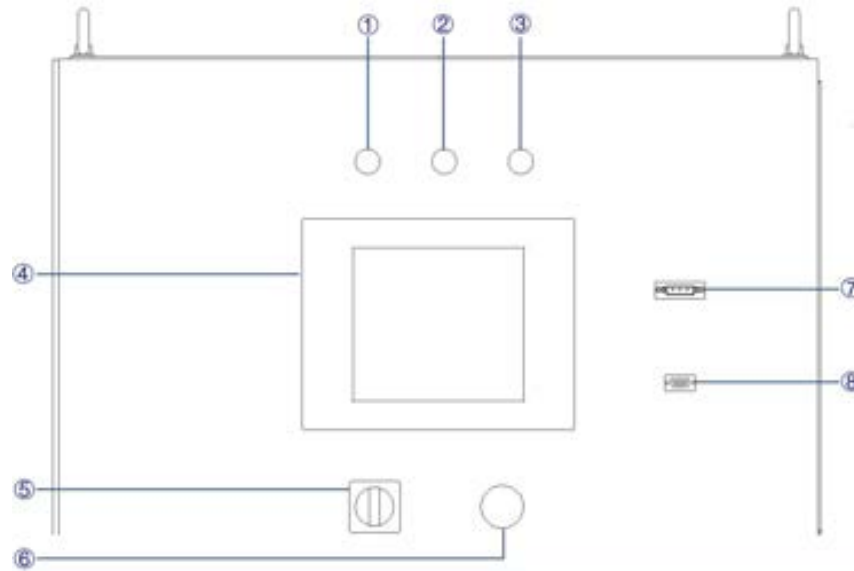


Figure 3-4 Front Panel



Figure 3-5 Touch screen software indicators

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
- Display measurements: voltage, current, power, etc.
 - Real-time display of input / output voltage, current, power and IGBT temperature and other parameters
- Capture, display and save output voltage and current waveforms.
- Display power source faults

The specific functions of the software will be introduced in chapter 5.

3.3 GUI Software Operation (Remote Control)

Please refer to 5.2 for more detail information.

3.4 Power-off Operation

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

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

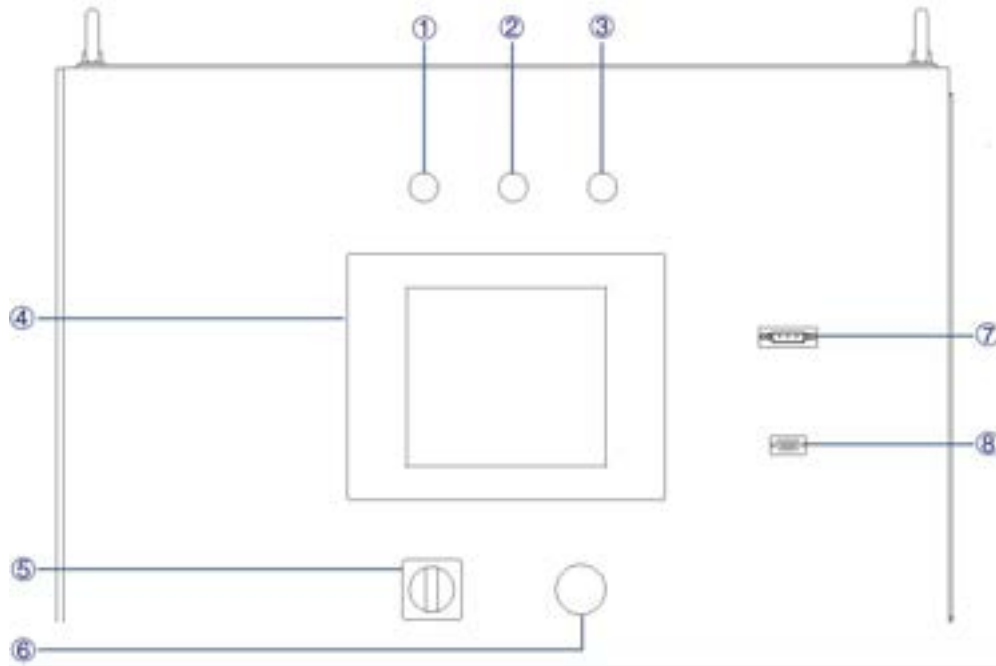


Figure 3-6

Step 3: Open the cabinet door and power off the control unit switch (Figure 3-7④).

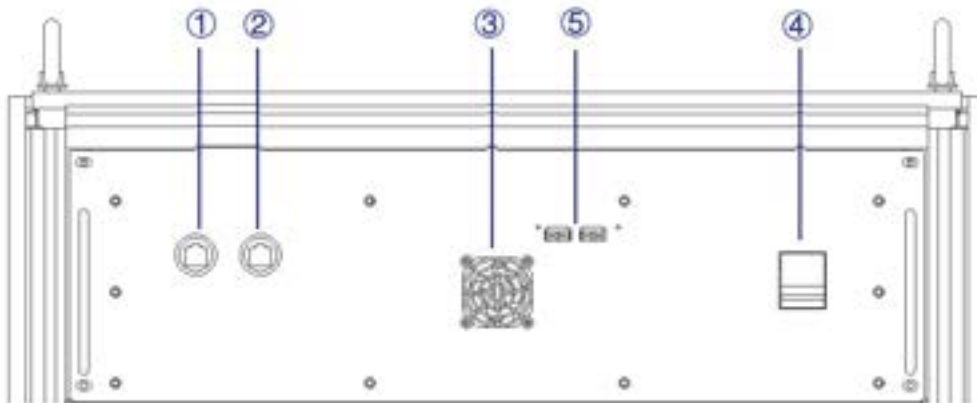


Figure 3-7

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

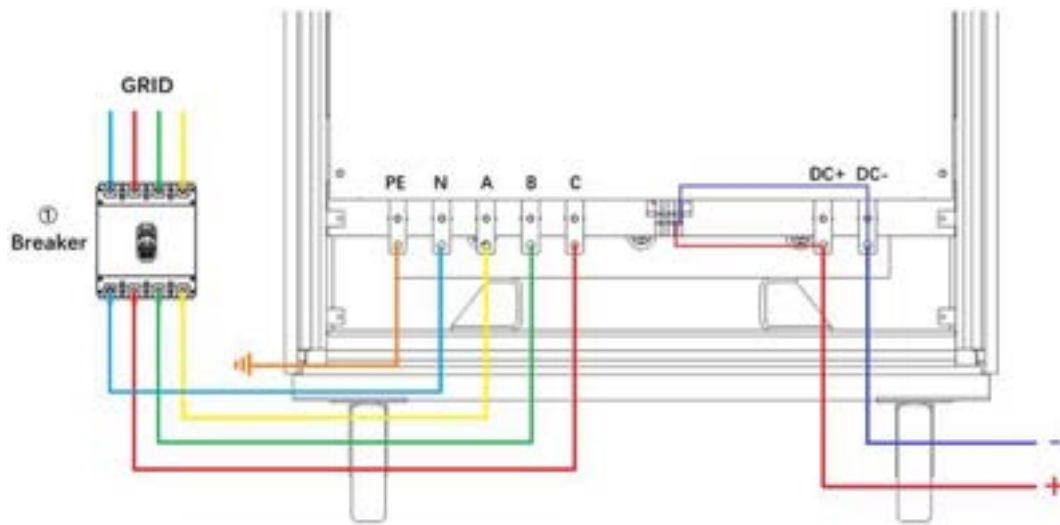


Figure 3-8

IMPORTANT INFORMATION



When the power supply system is composed of cabinets connected in parallel, in the step 2/3, the switches or knobs of all parallel cabinets should be off in sequence.

Chapter 4 Software Introduction

4.1 Battery Simulation

4.2 Battery Test

4.3 PV Simulation

4.4 Re-generative DC Load

4.5 Low Voltage Operation Mode

4.1 Battery Simulation

As an energy storage component, batteries play a key role in solar power stations, electric vehicles, and other fields. Due to the product characteristics of the battery, each application specification of the battery must be tested under all possible electrical and environmental conditions.

As an advanced battery simulator, bidirectional DC power supply of ET System LAB/SLV1 series can not only cover the full range of battery charge and discharge voltage and current, reproduce the accuracy of the charge and discharge curve, but also simulate all the features of the electrochemical storage elements in any charge or discharge activity.

The LAB/SLV1 series provides battery simulation software, which can simulate different types of batteries, lithium-ion batteries, etc., supporting multiple parameter settings, including: battery capacity, the number of cells in series and parallel, the state of charge, etc. (The simulation software is detailed in 5.6).

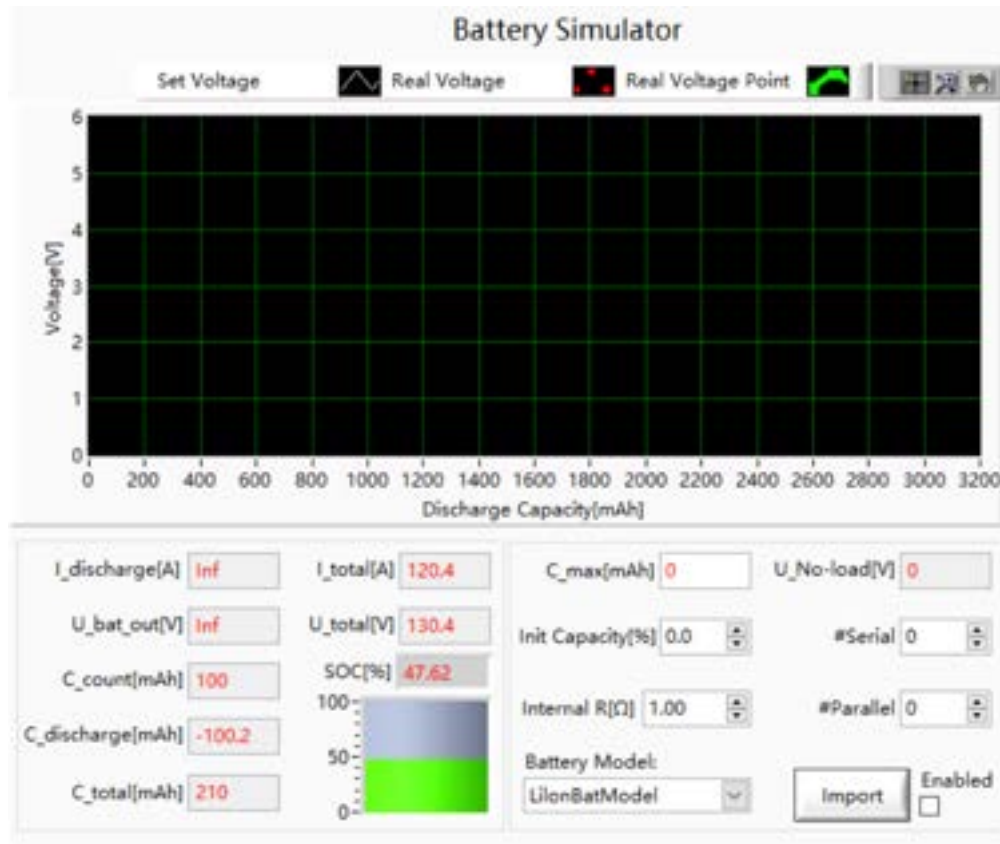


Figure 4-1 Battery simulator panel

4.2 Battery Test

LAB/SLV1 series DC power supply can be used as battery charger/discharger. It usually used to test battery cycle life, capacity, charge/discharge performance, etc. LAB/SLV1 provides battery test software, which can set parameters such as charge/discharge mode, duration, termination condition, rest time, and display the voltage and current waveforms of the battery or battery pack, so as to realize continuous tests of DUT under different working conditions. (The software is detailed in 5.7)

The 'Battery Test' software interface displays four test cycles. Each cycle has a 'Mode' dropdown, 'Time[s]' (2.0), 'Voltage[V]' (0.0), 'Current[A]' (0.0), 'Power[kW]' (0.0), 'NO.' (1-4), and 'Keyboard' button. The 'Cut-off Condition Parameter' is set to 'Discharge Voltage(V) <=' for cycle 1, 'Current(A) >=' for cycle 2, 'Current(A) <=' for cycle 3, and 'Charge Voltage(V) >=' for cycle 4. All 'RPT[s]' values are 0.0. A 'Wave' button and 'Loops' (1) are at the bottom.

