Name of Product

Electrical Safety Comprehensive Test System

Models covered in this manual:

AN9640B V3（F）: Six- in-One (GB+IR+ACW +LC+PA+ST+DCW);

Meaning of abbreviations:

ACW	**:**	**AC Withstand Voltage Test**
IR	**:**	**Insulation Resistance Test**
GB	**:**	**Ground Resistance Test**
LC	**:**	**Touch Current/Leakage Current Test**
PA	**:**	**Power Test**
ST	**:**	**Low-voltage Start-up Test**
DCW	**:**	**DC Withstand Voltage Test**

AN9640BV3（F）&AN9651BV3（F）&AN9651CV3（F）

Comprehensive Safety Performance Analyzer &

Comprehensive test system for safety performance

User Manual（V1.0）

Applicable standards and regulations

This series of products are manufactured according to the following criteria:

GB/T 32192-2015 Withstanding voltage tester

SJ/T11385-2008 General specification of insulation resistance tester

GB/T 32191-2015 Leakage current tester

GB/T 28030-2011 Earth continuity tester

This series meets the following verification regulations:

JJG843-2007 Verification regulation of leakage current tester

JJG795-2016 Verification regulation of withstanding voltage testers

JJG1005-2019 Veification regulation of electronic insulating resistance testers

JJG984-2004 Veification regulation of ground resistance tester

Table of Content

Chapter 1 Safety Rules

Guide:

- General
- Warning Signs
- Testing Station
- Operating Regulation
- Operating Rules

1.1 General

Before operating this analyzer, **read** this manual **carefully**, and operate according to this manual.

- Keep this manual in place convenient for operator to access.
- Never touch the live parts of the tester or the house of the object under test during testing, otherwise **electric shock** will occur!
- Be sure to turn off the **power switch** before connecting/disconnecting the wire on the rear panel!
- For insulation and ACW/DCW, the Device Under Test (DUT) shall be isolated from the ground and surroundings properly. Especially: the DUT shall be isolated from the line body properly!
- Ground the analyzer **properly**.

1.2 Warning Signs

 or  High-voltage, indicating high-voltage output between terminals.

 **Alarm, attached at eye-attracting position of the panel of instrument.**

 Earth, attached close to the earth terminal of instrument.

Warning, prompting that the operation, application or conditions are dangerous, or even cause personnel death/injury.

Caution, prompting that the operation, application or conditions are dangerous or even damage to the tester, or the data stored in the instrument is lost.

1.3 Testing Station

1 Position

The station must be positioned away from persons other than the operators. Keep the station isolated with other facilities, indicating **"High-voltage Testing Station".** Indicate "**Danger! Testing ..., Non-operators keep away!**" during testing.

2 Power supply

Available power supply: **single-phase 220V±10%,** 50Hz±5%. Ensure proper power supply to avoid damage to instrument and personal injury.

Only use fuse of proper specification.

Ground the tester well before operation so as to guarantee personnel safety. Set a power switch for the testing station at the entrance and prompt especially. In case of emergency, shut off the power supply and then handle the accident.

3 Workplace

Use non-conductive worktable or platform as possible. Metal between the operator and DUT is forbidden. The operators shall not operate or adjust the tester over the DUT. The testing place must be clear, clean and in order. Keep the instrument and the testing line in proper place after operation. All persons shall identify the objects under testing, to be tested and that tested. Keep the testing station and surrounds free of flammable or corrosive gases. Do not operate the tester near flammable substance.

1.4 Operating Regulation

1 Qualification

Any electric shock due to wrong operation of the voltage and current from this analyzer will cause injury to persons, or even death. This analyzer must be used and operated by qualified operators according to the manual.

2 Safety rules

The operators must be educated and trained in time, so as to understand all operating regulations, and operate this analyzer taking the safety rules into consideration.

3 Clothing

The operators shall not wear clothing with metal garnishry or metal jewelry and watches, to avoid electric shock or even more serious results.

The operators must wear insulated gloves during operation of the analyzer.

4 Medical regulation

This analyzer can not be operated by persons wearing cardiotach adjuster or pacemaker.

1.5 Operating Rules

The maximum output of this tester is 5kVAC. Observe the following provisions during test to avoid injury or death!

1.5.1 Forbidden

- Frequent ON/OFF of the instrument is forbidden. Switch on/off the instrument at interval of 30 seconds or move.
- Never open the house of the analyzer. The analyzer must be maintained by trained and qualified engineers or technicians.

1.5.2 Precautions during testing

- The operators must wear insulated gloves.
- To leave the operating area temporarily or to perform the test later, switch off the power supply.
- During high-voltage testing, never touch DUT or any objects connected with the DUT.
- The operator must be able to master the control switch and the remote switch independently. Please remove the remote switch if it is not used. Non-qualified operators and other persons should keep away from high voltage area.
- Connect the earth wire of analyzer properly. Only insert the high-voltage testing line for testing. Hold the insulated parts of high-voltage line (clip). Never directly touch the high-voltage output terminal (clip).

In case of any problems, press STOP immediately. Turn off the power supply directly if necessary.

Chapter2 Overview

Summury:

- Introduction
- Features
- Front Panel
- Rear Panel
- Accessory

2.1 Introduction

2.1.1AN9640BV3(F) Comprehensive safety performance analyzer

AN9640BV3(F)series Safety Analyzer is a comprehensive instrument for testing of electrical strength (ACW/DCW), GB, IR, LC, PA, and other functions, an important tester of electrical manufacturers and inspection department. This series of testers are developed by Ainuo with industry-leading technology, automation and performance:

1 Fast

This instrument adopts DSP microprocessor as the control core for real-time measurement of the compliance parameters of the DUT, finishing four tests within 4.5s, particularly suitable for fast test in the line.

2 Simple

This instrument is designed with menu prompt operation. User can quickly complete settings of a variety of test conditions and instrument parameters through F menus and numeric keypad, easy to operate. All accessories are clearly identified separately, wire connectiong can be completed according to identified marks, simplify installation.

3 Intelligent Judgment

This instrument has intelligent judgment based on upper/lower limit to automatically identify defective products, while providing audio and video alarm.

4 Reliable

This instrument adopts a variety of anti-jamming measures for the wiring, adopting SPWM technology to generate standard 50Hz or 60Hz sine wave, which is driven and output via high-power MOS transistor to achieve non-contact conditioning of high voltage and high current, realize hardware/software protection, greatly improving reliability of the instrument.

5 Safe

Auto over voltage/over current protection, secure and safe.

2.1.2 AN9651BV3(F) Comprehensive safety performance analyzer

AN9651BV3(F) is composed of AN9640BV3 and intelligent variable frequency power supply.

2.1.3 AN9651CV3(F) Comprehensive test system for safety performance

AN9651CV3 is composed of AN9640BV3, intelligent variable frequency power supply and system controller. The configuration of the system controller is as follows:

System controller (industrial computer and peripherals) IPC:

Intel CPU 2.8GHz;

120GB hard drive;

4GB memory;

SVGA monitor;

USB, wireless mouse, keyboard;

2.2 Features

1, Intelligent: Industry first, Andrews platform, full-screen touch, continuous upgrade of APP applications; barcode recognition, data storage, network transmission;

2, Accurate: tester accuracy of 1%, power accuracy of 0.2%, stable and accurate for complex environments;

3,Comprehensive: Seven- in-One testing: GB/ACW/IR/LC/PA/ST/DCW.

2.3 Front Panel

Figure 2-3-1 Front Panel

There are Keys, lamps and LCDs on the front panel, as shown in Figure 2-3-1, including 7 sections:

(1) Power switch: turn on/off the input power.

(2) START/STOP button:

: STOP: stop current test and return to the parent directory.

: START: start current group test.

(3) LCD screen: show settings and measurement information, as shown in Figure 2-3-2, including 6 districts.

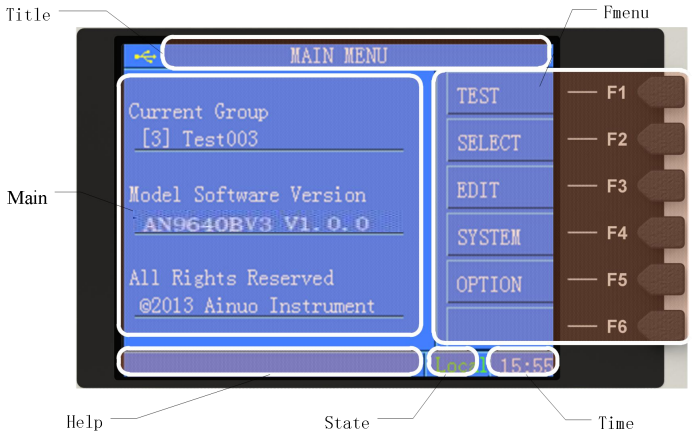


Figure 2-3-2 LCDs

Tile: display title of current screen.

Main: dispaly settings and test information.

Help: Help information for the user's operation.

Status: current operating status of the instrument, including Local, PLC and Barcode.

Time: current time (24h system).

F menu:operate F keys according to the soft keyboard displayed on the screen.

(4) **F menus:**operate as the soft keyboard displayed at right.

(5) **Keys:** Described as follows:

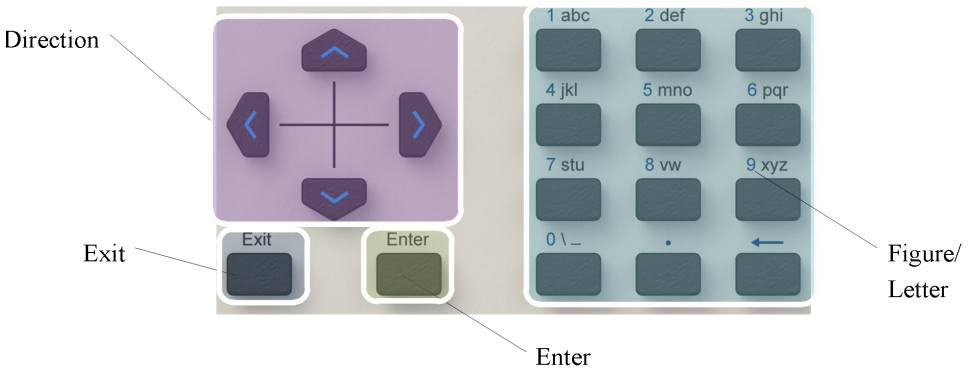


Figure 2-3-3 Function of keys

Keys	Function
Direction	To move the cursor

Exit	1. Cancel current input under edit mode. 2. Exit current screen under non-edit mode.
Enter	1. Conform current input under edit mode. 2. Move the cursor to the next line under non-edit mode.
Figure/Letter	Input letter or figure at the cursor position.

(6) **Status LED:** TESTING (yellow), FAIL(red), PASS(green).

(7) **USB port:** external U disk interface for import/export of testing file and data storage;

Note: restrictions of this tester on U disk:

- *USB2.0 protocol, format FAT32, capacity not greater than 16GB;*
- *U disk other than system U disk (those which can be used for operating system restoration);*
- *Less other files in the U disk as possible. Too many files will affect the speed of recognition.*

2.4 Rear Panel

On the rear panel, terminals and interfaces are shown in Figure 2-4-1.

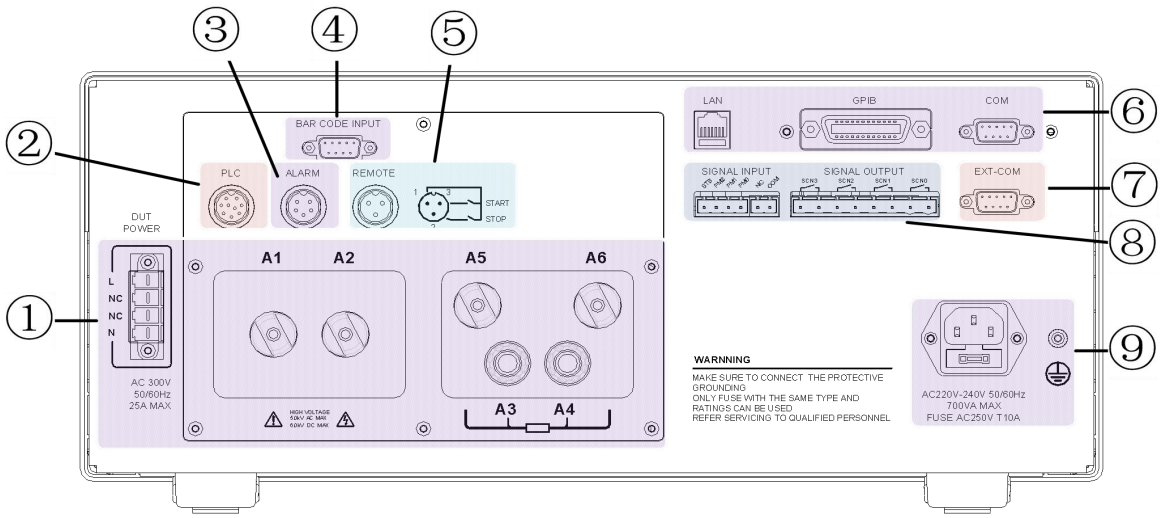


Figure 2-4-1 Interfaces on the rear panel

① **Terminal area**:The detailed functions are as follows,

A1: High voltage L line;

A2: High voltage N line;

A3: GB voltage sampling positive;

A4 GB current output;

A5: Measurement loop;

A6: GB current circuit;

L: L end of the power input line;

N: N terminal of the power input line;

DUT POWER: input of DUT power, to connect mains power or inverter power;

②**PLC:** Support PLC control to start, stop, change the test group and other operations. For definitions of ports, refer to Section 5.3;

③**ALARM:** to connect alarm LED (three colors). For definitions of ports, refer to Section 5.1;

④**BAR CODE INPUT:** to connect barcode scanner with RS-232 port for barcode input.

⑤**REMOTE:** to connect remote control box. Support start/stop operation. For definitions of ports, refer to Section 5.2;

⑥**Communication port:** optional RS232/RS485/GPIB/LAN COM.

⑦**External power supply communication interface:**

can be connected AN97 / AN16 series inverter power supply and other external devices.

⑧SINGAL INPUT: quick select. For definitions of ports, refer to Section 5.8;

SINGAL OUTPUT: programmable digital output, set on the screen;

⑨**Input Power:** power socket, 220V/50Hz, 10A fuse.

2.5 AN9651BV3/AN9651CV3 installation and connection

2.5.1 AN9651BV3Assembly wiring

The comprehensive test system needs to install the corresponding test fixtures and accessories, and the input power supply can be used normally. Please refer to the steps shown in Figure 2-1 for the installation and connection.

Note: Make sure that the power supply is single-phase AC220V -240V, 50/60Hz.

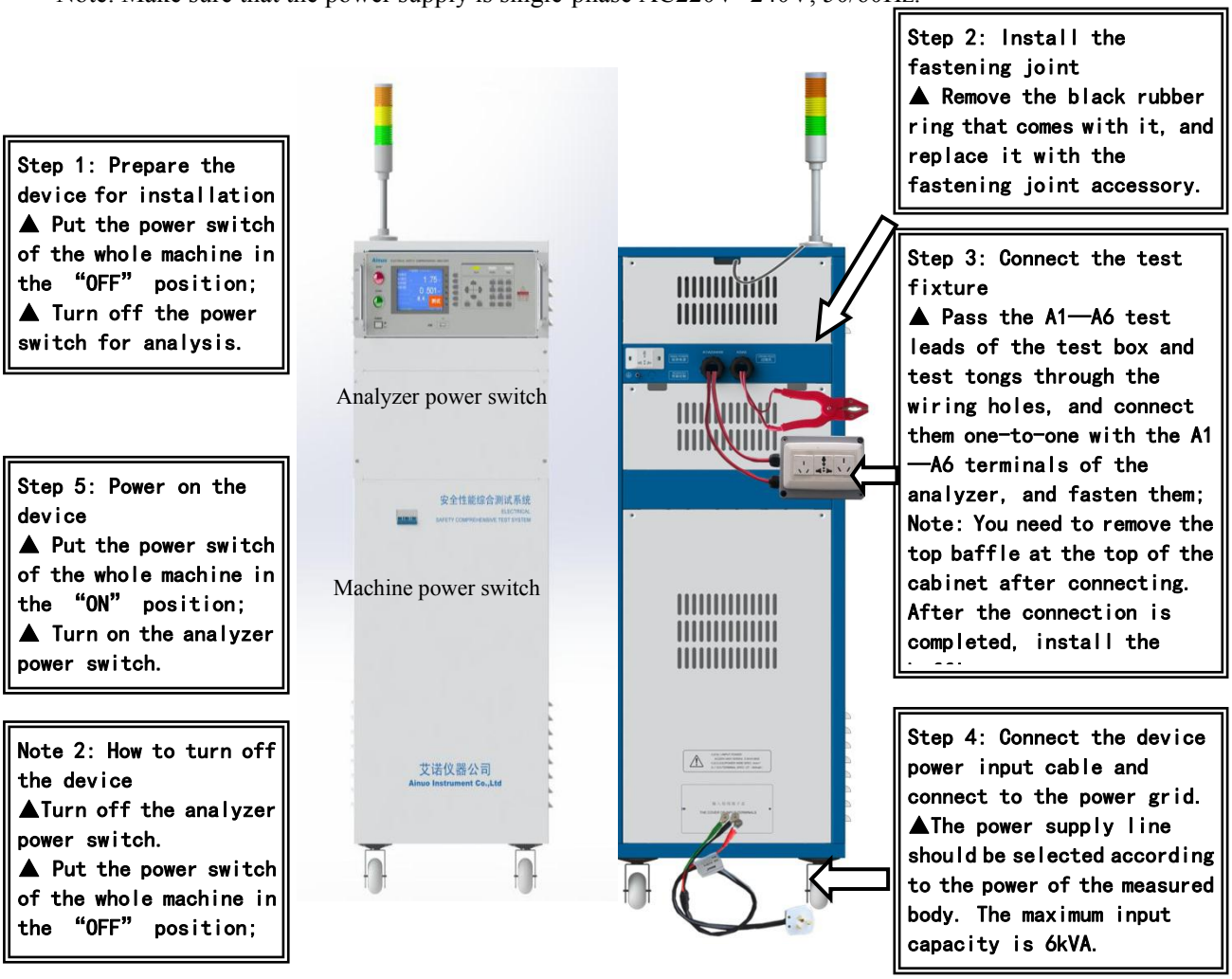


Figure 2-5-1 Wiring diagram of the comprehensive test system

Note: The comprehensive test system is a 220V/50Hz power supply system. The maximum power required by the system is 6kVA (including the operating power of the product under test). Please confirm that the connected power supply can provide the required frequency and power capacity. Do not use power supplies that do not meet the above requirements to avoid equipment damage.

2.5.1 AN9651CV3Assembly wiring

①**Hardware installation:** The hardware devices of AN9651CV3 comprehensive measurement system are installed in a chassis. When installing, please refer to the following installation steps. For the detailed hardware configuration and installation sequence, please refer to the hardware configuration diagram included with the system. The following only provides the installation method of the general standard configuration of the AN9651CV3 comprehensive measurement system.