Figure 4-2 Battery test panel

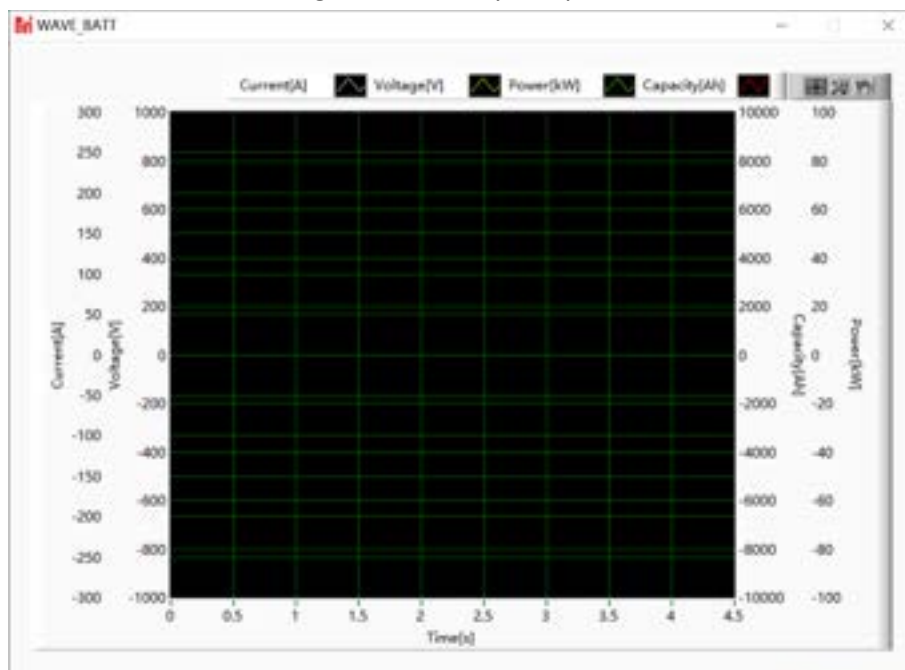


Figure 4-3 Battery test Waveform panel

4.3 PV Simulation (-PV Option)

With development of the photovoltaic industry, photovoltaic inverters are a key component of photovoltaic power generation systems, and the number of connected grids is increasing year by year. To ensure the safe operation of the power grid system, manufacturers or related R&D institutions should test the performance of products during the development or mass production of photovoltaic inverters to ensure that the products meet the relevant regulatory requirements when they are connected to the power grid, and prove whether their equipment is qualified .

With -PV option, LAB/SLV1 power supplies can be used as a photovoltaic simulator, which can simulate the output characteristics of real solar photovoltaic panels under various conditions in the laboratory test environment, to test the photovoltaic inverter the static & dynamic maximum power point tracking performance. It has the characteristics of accurate measurement, high stability, fast response speed, etc. It is widely used in the research and quality inspection of solar photovoltaic devices.

LAB/SLV1 series provides PV simulation software, which can simulate the characteristics of crystalline silicon/thin film solar cells. After simply setting the I/U characteristics, temperature, irradiance, open circuit voltage, short circuit current, peak voltage, and other parameters, the IV curve can be created. The user can call to view the test records when test is completed (The simulation software is detailed in 5.8).

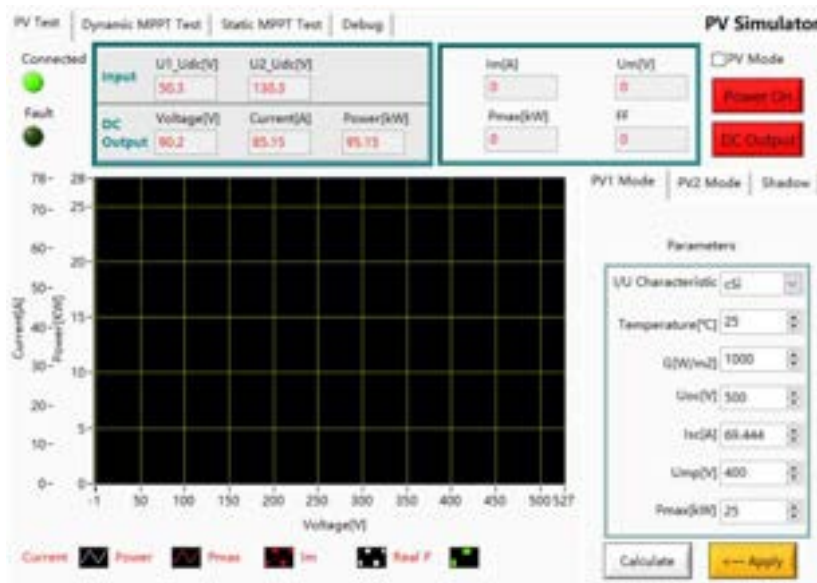


Figure 4-4 PV Simulation software panel

4.4 Re-generative DC Load (-LD Option)

DC electronic loads are widely used in the design, development, manufacturing, product testing, aging test design, manufacturing, and evaluation of power supply (such as fuel cells, charging piles and inverters) and power electronic components.

LAB/SLV1 series with -LD option can be used as regenerative DC electronic load. DC load simulation includes constant current, constant resistance, constant voltage, and constant power modes. DC load simulation can be used for fuel cell and battery testing. (The simulation software is detailed in 5.5-Sequence panel)

4.5 Low Voltage Operation Mode (-ZV Option)

The LAB/SLV1 series DC electronic load with the -ZV option can generate a large current that meets the requirements under the input voltage close to 0.4V, and can be used to evaluate the electrical characteristics of fuel cells (such as VI characteristics)

Chapter 5 Software Interface

5.1 GUI Software Introduction

5.1.1 Operating status

5.1.2 Operating mode

5.1.3 Input/output controls

5.2 Communication Setting

5.3 Hardware Limits

5.4 Output Setting

5.5 Sequence Mode

5.6 Battery Simulation

5.7 Battery Test

5.8 PV Simulation

5.8.1 I-V curve setting

5.8.2 Dynamic MPPT Test

5.8.3 Static MPPT Test

5.9 Measurements

5.10 Wave

5.10.1 Real-time wave browsing

5.10.2 Historical waveform browsing

5.11 System Status

5.12 Administrator Account

5.1 GUI Software Introduction

5.1.1 Operating status

LAB/SLV1 series provides GUI software, which is installed on the front touch screen, using the windows OS. (the software can also be installed on the control PC connected to the power supply). A few seconds after the power supply is initialized, the control unit and touch screen begin to work, the power supply is standby. If the power supply communication is normal, the white light (Figure 3-3①) and the “connected” green light (Figure 5-1①) are always on. All functions and parameters can be accessed through the TFT-Touch panel or GUI software to set up and run.

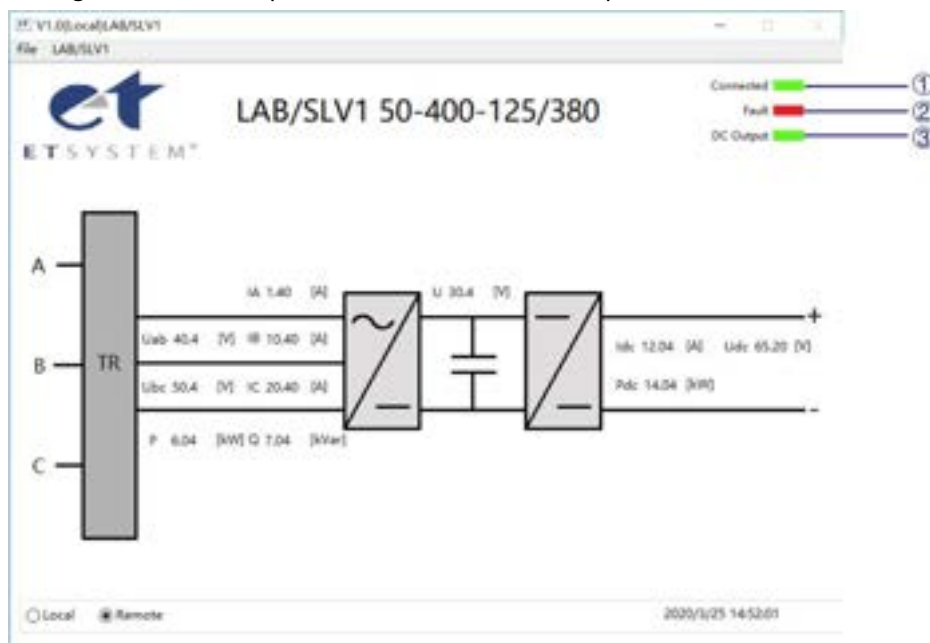


Figure 5-1 Main panel

Table 5-1

Number	Name	Note
①	Connect	A few seconds after the power supply is initialized, the TFT-Touch panel displayer starts to work, the green light is always on when the software and the equipment are connected normally. If the connection fails, please check whether the AC source is normally powered, the communication cable is connected normally, or the IP address of computer is 192.168.1.2.
②	Fault	The red light indicates the equipment automatically stops working when a fault occurs during operation; when the equipment is in normal, the light is dark green.
③	DC Output	When the equipment is operating normally and outputs DC, the green light is always on; when the equipment has no DC output, the light is dark green.

5.1.2 Operating mode

On the right side of the output setting and the sequence, the user can select the operating mode of the power supply according to test requirements (Figure 5-2), and the software will automatically display the current operating status (Figure 5-2).

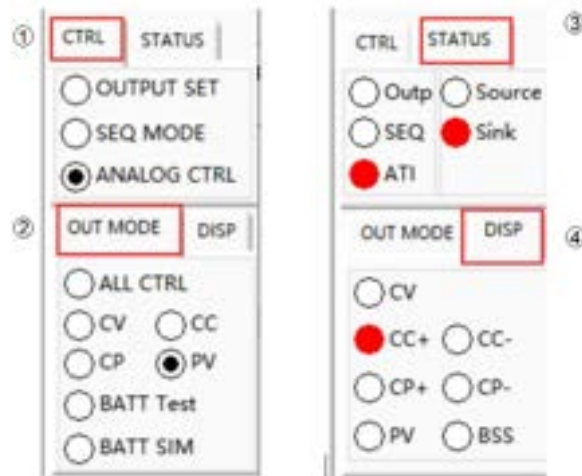


Figure 5-2 Control Mode/Output Mode/Status

Table 5-2

No.	Name	Note
(1) CTRL	OUTPUT SET	Control the power supply by Output Setting panel
	SEQ MODE	Control the power supply by Sequence panel
	ANALOG CTRL	Control the power supply by ATI interface
(2) OUT MODE	ALL CTRL	CV & CC & CP & CR Mode
	CV	Constant voltage operation mode
	CC	Constant current operation mode
	CP	Constant power operation mode
	BATT SIM	Battery simulation
	BATT Test	Battery Test
	PV	PV simulation
(3) STATUS	Outp/SEQ/ATI	Control Mode Status
	Source/Sink	The power source is working under power mode or sink mode
(4) DISP	CV/CC+/CC-/ CP+/CP-	The current operating status of the power supply
	PV	The power source is working under PV simulation mode
	BATT	The power source is working under Battery simulation mode

5.1.3 Input/output controls

In the output setting panel and sequence panel, there are some important controls to control the input/output of the power supply in the lower right part (Figure 5-2③). Click "Apply" → "Power On" → "DC Output" → "Output Switch", the power supply starts to work normally; click "Output Switch" → "DC Output" → "Power On", the po equipment wer supply stops working.



Figure 5-3 Input/output controls

Table 5-3

Number	Name	Note
	Power On	It is used to start and stop the grid side. The button is green when the grid side starts, and it becomes red when the grid side stops.
③	DC Output	It is used to start and stop the DC output. The button is green. When the DC side is output, and the green light of "DC Output" is always on; the button is red when there is no output on the DC side.
	Output Switch	It is used to control the DC output contactor; the power output terminal is live after closing the power supply.

5.2 Communication Setting

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

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

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

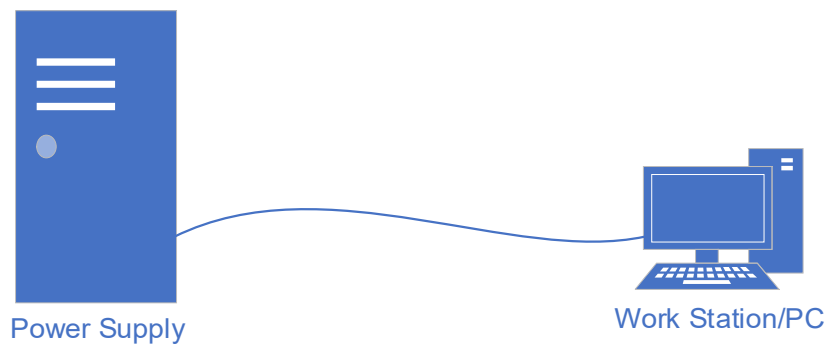


Figure 5-4 Power supply connected to workstation/PC

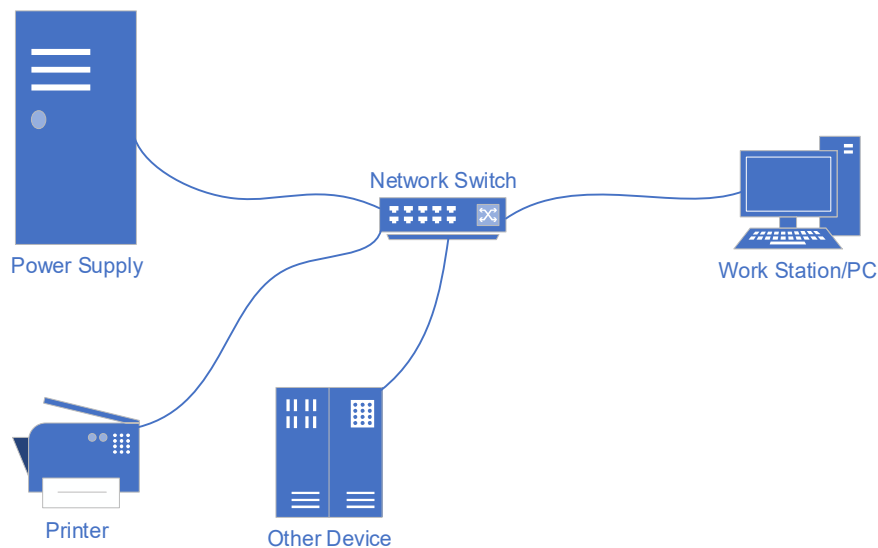


Figure 5-5 LAN connection of power supply and workstation/PC

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

- Processor: Intel core 2 duo or above
- RAM: 2GB¹ or above
- Operating System: Windows 7 or above
- 10/100/1000 Mbps network port adaptor
- Network Switch (LAN users)
- CAT 5 network cable

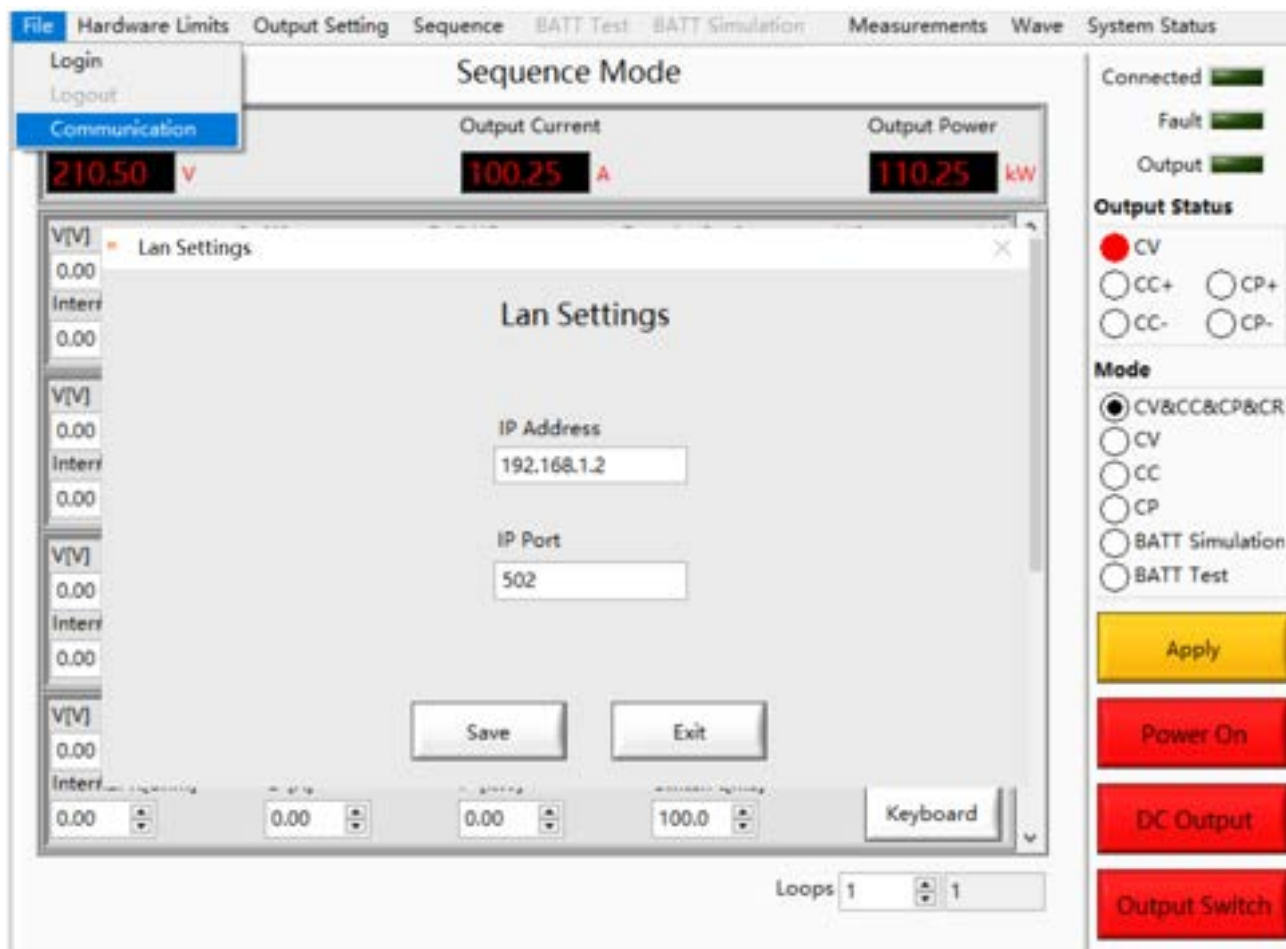


Figure 5-6 Default network address and port of power supply

¹ The actual demand for the processor and internal storage also depends on the other software actually running on the workstation/ PC.

5.3 Hardware Limits

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

Operation steps:

Click "Hardware Limits" to enter the panel (Figure 5-7). After setting the parameters, click "Apply", the corresponding voltage, current, and power limits displays at the bottom of Figure 5-8.

Figure 5-7 Hardware limits panel

Table 5-4

Number	Name	Note
①	Run	Independent operation / parallel operation (Master) / parallel operation (slave) can be selected
②	External Emergency Stop	External emergency stop check box, when checked, the external emergency stop is valid
③	Remote Sense	Remote sense check box, when checked, the remote sense is effective
④	Output Switch Auto-control	Output switch auto-control check box, when checked, no need to manually control the "Output Switch" button.
⑤	OCP (Max~120%)	Overcurrent protection value, when the output current exceeds this value, the power output will be off.
⑥	OVP (Max~110%)	Overvoltage protection value, when the output current exceeds this value, the power output will be off.

⑦	OPP [kW]	Overpower protection value, when the output power exceeds this value, the power output will be off.
⑧	Upper Limit of Current	Output current upper limit setting, the output current will be clamped below this value, it is usually smaller than the over current protection value.
⑨	Regenerative Current Limit	The upper limit value of regenerative current setting, the output current will be clamped below this current.
⑩	Limit of Voltage	Output voltage upper limit setting, the output voltage will be clamped below this value, it is usually smaller than the overvoltage protection value.
⑪	Upper Limit of Power	Output power upper limit setting, the output power will be clamped below this value.
⑫	Regenerative Power Limit	The upper limit of regenerative power setting, the output power will be clamped below this power.

WARNING



1 is only for devices with -MS option.

2/3/4 are valid after being checked. Before checking, please ensure that the corresponding wiring connection has been completed.

5.4 Output Setting

Users can set parameters such as output voltage, output current, output power and equivalent internal resistance on the "Output Setting" panel according to test requirements.

Test steps:

After setting the hardware limit, click "Output Setting" (Figure 5-8). Select the mode (Figure 5-8②) and set the parameters. After completion, click "Apply" → "Power On" → "DC Output" → "Output Switch", the power supply starts to work.

The screenshot shows the 'Output Setting' interface. It features three main columns for setting Output Voltage, Output Current, and Output Power. Each column includes fields for Preset, Slew Rate, and Upper/Lower Limits. On the right, there are status indicators (Connected, Fault, Output) and a control section with radio buttons for mode selection (OUTPUT SET, SEQ MODE, ANALOG CTRL) and output mode selection (ALL CTRL, CV, CC, CP, PV, BATT Test, BATT SIM). At the bottom right, there are four large buttons: Apply, Power On, DC Output, and Output Switch.

Figure 5-8 Output setting panel



IMPORTANT INFORMATION

When CR mode is selected to simulate constant resistance, set the voltage to 0V, and then set "internal R".

5.5 Sequence

The sequence mode is used to set different working conditions for realizing continuous testing of the DUT under different working conditions. In the panel, parameters such as output voltage, output current, output power, duration, switching time, whether to cycle and the number of cycles can be set. The output parameters are displayed in real time at the top of the panel. In addition, SLV1 can also realize the storage and import of complex sequences.

Test steps:

Click "Sequence" to enter the panel (Figure 5-9). Select the operating mode on the right side, set the parameters and select the operating sequence. After completion, click "Apply" → "Power On" → "DC Output" → "Output Switch", the power supply starts to operate in sequence mode.



Figure 5-9 Sequence panel

Table 5-5

Number	Name	Note
①	Real-time parameters	The current output voltage, current and power of the power supply displays in Real time.
②	Parameter setting	The user can set parameters such as output voltage, equivalent internal resistance, upper and lower limits of current and power, dwell time and switching time between working steps. The right side of each working step is the serial number and valid check box.

③	Cycle number of working steps	When “While” is not checked, set the number of loops (loops), and the current number of remaining cycles displays on the right; when “While” is checked, no need to set the number of cycles, the sequence will continue to loop, and current looped frequency displays on the right side.
④	Save	Click "Save", the user can save the parameters a .csv format file during the test run as. When more complicated parameters need to be set, saving the parameter data file for future using (Figure 5-10).
⑤	Import	Click "Import", the user can reload the sequence parameter file of historical test settings.

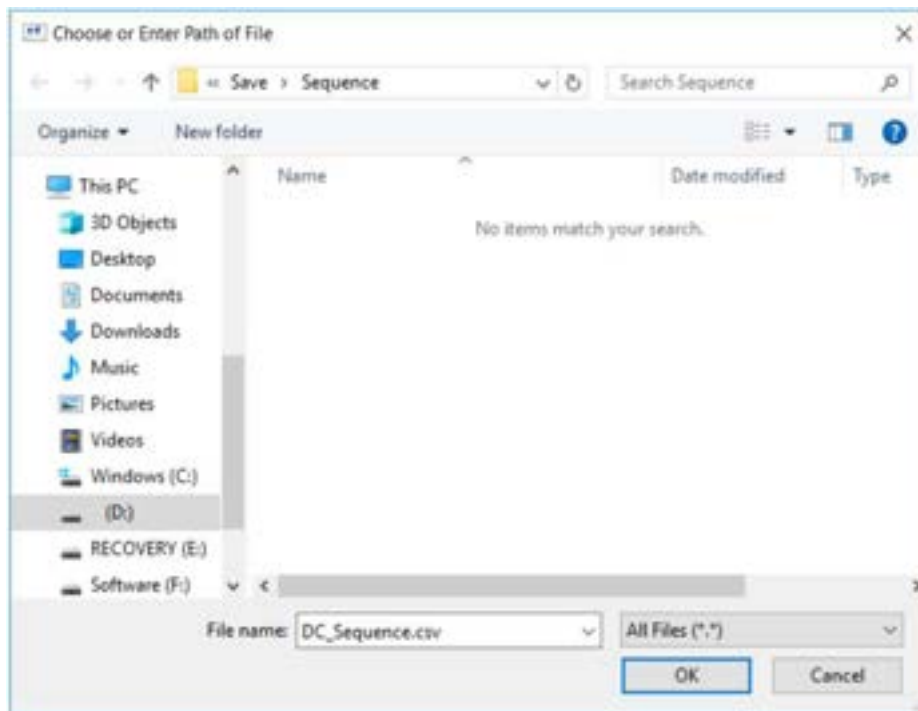


Figure 5-10 Sequence save/reload



IMPORTANT INFORMATION

Output settings can be changed by clicking the “keyboard” button and modifying the parameters when the power source is working (Do not turn off the power).

5.6 Battery Simulation

As an advanced battery simulator, bidirectional DC power supply of ET System LAB/SLV1 series can not only cover the full range of battery charge and discharge voltage and current, reproduce the accuracy of the charge and discharge curve, but also simulate all the features of the electrochemical storage elements in any charge or discharge activity.

LAB/SLV1 series provides battery simulation software, which can simulate different types of batteries, lithium-ion batteries, lead-acid batteries, nickel-cadmium batteries, nickel-metal hydride batteries, etc. Parameters such as battery type, number of serial/parallel batteries, battery internal resistance, initial capacity, maximum capacity, etc. can be set according to actual needs.

Test steps:

Select "Battery Mode" (Figure 5-11), click "Import", import the default battery simulation curve, then set the parameters, after completion, click "Apply" → "Power On" → "DC Output" → "Output Switch". The equipment starts to simulate the battery characteristics according to the default battery simulation curve.



Figure 5-11 Battery simulation

Table 5-6

Number	Name	Note
①	Parameters setting	The user can set parameters such as battery type (Battery Model), number of serial/parallel batteries (# Serial/# Parallel), battery internal resistance (Internal R), initial capacity (Init Capacity), etc. according to actual test requirements.

②	Parameters display in real-time	The battery or battery discharge current (I_discharge), battery voltage (U_bat_out), battery capacity (C_count), discharge capacity (C_discharge), maximum capacity (C_total), total current (I_total), total voltage (U_total), State of charge (SOC), maximum capacity value (C_max) and no-load voltage value (U_No-load) displays in Real-time.
③	Waveform display	It displays battery charge / discharge waveform.
④	Import button	Click "Import" to import the curve.
⑤	Enable	When perform battery simulation need to be based on other curves, select Enable, click "Import" to import the user battery simulation curve (.csv file) (Figure 4-12), and then set parameters, and click "Apply" → "Power" On "→" DC Output "→" Output Switch ", the power supply starts to simulate the battery characteristics according to the imported curve.