Installation steps:

(1) Fix the display and alarm light on the upper part of the chassis and tighten the screws, as

shown in Figure 2-1;

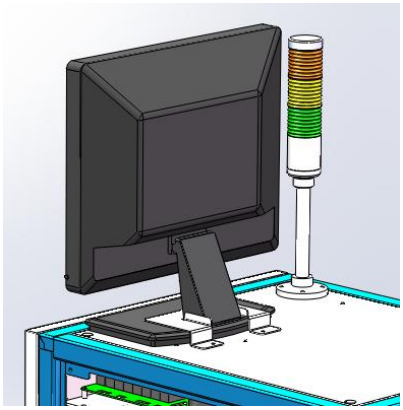


Figure 2-5-2 Fixed display

(2) According to the actual wiring diagram of the system, connect each instrument according to the specified wire, including the power supply line, communication line and test fixture of each single meter, as shown in Figure 2-5-3, confirm that the power supply is single-phase 220V±10%, 50Hz±5%。

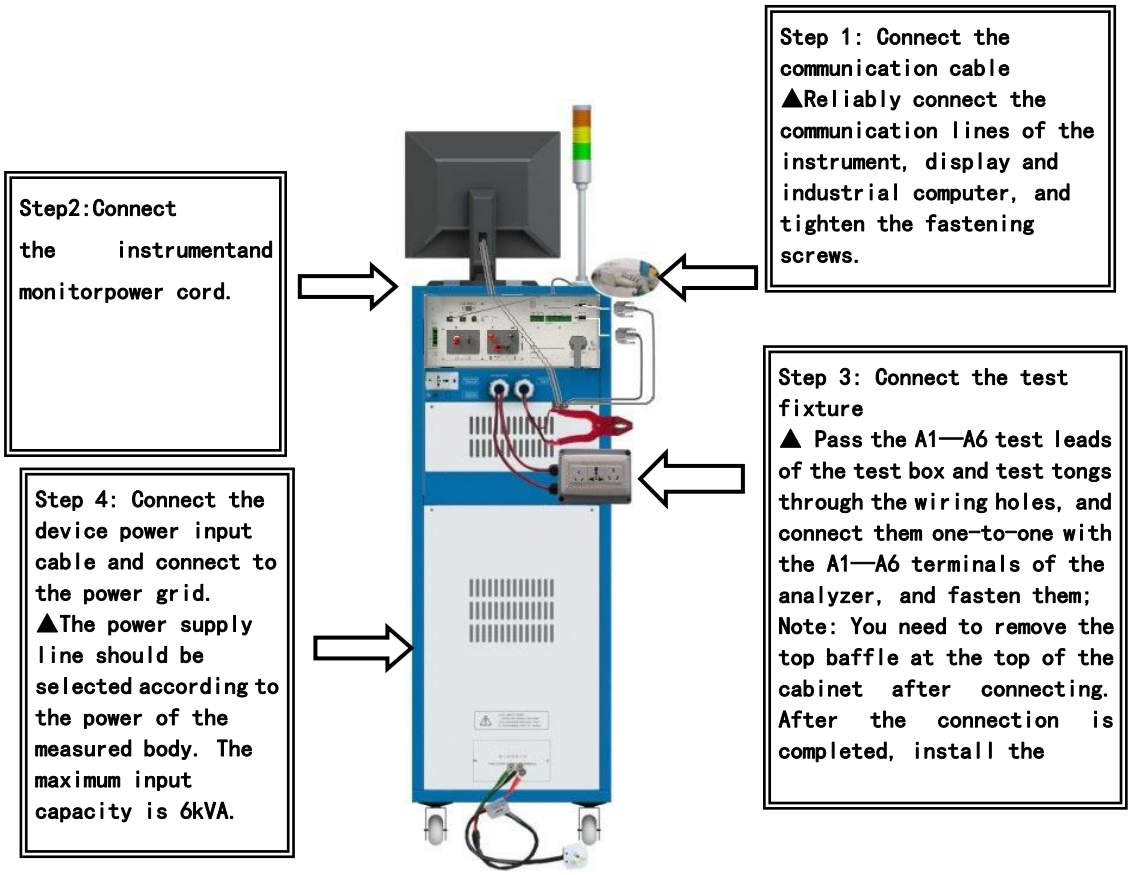


Figure 2-5-3 Wiring diagram of the comprehensive test system

②Install/uninstall ESRS system software: Before you use ESRS system, you must first install ESRS system software to your computer. In the following chapters, we will tell you how to install ESRS system software step by step on your computer window environment.

Install the ESRS system software on the Windows environment.

Before you install, the hard disk in your computer should reserve at least 100MB of storage space.

You can select the SETUP.EXE file in the root directory of the installation file to install.

The installation process is as follows:

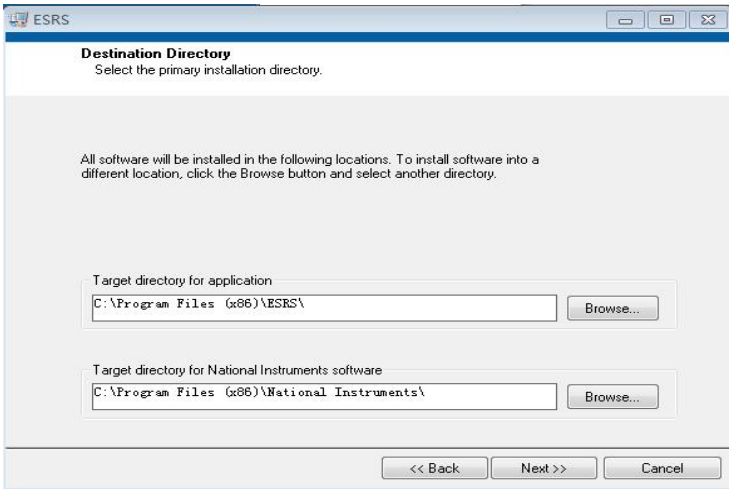


Figure 2-5-4 ESRS driver

The installation location of some modules of the software in Figure 2-5-4 above is recommended to be installed in a hard disk partition with a large remaining space, because the data generated by the test will be automatically saved in this directory, occupying a large hard disk space, 2-5-4 are some necessary drivers required for the software to run, generally installed in the default directory.

2.6Accessory

2.6.1Test Box

To connect the power line of DUT, so asto connect the DUT with the analyzer.

Figure 2-6-1Test box

2.6.2GB clamp

For GB, connect the GB point. In fact, this GB clamp acts as a large current output terminal, and used for current and voltage sampling.

Figure 2-6-2 GB clamp

2.6.3ALARM light

The ALARM light can provide three signals: PASS (green), Testing (yellow) and FAIL (red). Insert the ALARM light 5P aero plug into the 5P ALARM light aero socket on the rear panel.

Figure2-6-3 ALARM light

2.6.5 RS232 cable

For serial communication. Insert one end of the cable into the interface on the rear panel, and the other end into the serial port of the computer for communication.

Figure 2-6-5 RS232 cable

Chapter 3 Unpack and Installation

Guide:

- Installation Environment
- Unpack and check
- Check before power-on

3.1 Installation Environment

To select installation position, take the following into consideration:

1 Away from flammable, explosive or corrosive substance, e.g., alcohol, thinner, sulfuric acid etc.

2 Away from heat or sun.

Operating Temp.: 0℃~+40℃

Storage Temp.: -10℃~+50℃

Avoid sudden change of temperature, otherwise condensate will occur inside the instrument.

3 Away from boilers, humidifiers and water and so on.

Operating relative humidity: 20~75%RH

Storage relative humidity: 0~90%RH

Stop usage of the tester as condensate occurs.

4 Away from strong electromagnetic interference.

5 Away from the obvious shock and vibration.

6 Keep the working environment free of dust. Keep good ventilation. The scanner is cooled via natural air. Poor ventilation can lead to damage to the equipment. Keep the rear panel at least 30cm away from the wall during operating.

7 Away from precise instruments - As high-voltage is output, corona discharging will occur near the test point of DUT, emitting radio electromagnetic wave and interfering measuring accuracy of precise instruments.

3.2 Unpack and Check

First check the nameplate and see if the model is consistent with that in the order; then check if the items are complete according to the Packing List in the manual. If the items are not consistent with those in the Packing List, please contact Ainuo service center or the dealer.

If the package is damaged, check the instrument for any deformation or scratch, or damage to the panel etc. In case of any damage, inform Ainuo Instrument Company or the dealer immediately. Our service center will repair or replace it with new one. Do not return the product before informing Ainuo Instrument Company or its dealer.

Do not open the cover of the instrument freely so as to avoid electric shock. In case of abnormities of the instrument, ask Ainuo Instrument Company or the dealer for maintenance.

3.3 Check before power-on

After confirming that the instrument is intact and attached to the work location, please check in the following steps:

(1) Only connect the power line and do not connect other test line. Turn on the power switch;

(2) After the instrument enters the selection screen, press the menu Goto Test to enter test screen, press START button to test. If the test conditions are described below:

a. Alarm for open ground;

b. IR >50GΩ;

c. Low breakdown current or zero for ACW/DCW;

d. For PA, displayed output voltage: 220V, output power: 0W;

e. For LC, displayed output voltage: 233V, current (rms): 0μA.

The analyzer is normal; check the analyzer according to the instruction in Section 4.

(3) Start the analyzer for the first time, if there is no display, check and make sure the power line is connected well; during start to test, if the start fails, there is no response after pressing the key, or there is no action sound of relay etc, please contact Ainuo or designated dealer for technical support.

3.4 ESRS software operation instructions (only AN9651CV3 uses this software)

3.4.1 How to start the ESRS system software

If you have installed the ESRS software to your hard drive according to the instructions in Chapter 2, a shortcut to the ESRS software will appear on the desktop of your industrial computer. Click the shortcut button with the mouse to start the ESRS software. In addition, you can also start as follows: Start-Program-ESRS-Start system software.

Figure 3-2-1 A shortcut

After executing the ESRS system software, the login interface as shown in Figure 3-2-2 will appear first:

Figure 3-2-2 login interface

This system supports multiple models of instrumentation equipment. Please select the instrumentation equipment model when logging in.

Click the "Options" button to switch between showing or hiding language selection and mode selection options.

Language selection can choose Chinese or English, the mode can choose control mode or query mode.

The difference between these two modes is:

1) In the control mode, you can only have one comprehensive tester in the operating system, you can set test items for the tester, start or stop the test, read test data and other operations;

2) In the query mode, you can query the data of one to eight testers in the system, but you cannot set test items, start or stop, etc.

After the language and mode are selected, the next time you log in, it will automatically remember what you have selected, and there is no need to repeat the selection.

Please enter the user's name and the correct password in the "User Name" and "Password" input boxes, and then press the OK button to start using the ESRS system software.

The system provides 2 default login users:

1) The "root" user is an administrator user and the password is blank. This user cannot be deleted and has all permissions, but the password can be changed. This user belongs to a non-production person and does not keep data to the database during testing.

2) The "user" user is an operator user, and the password is empty. This user can be deleted.

By default, he has all permissions, and the permissions can be modified, and the password can be modified. This user belongs to the production staff and can save the data to the database during the test.

If you are using this software for the first time, please log in with the "root" user, the password is blank, and modify the password for the user "root" after login to ensure safe use.

When you successfully complete the login procedure, the main interface of the ESRS system software as shown in Figure 3-2-3 will appear.

Figure 3-2-3 Main interface

The main interface of the ESRS system software is composed of 6 function buttons, which are described as follows:

1) Product test Perform the edited test process, display the test process and results;

2) Program editing Edit the test process and various parameters; (in query mode, this function is not available)

3) Report generation According to the selected query conditions, the test result data is generated into a report;

4) Hardware configuration Add and delete hardware devices and configure each instrument in the system;

5) MES configuration related to configuration database;

6) System management Set the permissions of each user, view the test log of each registrant, and set the effective system configuration and test process;

3.4.2 ESRSSystem software operation flow

The operation process of the ESRS system test software is as follows:

In control mode:

The first step is to enter the "Hardware Configuration" module and configure the tester device parameters you want to control. This step is generally only required once, unless you change the hardware configuration of the device, you need to re-enter the module settings.

The second step is to enter the "program editing" module to edit the test project process and parameters you want to carry out.

The third step is to enter the "System Management" module and publish the test program you just edited.

The fourth step is to enter the "Product Test" module and open the test program you just edited to start the test.

The fifth step, enter the "report generation" module, you can query and count test data, and generate reports.

In query mode:

The first step is to enter the "Hardware Configuration" module and configure the tester device parameters you want to query. This step is generally only required once, unless you change the hardware configuration of the device, you need to re-enter the module settings.

The second step is to enter the "Product Test" module, open the hardware configuration file you just edited, and you can start the query.

The third step, enter the "report generation" module, you can query and count test data, and generate reports.

3.4.3 System Management

Select the system management option in the main interface of the system ESRS system software, and the system management interface as shown in Figure 3-2-4 will be displayed.

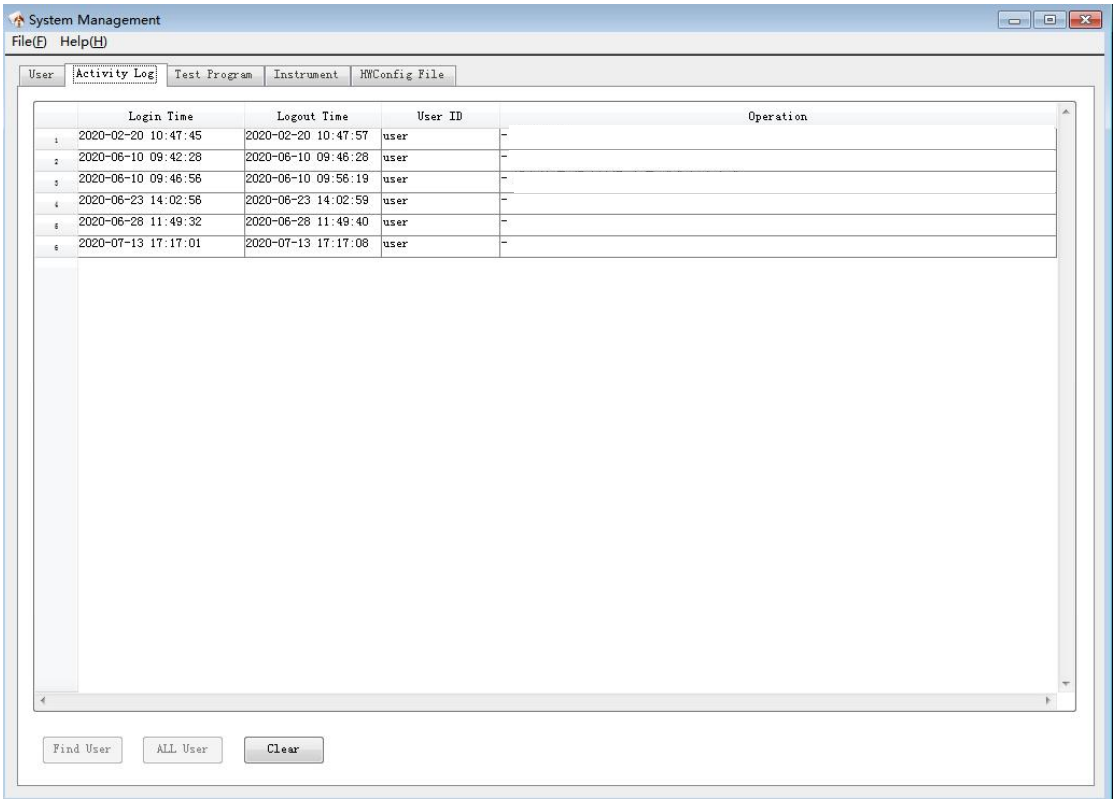


Figure 3-2-4 System management interface

System management is divided into 5 modules: user information management, login log management, test program management, device information viewing, hardware configuration file management, etc.

User information includes user name, user password, expiration date, production line personnel, operation authority and remarks of each module of the ESRS system. The user information management module mainly implements operations such as modification, addition, deletion and preservation of these information.

The login log records the user's login information, including login time, logout time, user name and operation content, etc. The login log management module mainly implements operations such as viewing and deleting such information.

The test program information records the name of the test program, the time of creation of the test program, the product model corresponding to the setting program, etc.; the test program management mainly implements operations such as setting the product model and deleting program files.

The device information records the hardware devices that can be used by the system, including device type, model, interface, interface parameters, and corresponding dynamic link library; this part of the content can only be viewed and cannot be modified.

The hardware configuration file information records the system hardware configuration file name, remarks, etc.; the hardware configuration file management mainly implements operations such as deleting the configuration file.

3.4.4 Hardware Configuration

Select the device management option in the main interface of the ESRS system software, and the device management interface shown in Figure 3-2-5 will be displayed. Please be sure to set its related parameters according to the configuration of the instrument on the system, such as GPIB address, RS-232 parameters, etc. After setting, pay attention to save the device configuration file.

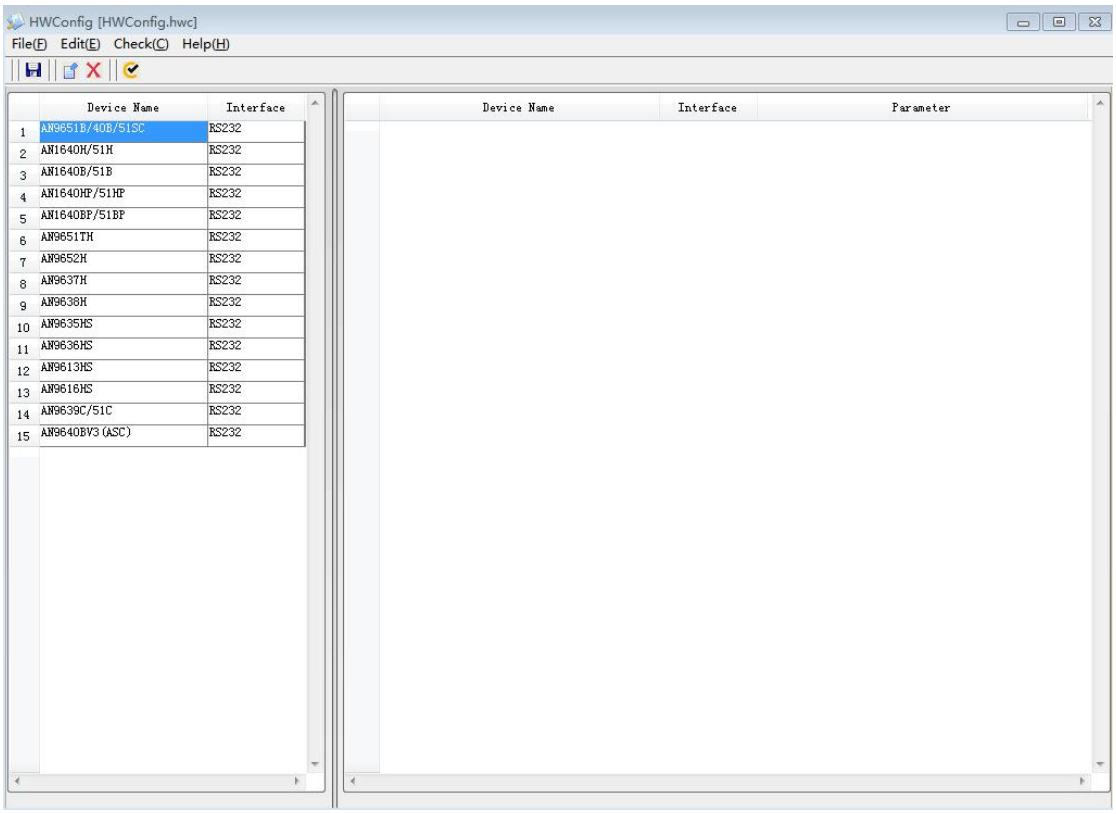


Figure 3-2-5 Device management interface

3.4.5 Program editing

Select the program editing option in the main interface, and the program editing window shown in Figure 3-2-6 will be displayed. Each test process is composed of multiple test items. Multiple fixed test items have been established in the system. You can use them directly to establish the test process you need and then set the parameters of each test item.