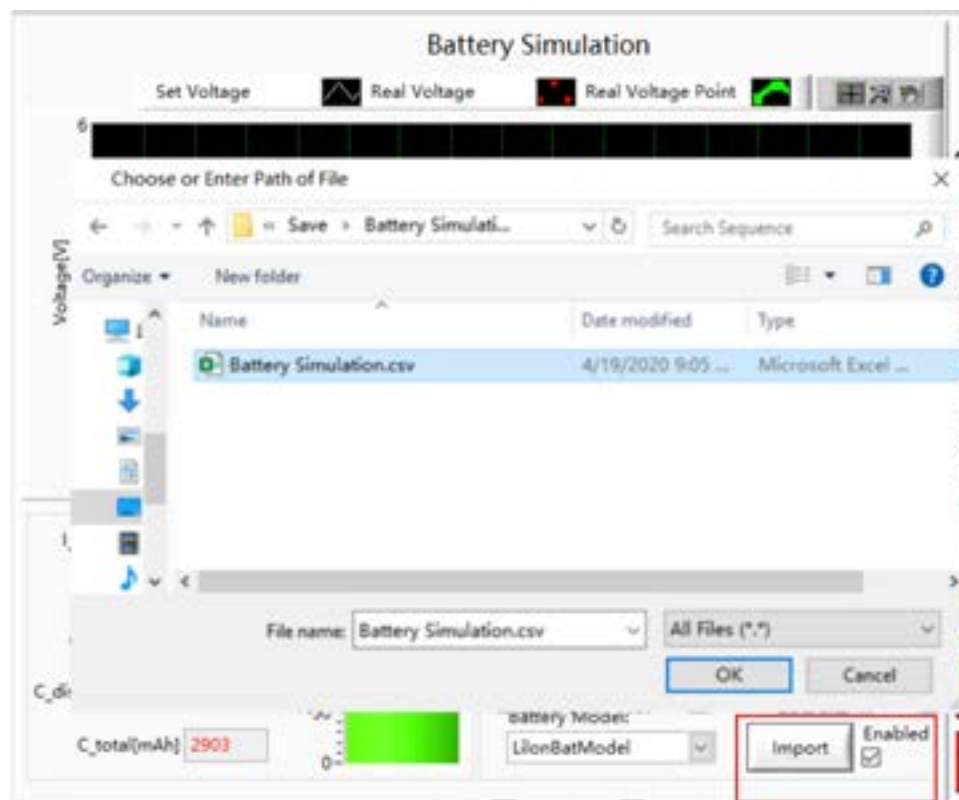


Figure 5-12 Import non-default battery simulation curve

5.7 Battery Test

LAB/SLV1 series DC power supply can also be used as battery charger/discharger, usually used to test battery cycle life, capacity, charge/discharge performance, etc. It Supports multiple parameter settings, including: charge mode value, charge or discharge termination conditions, the value of the termination condition, as charge/discharge mode, value of charge/discharge mode, charge/discharge termination condition, charge/discharge duration, termination condition value and rest time.

Test steps:

Click "Battery Test" to enter the panel (Figure 5-13). After setting the parameters, click "Selected" → "Apply" → "Power On" → "DC Output" → "Output Switch" to start the battery test.

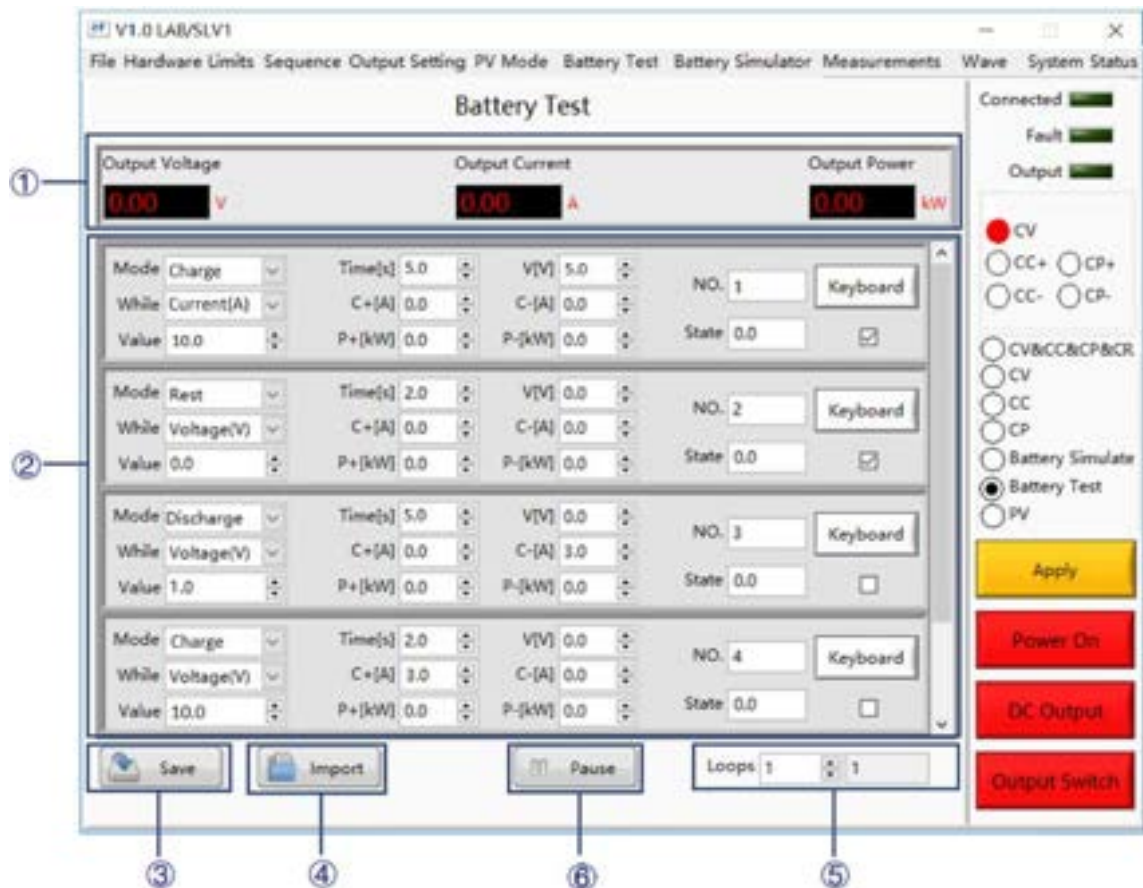


Figure 5-13 Battery Test

Table 5-7

No.	Name	Note
①	Save	Click "Save", the user can save the parameter sequence set in the battery test running process as a .csv format file, which is convenient for the user to retrieve later.
②	Import	Click "Import", the user can reload the sequence parameter file of historical test settings.
③	Parameter display	It displays the output voltage / current / frequency of power supply in real-time.
④	Mode	Modes, including charge mode, discharge mode, rest mode.
	Time	Duration value of charge / discharge / rest mode.
	V	Charge / discharge Voltage
	Current	Charge / discharge Current
	Power	Charge / discharge Power
	Parameter	Cut-off condition and corresponding values
	RPT	Remaining Processing Time
⑤	Cycle number	Set the number of loops, and the current number of remaining cycles displays on the right.
⑥	Wave	Click "Wave" to automatically pop up the waveform panel of battery test, as shown in figure 5-13-2

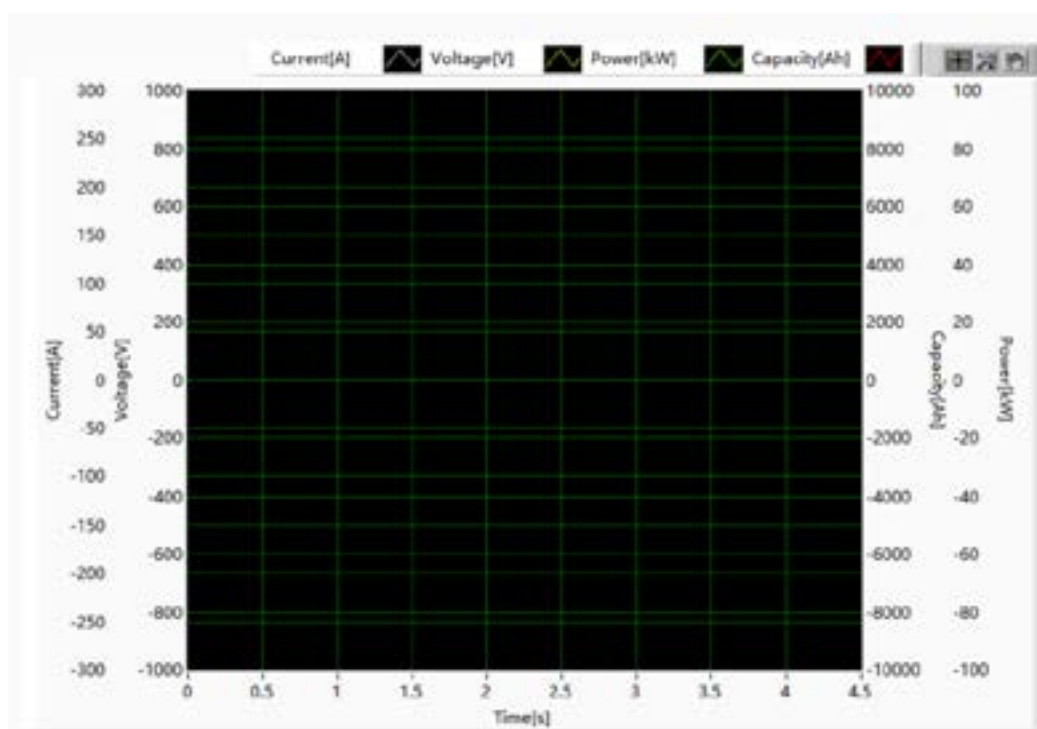


Figure 5-13-2 Waveform of Battery Test

**IMPORTANT INFORMATION**

In battery test mode, if parameters need to be modified, the steps are:

Click "Apply" → "stop" → modify parameters → Click "Apply" → "start".

Mode	Charge	Time[s]	6000.0	Voltage[V]	0.0	NO.	1	Keyboard
		Current[A]	100.0	Power[kW]	0.0			
Cut-off Condition	Parameter	Charge Voltage(V)	>=	400.0	RPT[s]	0.0		<input checked="" type="checkbox"/>
Mode	Charge	Time[s]	6000.0	Voltage[V]	400.0	NO.	2	Keyboard
		Current[A]	100.0	Power[kW]	0.0			
Cut-off Condition	Parameter	Current(A)	<=	2.0	RPT[s]	0.0		<input checked="" type="checkbox"/>
Mode	Rest	Time[s]	6000.0	Voltage[V]	0.0	NO.	3	Keyboard
		Current[A]	0.0	Power[kW]	0.0			
Cut-off Condition	Parameter	Invalid		0.0	RPT[s]	0.0		<input checked="" type="checkbox"/>
Mode	Discharge	Time[s]	6000.0	Voltage[V]	0.0	NO.	4	Keyboard
		Current[A]	50.0	Power[kW]	0.0			
Cut-off Condition	Parameter	Discharge Voltage(V)	<=	300.0	RPT[s]	0.0		<input checked="" type="checkbox"/>
Mode	Rest	Time[s]	6000.0	Voltage[V]	0.0	NO.	5	Keyboard
		Current[A]	0.0	Power[kW]	0.0			
Cut-off Condition	Parameter	Invalid		0.0	RPT[s]	0.0		<input checked="" type="checkbox"/>

Figure 5-13-3 Example of Battery Test

Step 1:

Constant current (100A) charging. When the voltage of battery $\geq 400V$ or the charging time reaches 6000s, enter step 2

Step 2:

Constant voltage (400V) charging. When the current of battery $\leq 2A$ or the charging time reaches 6000s, enter step 3

Step 3:

Rest for 6000s, enter step 4

Step 4:

Constant current (50A) discharging. When the voltage of battery $\leq 300V$ or the charging time reaches 6000s, enter step 5

Step 5:

Rest for 6000s and stop the battery test.

5.8 PV Simulation

LAB/SLV1 series DC power supply can realize the simulation of PV array. The equipment can be used to simulate the I-V curve of solar panels under various temperature and radiation conditions, and test MPPT characteristics according to EN 50530: 2010.

5.8.1 I-V curve setting

I-V curves can be created by entering simple parameters, and each curve contains 1024 data points. The performance of the grid-connected inverter under real conditions (cloud shading and panel temperature increase) can be tested by modifying the radiation level and temperature. There are three methods for setting the I-V curve, such as PV1, PV2, and shadow (such as Figure5-14).

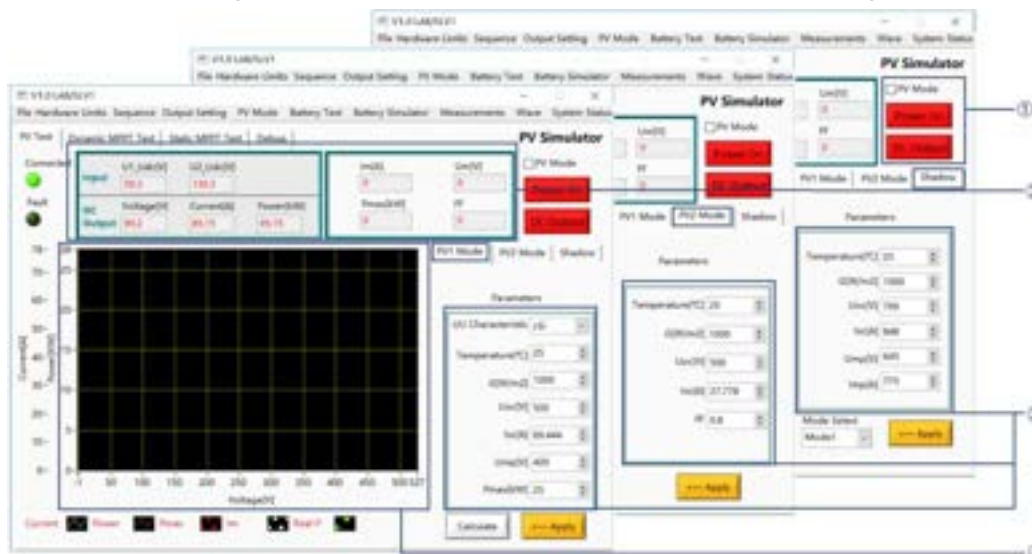


Figure 5-14 I-V curve setting

Table 5-8

Number	Name	Note
①	PV mode starts	Check "PV Mode" box, the PV test is valid. Click "Power On" → "DC Output" to turn on the power.
②	Battery parameter settings	The user can set parameters such as temperature, I/U characteristics, irradiance, open circuit voltage, short circuit current, peak voltage, peak current according to actual test requirements.
③	Real-time display of parameters	Pm, Um, Im, fill factor (FF) and other parameters are automatically calculated in real time.
④	Waveform display	I-V curve display area.

PV1 settings


Test steps:

Set I/U characteristics (crystalline silicon/thin film mode), temperature (Temperature), irradiance (G [W/m²]), open circuit voltage (Uoc), short circuit current (Isc), peak voltage (Ump), maximum power (Pmax) and other parameters, click "Calculate" → "Apply" button, then click "Power On" → "DC Output" to turn on the power. The software automatically calculates, Pm, Um, Im, FF parameter values are displayed in real time at the top of the panel, and generate $I = f(U)$ and $P = f(U)$ curves in the waveform display area.

PV2 settings

Test steps:

Set the temperature (Temp of Module), irradiance (Irradiance), open circuit voltage (Uoc), short circuit current (Isc) and other parameters of the photovoltaic module, after pressing the "Apply" button, the software automatically Calculate Pm, Um, Im, fill factor (FF) and other parameter values are displayed on the top of the panel, and generate $I = f(U)$ and $P = f(U)$ curves in the waveform display area.

**IMPORTANT INFORMATION**

Uoc must be greater than Ump, Isc must be greater than Imp, otherwise the software will prompt to reset.

5.8.2 Dynamic MPPT test

The dynamic MPPT test includes 3 test procedures: 10% -50% PDCn test, 30% -100% PDCn test, and SLOW switch test. The dynamic maximum power point tracking (MPPT) efficiency test is performed in accordance with $\text{light} = f(\text{time})$. The LAB/SLV1 series defaults to the typical test mode defined by the international norms and can also build or load various dynamic weather conditions to achieve the storage and import of complex parameters (Excel .csv file).

Test steps:

Set the temperature (Tamp), I/U characteristics (crystalline silicon/thin film mode), Um, Pmax, initial irradiance and other parameters (Figure 5-15②③), click to switch the state of the test line to the ready state (Figure 5-15④), Click "Initialize button" (MPPT Init) → "MPPT Test button" (MPPT Test) (Figure 5-15⑤), the software will automatically calculate and display the real-time parameters during the test (Figure 5-15⑥), and generate a simulation curve in the waveform display area (Figure 5-15⑦). After starting the MPPT test, the remaining test time will be displayed according to the test progress, and the corresponding status will be displayed. When each line is executed, the dynamic maximum power point tracking efficiency MPPT will be calculated. When the test is completed or the test is stopped, the MPPT test parameters in the table will return to the initial state.

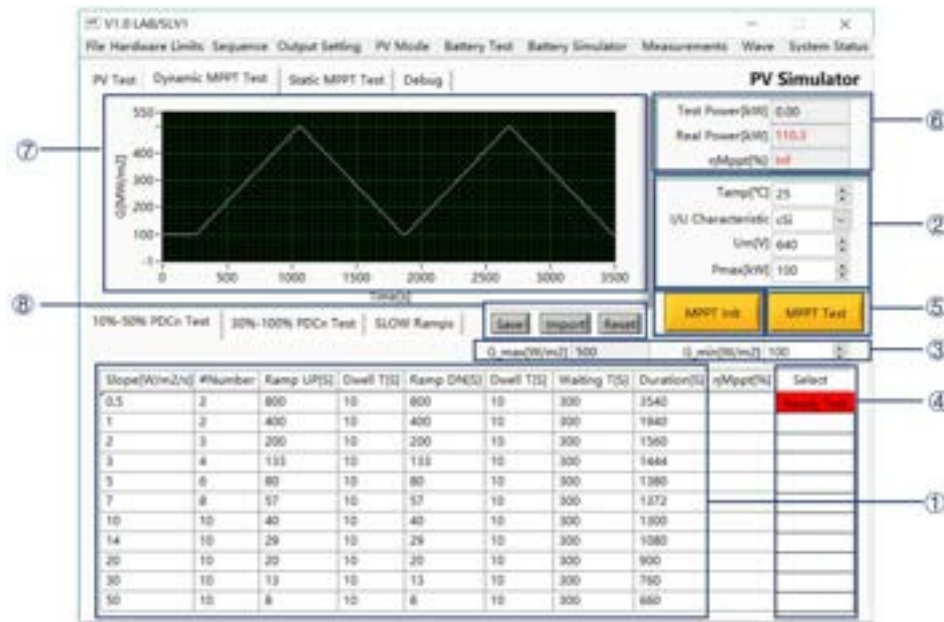


Figure 5-15 Dynamic MPPT test

Table 5-9

Number	Name	Note
①	Standard parameters	According to the data set in “Photovoltaic power adjustment device_Part1_Grid-connected inverter (Specification) 2011-4-10V1”, the percentage in the irradiance intensity shows the standard test conditions (STC). For reference, 100% corresponds to the irradiance condition of 1000 W/m ² at 25°C. Multiple I-V curves can be saved and executed in sequence, and the time of each step can be modified individually.
②	Battery parameter setting	The section of battery parameter setting.
③	Initial irradiance setting	The maximum irradiance specified by STC standard is displayed on the left, and the initial irradiance can be set on the right.
④	Selection status	Click to select the row of the test. Among them, the red shows the selection and displays "Ready Test", the white shows that the test line is not selected.
⑤	Initialization button Dynamic MPPT test button	After clicking "Initialization button" (MPPT Init), the setting parameters become effective. Click the pop-up dialog box [Start] [Stop] [Cancel], click [Start] to start the MPPT test, click [Stop] to stop the MPPT test, click [Cancel] to cancel the operation.
⑥	Real-time parameter display	Test power, real power, dynamic MPPT efficiency and other parameters display in real-time.
⑦	Waveform display area	Irradiance curve with time displays in real-time.
⑧	Save	Users can build various dynamic weather conditions in the table according to actual needs. After setting, click "Save" to save complex parameters.
	Import	Click "Import" to load complex weather parameters.
	Reset	Click "Reset", parameters of the weather simulation return to the default value.

IMPORTANT INFORMATION



After the test is completed, the power supply will automatically stops, the user can view the test record in.\DC (Client is controlled) \Save. If the data is not saved, please confirm whether Office 2007 has been installed.

IMPORTANT INFORMATION



According to (STC) standards:

10% -50% PDCn test, the initial irradiance is 100 W / m², the maximum is 500 W / m²;
30% -100% PDCn test, the initial irradiance is 300 W / m², the maximum is 1000 W / m²;
SLOW switch test, the initial irradiance is 2 W / m², the maximum is 100 W / m²; In practice, if the maximum irradiance need to be increased, the user can modify the step size or the initial irradiance.

5.8.3 Static MPPT test

The measurement of static MPPT efficiency must be performed in accordance with the test specification "EN 50530-2010 Overall energy efficiency of photovoltaic inverters". With-PV option, it can be used for the simulation of real working conditions under various static conditions, limited low-intensity changes, and less involving long-term and high-intensity.

Test steps:

Set the temperature (Tamp), I/U characteristics (crystalline silicon/thin film mode), irradiance (Irradiance), Pmax and other parameters (Figure 5-16②), click the initialization button (Static MPPT Init) (Figure 5-16③), and finally click Static MPPT Test button (Static MPPT Test) (Figure 5-16④), the software will automatically calculate and display the real-time parameters during the test (Figure 5-16⑥). 5 minutes for each line and 10 minutes for the test. When the test is completed, the equipment will automatically shut down. When all tests are completed, the static maximum power point tracking efficiency η_{Mppt} will be calculated according to European standards and CEC standards. Click "Reset" to restore the data in the static efficiency test panel to the initial state.

Table 5-10

Number	Name	Note
①	Standard parameters	The data set according to the specified test specification "EN 50530-2010 Overall energy efficiency of photovoltaic inverters". In the table , test the static maximum power point tracking efficiency and conversion efficiency of 0.05 times, 0.1 times, 0.2 times, 0.25 times, 0.3 times, 0.5 times, 0.75 times, and 1 times the rated power point (Figure 5-16①).
②	Battery parameter setting	The section of battery parameter setting.
③	Initialize button	Click to make the test take effect.
④	Static MPPT test button	Click the pop-up dialog box [Start] [Stop] [Cancel], click [Start] to start the static efficiency test, click [Stop] to stop the static efficiency test, click [Cancel] to cancel the operation.

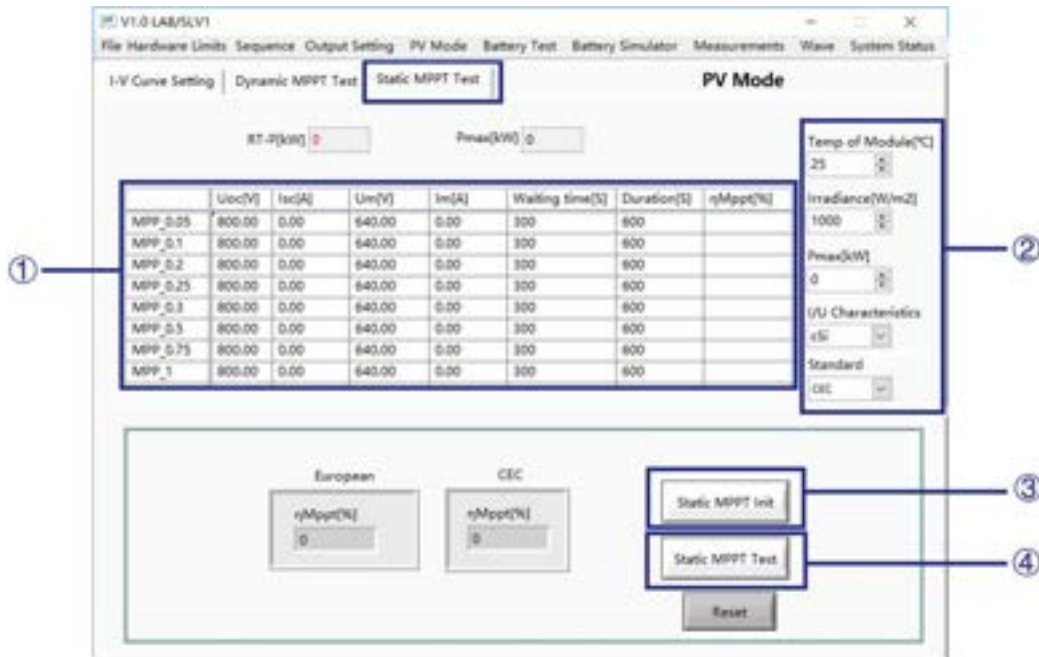


Figure 5-16 Static MPPT test

IMPORTANT INFORMATION



After the test is completed, the power supply will automatically stop, and the user can view the test record in ..\DC (Client is controlled)\Save. If the data is not saved, please confirm whether Office 2007 has been installed.

IMPORTANT INFORMATION



When the static MPPT test starts, the remaining test time will be displayed according to the test progress. After each line is executed, the static maximum power point tracking efficiency η_{Mppt} will be calculated. After the test is completed or the test is stopped, the MPPT test parameters in the table will return to the initial state.

IMPORTANT INFORMATION



When Uoc is modified, or Um and Uoc are not modified in the table, other parameters are calculated according to Uoc. When Um is modified, other parameters are calculated according to Um.

5.9 Measurement

The GUI software of LAB/SLV1 series can monitor the input/output status of the equipment in real time. Click "Measurement" to enter the panel (Figure 5-17). The user can monitor real-time input current/voltage/power, output current/voltage/power, remote control voltage, leakage current and temperature on the panel.