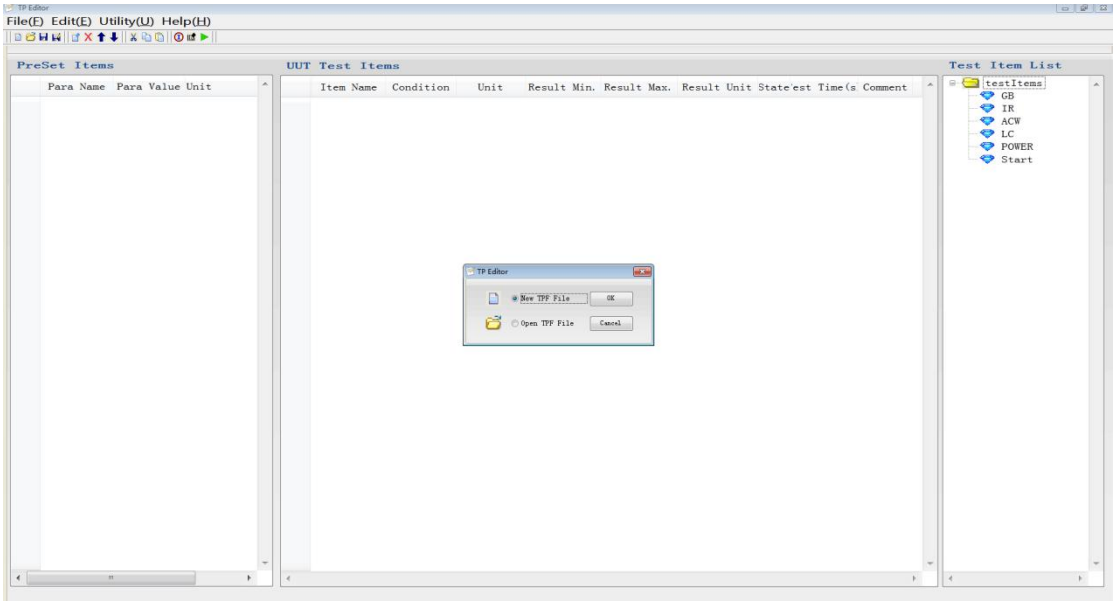


Figure 3-2-6 Program editing window

At this time, the user will be asked whether they want to create a new test process or open an existing test process. If you choose to create a new test process, a dialog box will appear, as shown in Figure 3-2-6. The user enters the corresponding information in this dialog box, and then clicks the "OK" button to display a blank editing interface, as shown in the figure 3-2-6, the user can edit the desired test process and test parameters on this page.

The user can also choose to open an existing test process file, as shown in Figure 3-2-7. After opening the file, the user can modify the test process and test parameters, as shown in Figure 3-2-8.

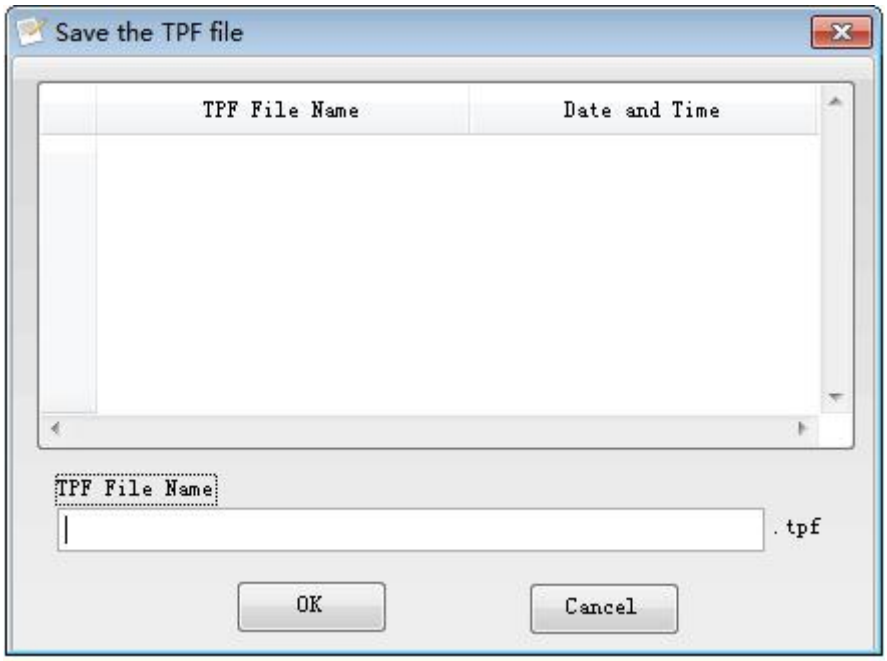


Figure 3-2-7 Open an existing test process file

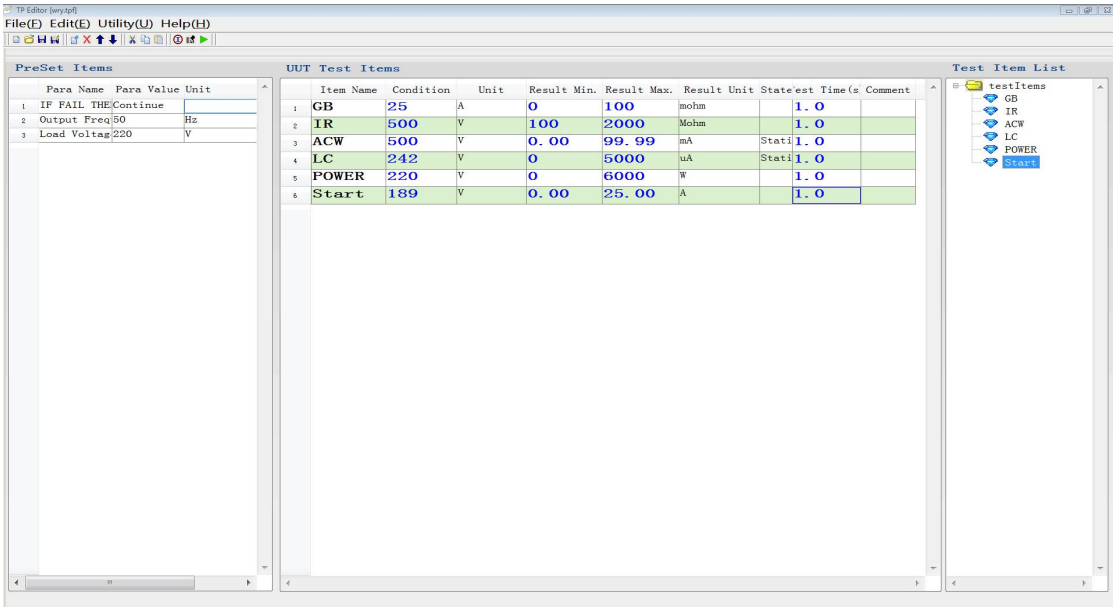


Figure 3-2-8 Open the interface

After creating or modifying a test process, save the test process file and publish it. Note that if you modify a test program, it is best to rename it after modification, otherwise it may affect the generation of the report. If there is a program with the same name in the folder when saving, it will be given. Prompt for user to rename.

3.4.6 Product testing

In the main interface of the system, select the product test interface as shown in Figure 3-2-9 (control mode) or Figure 3-2-10 (query mode). After opening a program file, click the "Execute Test" button, and the system will test the test object according to the set system equipment and test process. Test information and test results will be displayed in their respective display areas.

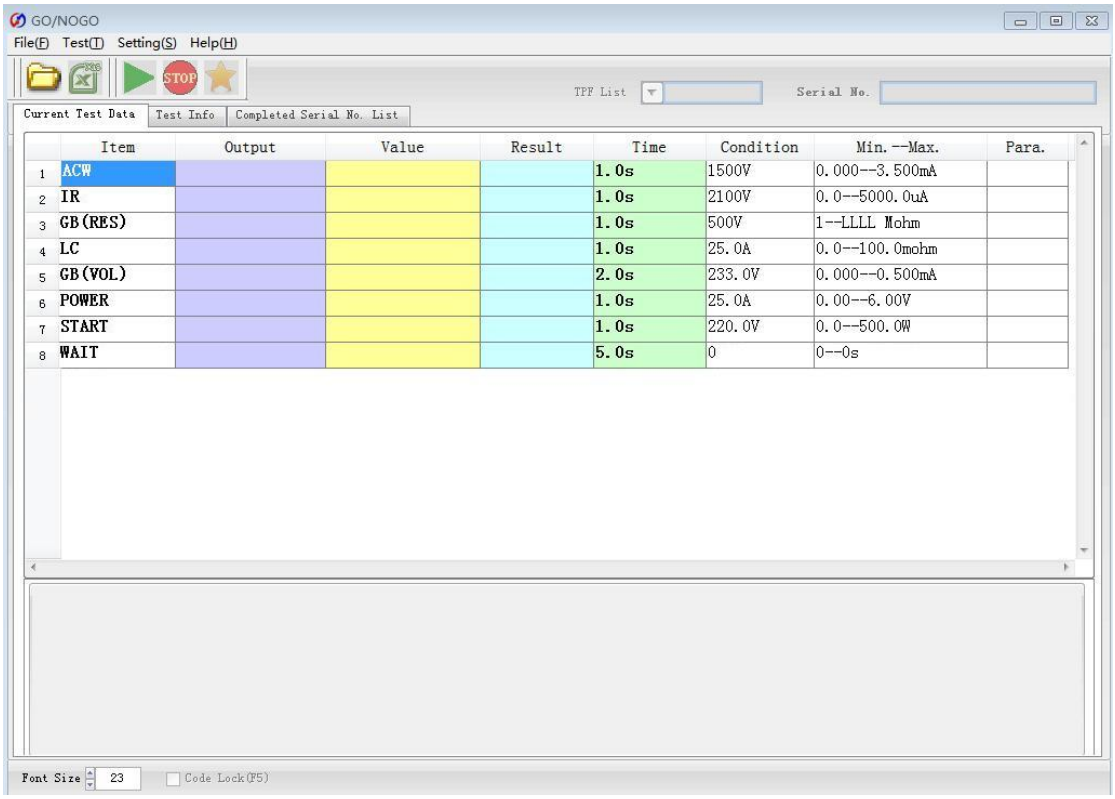


Figure 3-2-9 Control mode

3.4.7 Report generation

In the main interface of the system software, select report generation as shown in Figure 3-2-10, select the date and filter method, and then click the "Find" button. All test serial numbers that meet the query conditions will be displayed in the display area. Click on the row of one of the serial numbers to see detailed test data and results.

3.4.8 End ESRS system software

In the main interface of the ESRS system software, you have the following two ways to end the ESRS system software program:

(1) Move the mouse cursor to the button in the upper right corner of the window in the main interface and click with the left mouse button;

(2) Type Alt + F4 in the main interface.

Chapter 4 Settings and Test

Guide:

- Wiring connection
- Power on
- System SettingsSettings
- Group Selection
- Parameters Settings
- Start to test
- Extended Function
- Calibration
- Shutdown

Precautions before starting the comprehensive measurement system

The comprehensive test system includes AN9651BV3 and AN9651CV3. Before turning on, please make sure that the comprehensive test system has been connected to a sufficient capacity and stable AC power supply. In order to reduce the impact of the inrush current (Inrush Current) on the comprehensive measurement system at the moment of startup, it is recommended that the startup sequence is to turn on the power switch of the whole machine (front panel air switch), and then turn on the power switch of the electrical safety comprehensive analyzer.

4.1Wiring connection

Connect the wire according to the following sequence:

Connect test box and GB clamp → connect input power of DUT → connect input power of the instrument → connect DUT to test box.

4.1.1 Connect Test Box and GB clamp

Connect the wire as shown in Figure 4-1-1:

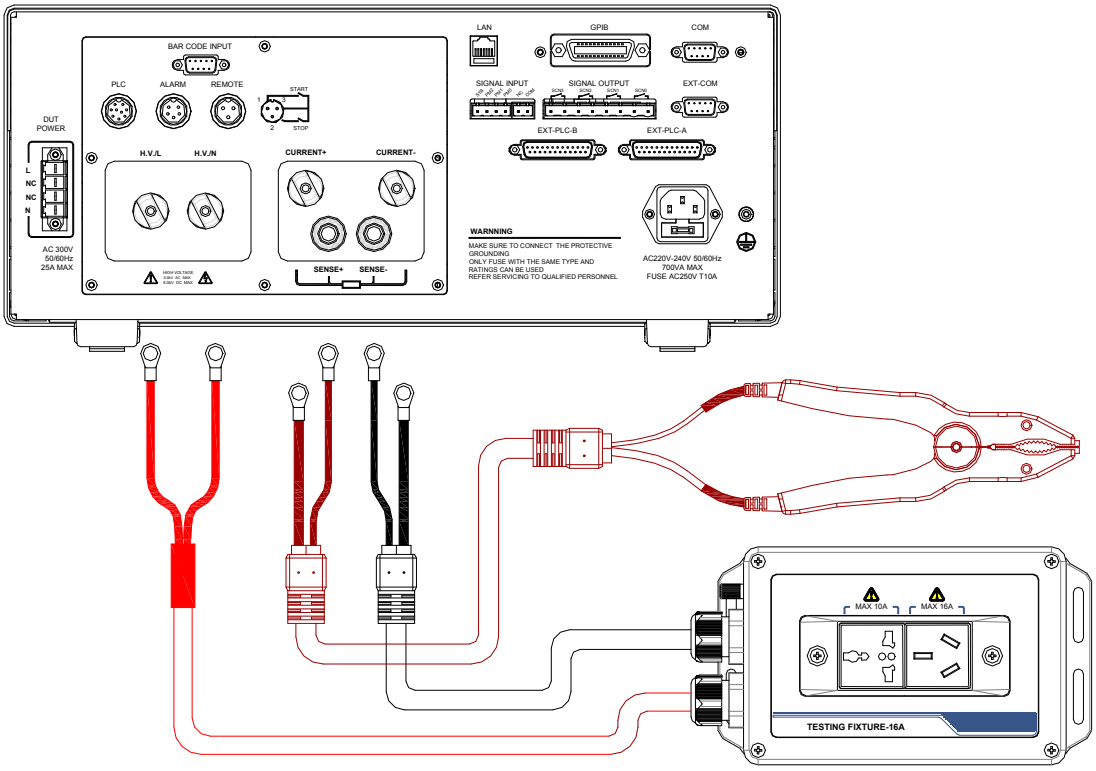


Figure 4-1-1 (1) 9640BV3 connection test box and ground test clamp schematic

1) Connect the four wires on the test box as shown, and lock the terminals.

2) Connect the two wires on the ground test clamp as shown in the figure, and lock the terminals.

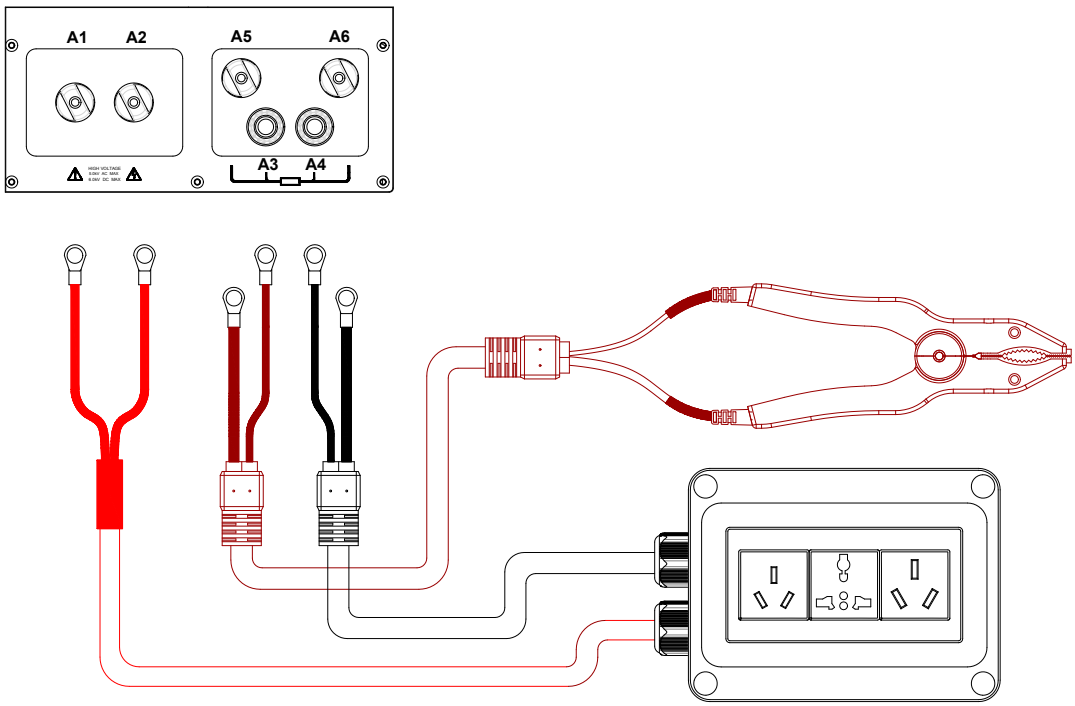


Figure 4-1-1 (2) 9651BV3/9651CV3 connection test box and ground test clamp

1) After passing the four wires on the test box through the wire hole at the rear of the

comprehensive measurement system, according to the markings on the wire, one-to-one correspondence, connect and fasten the terminals (A1, A2, A4, A6);

2) After passing the two wires on the grounding test pliers through the wire hole at the rear of the comprehensive measurement system, according to the markings on the wire, one-to-one correspondence, connect and fasten the terminals (A3, A5);

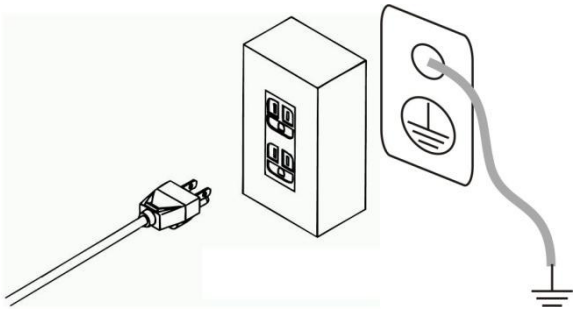
3) Tighten the locking device on the cable hole.

Warning! Make sure to place GB clamp and test box on an insulation pad.

4.1.2 Connect input power of the instrument

Input Power: single phase 220V±10%, 50Hz±5%. Fuse spec: 250V/10A fast blown. Apply the power line.

Warning! To ensure the safety and measurement accuracy , connect the protective grounding well!



(a) Connect to grounding by 3-core power line

(b) Connect to grounding by the GND terminal on the rear panel

Figure 4-1-3 Connect to protective grounding

There are two grounding connection methods, as shown in Figure 4-1-3.

1) The instrument fixes with 3-core power line. Connect the power line to the socket with earth line

2) Connect the grounding terminal of instrument to the grounding terminal of input power.

4.1.3 Connect DUT

DUT wire connections is as shown in Figure 4-1-4.