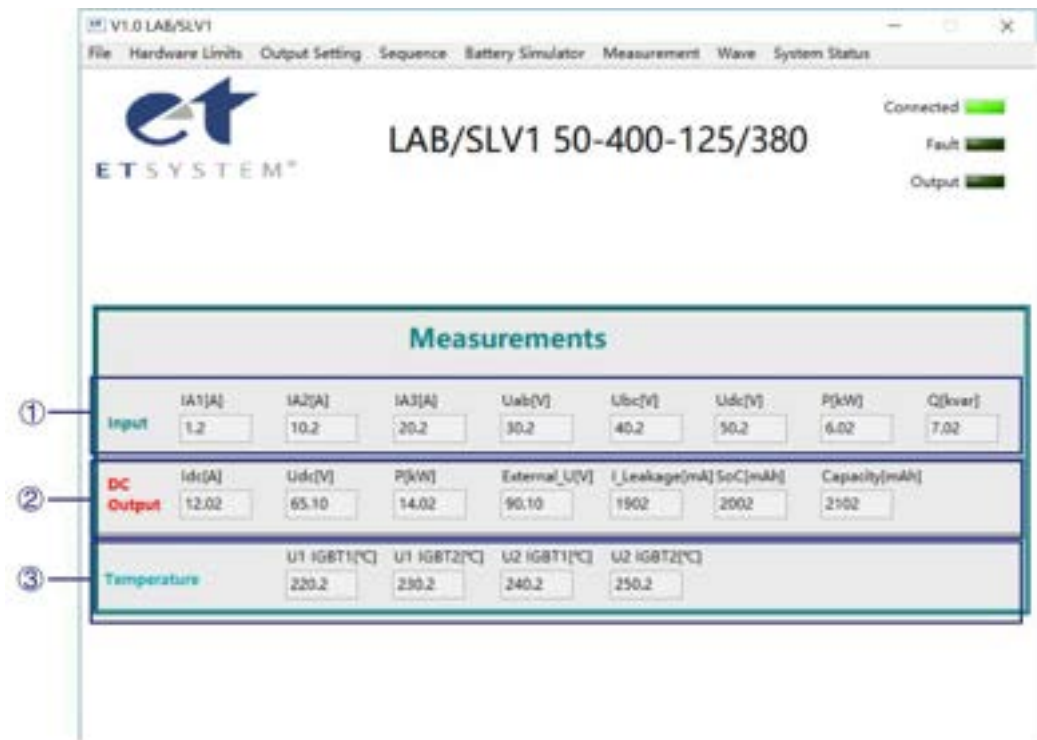


Figure 5-17 Measurement panel

Table 5-11

Number	Name	Note
①	Input Parameters	The input phase current, input voltage, input active/reactive power and other parameters display in real-time.
②	Output Parameters	Parameters such as output current, voltage, power, remote sense voltage, leakage current, state of charge and battery capacity display in real-time.
③	IGBT Temperature Value	Each IGBT temperature value displays in real-time.

5.10 Waveform

5.10.1 Real-time waveform browsing

The GUI software of LAB/SLV1 can record the waveform of output voltage and current, and store in the TFT touch panel/workstation, for the user to retrieve browsing and analysis in future (figure 5-19).

Operation steps:

Click "Wave" to enter the panel (figure 5-13). In the waveform browsing window, the user can individually or simultaneously select the data of Idc or Udc (figure 5-18⑦) to browse its waveform. In addition, the user can also set the waveform data point window display time, sampling time interval and other parameters (figure 5-18⑧).

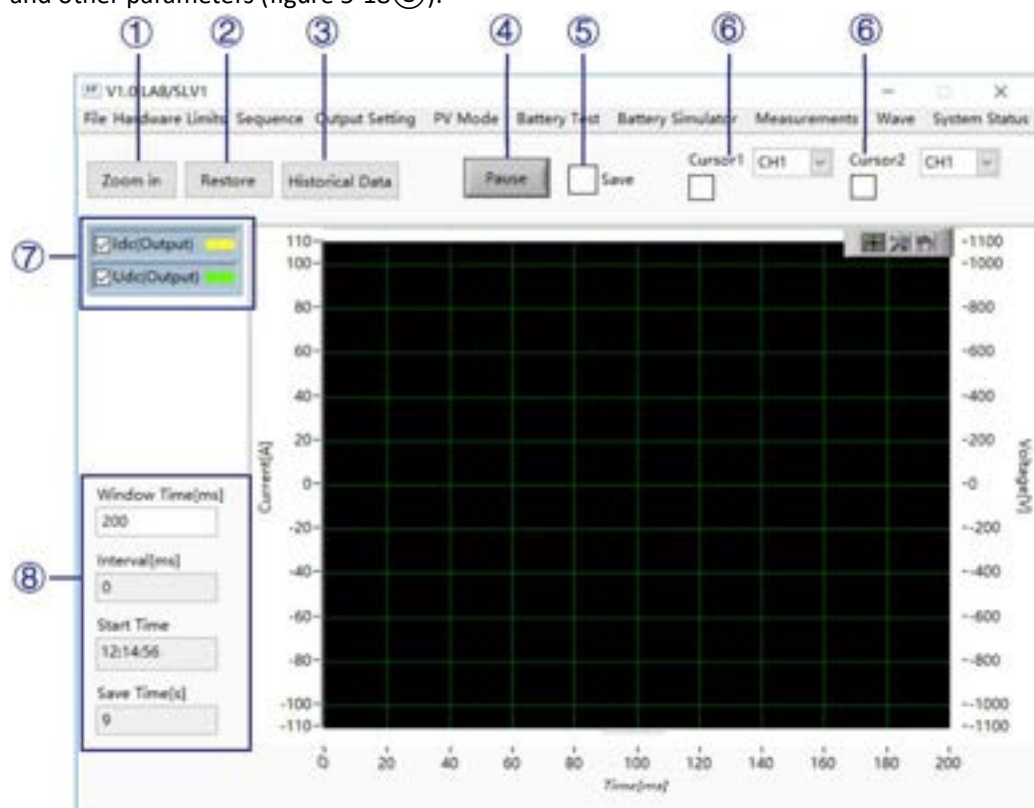


Figure 5-18 Wave Panel

Table 5-12

Number	Name	Note
①	Zoom In	Click "Zoom in" control to zoom in the waveform.
②	Restore	Click "Restore" control to restore the enlarged waveform to the default scale for browsing.
③	Historical Data	Retrieve the historical waveform data, click it to pop up the historical waveform browsing window as shown in Figure 5-19.

④	Pause	Click pause control, the waveform will stop updating and stay on the captured.
⑤	Save	Check "Save", the data in the waveform browsing window will be saved.
⑥	Cursor1	Cursor 1, the amplitude and time of a point on the waveform, often cooperate with cursor 2 to measure the time interval.
	Cursor2	Cursor 2, the amplitude and time of a point on the waveform, often cooperate with Cursor 1 to measure the time interval.
⑦	Waveform selection	The data of Idc or Udc can be selected individually or simultaneously (Figure 5-18 ⑦), and the waveform can be browsed.
⑧	Parameter Setting	Parameters such as the window display time and sampling interval of the waveform data points can be set.

5.10.2 Historical waveform browsing

Click "**Historical Data**" to enter the panel (Figure 5-19). The historical waveform is arranged in the left window in the order of recording time. Selecting a waveform, click "Read Wave" to browse the history waveform (the operation steps are the same as 5.10.1).

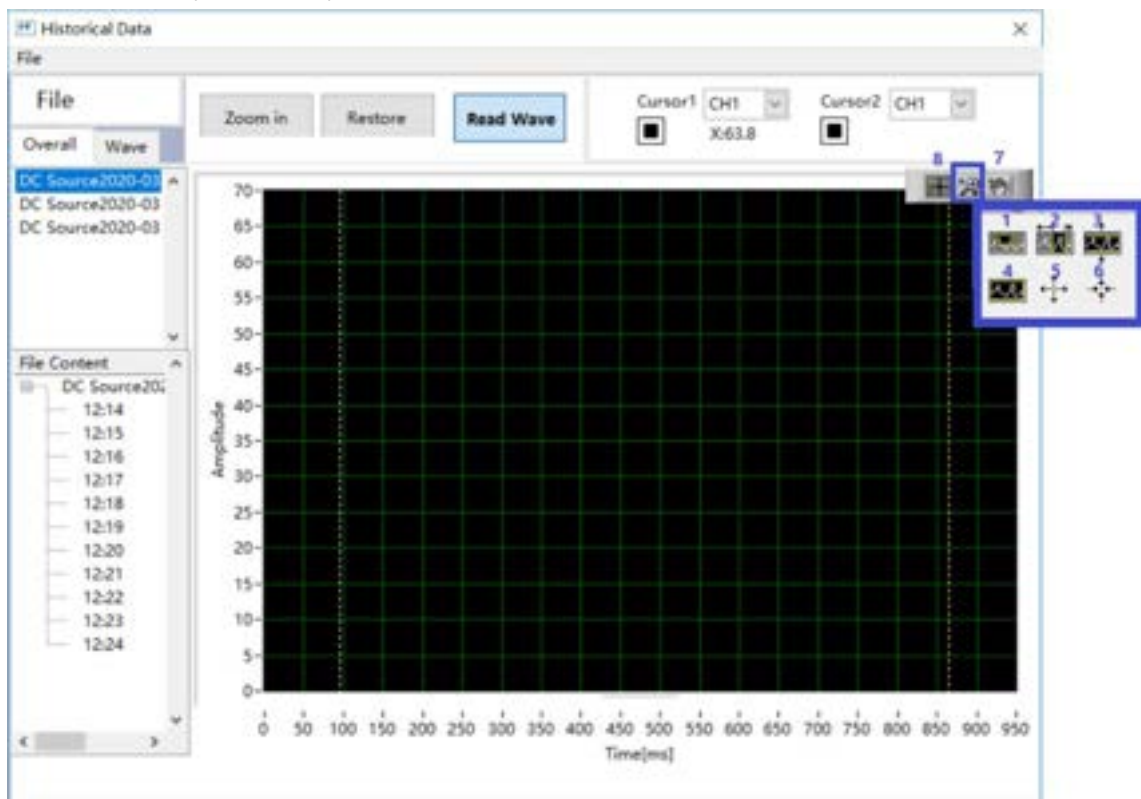


Figure 5-19 Historical waveform browsing panel

By checking different boxes on the left side of the panel, the corresponding output voltage/current and DC bus voltage waveform s can be observed. Click the partial zoom button and drag the mouse, the Waveform area in the box will be partially enlarged (Figure 5-22-1); click the horizontal/vertical zoom button and drag the mouse, the waveform between the cursors can be zoomed horizontally/vertically (Figure 5-22-2 and Figure 5-22-3); click the Waveform restore button, the waveform in the Waveform display area will be restored (Figure 5-22-4); click the overall zoom in/out button and click the mouse, the waveform will be overall zoomed in/out (Figure 5-22-4, 5-22-5 and Figure 5-22-6); click the drag button to move the waveform freely (Figure 5-22-7); click the cross button can reset all functions (Figure 5-22-8).

5.11 System Status

The User can browse the status and faults of each part of the equipment during the testing through the GUI software panel. Click "System Status" to enter the panel, the user can browse the status and errors of the subsystem (Figure 5-20) and the main circuit failure (Figure 5-21). Dark green light means no fault, red light means fault occurs. After troubleshooting, the user can click "Reset" to reset the power supply.

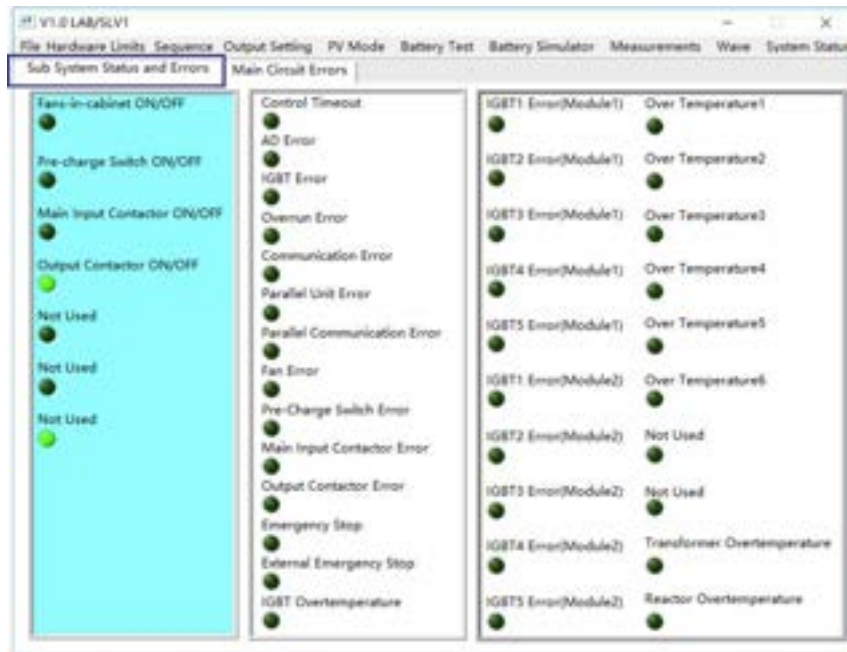


Figure 5-20 System status panel-Subsystem status

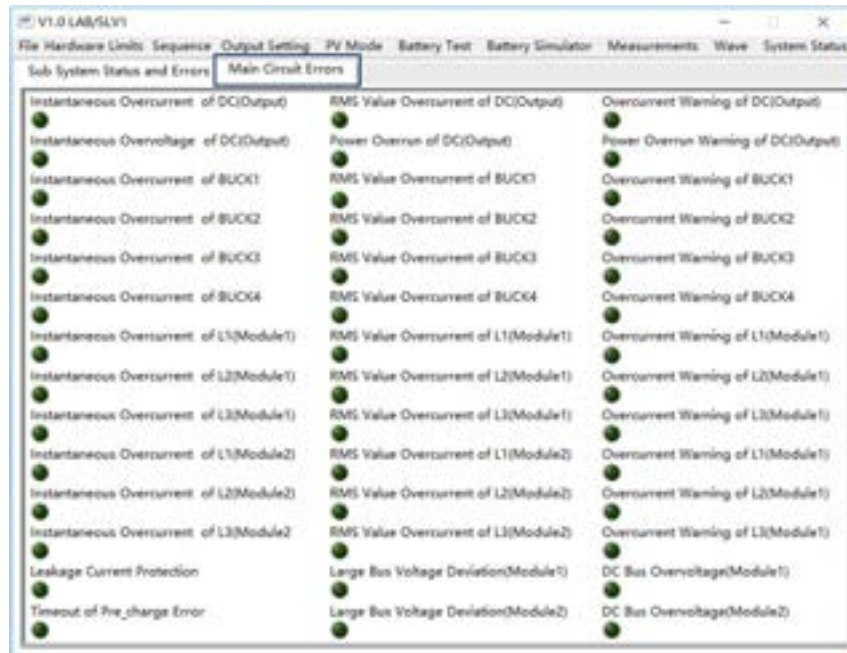


Figure 5-21 System status panel-main circuit failure

5.12 Administrator Account

Enter the administrator account, the user can set the internal parameters. For avoiding accidental settings which leading to equipment failure or loss of accuracy, it is not recommended that the user perform this operation. The default login account is a guest account, and all functions of the equipment are open and can be used normally.



Figure 5-22 System status panel

Chapter 6 Equipment verification and calibration

6.1 Performance Verification

6.1.1 Verify equipment and settings

6.1.2 Verify content

Voltage Range

Voltage Accuracy

Current Accuracy

Power Accuracy

Output Characteristics

Ripple Test

Load Regulation

Slew Rate

Current Rise Time

Protections Function Test Short

Circuit Test

LCD Display Test

6.2 Test Record Form

6.1 Performance Verification

6.1.1 Verity equipment and settings

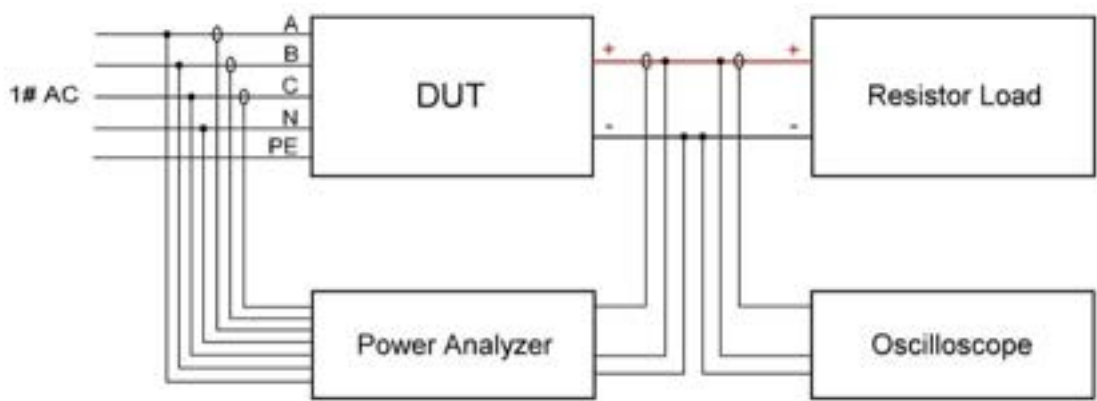


Figure 5-1 Test system connection diagram

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

CAUTION

To achieve the best performance, all verification and calibration procedures should follow the recommendations:



The ambient temperature remains constant and is between 25±5°C.

The relative humidity of the environment is 20% ~ 90%.

Keep the cable length as short as possible, and use twisted or shielded cables to reduce noise.

SHOCK HAZARD



Danger of electrical hazards, lethal voltage, the maximum voltage generated by LAB/SLV1 can reach 2000VDC and above!

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 LAB/SLV1 with pure resistive load, make the output current within the specified range of the product, change the output voltage, and record the voltage data on the power analyzer.

- **Voltage Accuracy**

Connect LAB/SLV1 with a pure resistive load, make the output current within the specified range of the product, change the output voltage, record the voltage data on the tester and the displayed value of the output voltage on the tested power supply. Test at the upper limit, lower limit and intermediate value (at least three points) of the specified output voltage range. Take the one with the largest error for calculation to determine its indication error.

Its accuracy is obtained from the following formula:

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

And:

δ_U —Voltage Accuracy;

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 LAB/SLV1 with a pure resistive load, make the output voltage within the specified range of the product, change the output voltage, record the current data on the tester and the display value of the output current on the tested power supply. Test at the upper limit, lower limit and intermediate value (at least three points) of the specified output current range. Take the one with the largest error for calculation to determine its indication error.

Its accuracy is obtained from 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;

- **Power Accuracy**

Connect LAB / SLV1 with a pure resistive load, make the output current within the specified range of the product, change the output voltage, and record the power data on the tester and the displayed value of the output power on the tested power supply. Test at the upper limit, lower limit and intermediate value (at least three points) of the specified output voltage range. Take the one with the

largest error for calculation to determine its indication error.

Its accuracy is obtained from 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 (power Factor, efficiency)**

Connect LAB/SLV1 with a pure resistive load, make the output current within the specified range of the product, change the output voltage, read the parameters, PF values and efficiency on the power analysis on the premise of meeting the performance characteristics specified in the product standard, and record them.

- **Ripple Test**

Ripple voltage is the superposition of all AC voltage components at the output of power supply. When the power supply DC output, LAB/SLV1 is connected with pure resistive load, so that the output voltage and output current are set at the maximum value specified by the product, read the AC voltage indication value, and take the maximum value in the test.

The ripple coefficient is obtained from the following formula:

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

And:

Y ——Ripple coefficient;

U_{mrs} ——RMS of voltage ripple, V;

U_N ——Rated Voltage, V;

- **Load Regulation**

Connect SLV1 50 with pure resistive load, adjust the output voltage value within the specified output voltage range, so that the current changes between 0-90%, that is, read the output voltage display value of the power analyzer under no-load and load. Take its value for calculation to determine the load adjustment rate of its power supply.

The load adjustment rate is obtained from the following formula:

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

And:

L ——Voltage Accuracy;

U_1 ——On-load voltage, V;

U_0 ——No-load voltage, V;

U_n ——Rated voltage, V;

- **Slew Rate**

The input voltage and frequency of LAB/SLV1 shall be within the range specified in the product standard, and the pure resistive load shall be connected. The output voltage shall be 0% - 100% of the maximum output voltage as the reference, and the voltage climbing rate shall be recorded with an oscilloscope, and the change of output power within the switching time shall be calculated.

Its output power is calculated by the following formula:

$$P_1 = \frac{(U_N)^2}{R} \times \frac{0}{3} = 0KW$$
$$P_2 = \frac{(U_N)^2}{R} \times \frac{160000}{3} = 53.33KW$$

And:

- P_1 ——Total output power of 0V;
- P_2 ——Total output power of 0V;
- U_N ——Setting Voltage Value, V;
- R ——Resistor Load, Ω ;

- **Current Rise Time**

The input voltage and frequency of LAB/SLV1 shall be within the range specified in the product standard, and the pure resistive load shall be connected. The output voltage shall be 10% - 90% of the maximum output voltage as the reference, and the voltage climbing rate shall be recorded with an oscilloscope, and the change of output power within the switching time shall be calculated.

Its output power is calculated by the following formula:

$$P_1 = \frac{(U_N)^2}{R} \times \frac{1600}{3} = 0.53KW$$
$$P_2 = \frac{(U_N)^2}{R} \times \frac{129600}{3} = 43.2KW$$

And:

- P_1 ——Total output power of 10V;
- P_2 ——Total output power of 360 V;
- U_N —— Setting Voltage Value, V;
- R ——Resistor Load, Ω ;

- **Protections Function Test**

If the output voltage is set above the rated voltage specified by the power supply, the power supply should be able to limit the voltage output.

If the input voltage is set above the rated voltage specified by the power supply, the power supply should cut off the input immediately and give an alarm.

Adjust the load or output voltage so that the output current is more than 1.2 times the rated value. The power supply should be able to start protection immediately and cut off the output.

- **Short Circuit Test**

Short-circuit the positive and negative terminals of the power supply and the product will be current

limiting protection.

- **LCD Display Test**

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



IMPORTANT INFORMATION

The above is the test method of LAB /SLV1 50-400-125.

The test method varies with the power level of the equipment.



6.2 Test Record Form

Please refer to the LAB/SLV1 test report for the test record form.

Chapter 7 Equipment Maintenance and Repair

7.1 Equipment Maintenance

7.1.1 Equipment operating environment

7.1.2 Equipment maintenance

7.2 Equipment Repair

7.2.1 Equipment self-test

7.2.2 Maintenance service

7.2.3 Equipment return

7.1 Equipment Maintenance

Please notice the maintenance environment of equipment, ET System has no liability for failures caused by breaking equipment rules.

7.1.1 Equipment operating environment

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

7.1.2 Equipment maintenance

- No dust accumulation on the equipment, 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.

CAUTION



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

7.2.2 Maintenance service

If the purchased equipment failure during the warranty period, ET System will repair the equipment according to the specific information provided by the customer. Contact information is on Page 02

7.2.3 Equipment return

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

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

Chapter 8 Programming

8.1 Command Format

8.1.1 Parameters data type

8.1.2 Command parameters/Return value units

8.1.3 Command format

8.2 Command Sets

8.3 Example

8.1 Command Format

This chapter introduces the parameter data types, parameters and the value range and formats of the programmed commands of the power supply. The user shall carefully read the content of the following chapters before developing the control operations.

8.1.1 Parameters data type

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

8.1.2 Command parameters/Return value units

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

8.1.3 Command format

The command set of the LAB/SLV1 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

Commands	Return Value	Description
*IDN	Return: LAB/SLV1 50-400-125 Firmware Version 1.0	Return the information of equipment
*RST	None	Fault Rest
Remote?	Remote,1/0	Inquire the status of Remote/Local. It will return 1 if working in Remote mode, else return 0.
FAULT?	FAULT,1/0	Check if there is a fault. It will return 1 if fault occurred, else return 0.
OVP <NRf>	None	Set the value of Over Voltage Protection
OCP <NRf>	None	Set the value of Over Current Protection
OPP <NRf>	None	Set the value of Over Power Protection
OLP <NRf>	None	Set the value of Over Leakage Current Protection
LIMIT:VOLT <NRf>	None	Set the value of upper limitation for voltage
LIMIT:CURP <NRf>	None	Set the value of upper limitation for current
LIMIT:CURN <NRf>	None	Set the value of lower limitation for current
LIMIT:POWP <NRf>	None	Set the value of upper limitation for power
LIMIT:POWN <NRf>	None	Set the value of lower limitation for power
LIMIT <NRf1><,NRf2><,NRf3><,NRf4><,NRf5>	None	Set the values of following parameters of hardware limits for one time: upper limitation for current; lower limitation for current; upper limitation for voltage; upper limitation for power; lower limitation for power

OVP?	OVP <,NRf>	Inquire the value of Over Voltage Protection
OCP?	OCP <,NRf>	Inquire the value of Over Current Protection
OPP?	OPP <,NRf>	Inquire the value of Over Power Protection
OLP?	OLP <,NRf>	Inquire the value of Over Voltage Protection
LIMIT:VOLT?	LIMIT:VOLT <,NRf>	Inquire the value of upper limitation for voltage
LIMIT:CURP?	LIMIT:CURP <,NRf>	Inquire the value of upper limitation for current
LIMIT:CURN?	LIMIT:CURN <,NRf>	Inquire the value of lower limitation for current
LIMIT:POWP?	LIMIT:POWP <,NRf>	Inquire the value of upper limitation for power
LIMIT:POWN?	LIMIT:POWN <,NRf>	Inquire the value of lower limitation for power
LIMIT?	LIMIT <,NRf1><,NRf2><,NRf3><,NRf4><,NRf5>	Inquire the value of: upper limitation for current lower limitation for current upper limitation for voltage upper limitation for power lower limitation for power
MODE CV&CC&CP&CR/CV/CC/CP/BA TSIM/BAT	None	Set the mode of output to CV&CC&CP&CR or CV or CC or CP or Battery Simulate or Battery Test
MODE?	MODE 5/4/3/2/1/0	Return mode of output 0:CV&CC&CP&CR 1:CV 2:CC 3:CP 4: BATSIM 5: BAT
SET:VOLT <NRf>	None	Set the value of voltage
SET:CURP <NRf>	None	Set the value of upper bound for current

SET:CURN <NRf>	None	Set the value of lower bound for current
SET:POWP <NRf>	None	Set the value of upper bound for power
SET:POWN <NRf>	None	Set the value of lower bound for power
SET:RES <NRf>	None	Set the value of internal resistance while the corresponding function is selected.
SET <NRf1><,NRf2><,NRf3><,NRf4 ><,NRf5><,NRf6>	None	Set the values of following parameters for one time: Voltage; upper bound for current; lower bound for current; upper bound for power; lower bound for power; internal resistance
SET:VOLT?	SET: VOLT <,NRf>	Inquire the value of voltage
SET:CURP?	SET: CURP <,NRf>	Inquire the value of upper bound for current
SET:CURN?	SET: CURN <,NRf>	Inquire the value of lower bound for current
SET:POWP?	SET: POWP <,NRf>	Inquire the value of upper bound for power
SET:POWN?	SET: POWN <,NRf>	Inquire the value of lower bound for power
SET:RES?	SET:RES <,NRf>	Inquire the value of internal resistance while the corresponding function is selected.
SET?	SET <,NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6>	Inquire the values of following parameters for one time: Voltage; upper bound for current; lower bound for current; upper bound for power; lower bound for power; internal resistance
SET APPLY	None	Validate the parameters that have been set.
POWER ON/OFF	None	Turn ON/OFF the switch of grid side.