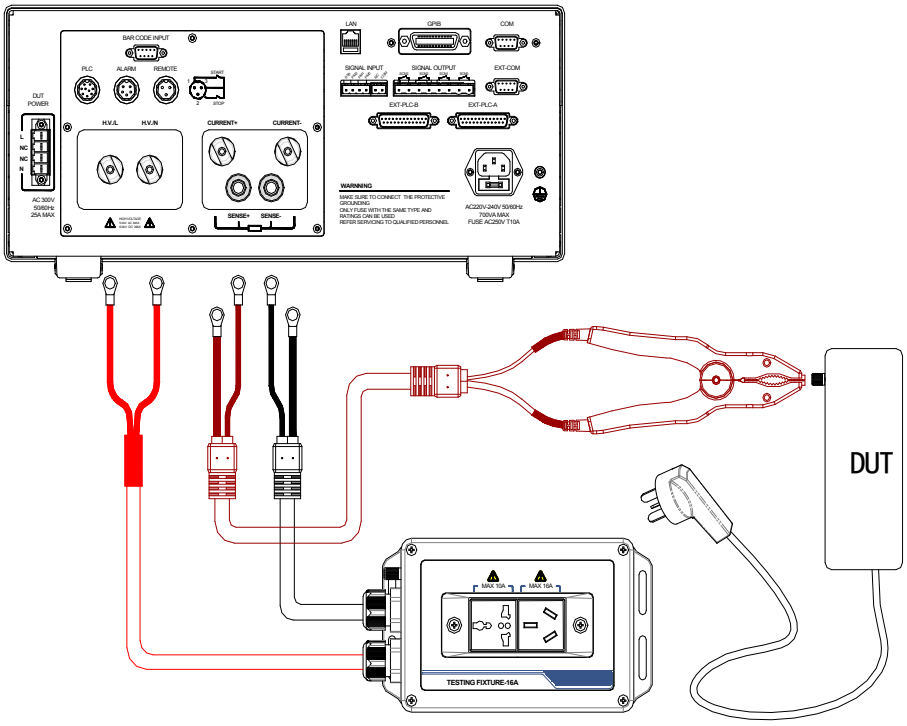


Figure 4-1-4 DUT wire connection

Note: Connect DUT with the test box and the GB clamp.

4.2 Power On

After finish wiring connections, turn on the power switch on the front panel to start the instrument.

4.2.1 Function Selection

After finishing start, it will enter into function selection screen, shown in Figure 4-2-1.

Figure 4-2-1 Selection of Function

In the Function Selection screen, press F menu button to select the corresponding function, as shown in the following:

No.	F menu	Function & Description
1	Start Test	Enter into test standby page
2	Group Selection	Enter into Group selection module to select and call the group
3	Parameters Settings	Enter into Parameters setting module to set the current selected group
4	System Settings	Enter into System setting module to set system parameters
5	Extended Function	Enter into Extended Function module to set barcode,U-disk, channel scan, print, PLC etc information
6	Calibration	Enter into Calibration module to make calibration or reset factory settings etc.

For first power-on, it is recommended to set the analyzer as the following sequence.

4.3 System Settings

System setting screen is as shown in Figure 4-3-1.

Figure 4-3-1 Analyzer Settings

Press  or  to move the cursor, press F menu button and numeric key to set parameters in system setting page.

After finishing settings, press Exit to return main page, select “Save” or “Cancel” current settings and return to the main page.

Caution! Be careful to change the settings of the instrument.

The settings of various parameters are described in the following sections.

4.3.1 Alarm Volume

To set the buzzer alarm sound, including 1 to 9 levels. Level-0: closed.

4.3.2 Password

1) Password function: ON/OFF. If the password is set to ON, before enter into Parameters Settings page, System Settings and Extended Function in the Function Selection page, the

password screen will pop up, to prevent unauthorized change to the settings of the instument.

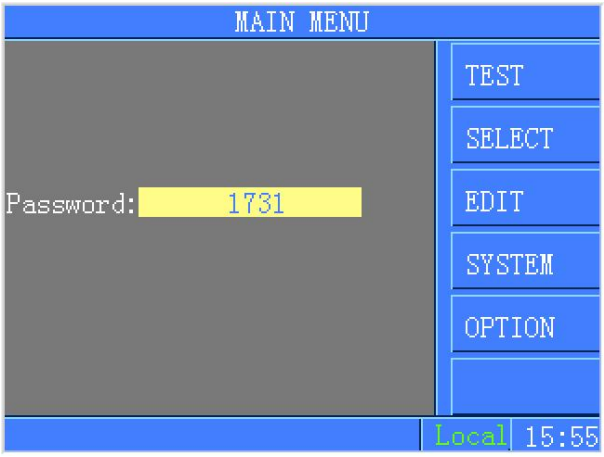


Figure 4-3-2 Password screen

2) Password range: 0000~9999. the factory default password: OFF.

4.3.3 FAIL Mode

Including two types: Stop and Continue:

Type	Description
Stop	Abort the whole test process immediately in case of failed test. Press START again to re-start the test process.
Continue	Abort the current step immediately in case of failed test and go on to the next test step.

4.3.4 Starting voltage

Starting voltage value of ACW/DCWoutput is set by the percentage of the setting value, range: 0~50%. The wave of output voltage was distributed into 5 stages: Fast-rising, Ramp up, Hold, Ramp Down and Fast-dropping. 5 stages and the judgements are as shown in the following figure:

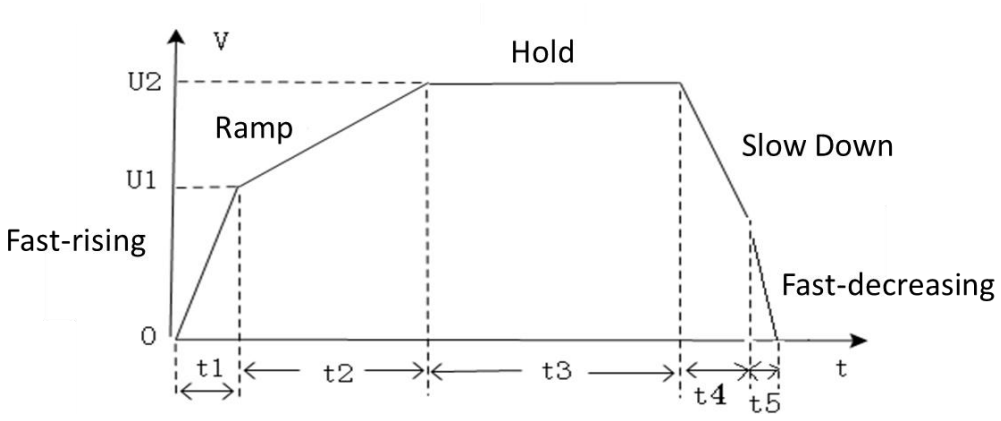


Figure 4-3-3 Fast-rising, Ramp up, Hold, Ramp Down and Fast-dropping

Where:

a) t1: Fast-rising, time is 0.1s maximum.

b) t2: Ramp up.

c) t3: test period.

d) t4: Ramp Down.

e) t5: Fast-dropping, time is 0.2s maximum, mainly used to discharge.

f) If the test is judged as fail before stage t4, there is no Ramp Down stage.

U2 is test voltage. U1 is output starting voltage (U2*XX%).

4.3.5 Display Brightness

Backlight Brightness of LCD screen, including 8 steps.

4.3.6 Theme

Settings of the background/foreground color. Three themes Light Blue, Deep Blue and Light Gray.

4.3.7 Language

Chinese/English.

4.3.8 Communication

1) Address: 0~255.

2) Baud rate: 9600, 19200, 38400, 57600.

3) Protocol: Built-in Ainuohex protocol or SCPI protocol.

4.3.9 Display of Result

There are two types:

Mode	Remark
Single step result	Hold at the result of the failed step or the first step after completing the test
Group result	The test result of each step in the group is listed after completing the test

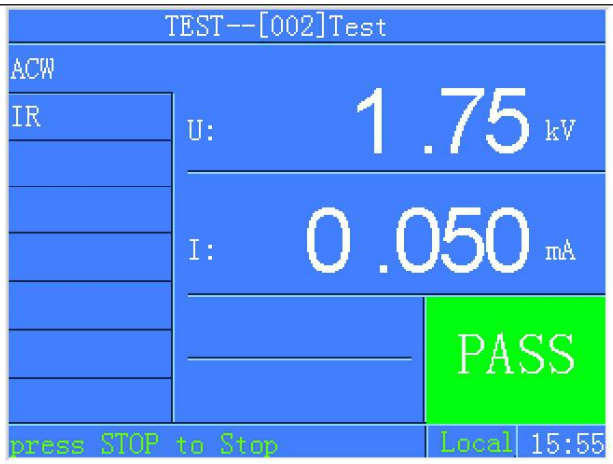


Figure 4-3-4 Display the result of single step after completing the test

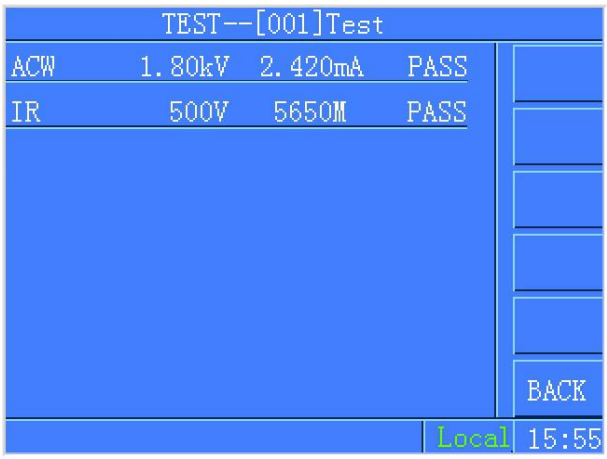


Figure 4-3-5 List the test results after completing the test

4.3.10 Date

To set the date/time of the instrument.

4.4 Group Selection

Provide 100 built-in groups to edit and recall the settings.

Press  or  to move the cursor and select the group to ediy. Press the F menu button Re-name and Load to edit and recall the settings.

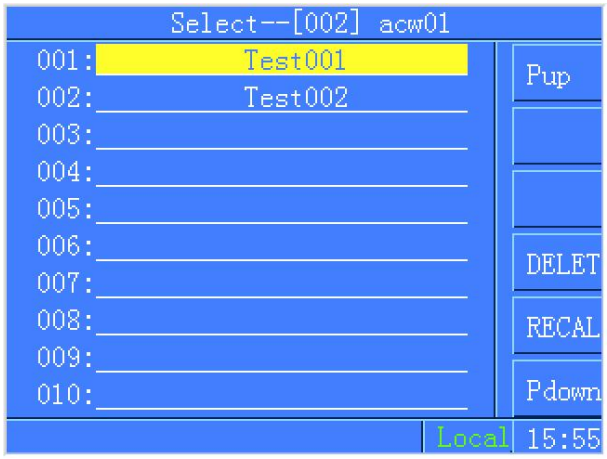


Figure 4-4-1Selection of Group

4.5 Parameters Settings

In function selection screen, choose Settings of Parameters menu to enter into group settings screen , as shown in Figure 4-5-1:

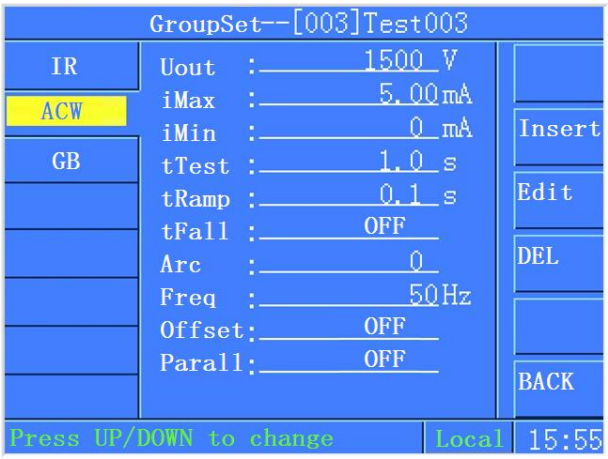


Figure 4-5-1 Group Settings

Remarks: if password function is set to ON, it will prompt the password screen first. Enter the correct password before enter into the settings screen.

To revise the current test items, move the cursor to the test item at left first. Press the corresponding key ACW/DCW, GB, IR, Wait, Delete to revise or delete current test items.

To edit current step, move the cursor to the right area to edit the parameters of current step.

Press to change the left or right parameters.

Each group supports up to 8 steps. If do not need 8 steps, just delete the others items. The parameters range and definition are described as following.

Press to select to save or cancel current settings and return to the main menu.

To abort the current exit operation after press, press STOP button to return to the edit state.

4.5.1 GB settings

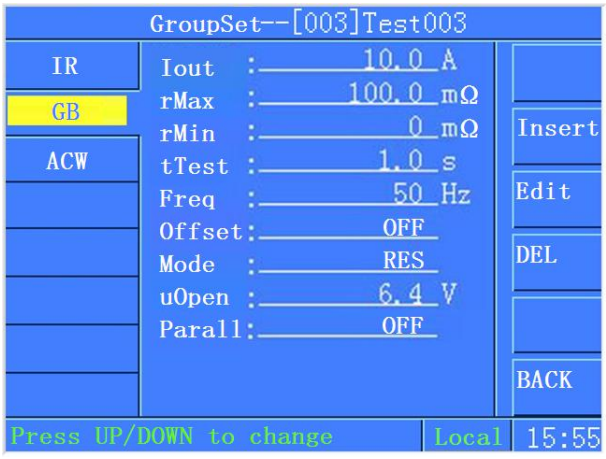


Figure 4-5-2 GB Settings

GB Parameters Settings definition:

No.	Item	Range	Description
1	Output current	(2.0~32.0)	Output current for GB test
2	Resistance/voltage upper limit	Set according to current. Output voltage shall not exceed **7.5**V	Ground resistance/voltage alarm upper limit

3	Resistance/voltage lower limit	Set according to current. Output voltage shall not exceed **7.5**V	Ground resistance/voltage alarm lower limit
4	Test time	(0.5~999.9) s/continuous test	Test time of current step
5	Output frequency	50Hz/60Hz	Ground current output frequency
6	Compensation test	ON/OFF	Include compensation value or not
7	Test mode	Resistance/voltage	Display the result as resistance/voltage
8	Open voltage	(3.0~10.0) V	Set the max output voltage of current step

4.5.2 IR Settings

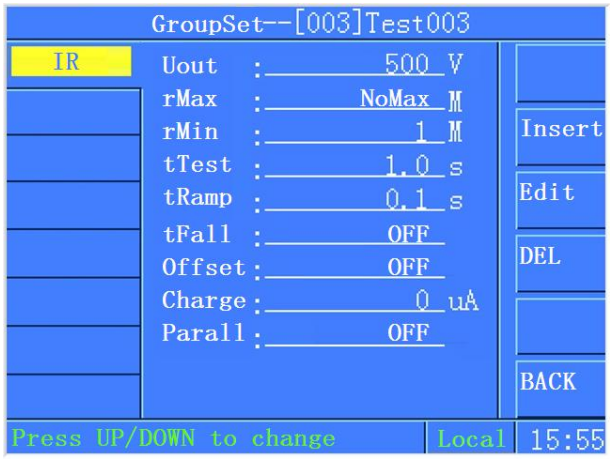


Figure 4-5-3 IR Settings

IR Parameters Settings definition:

No.	Item	Range	Description
1	Output Voltage	(100~2500) V	Output voltage for IR test
2	Resistance Upper Limit	(1~**50000**) MΩ/ without upper limit	Insulation resistance alarm upper limit
3	Resistance Lower Limit	(1~**50000**) MΩ	Insulation resistance alarm lower limit
4	Delay Time	(0.5~999.9) s/continuous test	Delay judgement of insulation resistance
5	Ramp Time	(0.1~999.9)s	Voltage ramp time
6	Descent Time	(1.0~999.9)s/OFF	Voltage descent time
7	Compensation Test	ON/OFF	Include the compensation value or not
8	Charge Lower Limit	(0~3.50) uA	Upper limit to judge peak current during charging

4.5.3 ACW Settings

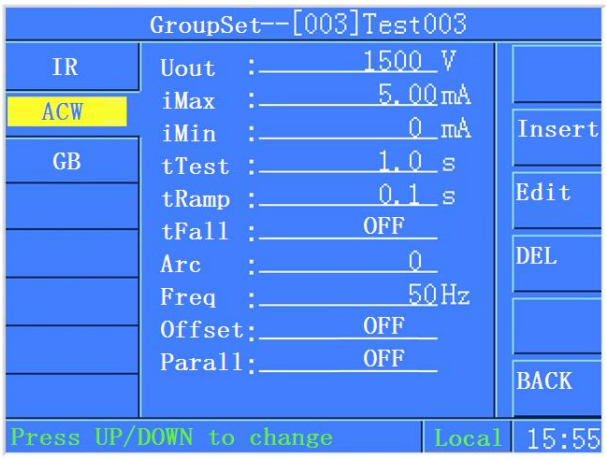


Figure 4-5-4 ACW Settings

ACW Parameters:

No.	Item	Range	Description
1	Output Voltage	(100~5000)V	ACW Output voltage
2	Current Upper Limit	(0~100.00) mA	Breakdown current alarm upper limit
3	Current Lower Limit	(0~9.999) mA	Breakdown current alarm lower limit
4	Test Time	(0.5~999.9)s/continuous	Test time of current step
5	Ramp Time	(0.1~999.9) s	Voltage ramp time
6	Descent Time	(1.0~999.9) s/OFF	Voltage descent time
7	Arc Level	0~9	Arc test alarm level
8	Output Frequency	50Hz/60Hz	ACW output frequency
9	Compensation Test	ON/OFF	Include the compensation value or not

The arc alarm level can be pre-set and judged in following levels: 0 and 1~9. Level-0: arc detection is disenable. level-9: top level. The peak current at each alarm level is listed in the following table.

Arc alarm level	9	8	7	6	5	4	3	2	1
Threshold peak current (mA)	2.8	5.5	7.7	10	12	14	16	18	20

4.5.4 DCW Settings

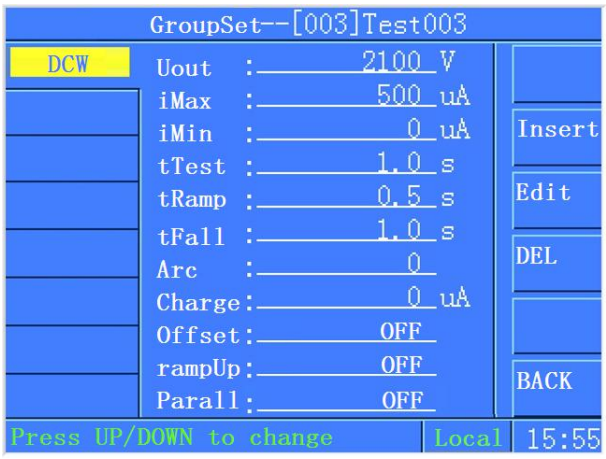


Figure 4-5-5 DCW Settings

DCW Parameters:

No.	Item	Range	Description
1	Output voltage	(100~6000) V	DCW Output voltage
2	Current upper limit	(0~10000) uA	Breakdown current alarm upper limit
3	Current lower limit	(0~999.9)uA	Breakdown current alarm lower limit
4	Test time	(0.5~999.9)s/continuous	Test time of current step
5	Ramp time	(0.1~999.9) s	Voltage ramp time
6	Descent time	(1.0~999.9) s/OFF	Voltage descent time
7	Arc level	0~9	Arc test alarm level
8	Charge lower limit	(0~350) uA	Upper limit to judge peak current during charge
9	Compensation Test	ON/OFF	Include the compensation value or not
10	Ramp upper limit	ON/OFF	Whether to judge alarm upper limit during ramp
11	Parallel switch	ON/OFF	Whether it can be tested in parallel with the ground test step of the previous step

4.5.5 LC Settings

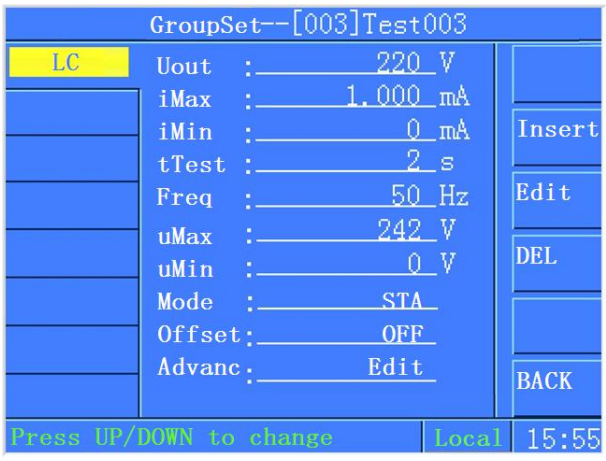


Figure 4-5-6Settings of TC

Parameters for LC:

No.	Item	Range	Description

1	Output Voltage	(80.0~300.0)V	Output voltage for LC
2	Current Upper Limit	Rms 0.0μA~12.00mA	Touch current upper limit
3	Current Lower Limit	As above	Touch current lower limit
4	Test Time	(0.5~999.9)s，0= continuous test	Test time of current step
5	Test Frequency	50Hz/60Hz	Output Frequency
6	Voltage Upper Limit	(80.0~300.0)V	Output voltage upper limit
7	Voltage Lower Limit	(80.0~300.0)V	Output voltage lower limit
8	Test Mode	Dynamic/Static	Test Mode of LC
9	Judge Mode	Max/Final value	Judge the result based on the Max/final value
10	Advance		Setup the Power State

4.5.6PA Settings

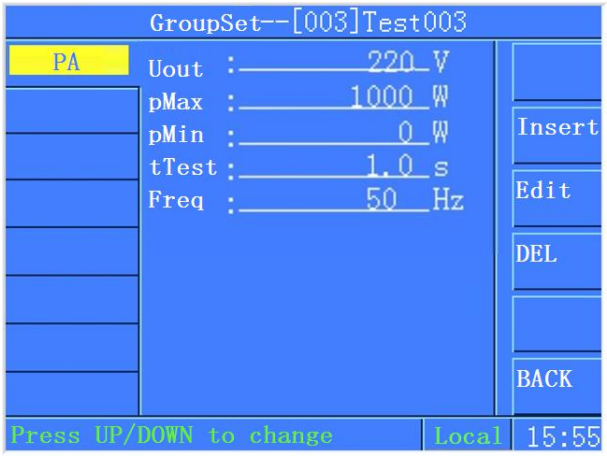


Figure 4-5-7 Settings of PA

Parameters for PA:

No.	Item	Range	Description
1	Output Voltage	(0.0~300.0)V	Output voltage of PA
2	Power Upper Limit	(0.00~6000)W	Power alarm upper limit
3	Power Lower Limit	(0.00~6000)W	Power alarm lower limit
4	Test Time	(0.00~999.9)s	Test time of current step
5	Test Frequency	50Hz/60Hz	Output Frequency

4.5.7ST Settings

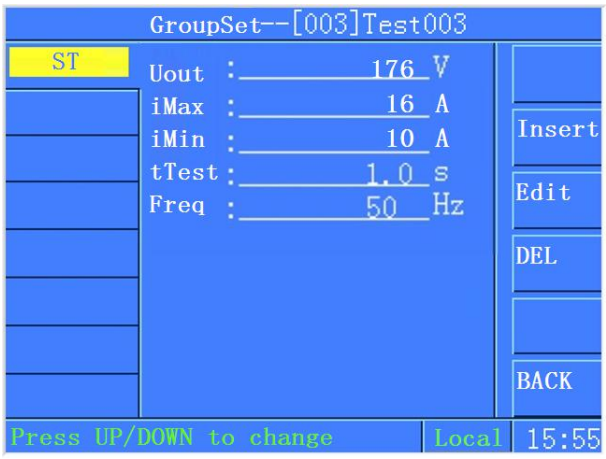


Figure 4-5-8 ST

Parameters for ST:

No.	Item	Range	Description
1	Test Voltage	(0~300)V	Test voltage for ST
2	Current Upper Limit	(0.00~25.00)A	Current alarm upper limit
3	Current Lower Limit	(0.00~25.00)A	Current alarm lower limit
4	Test Time	(0.00~999.9)s	Test time of current step
5	Test Frequency	50Hz/60Hz	Test frequency

4.5.8 Waiting Test settings

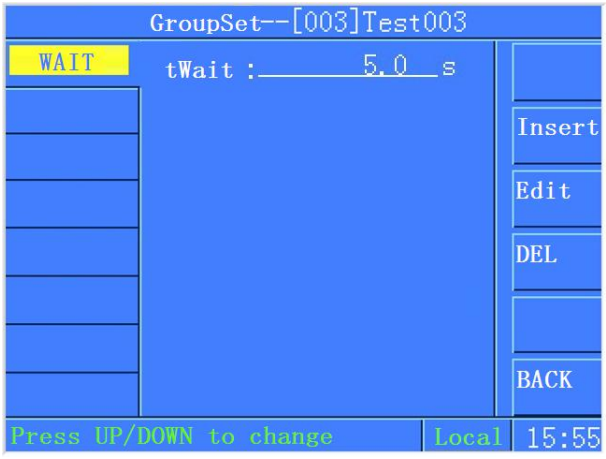


Figure 4-5-9Waiting Test settings

Test time can be set, range: 0.1s~999.9s/infinite. Press START button again under waiting test screen to complete the current step test.

4.5.8 Deleting test items

The current step test items can be deleted through press DELETE button, as shown in Figure 4-5-10.

Figure 4-5-10Parameters setting screen after delete the test step

4.6 Start to test

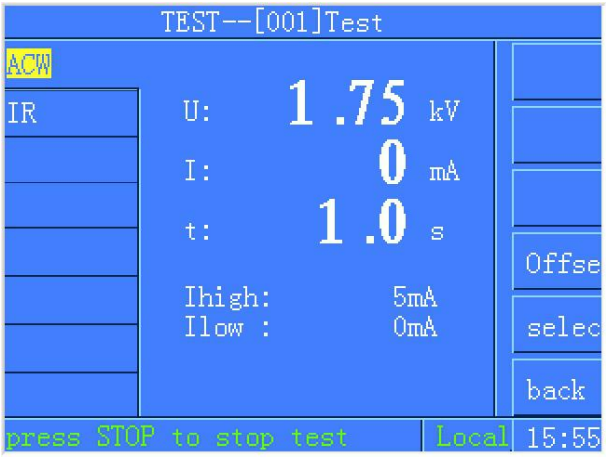


Figure 4-6-1 Test waiting screen

It will return to the Selection of Function screen after completing all the settings. Press F Menu START Test to enter into Test wiating module. Insert the power line of DUT into the test box. Connect the GB clamp with GND point of DUT. After finishing wire connection, press START button to start to do testing of the current group. If do not need to change test settings, press START button to repeat testing. During testing, press STOP button to stop testing at any time.

WARNING The START/STOP signals on the remote control port are the same as those on the front panel. If the remote control port is not used, disconnect the remote control cable to ensure safety!

4.6.1 Start to test

1) During testing, it is as shown in Figure 4-6-2:

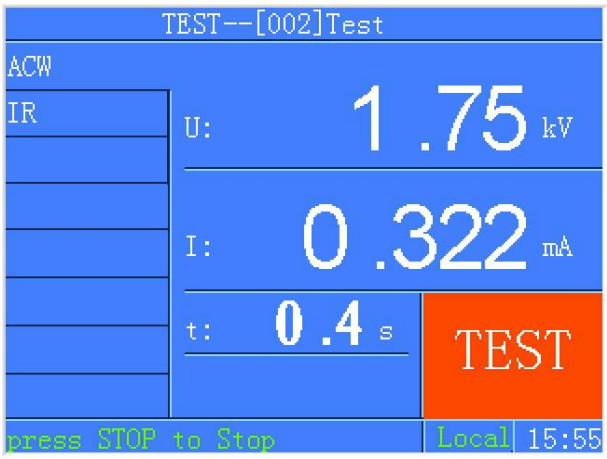


Figure 4-6-2 Testing process

Now, TEST lamp turn to yellow on the front panel, and ALARM light port gives TESTING signal.

2) Test Pass, as shown in Figure 4-6-3.

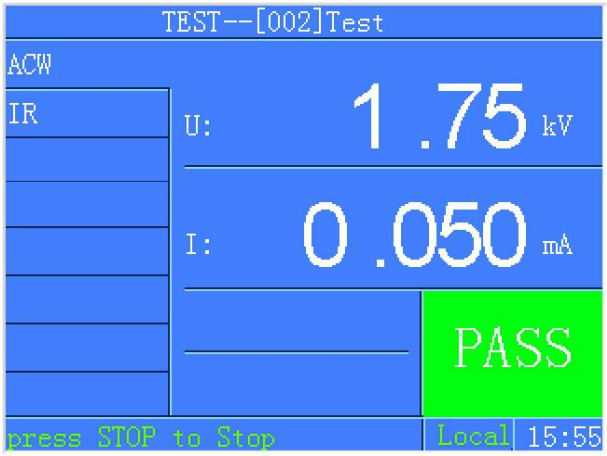


Figure 4-6-3 All test items pass

If all test items pass, PASS led turn to green on the front panel, and ALARM light port gives PASS signal.

3) Test failed or is abnormal, as shown in Figure 4-6-4, 4-6-5.

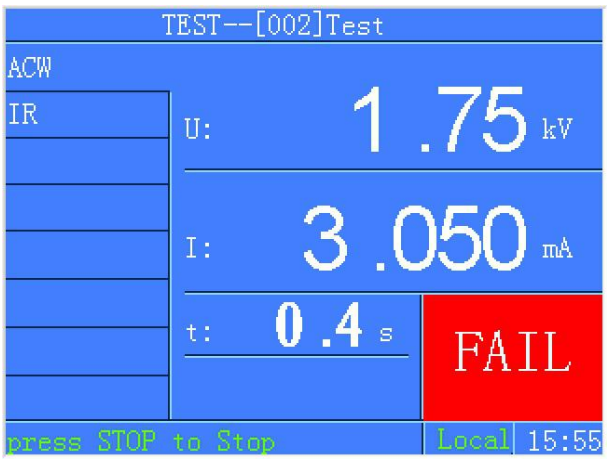


Figure 4-6-4 Test failed

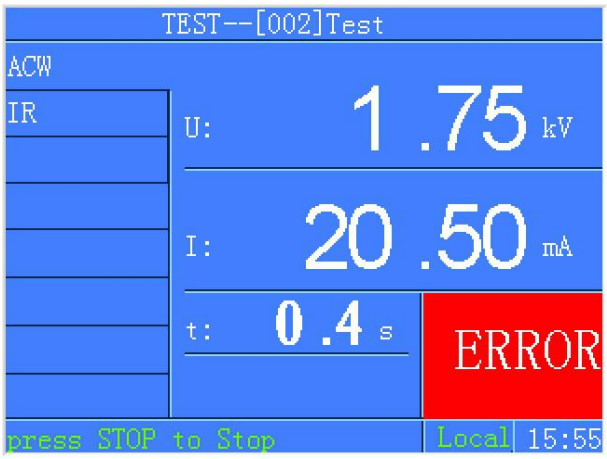


Figure 4-6-5 Test abnormal

If test failed or abnormal, alarm LED turn to red on the front panel. The buzzer gives three sounds, and ALARM light port gives FAIL signal.

CAUTION

1) Abnormal protection will occur in the following cases:

a. GB clamp open circuit or ground bond resistance is too high during GB testing.

b. DUT Insulation failure during IR or ACW/DCW.

2) Measurement Judgement:

a. For breakdown current upper limit during ACW/DCW. testing, judge the measurement at any time. For ground resistance upper limit during GB testing, judge the measurement at any time.

b. For IR, give the judgement results approaching the complete testing

4.6.2 Compensation

1) Purpose

To eliminate the effects caused by the test wires or non-standard measurement conditions and other factors to achieve high accuracy.

2) Settings

See 7.1 Specifications range of compensation value.

3) Wiring

a)Connect GB clamp with the ground terminal of the test box. Keep return terminal in short circuit

b) Remove DUT from the test box. Keep high voltage terminal in open circuit.

4) Getting compensation value

This AN9640BV3(F)series analyzer provides two compensation methods:

Single step compensation	In Parameters Settings screen, move the cursor to the compensation Enalbe/Disenable position. Set compensation test to ON, and then press START button. The analyzer will get the compensation value automatically and display the result on the screen.
Group compensation	In Waiting Test screen, press F menu Compensation key to finish wire connections as prompt on the screen. Press START to complete automatic group compensation.

4.7 Extended Function

Extended Function: barcode, USB flash disk and PLC functions, as shown in Figure 4-7-1:

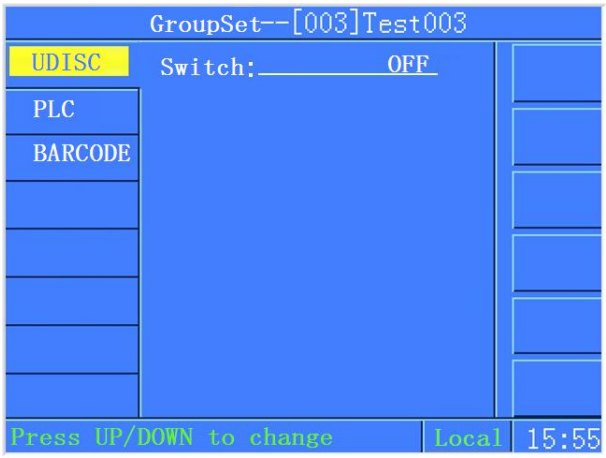


Figure 4-7-1 Extended Functions

4.7.1 USB flash disk

USB flash disk function can be set to enable/disenable by F menu.

Around 5s after inserting USB flash disk, the following symbol will appear at the left upper corner of the screen.

Figure 4-7-2 Screen after inserting U-disk

If there is no respond after inserting USB flash disk, try to insert USB flash disk again. If USB flash disk has been inserted before starting analyzer, please wait for the analyzer finds

USB flash disk before operation, that is the symbol appeared at the left upper corner of the screen.

USB flash disk is used to store the test datas. A separate folder will be created for the current group, and a log file will be stored every day in the following format:

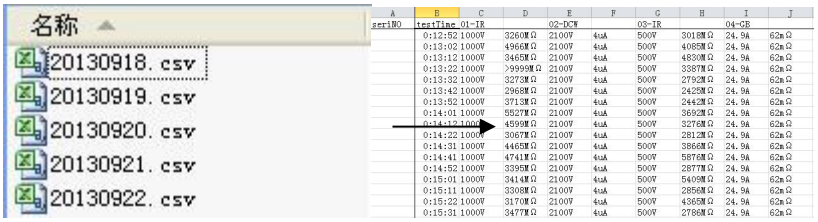


Figure 4-7-3 Files format in USB flash disk

4.7.2 PLC

PLC function can be set to enable/disenable by F menu.

The pin definition of PLC is described in section 5.3.

4.8 Calibration

User can't perform calibration of the instrument without the professional instruments, please contact Ainuo for the calibration.

4.9 Shutdown

Shut down the analyzer as the following steps:

1) Press STOP to stop testing and return to "Function Selection" screen.
2) Turn off the power switch on the front panel.
3) Remove the DUT.

1) To avoid shock, do not touch the DUT immediately after IR or DCW ttest!

2) Frequent start/stop of the instrument is forbidden. Keep 30s interval at least!

3) Never turn off the power during testing other than emergency!

Chapter 5 Interface

Guide:

- ALARM
- REMOTE
- PLC
- BAR CODE INPUT
- COM
- U DISK
- EXT-COM
- SIGNAL INPUT/SIGNAL OUTPUT

5.1 ALARM

Active signal output, using 5P aero socket (male), as shown in Figure 5-1-1.

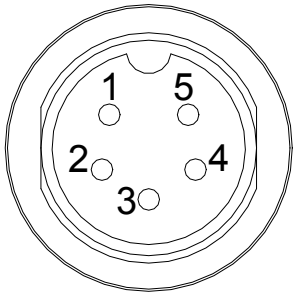


Figure 5-1-1 ALARM socket (male)

Definition of pins:

1) 1 - 4 ON: TEST
2) 2 - 4 ON: PASS
3) 3 - 4 ON: FAIL , or abnormal alarm
4) 4: Common (High end, +12VSW)
5) 5: Empty.

The optional attachment is 3-color ALARM. Insert the 5P aero plug of 3-color ALARM into the 5P ALARM socket on the left panel.

Caution **During self-check as booting, 1-4, 2-4 and 3-4 will be ON at the same time. Now the maximum allowable total output current is 450mA. The maximum allowable output current for single channel is 150mA. For self-made ALARM light, pay attention to this point!**

5.2 REMOTE

Active signal input interface, 3P aero socket (male), as shown in Figure 5-2-1.

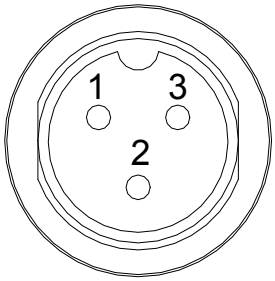


Figure 5-2-1 REMOTE (male)

Definition of pins:

1) 1 - 2 ON: STOP

2) 1 - 3 ON: START

3) 1: Common (Low end, GND)

The optional attachment is the remote control box. Insert the 3P aero plug of the remote control box into the 3P remote control socket on the left panel. The function of START/STOP keys are the same as those on the front panel.

For self-made remote control switch, use passive non self-lock switch!

5.3 PLC

This analyzer is fit with a 9-pin aviation plug (male) to provide PLC remote I/O signal (may be connected with PLC controller) and digital test state output signal, as shown in Figure 5-4-1. These terminals must match 9-pin aviation plugs (female), which is prepared by the operator. For optimum effect, it is recommended to use shielded cables as control line and output data line. To avoid forming a circuit of the shielded cables and ensure shielding effect, ground the shield net at one end of the shielded cable.

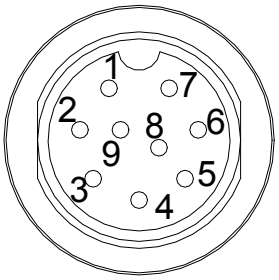


Figure 5-3-1 PLC port (male)

To enable PLC start, set Start Mode in Settings of System screen to PLC, now the START button on front panel is invalid; to enable PLC test state output, set on the Settings of System screen.

The definitions of pins are listed in Table 5-3-1.

Table 5-3-1 Definition of PLC pins

I/O	No.	Name of signal	Description
Remote signal input	9	START	START
	7	COM	COMMON
	8	STOP	STOP
Test state signal output	1	TEST	TESTING
	2		
	5	PASS	PASS
	6		
	3	FAIL	FAIL
	4		

The remote input signal adopts digital input (such as PLC). Never connect other voltage or current supply. Other power supply will cause damage or malfunction of control circuits in the analyzer.

5.4 BAR CODE INPUT

Use DB9 socket (male), matching Ainuo barcode scanner, asshown in Figure 5-4-1.

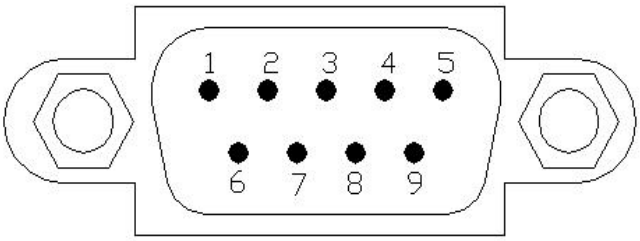


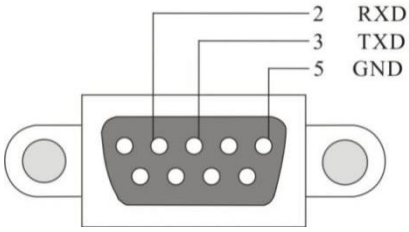
Figure 5-4-1 COM (male)

Pins of RS232 port (same for A and B)

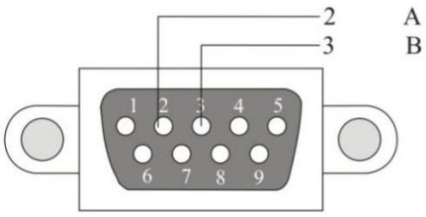
1) 2: RXD, receive data
2) 5: GND, ground

5.5 COM

This analyzer uses RS232 port (Optional RS485). The PC is connected with this port for control of this analyzer. A 9-pin D-sub connector (male) is used with signal definition as shown in Figure 5-5-1(a) and (b);



(a) Definition of RS232 port



(b) Definition of RS485 port

Figure 5-5-1 Definition of COM port

Caution **For communication,connect the PC in the following order: turn off the power of the analyzer. Connect the communication cable; turn on the power of the PC, and then start the analyzer after the PC starts.**

5.6 U Disk

Standard USB port, at lower in the front.