OUTPUT ON/OFF	None	Enable/Disable the output of power supply
SWITCH ON/OFF	None	Close/Open the switch of output
POWER:STAT?	POWER:STAT, 1/0	Return status of switch of grid side 1:ON 0:OFF
OUTPUT:STAT?	OUTPUT:STAT, 1/0	Return status of output of power supply 1:ON 0:OFF
SWITCH:STAT?	SWITCH:STAT, 1/0	Return status of switch of output 1:CLOSE 0:OPEN
SEQ:VOLT <NRf>	None	Set output voltage inactivated step in sequence mode
SEQ:CURP <NRf>	None	Set upper bound of current in activated step in sequence mode
SEQ:CURN <NRf>	None	Set lower bound of current in activated step in sequence mode
SEQ:POWP <NRf>	None	Set upper bound of power in activated step in sequence mode
SEQ:POWN <NRf>	None	Set lower bound of power in activated step in sequence mode
SEQ:RES <NRf>	None	Set internal resistance in activated step in sequence mode
SEQ:SWT <NRf>	None	Set switch time
SEQ:DUT <NRf>	None	Set duration

SEQ <NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7><,NRf8><,NRf9>	SEQ 2,1,	Set the values of following parameters for one time: Sequence No. duration, switch time; output voltage; upper bound for current; lower bound for current; upper bound for power; lower bound for power; internal resistance.
SEQ:VOLT?	SEQ:VOLT <, NRf >	Inquire output voltage have been set inactivated step in sequence mode
SEQ:CURP?	SEQ:CURP <, NRf >	Inquire upper bound of current in activated step in sequence mode
SEQ:CURN?	SEQ:CURN <, NRf >	Inquire lower bound of current in activated step in sequence mode
SEQ:POWP?	SEQ:POWP <, NRf >	Inquire upper bound of power in activated step in sequence mode
SEQ:POWN?	SEQ:POWN <,NRf >	Inquire lower bound of power in activated step in sequence mode
SEQ:RES?	SEQ:RES <, NRf >	Inquire internal resistance in activated step in sequence mode
SEQ:SWT?	SEQ:SWT<, NRf >	Inquire switch time
SEQ:DUT?	SEQ:DUT<, NRf >	Inquire duration
SEQ?	SEQ <NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7><,NRf8><,NRf9>	Inquire the values of following parameters for one time: Sequence No. duration, switch time; output voltage; upper bound for current; lower bound for current; upper bound for power; lower bound for power; internal resistance.

SEQ APPLY	None	Validate the parameters that have been set in sequence mode.
SEQ CLEAR	None	Clear the sequence's parameters in sequence mode and the current step return to 1
SEQ INC	None	Go to next step of sequence in sequence mode
SEQ:LAB <NRf>		Set the sequence step number
SEQ:LAB?	SEQ:LAB <NRf >	Inquire the sequence number of current step
VOLT?	VOLT<,NRf>	Measure the voltage of output
CUR?	CUR<,NRf>	Measure the current of output
POW?	POW<,NRf>	Measure the power of output
MEAS?	MEAS <NRf1><,NRf2><,NRf3>...	Inquire all measured parameters of power supply.
MSEQ?	MSEQ <NRf1><,NRf2><,NRf3><,NRf4><,NRf5><,NRf6><,NRf7><,NRf8><,NRf9><,NRf10><,NRf11><,NRf12>.....	Inquire all the parameters in Sequence one time. In turn, the following is:
		Sequence No. duration switch time; output voltage ; upper bound for current; lower bound for current; upper bound for power; lower bound for power; internal resistance;
		Sequence No. duration switch time; output voltage ; upper bound for current; lower bound for current; upper bound for power; lower bound for power; internal resistance;
.....		
FCODE?	System Fault!	Inquire fault code if happened.
INITCAPA <NRf>	INITCAPA <NRf>	Set the initial capacity

BAT <Nrf1><,Nrf2><,Nrf3><,Nrf4><,Nrf5><,Nrf6><,Nrf7><,DISCHARGE/CHARGE/REST><,CURR/VOLT><,Nrf10>	BAT <Nrf1><,Nrf2><,Nrf3><,Nrf4><,Nrf5><,Nrf6><,Nrf7><,DISCHARGE/CHARGE/REST><,CURR/VOLT><,Nrf10>	Set the values of following parameters of battery test for one time: Sequence No., Voltage, charge current, discharge current, charge power, charge power, Time, Mode: Discharge/charge/Rest, while: Current/Voltage value
BAT ON/OFF		Select “Start” or “Stop” after click on the “Apply” in battery test mode.
SERI <Nrf1>;PARA <Nrf2>;INTERNALR <Nrf3>; BATSIM	SERI <Nrf1>;PARA <Nrf2>; INTERNALR <Nrf3>; BATSIM	Set the number of batteries in series, parallel and internal resistance.

8.3 Example

1) Query information

*IDN

Return: ESD Firmware Version 2.0

Remote?

Remote ,1

:*IDN;;Remote?;;FAULT?;;MEAS?;;VOLT?;;CUR?;;POW?

2) Set the protection value

OVP, 455

OVP?

OVP, 455.00

OCP, 225

OCP?

OCP, 225.00

:OVP 1;;OCP 2;;OPP 3

LIMIT:VOLT 450

LIMIT:VOLT?

LIMIT:VOLT 450.00

LIMIT:CURP 220

LIMIT:CURN -220

LIMIT:POWP 100

LIMIT:POWN -100

LIMIT?

LIMIT ,450.00,220.00,-220.00,100.00,-100.00

:LIMIT:VOLT 4;;LIMIT:CURP 5;;LIMIT:CURN 6;;LIMIT:POWP 7;;LIMIT:POWN 8

3) Check for faults

FAULT?

FAULT,0 //No faults

FAULT?

FAULT,1 //Got a fault

*RST //reset the unit

4) Power up in output setting mode

SET:VOLT, 100

```

SET:CURP, 50
SET:CURN, -50
SET:POWP, 10
SET:POWN, -10
SET?
    SET ,100.00,50.00,-50.00,10.00,-10.00,0.00
SET APPLY
POWER ON
POWER:STAT?
    POWER:STAT ,1
OUTPUT ON
OUTPUT:STAT?
    OUTPUT:STAT ,1
VOLT?
    VOLT ,*. *
CUR?
    CUR, *. *
POW?
    POW, *. *

```

5) Power up in sequence mode

```

SEQ:LAB?
    SEQ:LAB,1
        SEQ:VOLT,200
        SEQ:CURP,100
        SEQ:CURN, -100
        SEQ:POW,10
        SEQ:PWN, -10
        SEQ:SWT,13
        SEQ:DUT,1000
        SEQ?
            SEQ,1.00,1000.00,13.00,200.00,100.00,-100.00,10.00,-10.00,0.00
SEQ:INC
    SEQ:LAB?
        SEQ:LAB ,2
        SEQ:VOLT, 400
        SEQ:CURP, 200
        SEQ:CURN, -200
        SEQ:POW, 50
        SEQ:PWN, -50
        SEQ:SWT, 5
        SEQ:DUT, 2000
        SEQ?
            SEQ ,2.00,2000.00,5.00,400.00,400.00,-400.00,50.00,-50.00,0.00

```

```

        SEQ:REPEAT,10
        SEQ:APPLY
    POWER,ON
POWER:STAT?
    POWER:STAT ,1
OUTPUT,ON
OUTPUT:STAT
    OUTPUT:STAT,1
    VOLT?
        VOLT ,*. *
    CUR?
        CUR ,*. *
    POW?
        POW ,*. *

```

6) Measurement

```
:*IDN;;Remote?;;FAULT?;;MEAS?;;VOLT?;;CUR?;;POW?
```

7) Output Mode

```

MODE CV&CC&CP&CR
MODE CV
MODE CC
MODE CP
MODE BATSIM
MODE BAT
MODE PV
MODE?

```

8) Power On

```

:POWER ON;;OUTPUT ON;;SWITCH ON
:SWITCH OFF;;OUTPUT OFF;;POWER OFF
*RST
:POWER:STAT?;;OUTPUT:STAT?;;SWITCH:STAT?

```

9) Hardware Limits

```

:OVP 1;;OCP 2;;OPP 3;;LIMIT:VOLT 4;;LIMIT:CURP 5;;LIMIT:CURN 6;;LIMIT:POWP 7;;LIMIT:POWN 8
LIMIT 1,2,3,4,5
:OVP?;;OCP?;;OPP?;;LIMIT:VOLT?;;LIMIT:CURP?;;LIMIT:CURN?;;LIMIT:POWP?;;LIMIT:POWN?;;LIMIT?

```

10) PV Mode

With a maximum of 800 data, you can send 800 data at one time or multiple times, automatically splice the received data, run the PV curve once with 800 data and return to pvsim OK, and ignore the data greater than 800. Note: the character at the end of the data is;

[illegible]

[illegible]

11) Battery Test

```
//Set the operation mode (the setting is valid before DC startup) and start the power output.
```

```
//Set the number of rows, voltage, current, power, time, mode, cut-off condition and condition value.
```

```
//Start battery test
```

BAT CLEAR

```
:MOD BAT;:POWER ON;:OUTPUT ON
```

BAT 1,2,3,4,5,1,1,8

BAT ON

BAT

```
1,2,3,4,5,(0-2)|DISCHARGE|CHARGE|REST,(0-4)CURRGREATER|CURRLESS|CHARVOLT|DISCHARVOL
T|INVALID,10
```

BAT OFF

12) Battery Simulation

//Set the operation mode (the setting is valid before DC startup), start the power output, and this line may not be set after the power output is started.

```
//Set initial capacity
```

```
//Set the number of batteries in series, in parallel, and the internal resistance of the battery.
```

```
//Battery simulation
```

:MOD BATSIM,;POWER ON,;OUTPUT ON,;INITCAPA 20,;SERI 10,;PARA 12,;INTERNALR 0.3,;BATSIM
0.000000,11.167000,54.522999,97.878998,141.235001,185.248001,230.574005,275.243988,319.25
6989,363.925995,408.596008,453.265991,497.934998,541.947998,586.617981,631.943970,677.270
996,722.598022,767.924011,813.250977,858.577026,904.560974,950.544006,996.528015,1042.510
986,1088.494995,1134.478027,1181.119019,1227.102051,1273.741943,1320.383057,1367.022949,
1413.663940,1460.303955,1506.943970,1553.584961,1600.881958,1647.522949,1694.819946,1741
.459961,1788.100952,1835.397949,1882.694946,1929.991943,1977.290039,2024.587036,2071.884
033,2119.181885,2166.479004,2213.775879,2260.416992,2307.714111,2354.354004,2400.995117,
2446.978027,2492.961914,2538.945068,2584.928955,2630.912109,2676.239014,2720.251953,2760
.979980,2799.737061,2834.552979,2863.457031,2885.791992,2903.529053,2917.979980,2930.461
914,2940.314941,2947.541016,2953.452881,2962.649902,
4.200000,4.260000,4.238000,4.217000,4.196000,4.176000,4.159000,4.141000,4.123000,4.105000,4.
086000,4.069000,4.050000,4.031000,4.014000,3.998000,3.982000,3.967000,3.951000,3.934000,3.9
18000,3.905000,3.891000,3.878000,3.864000,3.851000,3.838000,3.826000,3.815000,3.804000,3.79
4000,3.784000,3.776000,3.769000,3.760000,3.751000,3.744000,3.738000,3.732000,3.726000,3.718
000,3.713000,3.709000,3.706000,3.702000,3.698000,3.694000,3.690000,3.686000,3.680000,3.6750
00,3.670000,3.665000,3.657000,3.647000,3.636000,3.622000,3.608000,3.594000,3.578000,3.55800
0,3.532000,3.500000,3.463000,3.421000,3.374000,3.323000,3.271000,3.219000,3.166000,3.112000,
3.059000,3.005000;