5.7 EXT-COM

RS232 port, DB9 socket (male), as shown in Figure 5-8-1. Standard RS-232 port for mutual control with other RS-232 device.

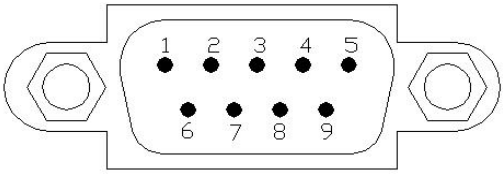


Figure 5-8-1 COM (male)

Pins of RS232 port:

2: RXD, receive data

3: TXD, send data

5: GND, ground

5.8 SIGNAL INPUT/SIGNAL OUTPUT

Use a 6-Pin European terminal, external adjustment device to select the group, up to 7 adjustable groups.

The user can input PM0, PM1 and PM2 three digit codes to choose any one of the 8 groups. The selection is valid at the rising edge of STB, as shown in Table 5-4-2:

Table 5-4-2 Remote signals

Digit input			Enable	Valid memory group
PM2	PM1	PM0	STB	
0	0	0	⎍	No operation
0	0	1	⎍	(Group 1)
0	1	0	⎍	(Group 2)
0	1	1	⎍	(Group 3)
1	0	0	⎍	(Group 4)
1	0	1	⎍	(Group 5)
1	1	0	⎍	(Group 6)
1	1	1	⎍	(Group 7)

Note:

1, 0----Open, 1---- Closed;

2, STB from closed to open, deemed as a valid rising edge. For the control time, see Figure 5-2 Timing of remote control test;

3, "Open" means open-circuit with COM. "Closed" means short-circuit with COM. The PLC will choose group following the timing in Figure 5-4-2.

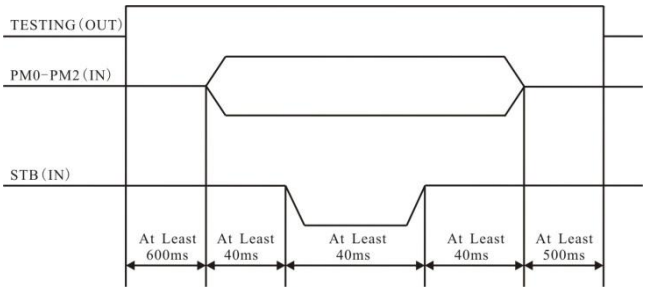


Figure 5-4-2 Timing of remote selection of group

Warning **The TEST in Figure 5-4-2 is output signal. Do not call any groups during testing, otherwise, the call instruction will be ignored!**

Chapter 6 Maintenance

Guide:

- Maintenance and Care
- Troubleshooting
- Storage and Transport

6.1 Maintenance and Care

6.1.1 Regular Maintenance

This analyzer can output voltage of 5kVAC. Calibration by users is dangerous. For any necessary calibration, please contact Ainuo service center.

◆ For long time storage of analyzer, power on every month lasting for at least 30 Min.

6.1.2 Daily Maintenance

◆This analyzer shall operate in dry, well-ventilated environment free of dust or strong EMI.

◆ After long time operation of the analyzer (24h), turn off the power supply and keep for at least 10 Min., to keep good condition of the instrument.

◆Ground the analyzer well.

◆ The power line, test box, GB clamp and other attachments may feature false-contact or damaged after long time operation. Check it before operation each time.

◆Clean the instrument using a soft cloth and mild detergent. Before cleaning, make sure to turn off the power supply and disconnect the power cable; Do not use thinner, benzene and other volatile substances, otherwise it will change the color of the chassis, wipe off the logo on the cabinet, or the LCD display is not clear.

6.1.3 Modification by operators

Never open the house freely to prevent shock; never modify the lines or parts freely, otherwise, the guarantee will become invalid. If the instrument is modified, the technical staff will recover the instrument and charge maintenance fees.

6.2 Troubleshooting

This analyzer must be repaired or maintained by an experienced professional. Otherwise, personnel injury or death may occur.

No.	Faults	Measures

1	LCD no display after Start.	Check and make sure the power line is connected relaibly.
2	Abnormal protection during ACW/DCW/IR.	Check ACW/DCW /IR lines for short circuit and correct.
3	Abnormal protection during GB.	Check GB line for open circuit and correct.
4	Analyzer crashed.	Shutdown and re-start after 30s.
5	Communication failure between the analyzer and PC.	1. Start the PC before Start the analyzer for the communication system. 2. Check and make sure the cable is connected reliably. 3. Check and make sure the software is installed well. 4. Check and make sure the serial port is correct. 5. Check and make sure the setting of address for the analyzer meet communication requirements for PC. 6. Check and make sure the baud rate of PC is consistent with that of the analyzer.
6	During import/export of test file, the U disk cannot be identified	Check if the U disk meets requirements in section 2.3.

6.3 Storage and Transport

6.3.1 Storage

Temperature: -10℃~+50℃ Relative humidity: 0~90%RH

Take dust measures during storage. Never place any objectsion the analyzer.

6.3.2 Transport

1 Package

Keep the instrument in original package for repair or transport. If it is impossible to pack the instrument using the original packing materials, handle according to the following:

a Wrap the instrument well;

b Place the instrument in a wooden or multi-layer paper box (Load: 150kg);

c Fill around the instrument using shock-proof materials (70~100mm thick). Protect the panels using foam;

d Seal the box properly.**Label Fragile, Handle with Care at eye-attracting position.**

Pack the power line, test line and all attachments with the analyzer for repair. Please note the fault.

2 Transport

Avoid bumps, rough handle, rain and upside-down during transport.

Chapter 7 Specifications

Guide:

- Specification
- Performance
- Port
- Attachment

7.1 Specification

Table 7.1 Specification

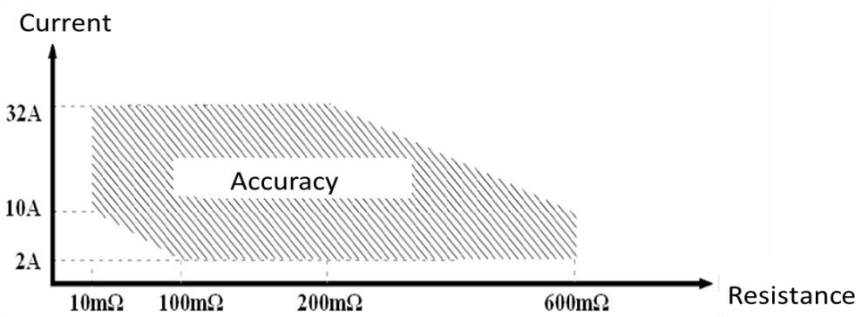
		AN9640BV3	AN9651BV3	AN9651CV3
Installation position		Indoor, altitude less than 2000 m		
Operating environment	Temp.	0~40℃		
	Humidity	40℃, (20~90)%RH		
Storage environment	Temp.	(－10～50)℃		
	Humidity	50℃, 90%RH, 24h		
Input Power		AC，220V±10%, 50Hz±5%, 10A		
Power	Zero load	50W Less than 50W		
	Full load	550W Less than 550W		
Dimension (mm)		483(W)x 178(D)x 550(H)	483(W)*1355(H)*600(D)	483(W)*1355(H)*600(D)
Weight		About 45kg	About 150kg	About 150kg

7.2 Performance

Table 7.2 Performance

ACW	
Rated output capacity	500VA (5000V/100mA), short circuit current higher than 200mA;
AC voltage output	Range: (100 ~ 5000) V. Resolution: 1V. Accuracy: ± (1%× setting +5V)
AC voltage measurement	Range: (0.10 ~ 5.00) kV. Resolution: 001kV. Accuracy: ± (1%× reading +1 word)
Output Frequency	50Hz / 60Hz. Accuracy: ±0.1Hz
Output adjustment	± (1%× setting +5V), Zero to Full load
Waveform distortion	Sine wave, ＜2% (Resistive load)
Settings of current upper limit	Range: (0.00~100.00) mA. Resolution: 0.01mA. Error: ± (1%× setting +5 words)
Settings of current lower limit	Range: (0.000~9.999) mA. Resolution: 0.001mA. Error: ± (1%× setting +5 words)
AC current measurement	Range: 0.01~100.00 mA. Resolution: 0.001/0.01mA. Accuracy: ± (1%× reading +5 words)
Ramp and slow down time	Range: (0.1~999.9) s. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word)

Duration	Range: 0, (0.5 ~999.9) s. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word)
Arc Detection	1 ~9 (9: most sensitive); 0: arc detection disenable
Current compensation	0.000~100.00mA, total current + compensation current ＜100mA, Auto/Manual
DCW	
Rated output	6kVDC / 10mA
DC voltage output	Range: (100 ~ 6000) VDC. Resolution: 1V. Accuracy: ± (1%× setting +5V)
DC voltage measurement	Range: (0.10 ~ 6.00) kV DC. Resolution: 10V. Accuracy: ± (1%× reading +1 word)
Output ripple	<2% (6kV/1mA Resistive load)
Output adjustment	± (1%× setting +2V), Zero to Full load
Setting of current upper limit	Range: (0.0~10000) μA. Resolution: 0.1μA/1μA. Error: ± (1%× setting +5 words)
Setting of current lower limit	Range: (0.0~999.9) μA. Resolution: 0.1μA. Error: ± (1%× setting +5 words)
DC current measurement	Range: 0.0~3500μA/3.00~ 10.00mA. Resolution: 0.1/1μA/0.01mA. Error: ± (1%× reading +5 words)
Ramp Time	Range: 0, (0.4 ~999.9) s, 0: Off. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word)
Duration	Range: 0, (0.5~999.9) s, 0: infinite. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word)
Slow Down Time	Range: 0, (1.0~999.9) s, 0: Off. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word)
Arc Detection	1 ~9 (9: most sensitive); 0: arc detection disenable
Current compensation	(0 ~200.0) μA, Auto/Manual
Ramp current upper limit	ON/OFF, On current upper limit: 12mA
Charge current lower limit	(0~350.0) μA, Auto/Manual
Discharge Time	≤200ms
Maximum capacitive load	1uF＜1kV, 0.75uF＜2kV, 0.5uF＜3kV, 0.08uF＜4kV, 0.04uF＜5kV
IR	
Rated output	2500VDC/50GΩ
DC voltage output	Range: (100 ~ 2500) V DC. Resolution: 1V. Accuracy: ± (1%× setting +5V)
DC voltage measurement	Range: (100 ~ 2500) V DC. Resolution: 1V. Accuracy: ± (1%× reading +5V)
Setting of resistance upper/lower limit	Range: 1MΩ~50000MΩ. The upper limit includes infinite.
Insulation resistance measurement	Range:1MΩ~50.00GΩ， Resolution:0.001MΩ /0.01MΩ /0.1MΩ /0.001GΩ /0.01GΩ Error: 100V~499V:0.100MΩ~2.000GΩ, ± (5%× reading +2 words) 500V~2500V: 0.100MΩ~999.9MΩ, ± (2%× reading +2 words) 1.000GΩ~9.999GΩ: ± (5%× reading +2 words) 10.00GΩ~50.00GΩ: ± (15%× reading +2 words)
Ramp Time	Range: 0, (0.1 ~999.9) s, 0: Off. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word)
Delay Time	Range: 0, (0.5~999.9) s, 0: infinite. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word)
Slow Down Time	Range: 0.0, (1.0~999.9) s, 0: Off. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word)
Charge current lower limit	(0~3.500) μA, Auto/Manual
Discharge time	≤200ms
Maximum capacitive load	1uF＜1000V, 0.5uF＜2500V
GB	

Rated output	Max. test current: 32A, Max.resistance: 600mΩ. Open voltage: less than 12V
Output current	Range: (2.0~32.0) A ac. Resolution: 0.1A. Accuracy: ± (1%× setting +2 words)
Current ripple	≤0.4%× setting/Min.
Output Voltage	Range: (3.0~10.0) Vac. Resolution: 0.1V. Accuracy: ± (1%× setting +2 words), open circuit
Output Frequency	50Hz/60Hz. Accuracy: ±0.1Hz
Setting of resistance upper /lower limit	Range: (0.1~600) mΩ, (2.0~10.6) A; (0.1~R) mΩ, (10.7~32.0) A. Resolution: 0.1/1 mΩ Where R= (6400 / current setting) mΩ Error: ± (1%× setting +2 words)
Resistance measurement	 Range: (10.0~99.9) mΩ. (100~600) mΩ. Resolution: 0.1/1 mΩ.
	Error: ± (1%× reading +2 words)
Voltage measurement	Range: (0.00~7.50) VAC. Resolution: 0.1V. Accuracy: ± (1%× reading +2 words), voltage display mode
Resistance compensation	(0~200) mΩ
Duration	Range: 0, (0.5~999.9) s, 0: infinite. Resolution: 0.1s. Accuracy:± (0.1%× setting +2word)
LC	
Test Mode	Single-phase load, leakage current at operating temperature (dynamic) and leakage current at non-operating temperature (static), L-G, N-G, AUTO (G-L, G-N); Require external isolation transformer or inverter power to provide the required test voltage and frequency.
Working power state	Polarity: On, Off, Auto; Zero line: On, Off; Earth line: On, Off
Built-in human network	Standard primary network as GB/T 12113 Figure 4; secondary network as GB/T 12113 Figure 5, Optional other test network, U1, U2 shown in Figure 4, U1, U3 shown in Figure 5,
Setting of alarm voltage	Range: 20.0V~300.0V AC. Resolution: 0.1V. Error: ± (0.4%× setting +0.1%× range)
Voltage measurement	Range: 0.0V~300.0V, 45Hz~65Hz Accuracy: 20.0V~300.0V: ± (0.4%× reading +0.1%× range)
Load current	Upper limit: 30A
Settings of Touch/Leakage current upper/lower limit (rms)	Range: 0.0μA~12.00mA. Resolution: 0.1μA /1μA /0.01mA Error: DC, 15Hz≤f≤100kHz: ± (1.5%× setting +10 words) 100kHz＜f≤1000kHz: ±5%× setting

Touch/leakagecurrent measurement (rms)	0.0μA～999.9μA: DC, 15Hz≤f≤100kHz: ± (1.5%× reading +10 words) 100kHz＜f≤1000kHz, 10.0μA～999.9μA: ±5%× reading 1000μA～7999μA: DC, 15Hz≤f≤100kHz: ± (1.5%× reading +10 words) 100kHz＜f≤1000kHz, 10μA～7999μA: ±5%× reading 8.00mA～12.00mA: DC: ± (1.5%× reading +10 words) 15Hz≤f＜1000kHz, 0.01mA~12.00mA: ±5%× reading
LC Compensation	Range: 0.000~1.000mA, Auto measurement, On or Off.
Duration	Range: 0, (1 ~999.9), 0: infinite. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word), (for test mode AUTO (G-L, G-N): half of the duration)
DC input impedance	2kΩ ± 1% (GB12113Figure 4)
Input impedance	≤100kHz 5%; ＞100kHz 10%
Frequency response	Accuracy: same as current measurement error
PA	
Alarm	Power upper/lower limit alarm;
Settings of power upper/lower limit	Range: 0.00W~6000W. Resolution: 0.01W /0.1W /1W, Error: ± (0.1%× setting +0.1%× range)
Active power measurement	Range: 0.10W~6.000kW. Resolution: 0.01W /0.01W /0.1W /0.001kW Accuracy: PF＞0.5: ± (0.1%× reading +0.1%× range) PF≤0.5: ± (0.4%× reading +0.1%× range)
Voltage measurement	Range: 5.00V~300.0V, peak factor: ≤1.6. Resolution: 0.01V /0.1V; Accuracy: ± (0.1%× reading +0.1%× range), 45Hz≤f≤65Hz
Current measurement	Range: 0.00mA~25.00A, peak factor: ≤1.6. Resolution: 0.01mA /0.1mA /0.001A /0.01A Accuracy: ± (0.1%× reading +0.1%× range), 45Hz≤f≤65Hz
Power factor measurement	Range: ± (0.100~1.000). Resolution: 0.001 Accuracy: ±0.01 (voltage/current amplitudes are greater than 10% of the corresponding ranges)
Frequency measurement	Range: 45.00Hz ~65.00Hz. Resolution: 0.01Hz. Accuracy: ± (0.1%× reading)
Duration	Range: 0, (0.5~999.9) s, 0: infinite. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word)
ST	
Settings of current upper/lower limit	Range: (0.00~25.00) A. Resolution: 0.01A. Error: ± (0.1%× setting +0.1%× range)
Voltage measurement	Range: 5.00V~300.0V, peak factor: ≤1.6. Resolution: 0.01V /0.1V; Accuracy: ± (0.1%× reading +0.1%× range), 45Hz≤f≤65Hz
Current measurement	Range: (0.02~25.00) A, peak factor: ≤1.6. Resolution: 0.01A Accuracy: ± (0.1%× reading +0.1%× range), 45Hz≤f≤65Hz
Duration	Range: 0, (0.5~999.9) s, 0: infinite. Resolution: 0.1s. Accuracy: ± (0.1%× setting +2word)
97006H	
Rated output	6000VA
Voltage output	Range:(0 ~300)VAC, Frequency: (45~65)Hz

7.3 Attachments

Table 7.3 Attachment

Name of attachment	Spec.	Standard or not
Camp, red	60A, 1.5m, red	√
Camp, black	60A, 1.5m, black	×
Test box	10A+16A socket, 1.5m cable	√
High-voltage test line	Test clamp+1.5m cable	×
PROBE	1.5m/3m/5m/10m cable optional	×
3-color ALARM light	5P plug,1.5m cable	√
REMOTE box (2 key)	3P plug, 3m cable	×
RS232 cable	DB9,1.5m/3m optional	×
CD	Esrs software	×
BAR CODE INPUT	Serial	×
Multi-channel scanner	AN960-08	×

Annex A Test Principle

Guide:

- Block Diagram
- Test Principle

A.1 Block Diagram

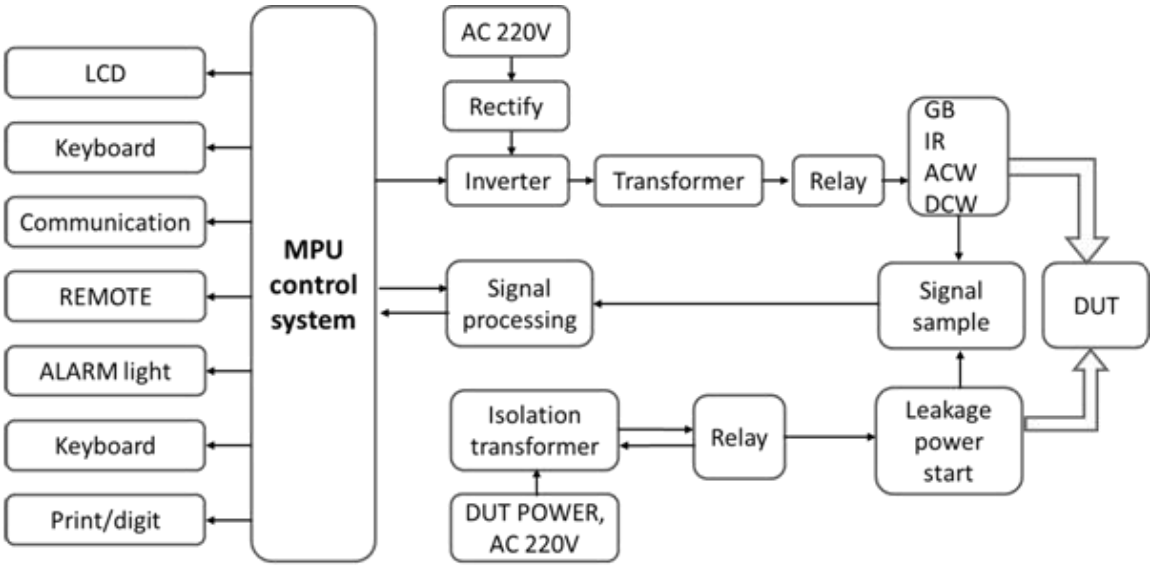


Figure A-1-1 Block Diagram

A.2 Test Principle

This AN9640BF(V3) series analyzer adopts DSP microprocessor for control, completing A/D convertion, output control, data process and management of display, key and serial communication etc.

In this system, the SPWM signal is generated by the processor DSP, driven via the high power MOS transistor, forming 50Hz or 60Hz sine wave through the filter circuit, which generates ACW/DCW (5000Vac/6000VDC), GR (32A) and IR (2500VDC) source output signal through the transformer. For LC, PA and ST, provide DUT with power input via external power supply.

The source output signals and the measured voltage or current signal is sampled via the voltage and current sensors for measuring. The value obtained is converted by the A/D converter, entering ARM processor for operation and judged as to PASS or FAIL etc., and the results are displayed on the LCD.

Annex B Safety Knowledge

Guide:

- **Importance of safety test**
- **GB**
- **IR**
- **ACW/DCW**
- **Arc test**
- **Charge current test**
- **LC**
- **PA and ST**

B.1 Importance of safety test

With the advancement of society, human needs constantly increase, paying more attention to safety, including electrical safety, traffic safety, food safety and environmental safety etc. The national and international organizations issued a variety of laws and regulations to protect people's safety interests; with the development of electronic and electrical applications, electrical equipments are widely used. Imagine how dangerous it is to touch potential live unsafe electrical equipment, so electrical safety is extremely important. It is necessary to use appropriate instruments to test safety of electrical equipments, in order to enable the manufacture to use quantitative means to confirm the safety of electrical equipments.

In the following conditions, safety analyzers shall be used to test the performance of various products:

- Design stereotypes - to determine the designed product reach the required conditions.
- Routine production check - confirm the produced products can meet the requirements.
- QA confirmation - confirm the quality of the products can meet the safety standards.
- Safety check after repair - confirm repaired products meet safety standards.

B.2 GB

GB is mainly adopted to measure the on-resistance between the metal house of electrical equipment which can be touched and the safe ground terminal of the device. The measurement approach is in accordance with the principle of Ohm's law. High current will go through the ground loop. Then the current and voltage values were measured. Then the resistance value is calculated following Ohm's Law. A large current, the abnormal current generated as the simulation apparatus is abnormal is adopted as the standard of test. If the

ground on-resistance of the apparatus can pass the test in such harsh environment, this appliance should be safe under normal conditions.

Although the ground resistance can be measured using general resistance meters, the current output from the resistance meter is usually very small and do not meet safety specifications. The result cannot be recognized by the safety inspection agency. Dedicated ground resistance analyzers must be used for measurement. For GB of appliance which is touched by users frequently, in addition to the specification of 30A as required in BSA regulation, the specification of 25A is required by most of the security agencies, and ground resistance must be less than 100mΩ. While current must be sustained 60s, while resistance must be maintained at less 100mΩ. For GB of appliance which is difficult to be touched by users, the current of 10A is required, and the ground resistance must be less than 500mΩ, but the time is still 60s. Some international standards are still more strict than the above specification, 5 times of the rated input current of the appliance is adopted as the standard of test, and ground resistance is still 100 mΩ and the test time is 60s. Most of these are motor which are dangerous, so the requirements for specification will be stricter than the general appliance.

The ground resistance analyzer can provide AC and DC output, both can correctly measure the ground resistance, but cause different damage to faulty contact. Although both types of analyzers are allowed by the security agencies currently, but it is particularly recommended to use the AC GB analyzer. Most appliances generally use mains power supply (AC), so AC GB analyzers are used for standard test, suitable for actual operating conditions.

B.3 IR

The IR is mainly used to measure the resistance between live wire of the apparatus and the house. The measurement mode is in accordance with Ohm's Law principle. Apply a voltage between the enclosure and the live wire, and the voltage and current are measured, then the resistance is calculated according to Ohm's law. Generally, a large constant voltage (DC 500V or 1000V) is applied and maintained for a predetermined period as the standard test. If the resistance remains within predetermined specifications within the specified time, the appliance should be secure under the normal operating conditions.

The higher the insulation resistance, the better the insulation of products. The insulation resistance measurements are the equivalent resistance between the two test points and its surrounding connected network.

However, the insulation test will fail under the following conditions:

(1) Dielectric strength of insulation material is too weak;

(2) Pinhole in the insulator;

(3) Distance between parts is not enough;

(4) Insulation is crushed and broken:

The above cases can only be detected by ACW/DCW.

B.4 ACW/DCW

The ACW/DCW is adopted to test the ability to withstand of low-voltage electrical equipment, insulation materials and the insulation structure. The basic theory for ACW/DCW is to expose a product in a very harsh environment, if the product can maintain the normal condition in this harsh environment, we can determine that in normal operating conditions, the product will be able to maintain a normal condition.

Different products have different specifications. In general, during ACW/DCW, a voltage higher than normal operating voltage is applied to the product for testing and holding for a specified period. If within the stipulated time, the leakage current of a component is also kept within the specified range, we can determine that the component should be safe under normal operating conditions. Good design and insulating material will protect the user.

For ACW/DCW of general appliances, apply the stipulated voltage between the live wire and the house. Measure the leakage current between them and compare it with the set value, the conclusion of pass or not is obtained. The basic requirement is that, twice of the operating voltage of the DUT plus 1000V is deemed as the test voltage standard. The test voltage for some products may be higher than twice of the operating voltage plus +1000V. For example, the operating voltage for some products is from 100V to 240V. The test voltage for these products may be 1000V to 4000V or higher. Generally, the test voltage for products with dual-insulation design may be higher than twice of the operating voltage plus +1000V.

B.4.1 Advantages/disadvantages of ACW/DCW

Please contact the safety test unit specified for the DUT what kind of voltage shall be applied. Some products can accept both ACW and DCW, but there are some products which only accept ACW or DCW. If the safety specification allows both ACW and DCW, the manufacturer can decide which test is more appropriate. To achieve this purpose, the user must understand the advantages and disadvantages of ACW/DCW.

B.4.2 Features and classification of ACW

Most devices for ACW/DCW will have some discrete electrical capacity. For ACW, this discrete capacitor cannot be fully charged. There is a continuous current flow through these discrete capacitors.

1 Advantages of ACW

In general, safety regulations will prefer ACW than DCW, for most products use AC power supply. The ACW can simultaneously test the positive and negative polarity of the product, consistent with the actual operating environment.

Because the discrete capacity cannot be fully charged during ACW, but there will not be instant impact current, and it is unnecessary to keep the voltage rising slowly. Apply full voltage at the start of test, unless such product is sensitive to shock voltage.

Because the discrete capacity cannot be fully charged during ACW, do discharge is unnecessary after the test, which is another advantage.

2 Disadvantages of ACW

For the current required to charge the discrete capacity of DUT, the output current will be much higher than the current during DCW. This will increase the danger of the operator.

B.4.3 Features of DCW

For DCW, the discrete capacity of the DUT will be filled, the capacitive current caused by DCW will drop to zero after the capacity is fully charged.

1 Advantages of DCW

After the discrete capacity of the DUT is filled, only the actual leakage current exists, which can be displayed clearly.

Another advantage is that the charging current of the DUT is only supplied in a short time, the current required to supply in other time is low, and the current capacity is much lower than that for ACW.

2 Disadvantages of DCW

Unless there is no capacity exists, the test voltage must raise slowly from Zero to avoid too large charge current, the higher the capacity, the longer the ramp time, and the lower the increased voltage. Too large charge current will cause misjudgment by the analyzer, and the test results are incorrect.

As the DUT may be charge during DCW, be sure to discharge the DUT after the test before the next step.

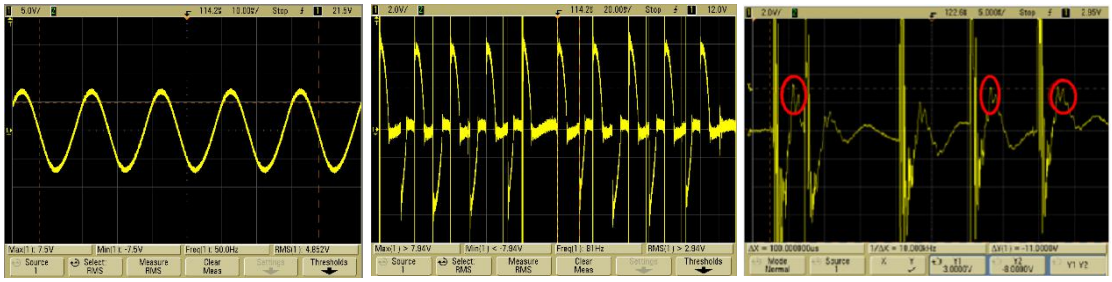
Different from ACW, DCW can only apply for single polarity test. If the product works with AC voltage, this disadvantaged must be considered. So most safety units recommend adopting ACW.

For ACW, the peak voltage is 1.4 times of the reading of the meter, which is not displayed by the meter in general, and not achieved during DCW. So most safety units require that, if DCW is adopted, the test voltage must be increased to equal value.

B.4.4 Difference between arc detection and ACW/DCW

ARC

The arc is actually a gas discharge phenomenon, the spark generated as the current flowing through some insulating medium (e.g., air) with wave as shown in B-4-1. The part circled in red in Figure B-4-1 (c) is several arc current waves. Factors affecting the arc include voltage, distance, current, material contamination level and so on.



(a) Wave without arc (b) Wave with arc (c) Arc expanding wave

Figure B-4-1 Arc wave

ACW/DCW

ACW/DCW is a measure to detect and measure the anti-electrical properties of the electrical equipment, insulation materials and insulation structures, assessment of the electrical strength. The electrical strength refers to insulation resistance (withstand capacity) of LV electrical equipment, insulation materials and insulation structures. During ACW/DCW, apply the specified frequency test voltage onto the insulator to assess its anti-electrical properties; the purpose of the test is:

Measure the insulation or repair quality of electrical equipment;

Detect damage to the insulation due to raw materials, processing or transportation, reducing early failure rate of the product;

Measure the insulation electrical clearances and creepage distances;

Measure the dielectric strength of insulation materials.

The standard for high dielectric strength is that there is no abnormal sound during the ACW/DCW, nor flashover or breakdown. Currently, the valid current (50Hz or 60Hz) through the insulator measured during ACW/DCW is adopted to determine whether the insulation properties meet the requirements; This method can effectively detect the change to insulator current or direct breakdown defects, but difficult to detect arcing arising from inadequate clearances and creepage distances, discharge or spark discharge and other defects, producing 3k ~ 250k Hz pulse current, which cannot be recognized during current RMS measurement. Therefore arc detection is necessary to detect these insulation defects.

B.5 Definition of Discharge, Arc, Flashover and Breakdown

B.5.1 **Gas Discharge**

Electric conduction in ionized gases. (GB/T 2900.1-2008)

B.5.2 **Arc**

Self-maintained gas conduction, the majority of carriers are electrons generated by the primary electron emission (GB/T 2900.1-2008).

B.5.3 **EDM**

Small short arc luminance. (GB/T 2900.1-2008)

B.5.4 **Discharge**

Start from the electron avalanche, the second process for complementary, continuous motion of carriers through the original insulating medium.

B.5.5 **Electrical breakdown**

All or part of the dielectric medium suddenly becomes conductive due to the discharge. (GB/T 2900.1-2008)

B.5.6 **Breakdown voltage**

Voltage at which breakdown occurs under specified test conditions or during operation. (GB/T 2900.5-2008)

B.5.7 **Withstand voltage**

Under test conditions, voltage applied to the specimen without causing breakdown and/or flashover. (GB/T 2900.5-2008)

B.5.8 **Flashover**

Breakdown occurred in gas, liquid or vacuum, partially along the solid insulation surface. (GB/T 2900.5-2008)

Flashover is destructive discharge of gases or liquid media along the surface of the insulation under high voltage. The discharge voltage is called flashover voltage. After the occurrence of flashover, the voltage between the electrodes quickly drops to zero or close to zero. The sparks or arcing in the flashover will cause local overheating or charring of the insulating surface, damaging the surface insulation. Discharge along the insulator surface is called flashover. The discharge inside the insulator is called breakdown.

B.5.9 **Gas conductivity**

Gas conductivity. (GB/T 2900.1-2008)

B.5.10 **Corona**

In the gas close to the conductor or at the surface of poor insulation conductor, for the

conductor is far away from other conductors, producing strong diverging electric field, so local discharge will occur that the point. Usually accompanied by light-emitting and noise. (GB/T 2900.5-2002)

B.6 Charge current test

a) Definition

The charge current means the Max. peak current obtained during voltage output process of the analyzer. Set for the capacitive load in general to determine whether the load is open.

b) Purpose

During ACW/DCW, the user is often only interested in whether the lower limit of the DUT is exceeded. If the DUT is not connected well with the test circuit, open circuit will often cause false judgment. The steady test current of capacitive loads is relatively low, it is difficult to determine via setting the upper limit for alarm. Charging current test can be adopted to determine whether the DUT is connected in the circuit.

c) Principle

As hown in the following figure, during voltage ramp process, the current of DUT will increase followingly. The analyzer will automatically record the peak current Ipk during ramp process. At the end of ramp process, judge if the peak test current exceeds the set lower limit of charge current Icharge. If Ipk>Icharge, the load is connected well, otherwise, it is open, and the analyzer will give alarm.

The user can enter the lower limit of the charging current manually, or select the value via the cursor and then press the "START" button to get the value automatically.

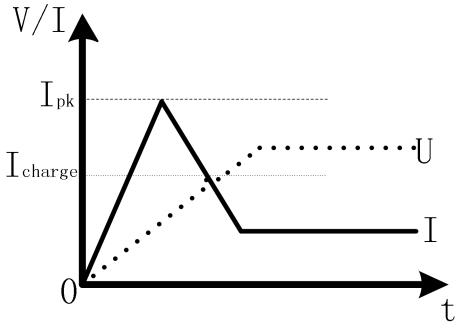


Figure B-6-1 Scheme of charge current test

B.7 LC

LC (Leakage Current Test) is a test item among many safety tests. General safety implementation units, such as UL, CSA, IEC, BSI, VDE, TUV and JSI etc, will require this test for certain products. The specifications of LC are different for different test products. For different applications and functions of products, the specifications are also different. Current

leakage and Line leakage are common test terms. In fact, it can be divided into three types of tests: Earth Leakage Current, Enclosure Leakage Current and Applied Part Leakage. The main difference is that the measurement locations of the test rod (clamp) are different. Earth Leakage Current means the leakage current flowing back to the earth through the earth line. Enclosure Leakage Current means the leakage current flowing back to the earth through the body as any one touches the enclosure. Applied Part Leakage or Patient Lead Leakage means the leakage current flowing between or to applied parts. This test is only required for medical instruments in general. The main purpose of these tests is to keep users safe during operating or holding of parts, and avoid risk of electric shock.

LC is a type of test for the leakage current of a product flowing through a set of simulated body impedance circuit as a measurement base. The simulated body impedance circuit is called Measuring Device (MD). For the impedance of human body, the location, size and current flow of man-machine contact points are different, so the specifications of MD depends on the types of tests and the allowed maximum leakage current. Measuring of leakage current is required for not only the normal operation of product and a fault, and shall be conducted after exchanging of polarity of power supply, to avoid any problems and dangers caused by improper use or faults when the product works under the highest input voltage (typically 110% or 106% of input voltage rating).

LC is usually required for product development and design and verification, to confirm that this product can meet the design specifications of the standard. However, this cannot guarantee that each product in the production line can meet the specification requirements, so this test is required for each product in the production line, in order to guarantee the products comply with specifications.

B.7.1 Type of LC

Include static LC and dynamic LC.

1. Static LC

The Static LC includes two steps. The first step is as shown in Figure B-7-1. The second step is as shown in Figure B-7-2.

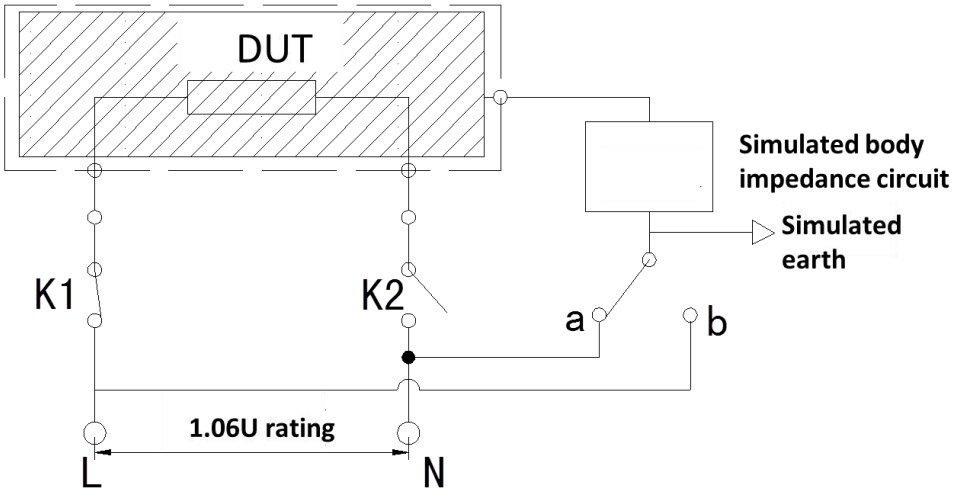


Figure B-7-1 First step of Static LC

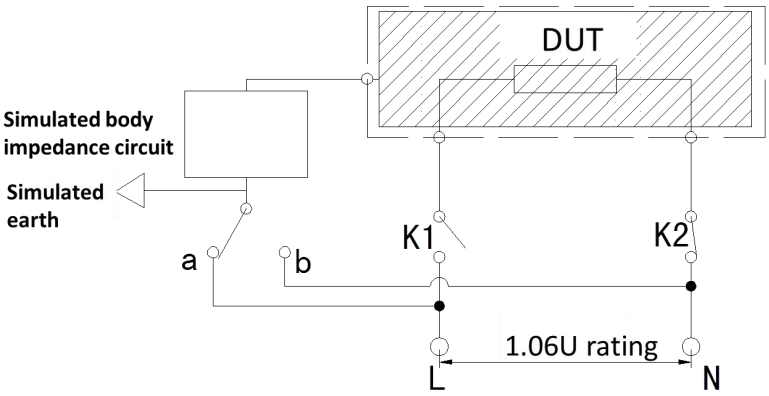


Figure B-7-2 Second step of Static LC

Where:

a) If the duration is set to n Sec., the duration for the first step and the second step is n/2 Sec.;

b) In the first step, measure for n/2 Sec., and the current measurement is I1;

c) In the second step, measure for n/2 Sec., and the current measurement is I2;

d) Neither I1 nor I2 is overlimit, otherwise the alarm is given.

e) 1.06U rating refers to 1.06 times of rated voltage.

2. Dynamic LC

The Dynamic LC includes two steps. The first step is as shown in Figure B-7-3. The second step is as shown in Figure B-7-4.

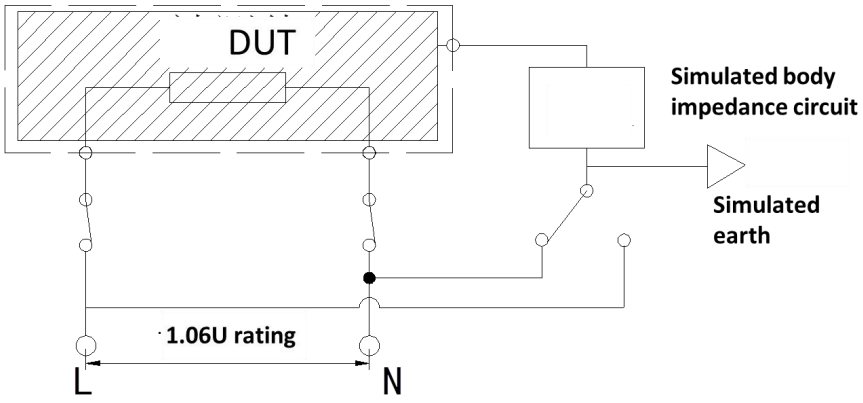


Figure B-7-3 First step of Dynamic LC

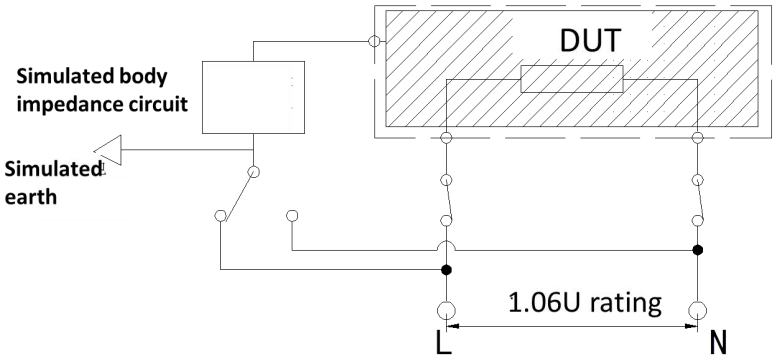


Figure B-7-4 Second step of Dynamic LC

Where:

a) If the duration is set to n Sec., the duration for the first step and the second step is n/2 Sec.;

b) In the first step, measure for n/2 Sec., and the current measurement is I1;

c) In the second step, measure for n/2 Sec., and the current measurement is I2;

d) Neither I1 nor I2 is overlimit, otherwise the alarm is given.

e) 1.06U rating refers to 1.06 times of rated voltage.

B.7.2 Simulated leakage body network

The simulated leakage body network is as shown in Figure B-7-5.

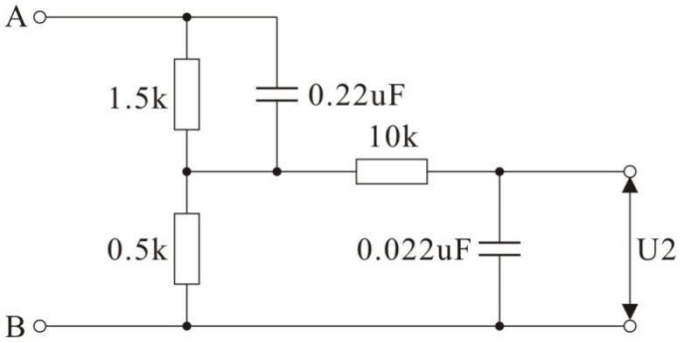


Figure B-7-5 Simulated leakage body network

Where:

a) The network is from GB/T12113-2003 Figure 4;

b) Non- inductance resistance accuracy: 0.1%, capacitance accuracy: 1%;

c) Leakage current I = U2/500R, U2 is rms;

d) Frequency response range: DC ~ 10kHz ~ 1MHz.

B.8 PA and ST

B.8.1 PA

1 Purpose

If the DUT has a rated input power, under normal operating temperature, the deviation of the input power to the rated power should not exceed the error shown in the table below. Once the deviation of the power exceeds the error, risks exist. For example, for heating appliances, high power or high temperature may cause a fire, resulting in dangers to lives and property. The power devices and wires etc inside the instrument are chosen based on the rated power. If the power is too high, the instrument will be seriously damaged, causing fire danger. To avoid accidents, and ensure safety of the environment and the instrument, PA is required to ensure that the input power of the DUT meets the requirements under in the table.

Type of DUT	Rated input power, W	Error
All instruments	≤25	+20%
Heating instruments and combined instruments	>25, ≤200	±10%
	>200	5% or 20W (higher one) -10%
Electric instruments	>25, ≤300	+20%
	>300	+15% or 60W (higher one)

2 PA conditions

PA shall be performed under stable input power of DUT. Stable input power means:

- All circuits which can operate simultaneously are in working condition;
- The instrument is under rated voltage supply;
- The instrument is working under normal condition;

If the current changes in the cycle, the current shall be determined based on the average current during a representative cycle.

B.8.2 ST

1 purpose

The purpose of ST is to measure and record the instantaneous current, voltage and other parameters of electric instruments or combined instruments during starting, to analyze and evaluate the start characteristic of instruments; if the instrument cannot start normally, there

will be a risk. For example, if the motor cannot start normally which leads to stall will cause too large input current, causing a fire etc. To avoid accidents, and ensure safety of the environment and the instrument, ST is required.

2 ST conditions

Under normal operating voltage, the motor should be able to start. Check if it is qualified via the following tests.

a. Under 32℃ or 43℃ based on the climate, close the door or cover of the instrument, and start it 3 times under 0.85 times of rated voltage.

b. After start of the instrument, keep sufficient time for turning on to ensure that the motor is properly started, and there is sufficient lubrication.

c. Keep sufficient interval between two successive starts, to avoid extreme overheating of the motor and abnormal pressure increase of liquid chiller, and keep balanced pressure between the high pressure side and the low pressure side.

d. It is allowed to start after the motor - compressor start relay acts for 3 times.

e. The voltage drop of power supply shall not exceed 1% during the test.

f. During the test, no overload protection device should act.

Annex C Protocol

Guide:

1) Handshake protocol
2) Ports
3) Protocol

Caution! For communication between the analyzer and PC, be sure to guarantee:

1. The RS232/485 address setting is consistent with those of PC!
2. The RS232/485 baud rate setting is consistent with those of PC!
3. The PC shall send command in Format of Download Command!

Otherwise, the communication will fail!

C.1 Handshake Protocol

In the monitoring network consisting of the master and the slave (as shown in Figure C-1-1), a communication starts from the download command initiated by a master, and ends as the slave answers. Therefore, one-way handshake protocol is adopted, that is, only the upload data of the clave contains the information on whether the data received by the slave is correct. The PC will determine whether the master will re-send the control command based on this information. After receiving the upload data from the slave, the master will determine whether the data is uploaded correctly according to the carried check word. If it is incorrect, resend the command to the slave.

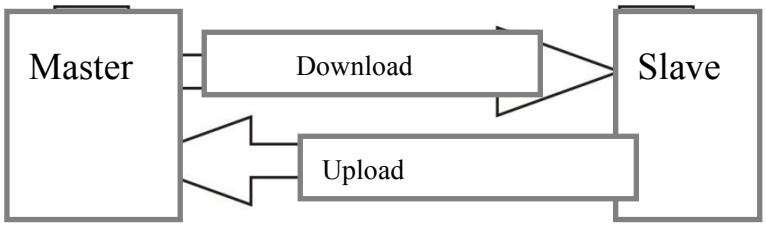


Figure C-1-1 Handshake protocol

C.2 Ports

Adopting 9-pin D-sub socket, defined as shown in Figure C-2-1.

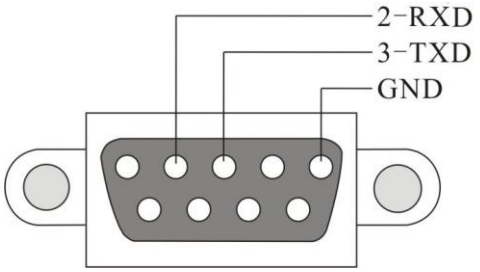


Figure C-2-1 Communication port

C.3 Protocol

3.1 Protocol format

The protocol adopts ascii code in transmission.

The command strings are not case insensitive.

The end bits of strings received by the instrument are 0x0A (\n) or 0x0D0x0A (\r \n), and the end bits of strings returned by the instrument are 0x0A (\n).

transmit：

No parameter class： Command string + end character

There are parameter classes: command string + space + parameter + end character

receive：

Correct implementation:

Control: return as is;

Set the class: the command string + the end character (ie, set the parameters no longer return);

Query Class: Command String + Space + Argument + Terminator

Wrong: return error message to a combination of multiple words, the error message in the follow-up form.

3.2 Protocol command list

Index	command string	parameter	Function
	Page switching related instructions		
1	ENTER-TEST	Null	Enter test screen in ready-for main menu
2	ENTER-SET	Null	Enter edit screen in ready-for main menu
3	ENTER-FILE	Null	Enter File manger in ready-for main menu
4	ENTER-SYS	Null	Enter system setting in ready-for main menu
5	RETURN-MAIN	Null	Return to main menu
6	RETURN	Null	Return to upper level
	Set the relevant instructions		
1	FN	**FN name** nameis the file name, up to 30 characters. This file is saved directly in the file location of the current call.	Create a new file

2	FS	Null	End the settings and save the file
3	DELI-LAST	Null	Delete the last step
4	DELI-ALL	Null	Remove all steps
5	SET-ACW	Detailed follow-up	Add a step at the end，ACW
6	SET-DCW	Detailed follow-up	Add a step at the end，DCW
7	SET-IR	Detailed follow-up	Add a step at the end，IR
8	SET-GB	Detailed follow-up	Add a step at the end，GB
9	SET-TCT	Detailed follow-up	Add a step at the end，LC
10	SET-PW	Detailed follow-up	Add a step at the end，PA
11	SET-ST	Detailed follow-up	Add a step at the end，ST
12	SET-WAIT	Detailed follow-up	Add a step at the end，WAIT
Test the relevant instructions			
1	TEST	Null	start testing
2	RESET	Null	Stop the test
3	TD?	Null	Query all test data Detailed follow-up
4	RD	RD nn? 1 to 8), - 1 = Read the current step	Single station: Query the specified step test data

3.3 Error return list

Index	Returns the error string	meaning
1	UnkownCmd	Unrecognized command word
2	CanntExecute	Unable to execute this directive. Such as the non-test page in the implementation of TEST command to return this error.
3	ExceedPara	Used for parameterized instructions, the received parameter is outside the normal range.

3.4 Operating procedures

Test: The test flow is as follows

1) In the main interface, send ENTER-TEST to enter the test page

2) On the test page, send TEST to start the test

3) After the start of the test, send RD -1 ?, or RD nn? Real-time query the specific data for each step

Or send TD? Query all data and conclusions

4) In the test, send RESET to stop the test

5) After the test, send TEST to start the next test

Or send RETURN back to the main interface

Settings: Set a file flow as follows:

1) In the main interface, send ENTER-SET to enter the parameter setting page

2) FN name Starts a file

3) Add item by item, up to 8 steps

4) FS end of the set, save the file

3.5Detailed agreement

TD? Query all test data

Return: Command word + space + parameter + end character

The parameters are: Name of each test item, test value (not measured as null), test conclusion, the three parameters separated by commas.

Multiple test items separated by a semicolon, and finally a comprehensive conclusion (which is related to follow-up)

Example:

transmit：TD?

Receive：

GB,25.0A,3.3mΩ,OK,;

ACW,0.20kV,2.638mA,OK,;

DCW,1.50kV,0.0uA,OK,;

IR,500V,3.564GΩ,OK,;

LC,0.0V,5.7uA,OK,;

PA,0.000W,0.00mA,OK,;

null,null,null,null,null;

null,null,null,null,null;

OK;

Comprehensive conclusion：

Null = test, testing = test, ok = test pass, ng = test failed, notTest = test aborted, error = exception

RD nn? Query one step test data

Nn Step number 0-7 (for steps 1-8), - 1 = Read the current step

Return: Command word + space + parameter + end character

The parameters are: Name of each test item, test value (not measured as null), test conclusion, the three parameters separated by commas.

Each parameter is separated by a comma, and the number of parameters depends on the test item.

Where the output value, test value, and other parameters return null when the corresponding item is not tested.

Example: Send: RD 2?

Return DCW, 1.50kV, 0.0uA, OK ,;

1） FN name: create a file.

"name" is the file name, up to 30 characters. This file is saved directly in the file location of the current call.

2） Add test items (total 8): SET-ACW, SET-DCW, SET-IR, SET-GB, SET-TCT, SET-PW, SET-ST, SET-WAIT.

Arguments:

1、 Arguments are separated by commas, arranged in chronological order in the following table.

2、 The number of arguments is free (0 to the Max.).

For example: If no argument is set, all arguments are default;

In case 4 arguments are set, the first four arguments are the settings, and the follow-up arguments are default.

In case the number of arguments exceeds the maximum, the front ones prevail, and the subsequent arguments are invalid.

The arguments must be consecutive. To keep any middle argument the default one, set it to -1 (-1 = default).

3、 For any argument, if the setting is outside the range, giving error ExceedPara, and this command is invalid.

The units of arguments are fixed, and the command does not contain units. Refer to the following table.

Item	**Command word**	**First 4 key arguments** Name of arguments, setting range, default
ACW	SET-ACW	1） Output Voltage,100~5000V,1500V 2） Current Upper Limit,0.00~100.00 mA,3.5mA 3） Current Lower Limi,0.000~9.999mA,0mA 4） Test Time,0.5~999.9s（0=LLLL）,1.0s 5） Three-channel scanning option, 0 \ 1 \ 2,0 represents input to output, 1 represents input to ground, 2 represents output to ground 6） Ramp Time,0.1~999.9s（0=OFF），0.1s 7） Descent Time,0.1~999.9s（0=OFF）,0s 8） Arc Level,0~9,0 9） Compensate Switch,0~1,0 （0=OFF，1=ON） 10） Output Frequency,0~1,0 （0=50Hz,1=60Hz）

		11）Compensation value, A Compensation value, B Example:SET-ACW 1500,3.50,0,1.0, Or:SET-ACW 1500,3.50,0,1.0,1,0.1,0,0,0,0,0,0,
DCW	SET-DCW	1） Output Voltage，100~6000V,2100V 2） Current Upper Limit，0~10000uA，5000uA 3） Current Lower Limi，0.0~999.9uA，0uA 4） Test Time，0.5~999.9s（0=LLLL），1.0s 5） Three-channel scanning option, 0 \ 1 \ 2,0 represents input to output, 1 represents input to ground, 2 represents output to ground 6） Ramp Time，0.4~999.9s（0= OFF），0.4s 7） Descent Time，1.0~999.9s（0= OFF），0s 8） Arc Level，0~9,0 9） Charge Lower Limit，0.0~350.0uA，0uA 10） Compensation Value，0.0~200.0uA，0uA 11）Compensate Switch，0~1,0 （0= OFF，1=ON） 12） Ramp Upper Limit，0~1,0 （0= OFF，1= ON） Example:SET-DCW 2100,5000,0,1.0, Or:SET-DCW 2100,5000,0,1.0,1,0.4,0,0,0,0,0,0,
IR	SET-IR	1） Output Voltage，100~2500V,500V 2） Resistance Upper Limit， 1~50000MΩ（0= No），0MΩ 3） Resistance Lower Limit， 1~50000MΩ，2MΩ 4） Delay Time，0.5~999.9s（0=LLLL），1.0s 5） Three-channel scanning option, 0 \ 1 \ 2,0 represents input to output, 1 represents input to ground, 2 represents output to ground 6） Ramp Time，0.1~999.9s（0= OFF），0.1s 7） Descent Time，1.0~999.9s（0= OFF），0s 8） Charge Lower Limit，0~3.500uA，0uA 9） Compensation Value，1~100000MΩ，50000 MΩ 10） Compensate Switch，0~1,0 （0= OFF，1= ON） Example:SET-IR 500,0,2,1.0, Or:SET-IR 500,0,2,1.0,1,1,0,0,50000,0,
GB	SET-GB	1） Output current，2.0~32.0A, 25.0A

		2） Resistance Upper Limit， 0.1~600.0mΩ（ 2.0~10.6A ）/0.1~R mΩ（10.7~32.0A，R=6400/ current setting），100mΩ Voltage Upper Limit 0~6.40V 3） Resistance Lower Limit， 0.0~600.0mΩ（ 2.0~10.6A ）/0.0~R mΩ（10.7~32.0A，R=6400/ current setting），0mΩ Voltage Lower Limit 0~6.40V 4） Test Time，0.5~999.9s（0=LLLL），1.0s 5） Open Voltage，3.0~10.0V，6.4V 6） Compensation Value，Resistance 0.0~100.0 mΩ/ Voltage 0~5.00V，0 mΩ 7） Compensate Switch，0~1,0 （0= OFF，1= ON） 8） Output Frequency，0~1,0 （0=50Hz，1=60Hz） 9） Test Mode，0~1,0 （0= Resistance，1= Voltage） Example:SET-GB 25.0,220.0,0,1.0, Or:SET-GB 25.0,220.0,0,1.0,6.4,0,0,0,0,
LC	SET-TCT	1） Output Voltage，0.0~300.0V,233V 2） Current Upper Limit，Rms0~12.000mA,0.500mA 3） Current Lower Limi，Rms0~12.000mA,0mA 4） Test Time，0.5~999.9s（0=LLLL），2.0s 5） Test Frequency，45~65Hz，50Hz 6） Voltage Upper Limit，0.0~300.0V，300.0V 7） Voltage Lower Limit，0.0~300.0V，0.0V 8） Compensate Value，0.0~1000.0uA，0uA 9） Compensate Switch，0~1,0 （0= OFF，1= ON） 10） Judge Mode，0~1,0 （0=MAX，1=END） 11）Power State - Neutral N，0~1,0 （0= Dynamic，1= Static） 12） Power state - Polarity Reverse，0~1,0 （0=A，1=B） 13） PowerState -Probe Position，0~2,0 （0=G-L; 1=G-N; 2=AUTO（G-L,G-N）） Example:SET-TCT 233.0,0.500,0,2.0, Or:SET-TCT 233.0,0.500,0,2.0,50,300.0,0,0,0,0,1,0,1,
PA	SET-PW	1） Output Voltage，0.0~300.0V,220V 2） Power Upper Limit，0.0~6000.0W， 500.0W

		3） Power Lower Limit，0.0~6000.0W， 0W 4） Test Time，0.5~999.9s（0=LLLL），1.0s 5） Test Frequency，45.00~65.00Hz，50.00Hz Example:SET-PW 220.0,500.0,0,1.0, Or:SET-PW 220.0,500.0,0,1.0,50.00,
ST	SET-ST	1） Test Voltage，0~300V, 195V 2） Current Upper Limit，0.00~25.00A，20.00A 3） Current Lower Limi，0.00~25.00A，0A 4） Test Time，0.5~999.9s（0=LLLL），1.0s 5） Test Frequency，45~65Hz，50Hz Example:SET-ST 195,20.00,0,1.0, Or:SET-PW 195,20.00,0,1.0,50,
WAIT	SET-WAIT	1） Test Time，1.0~999.9s（0=LLLL），1.0s Example:SET-WAIT 1.0,

Annex D Key Components

The key components of the product are shown in the following table

Key Components	Spec. & Model	Manufacturer
Mainboard	AN9640BV3(F) control board	Ainuo
High-voltage relay	LRL-101PCZ-10KV-M	TOWARD

Version：V1.2

Oct. 2020